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Non-Innovative Motives for China's Patent Surge

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Thèse présentée en vue de l'obtention du grade de M.Sc. en administration
(option Affaires Internationales)

Juillet 2018

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Abstract

China has caught worldwide attention with its most recent patent surge. Meanwhile, some researchers holding a skeptical view took a second look at this patent surge and found some correlations between non-innovative factors and patent filings. The objective of this research is to investigate the contributions of non-innovation-related drivers to China's patent surge. Based on individual applicant-level data across different provinces retrieved from State Intellectual Property Office of the People's Republic of China (SIPO), and interviews with sixteen patent applicants and five patent agents in Beijing, Shanghai and Guangdong Province, we collected information on individuals' motives for patent application. To our knowledge, no previous researchers have conducted such interviews on this topic at the individual level. The contribution of our research lies in unraveling a series of novel and interesting facts about patenting motives such as for obtaining an urban household registration, for easier admission to a higher-ranked school, for job promotion and for certification as national high-tech enterprise, which broaden the literature on the innovation and government policy in a developing-country context.

Key words: innovation, China, patent, motivation, points system

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List of abbreviations and acronyms

FDI: Foreign direct investment

R&D: Research and development

WTO: World Trade Organization

WIPO: World Intellectual Property Organization

SIPO: State Intellectual Property Office of the People's Republic of China

hukou: Chinese household registration

Project 985: refers to the project implemented to create world-class universities and high-level universities in China. The name came from May 4, 1998, when President Jiang Zemin made a speech at the 100th anniversary of Peking University to build a world-class university.

Project 211: refers to the project on which Chinese government has concentrated all aspects of central and local governments to build around 100 universities and a number of key disciplines and majors that reach the level of world-class universities in the 21st century. The “Project 211” is the largest key construction project in the field of higher education since the founding of the People’s Republic of China. It is the national higher education development project proposed during the “Ninth Five-Year Plan” period and a system reform project for higher education.

1 Introduction

In 2015, China's State Council unveiled its first 10-year plan for comprehensively upgrading China's manufacturing, entitled *Made in China 2025*, aiming to put China on a new path to industrialization, with greater emphasis on innovation and technology upgrading. The core of the plan includes developing leading-edge advanced technologies through investment in R&D from state and industry sources, accumulation of intellectual property to accelerate the development of innovation in manufacturing¹. There are even clear and specific measures for innovation mentioned in the plan. For example, manufacturing enterprises above a designated size should hold at least 1.1 effective invention patents per billion main business income by 2025².

Recent data suggest that the Chinese government's efforts to incentivize innovation seem to be working. China has caught world's attention by its recent great leap forward in patenting and was called *top innovator* by both domestic and foreign media³. China's explosive patenting growth in the past two decades reached a milestone in 2011, when the number of patents applications filed with the State Intellectual Property Office of the People's Republic of China (SIPO) for the first

¹ Cited from *Ministry of Industry and Information Technology of the People's Republic of China (2015): Interpretation of "Made in China 2025": Enhancing National Manufacturing Innovation Capabilities*. Available at: <http://www.miit.gov.cn/n973401/n1234620/n1234623/c3843826/content.html>

² Cited from *Ministry of Industry and Information Technology of the People's Republic of China (2015): Interpretation of "Made in China 2025": The main goal of "Made in China 2025"*. Available at: <http://www.miit.gov.cn/n1146295/n1652858/n1653018/c3780696/content.html>

³ According to *Reuter's article under the headline: "China top innovator with one million patent requests in year"* (available at: <http://www.reuters.com/article/us-global-economy-innovation-idUSKBN13I1L9>), *Quartz's article "China logged a record-breaking 1 million patent applications in 2015"* (available at: <https://qz.com/844928/china-logged-a-record-breaking-1-million-patent-applications-in-2015-un-agency-says/>), and *Hong Kong Standard's article "China wow the patent counters"* (available at: <http://www.thestandard.com.hk/section-news.php?id=176696>).

time overtook the U.S. Patent and Trademark Office (USPTO). In 2015, China became the first country to file for more than one million patent applications in a single year⁴.

But is the recent patent surge the result of true innovation or are there non-innovation reasons for patents to skyrocket? This is a debate that a number of scholars have been having in recent years. Some scholars have pointed out that it is perfectly possible for a patent surge to occur without an underlying increase in innovation. This may occur if a change in the legal environment (1) incentivizes people to patent for reasons other than protecting their invention, or (2) makes it easier to apply for or obtain patents. Hu and Jefferson (2009), for example, unravel that though true innovative factors such as R&D intensification contribute to almost a quarter of the patenting increase, the primary force behind the patent explosion is more associated to new patent law that creates a more patent-friendly legal environment. This is followed by other papers (Li 2012, Dang and Motohashi 2015, Eberhardt, Helmers et al. 2017, Hu, Zhang et al. 2017) providing solid evidence that government subsidies have a more significant impact on the increase of patent counts by providing economic incentives to patent applicants, which as a result spur large number of low-quality patents indicating more non-innovative patenting behavior than true innovation. Apart from the above explanations, Hu, Zhang et al. (2017) suggested that there could also be other motivations that played a part within and deserved further investigation, and that's where we embark our research.

The own observations of the author as an undergraduate student at Shanghai Jiao Tong University in Shanghai suggests there may be other non-innovative motives for individuals to apply for patents. What are those non-innovative motives for China's patent surge? Motivated by this

⁴ Data from the *World Intellectual Property Organization (WIPO)*. Available at: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=CN

question, we attempt to explore the underlying motivations and find that non-innovative motives do exist and may explain the patent surge to some extent. More specifically, at the individual level, the underlying motives include for obtaining the Chinese household registration (*hukou*) in large cities to benefit from better schooling and health care, government-funded welfare benefits and other citizenship entitlement, for easier admission to a more prestigious school, for job promotion and for awards and honors. At the enterprise level, the starting point of many enterprises to patent is to be certified as national high-tech enterprises to enjoy the subsequent benefits of preferential policies such as tax reduction and government funding support.

Towards this objective, our research conducts a systematic study to evaluate if there is evidence suggesting that non-innovative motives play a part in driving China's patent surge. For this purpose, we conduct research based on statistical data at individual-applicant level retrieved from State Intellectual Property Office of the People's Republic of China (SIPO) and individual interviews with patent applicants in Shanghai, Beijing and Guangdong. No previous researchers have conducted such interviews on this topic at the individual level before. These two approaches complementing each other provide us a more comprehensive picture of the current situation of innovation and patent filing in China and reveal more motivations behind the patent explosion.

Our study is distinct from previous studies. First, our study, employing both statistical and qualitative method, supplements previous studies with alternative and novel explanations for China's patent surge. Despite widespread doubts about the motivation of the patent application in China, however, to the best of our knowledge, there were no prior studies disclosing individual-level motivations apart from government subsidies. Second, our database bridges the gap of period from 2011 to 2015 as previous studies only covered the period before 2011, leaving a gap between 2011 and up to date. We cannot tell whether there have emerged other motives prompting the

patenting activities. Third, our database also included data on utility models and design patents, which were rarely taken into consideration by previous researchers but serve our research purpose.

The rest of the paper is structured as follows. Section 2 presents a review of relevant literature and brings forward our propositions. Section 3 explains the construction of our data set and research methodology. Section 4 describes key features of China's most recent patent surge from the dataset and outlines key findings of the interviews. We also combine the statistical data with qualitative data to support our propositions. We conclude our analytical results and implications in Section 5.

2 Literature review

2.1 Definition and measurement of innovation

Innovation is considered imperative for a nation in that it is considered a key determinant of both a nation's competitiveness (Schumpeter 1942, Penrose 1959, Hall and Soskice 2001) and a firm's performance (Mone, McKinley et al. 1998). It makes significant contribution to a nation's competitiveness and economic growth, and reduces the gap between Eastern and Western nations (Petrariu, Bumbac et al. 2013).

Innovation has a long history of being studied in many different fields thus different definitions have been given to the term "innovation". In a broad sense, innovation has been conceptualized as the first introduction of a new product, process, method or system (Schumpeter 1934) as well as a new mindset (Kahn 2018). It entails an outcome and the process to reach this outcome at the same time (Quintane, Mitch Casselman et al. 2011). Innovation as an outcome includes product (goods or services) innovation, process innovation, marketing innovation, business model innovation, supply chain innovation, organizational innovation, individual mindset, organization culture (Quintane, Mitch Casselman et al. 2011, OECD 2015, Kahn 2018), new ideas and solutions (Quintane, Mitch Casselman et al. 2011). Innovation as a process refers to the activities to be undertaken and the way to follow in order to develop innovations (Quintane, Mitch Casselman et al. 2011, Kahn 2018), i.e. product development process (Kahn 2018).

Innovation can take many forms, whatever form it takes, it aims to reduce unit costs and/ or helps expand market demand (Sengupta 2014). In other words, to be considered truly innovative, an innovation needs to create new economic value (Barlow and Safari Books 2015). Different

scholars have put forward different classifications for innovation. For example, Clayton Christensen, the “godfather” of modern innovation strategy, suggested two distinct forms of innovation: sustaining and disruptive innovation. Sustaining innovation is gradual or incremental improvement of existing products or product lines, while disruptive innovation creates not only brand new products but also new business models and new markets (Barlow and Safari Books 2015). The later form of innovation is riskier, more rushed and unpredictable. Another influential economist, Schumpeter (1934) distinguished between five types of innovation: product innovation, process innovation, organizational innovation, market innovation and input innovation. Other categorizations as technology-based innovation, endogenous/ exogenous innovation, innovation in selection mechanism in industry growth, innovation through technology consortium (Sengupta 2014), just to name a few.

There are different measurements and indicators for innovation capability. Generally, the measures of innovation capability can be divided into two categories: input measures and output measures (Saunila and Ukko 2012). Input measures such as R&D expenditures evaluates how the innovation activities are conducted and how the resources are allocated to them (Saunila and Ukko 2012). Traditionally, most attempts to measure innovation focused on innovation inputs, R&D expenditures particularly and human resources for innovation (Janger, Schubert et al. 2017). Although R&D expenditure is a good proxy for innovation capability because it is a direct indicator of the innovation investment, it still has some limitations and biases. First, R&D expenditure only measures how much investment is devoted but does not measure the effectiveness of R&D. Second, in some sectors such as service sectors, innovation is not necessarily connected to organized R&D investments, and some investments in innovation are intangible, such as networking and cooperation, customer integration and learning by doing (Tether and Hipp 2002, Gotsch and Hipp

2014, Lee 2015). That is why input measures alone do not reflect the actual comprehensive innovation capability (Saunila and Ukko 2012, Lee 2015).

Other studies have focused on output measures to evaluate the effects of innovation capability (Saunila and Ukko 2012, Gotsch and Hipp 2014, Lee 2015, Janger, Schubert et al. 2017). Among them, patents have been most used, especially for measuring technological innovations. Experts agree that patenting is an effective legal mechanism for protecting innovations (Li 2012), mitigating risks of unanticipated knowledge leakage or imitation (Falvey, Foster et al. 2006). Patents as an intermediate output indicator of innovation have the benefits of containing rich and timely information on innovative activities (Dang and Motohashi 2015), easy public availability of the data since they are recorded in centralized databases and published by the patent office of each country.

Patents are generally regarded as a reliable indicator of a nation's innovation effort (Griliches 1990) and an important signal of the health of innovation process (Hu and Mathews 2008). However, patent statistics can sometimes be misleading in that innovations are not necessarily patentable or patented in some sectors, and patent registrations do not necessarily reflect true innovation considering patent quality varies (Griliches 1990). For example, in service sector, the protection strategies for innovation different from those of manufacturing sector (Moser 2013) lead to low propensities to patent (Janger, Schubert et al. 2017), and innovation in services can take multiple forms and is not necessarily patentable. In knowledge-intensive service sector, scholars proposed using other indicators such as trademarks to measure the innovation (Gotsch and Hipp 2014). Furthermore, patents may not lead to actually implemented innovations and patented technologies are not always brought into use and automatically have economic effects (Janger, Schubert et al. 2017); in this case, patent counts overestimate innovation output. Patent data do reflect the output

of R&D processes to some extent but should not be equated with innovation output (Janger, Schubert et al. 2017). Therefore, despite the fact that patent has become very common in large parts of the innovation literature to be used as proxy for innovation output, patent is not perfect innovation indicator, either. We should combine different indicators in order to comprehensively evaluate a nation or a firm's innovation capability.

2.2 China's patent system and patent surge

The Chinese patent system was established in 1985. China's patent law was first amended in 1992 to broaden the scope and extend the length of patent protection. Afterwards, in preparation for accession to the World Trade Organization (WTO), China revamped the patent law in 2000 (Hu and Jefferson 2009). Patenting is one of the legal mechanisms for protecting innovations. The legal environment that stipulates the benefits and costs of patent protection for patent holders certainly has a great impact on inventors' willingness to patent. A favorable legislation change that provides patent holders with broader and stronger protection is a crucial driving force for raising inventors' propensity to patent (Li 2012).

The patent authority in China is the State Intellectual Property Office (SIPO) granting three types of patents: inventions, utility model patents and design patents. These three types of patents differ greatly in terms of economic value, technological importance and resource commitment. Invention patents represent the most technologically sophisticated innovation output and applications for this patent type need to pass a substantive examination for utility, novelty, and non-obviousness to be granted. It has a term of 20 years. Utility model and design patents are less innovative than inventions from the technological perspective, as they involve more incremental innovations and

are not subject to examination for novelty and non-obviousness (Hu and Jefferson 2009, Li 2009). Utility model patent applications are selectively examined for novelty while design applications are not examined. Both utility model patent and design patent have a term of 10 years. Domestic applicants have two ways to apply for a patent: directly submit patent application with SIPO or a representative office of SIPO or authorize qualified patent agent to file patent application with SIPO. However, foreign patent applicants without habitual residence or business office in China cannot directly file patent application with SIPO by themselves; instead, they must appoint a patent agent designated by SIPO to act as their agent. To file for a patent, applicants should submit all the required documents and pay the fee. At preliminary examination, SIPO will check whether all the necessary information and documentation has been provided, so that the application can be issued an application number and an acceptance notification which only means acceptance of the application by SIPO but does not indicate the patent will be granted. After the application is accepted, the applicants need to pay fee; otherwise, the application is presumed withdrawn. Within three years from the date an invention patent application is filed, the SIPO may, upon request made by the applicant, carry out substantive examination of the application. If the applicant, without legitimate reasons, fails to request substantive examination before expiration date, such application is to be withdrawn. Upon substantive examination, if the SIPO find no reason to reject the application, it will decide on granting of the invention patent right, issue an invention patent certificate, and meanwhile publish it in official journal. The invention patent right becomes effective as of the date of publishing.⁵

⁵ Translated from the official website of *State Intellectual Property Office of People's Republic of China (SIPO)*: http://www.sipo.gov.cn/zhfwp/zlsqzn_pt/zlsqspcxjs/zlsqsplc/index.htm

Since the establishment of patent system in China, patent applications grew moderately until the end of the 1990s. Patent applications have surged rapidly since 2000 when the Second Patent Law Amendment was enacted in China and one year before China's accession to WTO (Hu and Jefferson 2009, Li 2012). The growth rate of invention patent applications was about 12% from 1995 to 2000 while it surged to 29% from 2000 to 2007 (Li 2012). The annual growth rates of invention patents have exceeded 50% in several years such as 1989, 1993, 1999, 2000, 2003 and 2004; it was even above 90% in 1993, 2000 and 2003 (Liu and Sun 2009).

Applications submitted by domestic Chinese inventors growing at an annual rate of 30% from 1999 to 2009 (Dang and Motohashi 2015). Previous research shows that the year 2000 was also a watershed for foreign patent applications, the annual growth of which jumped from 12% prior to that year to more than 20% afterwards (Hu and Jefferson 2009). A major difference between patenting behavior of domestic and foreign inventors is reflected in the composition of the three types of patents they applied. More than 85% of foreign inventors filed for invention patents in 2004, while less than 25% of domestic inventors filed for invention patents. Nevertheless, the growth of domestic patent applications since 2000 has mostly come from invention patents (Hu and Jefferson 2009).

2.3 Spatial distribution of Chinese patents

Patent filings from all regions have notably risen. However, patents from provinces in the eastern region increased even more rapidly, leading to an increased disparity in patenting across regions. Though researchers have proposed several reasons for the dramatic patent surge since 2000, such as the national pro-patent legal change and increasing intensification of R&D investment, these

factors cannot completely explain the increasing regional variation in patenting across regions in China. Therefore, the unique regional pattern of patenting growth indicates that region-level factors should be taken into consideration as well (Li 2012).

It was found that spatial distribution of invention patents in China was more obvious than in the U.S. (Liu and Sun 2009). Patents in China were highly clustered in two areas: one is the economically fast growing coastal provinces and the other is three inland provinces with large bases of population of 178 million (Sun 2000), accounting for one tenth of China's total population⁶. Whereas the latter was gradually replaced by the former (Sun 2000), with the innovative activities measured by patents have gradually moved from the inland areas to the eastern coastal areas, particularly to the southeast coastal areas (Liu and Sun 2009). As a result, the distribution of Chinese patents shows a decreasing trend from the eastern regions (including Shanghai, Beijing and Guangdong) to the western regions (Liu and Sun 2009, Bai 2013, Ma, Ke et al. 2013). While Beijing was the strongest patent output region, after 2000, Shanghai and Guangdong have caught up quickly (Liu and Sun 2009, Li 2012). By 2011, Beijing, Guangdong and Shanghai remained as the top invention patent applications regions. And in that year, Shanghai and Guangdong were also among the top five regions for utility model applications (Hu, Zhang et al. 2017).

The unbalanced spatial distribution of Chinese patents has been attributed to different factors. The industrialization level, industrial structure and regional urbanization level largely exert a positive influence on the regional patent output (Ma, Ke et al. 2013). For example, Beijing concentrates disproportionately a handful of higher education institutes and research institutes while

⁶ Data from the official website of *National Bureau of Statistics of China*: <http://www.stats.gov.cn/>

Guangdong's share of foreign investment and international trade is extremely high. Furthermore, government subsidies which interplays between firms and universities also have a positive impact on the eastern region (Bai 2013). Li (2012) argued that the increasing regional disparity in patenting was due to the differences in launch time, total budgets and specific subsidy rules in each province.

2.4 Explanations for China's patent surge

There has been a significant discussion between researchers about the drivers of the patent explosion (see TABLE 1). One set of researchers have focused on innovation-based reasons. Fischer and Von Zedtwitz (2004), Hu and Mathews (2008) suggested that the patent explosion was simply a reflection of the rise in R&D expenditures in China. Other researchers, however, have pointed out China's patent explosion has not been triggered by any single event (Hu and Jefferson 2009, Li 2012, Eberhardt, Helmers et al. 2017, Hu, Zhang et al. 2017), and non-innovation related motives have played an important role within (Eberhardt, Helmers et al. 2017, Hu, Zhang et al. 2017). Hu and Jefferson (2009) concluded that innovation-based factors such as R&D intensification was unlikely to be the primary force while non- innovation-based factors such as growth of foreign direct investment, amendments to the patent law and ownership reform in China contributed significantly to the patent surge. For the time being, the latest explanation of government subsidies as the main non-innovative motives for patenting boom has the most supporters (Li 2012, Dang and Motohashi 2015, Prud'homme 2015, Yan, Liu et al. 2016, Eberhardt, Helmers et al. 2017, Hu, Zhang et al. 2017).

TABLE 1 Alternative explanations of China’s patent surge

Time series	Theories- Motives for patenting	Explanations	Supporters
2004	R&D	China's innovation is related with its R&D capabilities	Fischer and Von Zedtwitz
2008	R&D, GDP growth	Gross domestic product (GDP), R&D expenditure and R&D personnel, especially the R&D expenditure on universities boosted Chinese innovation capacity measured by patents	Hu and Mathews
2009	FDI, amendments to patent law, entry to WTO, changing ownership structure of Chinese industry	Three factors related with China’s patent boom: the growth of foreign direct investment (FDI) in China, amendments to the patent law, entry to WTO and the changing ownership structure of Chinese industry	Hu and Jefferson
2012	Patent subsidy	Patent subsidy programs played an important role in the recent Chinese patent surge	Li
2015	Patent subsidy	Patent policies have impacts on patent applications, grants and quality of granted patents	Dang and Motohashi
2017	Patent subsidy and others	Patent surge at SIPO was driven by factors other than underlying innovative behavior, including government subsidies that directly encouraged patent filings Further confirmed that the correlation between patents and R&D and that between patents and labor productivity have become weaker, especially for utility models	Eberhardt, Helmers et al. Hu, Zhang et al.

We organize the explanations mentioned above at a time series to clearly demonstrate the evolution of the theories. In early 2000s, Hu and Mathews (2008) gave credit to such innovative factors as

gross domestic product (GDP), increasing R&D expenditure and R&D personnel, especially the R&D expenditure on universities, having boosted Chinese innovation capacity measured by patents. Fischer and Von Zedtwitz (2004) also defaulted this relationship in his study of China's R&D capabilities. This explanation was later undermined by Hu and Jefferson (2009) and refuted by Li (2012). Li (2012) pointed out that the contribution of innovation-based factors like R&D expenditure to patent growth should be moderate as the constant ratio of R&D personnel was not consistent with the rapid patent growth in those eastern provinces in China.

In 2009, Hu and Jefferson (2009) provided the first economic analysis of China's patent surge (Hu, Zhang et al. 2017), relating three new non-innovative factors with China's patent boom: the growth of foreign direct investment (FDI) in China, amendments to the patent law and the changing ownership structure of Chinese industry. Per estimating the elasticity between patenting increase and different factors, they inferred that China's recent R&D intensification accounted for a very small fraction, and patenting growth has clearly outstripped R&D expenditure. Instead, the growth of foreign direct investment (FDI) in China is greatly prompting Chinese firms to file for more patents. The motive for foreign firms to file patents in China is to seek Chinese legal protection for innovations while this potentially stimulate domestic Chinese firms to use patents as a strategic tool to compete with foreign-invested firms. Patent law amendments in 2000 that creates a more patent-friendly legal environment, and ownership reform since mid-1990s that has clarified the assignment of property rights also emerge as significant sources of China's patent explosion. After the ownership reform, inefficient state-owned firms with low propensity to patent accelerated to exit while non-state enterprises increasingly enter. These non-state enterprises are generally more aware of protecting intellectual property rights (Hu and Jefferson 2009). Although Hu and Jefferson (2009)'s study is seemingly convincing enough, there are obvious limitations in their

dataset. They failed to distinguish between the different types of patents due to data source and are therefore unable to explore the potential differences in the motivation to apply for different types of patents. Moreover, the dataset they employed may fail to capture the characteristics of the most recent patent surge occurred after 2001 in that their dataset only covered the period from 1995 to 2001.

Later in 2010s, an institutional view was presented by Li (2012) who first empirically examined the effect of another non-innovative factor, patent subsidy programs, implemented by each province in China. He challenged previous Hu and Jefferson (2009)'s explanations for China's patent surge by noting that the patent law amendments cannot completely explain the patent surge since similar rapid rise prompted by Chinese inventors were also observed in the United States Patent & Trademark Office (USPTO) and European Patent Office (EPO) where no patent law amendments were taken place. In addition, the nationwide legal change cannot explain the different growth patterns across regions. Based on province-level data across different applicants from 1995 to 2007, Li (2012) then argued that patent subsidy programs exerted a large impact on the recent Chinese patent jump. Dang and Motohashi (2015) extended prior patent subsidy theories by providing a detailed clarification of policy designs and their impacts on applications by evaluating policy impacts on both the quantity and quality of patent applications. They gave solid evidence that subsidizing the filing fee did spur the number of patent applications but also generated applications of lower quality.

Most recently, Eberhardt, Helmers et al. (2017), first employing quantitative analysis based on representative firm-level data from SIPO and USPTO between 1985 and 2006, revealed that the patent surge at SIPO was driven by factors other than underlying innovative behaviour, including government subsidies that directly encouraged patent filings. Different from the study by Hu and

Jefferson (2009) using aggregated patent data, they differentiated between the three types of patents and focused on invention patents that represented for more novelty and inventiveness. Hu, Zhang et al. (2017) further confirmed that the correlation between patents and innovative factor, R&D, has become weaker, especially for utility models, which denoted that the patent surge was driven by non-innovation related motives. Using a more update dataset from 2007 to 2011, they justified the government policy incentive hypothesis. Meanwhile, they manifested that most of the patent growth came from firms that were not active in applying for patents in the past. They also left space for further research on other non-innovative motivations that played a part in propelling the patent boom.

What's more, there have been controversies on the relationship between the quality and quantity of Chinese patents during the patent surge. Li (2012)'s empirical examination based on the ratio of patent grants to applications also implied that the patent surge was not followed by lowered patent application quality. However, this implication was soon confuted by other scholars. Zhang and Chen (2012) estimated a lower value of patents requested by domestic applicants than foreign applicants. After assessing the quality of Chinese patent filings in EPO, Thoma (2013) provided support for the "strategic patenting" hypothesis on the lower value and quality of Chinese patents. Dang and Motohashi (2015) demonstrated that grant-contingent patent subsidies unintentionally encouraged applicants to file for patents with a narrow claim scope to increase the chance of grants, which resulted in lower economic value. Boeing and Mueller (2016) found an over-time quality decrease for Chinese Patent Cooperation Treaty (PCT) applications by international comparison, and they found evidence for a negative correlation between patent quality and patent subsidies as well.

To sum up, a patent surge is not always a reflection of increases in true innovation. Although prior studies have documented various non-innovative factors contributing to China's patent surge, they still could not provide us with a complete and satisfactory explanation (Li 2012). This leads us to wonder whether there exist other non-innovative motives that play a part in driving the patent surge. For example, Hu, Zhang et al. (2017) implied that Chinese firms may capitalize on the patents as an instrument to facilitate technology licensing, cooperation and venture financing and as performance measures for R&D personnel.

2.5 Patents filed by applicants besides firms

Most of prior studies used patent data of LMEs which may not necessarily representative of all patent applicants in China (Li 2012). Apart from patenting by firms, Li (2012) and Fisch, Block et al. (2014) observed a dramatic increase in patent propensity among universities, research institutes and individuals during the period of 1995 and 2009. In particular, universities and research institutes are major sources of invention patenting (Li 2009). Accordingly, not only firms, but also universities and research institutes are main innovators with regard to patenting (Li 2009). There are ample evidence showing that firms are driven by non-innovative motives to apply for patents. However, not many studies paid attention to the other types of patent applicants: universities, research institutes and individuals.

Universities and research institutes overpass firms in the grants of invention patents (Li 2009). Universities play a crucial role in the Chinese innovation system and contribute indirectly to the patent surge by educating future skilled labor force and by producing considerable spin-offs (Hu and Mathews 2008). Patenting by Chinese universities has gained importance in recent years

(Fisch, Block et al. 2014). In 2008, majority of the top 20 universities in patenting worldwide were from China (Luan, Zhou et al. 2010, Fisch, Hassel et al. 2014). The formerly first-placed MIT now ranked fifth, being surpassed by three Chinese universities and one Korean university; Zhejiang University (in Zhejiang province in eastern China), Tsinghua University (in Beijing), and Shanghai Jiao Tong University (in Shanghai) each filed more than 10,000 patents from 2001 to 2011. Moreover, Chinese universities file for most of their patents at Asian offices, especially the SIPO. Zhejiang University and Shanghai Jiao Tong University filed for more than 95 % of their patents in China (Fisch, Hassel et al. 2014).

One possible reason for this patent surge among Chinese universities and research institutes is that state-owned patenting organizations such as universities and research institutes are allowed to claim for ownership of patent rights after the amendment to patent law in 2000 (Li 2012).

It is true that patenting by Chinese universities increases dramatically overall. If we take a closer look, we see that universities with fewer patent applications in the past begin to catch up with top universities (Fisch, Block et al. 2014).

Nonetheless, there exists a widening gap between patent applications and citations of patenting by Chinese universities, which indicates an increasing divergence between patent quantity and quality (Fisch, Block et al. 2014). These findings of a very steep and non-international increase in patent applications by Chinese universities are consistent with other studies describing high patenting rates but a questionable patent quality (Luan, Zhou et al. 2010, Fisch, Hassel et al. 2014). The divergence between patent quantity and quality may reflect a problematic incentive structure for patentees, to whom submitting patent applications seems more important than producing innovation. This orientation merely towards patent quantity is not only evident in the university-

level but also be present at individual level (Fisch, Block et al. 2014). For example, scholars in universities are incentivized to file for patents which will facilitate their career development and promotion (Shapira and Wang 2009). This is something we explore further below, and to have a broader picture of the underlying non-innovative motives for patenting in China, our research involves different types of patent applicants besides firms.

2.6 Chinese household registration (hukou) policy and propositions

2.6.1 Chinese household registration (hukou) policy

In China, each citizen must register his name, date of birth, location of permanent residence, immediate relatives, marital status, etc. at the local police station and thus obtains his local household registration, called *hukou* in Chinese. It is the basic legal document that determines the legal status of natural persons as civil subjects and designed to manage population migration. Two most important parts of the household registration: type – agricultural or non-agricultural, and location, both are inherited at birth from parents (Song 2014). However, each citizen can only register his permanent residence in one single city.

Chinese household registration system acts like an internal visa system managing internal migration flows not only from rural to urban areas, but also inter-urban migration flows (Bosker, Brakman et al. 2012). There has been a series of household registration (*hukou*) policies managing citizenship and regulating internal migration across the country since 1950s. Local government now have full power and discretion to tailor their own *hukou* policies within their administrative jurisdiction. Hence, *hukou* policies may vary substantially from one province to another and from one city to another (Song 2014). Generally, the local *hukou* policies are made to serve local

economic development. The conversion of a *hukou* from one city to another and one province to another requires official approval (Zhang 2012) and in some circumstances it is not easy to change as one wishes.

The *hukou* system has been more and more restrictive with the approval process subject to more stringent conditions in recent decades. Functioning as a powerful tool for internal migration management, the existing *hukou* system is particularly stringent in China's largest and most developed cities: Beijing, Shanghai, Guangzhou (in Guangdong province) and Shenzhen top migration destinations in China (Bosker, Brakman et al. 2012, Johnson 2017, Song 2014). Empirical evidence showed that the entry barriers are among the highest in these cities mentioned above (Zhang and Tao 2012, Song 2014). Despite the high entry barriers, migrants are still willing to work and live in large cities because of more job opportunities, much higher income, better infrastructure, better medical care, more recreational activities, just to name a few. They are eager to obtain the local *hukou* to have full access to a variety of public services such as housing subsidies, social security programs and children education. Though the system may seem unfair, it is an effective way to prevent people from swarming into large cities to enjoy the social welfare there given the limited supply of social welfare considering the urban-rural gap is still large in China and there exist obvious differences in economic development in different cities and provinces. For instance, Shanghai offers the best medical system in China (Johnson 2017). If Shanghai municipal government does not impose restrictions on in-flow migrants, Shanghai would be flooded with people from less developed region to take advantage of its most advanced medical system and more sound welfare program. Clearly, Shanghai could not afford to provide all new comers with equal access to social welfare. Otherwise, either the local taxpayers could not enjoy the quality social benefits they deserve, or the municipal government would run behind its expenses.

Consequently, it is very difficult to convert one's permanent residence location to these large cities and obtain a local *hukou*.

Among these four cities, Shanghai has the most long-term immigrant residents who stay in the city for over six months without local *hukou*, nearly 10 million people, 41% of the city's population (ShanghaiStatisticalBureau 2015). The population of permanent resident in Guangzhou is the least, with only 5.34 million and there is a large gap between Guangzhou and other first-tier cities. From the perspective of the proportion of the immigrant residents, Shenzhen has the highest among the four first-tier, reaching 67.7% (ShenzhenStatisticalBureau 2016), which is much higher than that of the other three first-tier cities. The reason for this is that Shenzhen, as a newly emerging city after the Chinese Economic Reform and Opening up in 1978, has a relatively small number of indigenous residents holding local *hukou*. Even the current population with local household is the population that settled in Shenzhen after 1978.

Shanghai took a lead among these large cities in developing the local *hukou* policies for governing in-coming migrants with the implement of China's first points system for *hukou* eligibility in 2004. The points system was designed to attract talented migrants, especially fresh graduates from universities. By awarding points to candidates as determined by their respective quality, the city government seeks to ensure the selection of highly-skilled migrants to serve in key industrial sectors and enterprises or in government positions for the purpose of local economic development. To be more specific, a fresh graduate with non-Shanghai origin who graduated from any authorized university in Shanghai and secures long-term employment in the city is eligible for applying for Shanghai *hukou*. However, only those who scores higher can finally obtain a Shanghai *hukou*. In 2007, only 38% of non-Shanghai graduates were outstanding enough to get a Shanghai *hukou* (Li,

Li et al. 2010). A similar points system was adopted by cities in Guangdong province in 2009, by Beijing in mid- 2016 (Zhang 2012, Johnson 2017).

Although the points systems in different provinces and cities have different categories and different requirements, there exist similarities. First, granting of urban *hukou* is subject to both “qualification” and “quota” controls. Qualifications are associated with the eligibility criteria that are rated by various variables under multi-tiered categories with different numerical scores assigned to each category, while the quotas control the number of qualified applicants who will receive the local *hukou* (Zhang 2012). To be a qualified candidate, one must accumulate sufficient points in total. However, he may still fail to obtain the local *hukou* if the annual quota has been reached. All qualified candidates are ranked based on their total scores, and available *hukou* are granted to those with the highest scores. Unsuccessful candidates are allowed to reapply in future rounds.

Second, we can find similarities in the rating scheme of these large cities. In order to attract talented migrants, most of the points system list scientific inventions as one of the categories in its rating scheme. And the scientific inventions either refers to holding a patent or submission of an application for a patent for invention. Overall, the rating scheme include assessment of the candidate’s personal quality in terms of *educational level* (the type of degree granted), *professional level* (the type of professional certificate awarded), *personal contribution*, *personal competence*, and *qualifications of candidate’s employer*. The higher educational and professional level the candidate possesses, the higher score he is rated. *Personal contribution* can be calculated in terms of national or provincial-level awards and honors, amount of investment capital or charitable donations. Holding a patent for an invention/utility model/ product design, or submission of an application for an invention patent falls in the category of *personal competence* (Zhang 2012).

Considering the annual quotas are extremely small compared to the number of migrants in large cities, to obtain the local *hukou* is extremely competitive (Li, Li et al. 2010, Zhang 2012, Song 2014). For instance, in 2010, the first year of implementation of the points system in Guangdong province, Guangzhou, a city with 7.26 million migrants, set its quota at only 3,000 (Zhang 2012). Consequently, potential candidates in these large cities would take every effort to score higher in the points system in order to realize their *hukou* conversion to large cities.

Since the points awarded to candidate's education level above bachelor's degree account for one thirds of the total qualification points, and zero point is awarded if below university degree, highly-skilled graduates from universities are obviously the main targets for the *hukou* rating schemes designed to recruit talented migrants.

2.6.2 Propositions

Grounding on prior studies on Chinese patenting and Chinese household registration (*hukou*) policy, we conjecture a correlation between these two: the *hukou* system can generate incentives to file for patents. This is a novel and courageous inference since no previous researchers have brought up before. To confirm our conjecture, we investigate the correlation through following propositions:

- **Proposition 1:** The *hukou* points system which includes scientific invention as one of the scoring categories incentives people to file for patents.
- **Proposition 2:** A large part of the individual patent applicants in China are migrants from other cities or provinces.
- **Proposition 3:** Universities and individuals contribute to a significant part of the patent surge in large cities.

3 Methodology

3.1 Data

This study uses the patent information from State Intellectual Property Office (SIPO) and from the qualitative interviews conducted by the researcher. Descriptive data were collected from State Intellectual Property Office (SIPO) and interviews to describe participants' sociodemographic and patent filing characteristics.

3.1.1 Chinese patent data

This study only uses patent data from Chinese patent office in that we focus only on the domestic applicants filing with SIPO to investigate their non-innovative motives. We assume that if the main purpose of the applicants is to score higher in the *hukou* points system, they would not file abroad which requires more direct and indirect costs and a higher novelty threshold to overcome (Eberhardt, Helmers et al. 2017). Instead, they intended to file with Chinese patent office which is a relatively easier way. Patent data in China is available on the China Intellectual Property Office (SIPO) website (<http://www.sipo.gov.cn/>). It provides patent data covering all three types of patent applications since 1985 when China established its patent system and started record of patent information. The patent data we downloaded from the website provides us with the following information:

- (1) General patent application information: application year, number of domestic applications received per province for three types of patents, number of domestic applications received of several metropolitans for three types of patents, monthly applications for three types of patents;

- (2) Detailed patent application information of invention patents, utility models and product design patents: application number, application date, place of application, type of patent, name of patent agencies if any, the latest legal status, whether applied internationally, and content of the patent, etc.;
- (3) Information of patent applicants and inventors: name and address.

We retrieved the Chinese version of the patent data since it not only includes formatted data of scientific inventions, but it also includes utility models and product design patents. Most of prior scholars did not include utility models or product design patents in their study. However, it is worthwhile to include these two types of patents in our study considering they are more likely to be subject to non-innovative motives since they do not require substantive examination. Recent research suggests that a part of Chinese utility models are only filed to meet performance evaluation criteria tied to patent targets, and to claim government-provided incentives (Prud'homme 2015). Besides, patents for utility model and design do count for the point system. Prior research pointed out that there was an explosion in utility model filings in China from 2010 to 2013, with utility model filings outnumbering invention patent filings (Prud'homme 2015). Meanwhile, we notice that in the rating scheme promulgated in 2011 for qualifying for an urban *hukou* in Shanghai for college graduates with job offer, it credits to college graduates who hold a patent for scientific invention or utility model or product design and to who submitted an application for a patent for an invention (Zhang 2012).

This study used statistical data of domestic patent applications for all three types from 2000 to 2016. We limit our research to domestic applicants because only Chinese citizens are eligible for obtaining a local *hukou*. And according to WIPO, domestic applicants accounted for an

increasing part of the rapid growth of China's patenting, reaching about 88% in 2015⁷. Therefore, data of domestic applicants are enough to cover our research scope.

3.1.2 Qualitative data

This study employed exploratory qualitative method as semi-structured interviews with open-ended questions to investigate the non-innovative motives of individuals to file for patents in China for several reasons. First, this approach aiming to ensure that the topic was discussed in depth with the interviewees (Magdaleno, Chaim et al. 2010). Also, we used qualitative research method would complement the lack of quantitative data on patenting motives, which was supported by Yin (2016) pointing out that qualitative research could overcome the constraint of the unavailability of sufficient data series or lack of coverage of sufficient variables and study the ongoing event. Second, a major strength of qualitative research is that it pays attention to what can be learned from field evidence and data, raises the possibility of discovering or revealing new ideas and explanations uncovered by original hypotheses or theoretical issues (Yin 2016). In addition, qualitative research enables us to represent the views and perspectives of the people in our study, to contribute insights into emerging phenomenon that helps to explain human social behavior, and to use multiple sources of evidence rather than relying on a single source alone (Yin 2016). These distinctive features of qualitative research well apply to our research content. Therefore, to better understand the facts behind the statistical data of patents from Year 2001 to 2016, we adopted the interview as our qualitative research method.

⁷ Data from the World Intellectual Property Organization (WIPO). Available at: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=CN

As one of the fundamental objectives of qualitative research is to depict a complex social world from participants' perspective, it is vital to have qualified participants. The participant recruitment for the interviews was conducted in October, 2017. Each interview was conducted based on either face-to-face meeting or one-to-one Skype meeting in Chinese, and lasted approximately from thirty to sixty minutes. We employed semi-structured interviews instead of fully-structured ones on account of its flexibility, richness and depth we were able to reach (Yin 2016). We could adapt our questions to the different situations of the interviewees and the different answers they gave. Some questions were inspired from their previous answers. The semi-structured interview guideline included three parts: the participant's personal background; the details of the participant's patent information; and the participant's motivation for patent application.

The language we used during the interviews is Chinese because both the interviewer and the interviewees are native Chinese speakers, and using a language they were most comfortable with could encourage the interviewees to talk more and more freely, and allowed the researcher to better master the meanings of the interviewees' words and phrases, thus reducing the risk of incomplete or incorrect information conveyed due to language barrier. The interviews were audio recorded and the transcription was then translated into English by the researcher.

Sixteen individuals who applied for patents in China after 2009, five patent agents and one university professor specializing in intellectual property were selected as interviewees and were interviewed during Jan and Feb in 2018 (see TABLE 2). We control the nationality of these individuals as Chinese citizen considering the initial propositions that these individuals might apply for patents to obtain local *hukou*, which is granted only to Chinese citizens.

TABLE 2 Interview summary

Inter- viewee	Identity by the time of patenting	Interview place	Interview time
#1	Fresh graduate of Master's Degree from a "Project 211" university in Shanghai	Shanghai	Jan, 2018
#2	College student from a leading "Project 985 &211" university in Shanghai	Shanghai	Jan, 2018
#3	College student from a leading "Project 985 &211" university in Shanghai	Shanghai	Jan, 2018
#4	College student from a leading "Project 985 &211" university in Shanghai	Shanghai	Jan, 2018
#5	Mother of a high school student	Online interview	Feb, 2018
#6	Certified patent agent	Shanghai	Jan, 2018
#7	College student in Guangdong	Online interview	Feb, 2018
#8	College student in Shanghai	Shanghai	Jan, 2018
#9	Online patent agent	Online interview	Feb, 2018
#10	Online patent agent	Online interview	Feb, 2018
#11	Online patent agent	Online interview	Feb, 2018
#12	Online patent agent	Online interview	Feb, 2018
#13	University professor specializing in intellectual property laws	Shanghai	Jan, 2018
#14	Graduate student from a "Project 211" university	Beijing	Jan, 2018
#15	College student from a leading "Project 985 &211" university in Shanghai	Shanghai	Jan, 2018
#16	College student from a leading "Project 985 &211" university in Shanghai	Shanghai	Jan, 2018
#17	College student from a leading "Project 985 &211" university in Shanghai majoring in industrial design	Shanghai	Jan, 2018
#18	Technical clerk from a medium-sized technology enterprise	Beijing	Jan, 2018
#19	College graduate in Beijing	Beijing	Jan, 2018
#20	College student in Guangdong	Online interview	Feb, 2018
#21	College student in Guangdong	Online interview	Feb, 2018
#22	College student in Guangdong	Online interview	Feb, 2018

3.2 Procedures

First, we studied our patent data downloaded from State Intellectual Property Office (SIPO), we organized, processed and summarized the data to identify the trends and spikes of patent applications year over year per region.

After we studied our dataset, we had a few questions about the trends and spikes, which we did not find answers to in prior literature. We concluded our questions in our interview guideline (see Appendix A) preparing to ask our interviewees about. Meanwhile, we looked for patent-related local policies to help explain those trends and spikes of patent applications.

Next, we needed qualitative interviews to help dig out the deeper reasons behind the trends and spikes of patent applications. We were not able to contact the applicants or inventors directly and randomly selected from the database we downloaded from State Intellectual Property Office (SIPO) in that the contact information of the applicants and inventors were not contained, and even if we know the company or education institutes of the applicants and inventors, most of the personal information were dated back to ten years ago and were not updated. We had no way to randomly selected our potential interviewees from the database. Therefore, we recruited our interviewees through these Chinese social media:

- (1) WeChat, the most popular messaging and social media app in China. We distributed our recruitment information through different groups.
- (2) Baidu Tieba (<https://tieba.baidu.com/>), the largest Chinese online community. This communication platform functions by having users search or create different forums based on different keywords. We posted our recruitment information in several forums such as Fresh Graduates Bar, Patent Bar, Patent Application Bar, Patent Agent Bar,

and community of several metropolitan cities such as Shanghai Bar, Beijing Bar, Guangdong Bar, Shenzhen Bar and Guangzhou Bar.

(3) Bulletin Board System of Fresh Graduates (<http://bbs.yingjiesheng.com/>), an online community based on one of the most popular recruiting website for college students and fresh graduates in China.

(4) Bulletin Board System of thirty different type of education institutes including universities, colleges, elementary schools, secondary schools and high schools.

Through the online recruitment, we approached sixteen individuals who accepted to participate in our interview. We contacted five patent agents through LinkedIn, and through the online websites we searched by ourselves and mentioned by our interviewees during the interviews. The researcher also got connected with a university professor in Shanghai who studied the intellectual property law and noticed the non-innovative motives of domestic patenting in China.

3.3 Research ethics approval

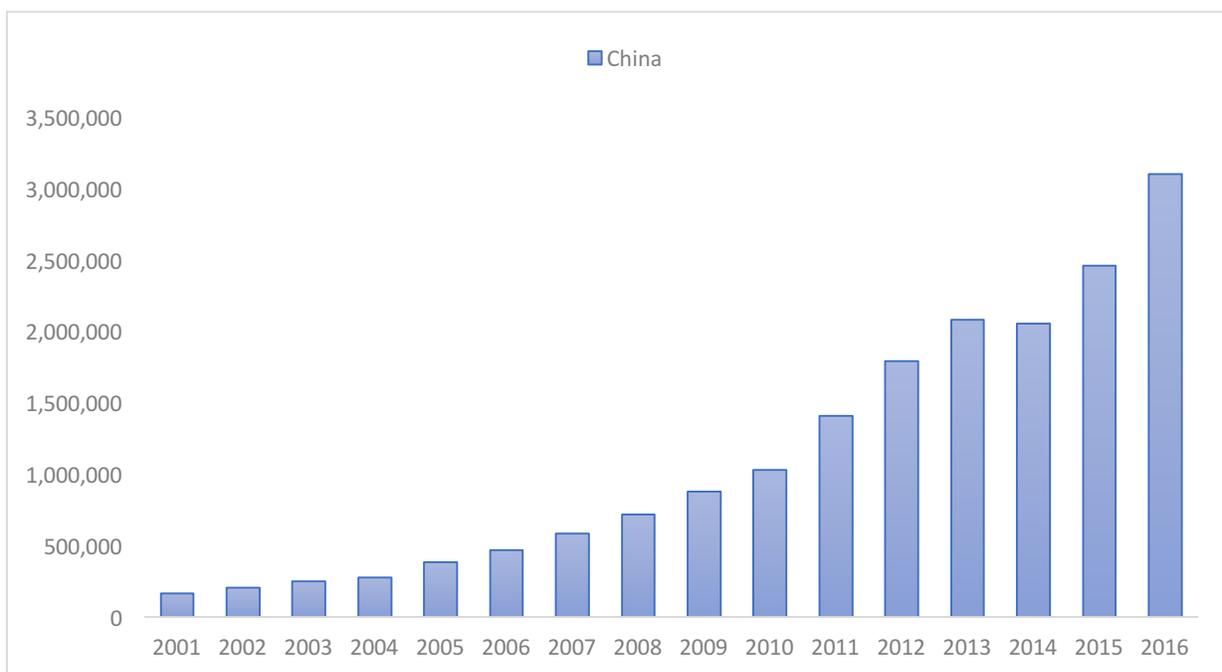
This study was approved by the Research Ethics Board of HEC Montreal. Verbal consent was obtained from all participants before the interviews commenced.

4 Findings and Analysis

4.1 Descriptive statistics

China has experienced its most recent patent surge since 2001 (see FIGURE 1). The number of domestic patent applications rose from 165,000 in 2001 to over 3,000,000 in 2016, during which period the average annual growth rate was 21.9%.

FIGURE 1 Number of Domestic Patent Applications in China



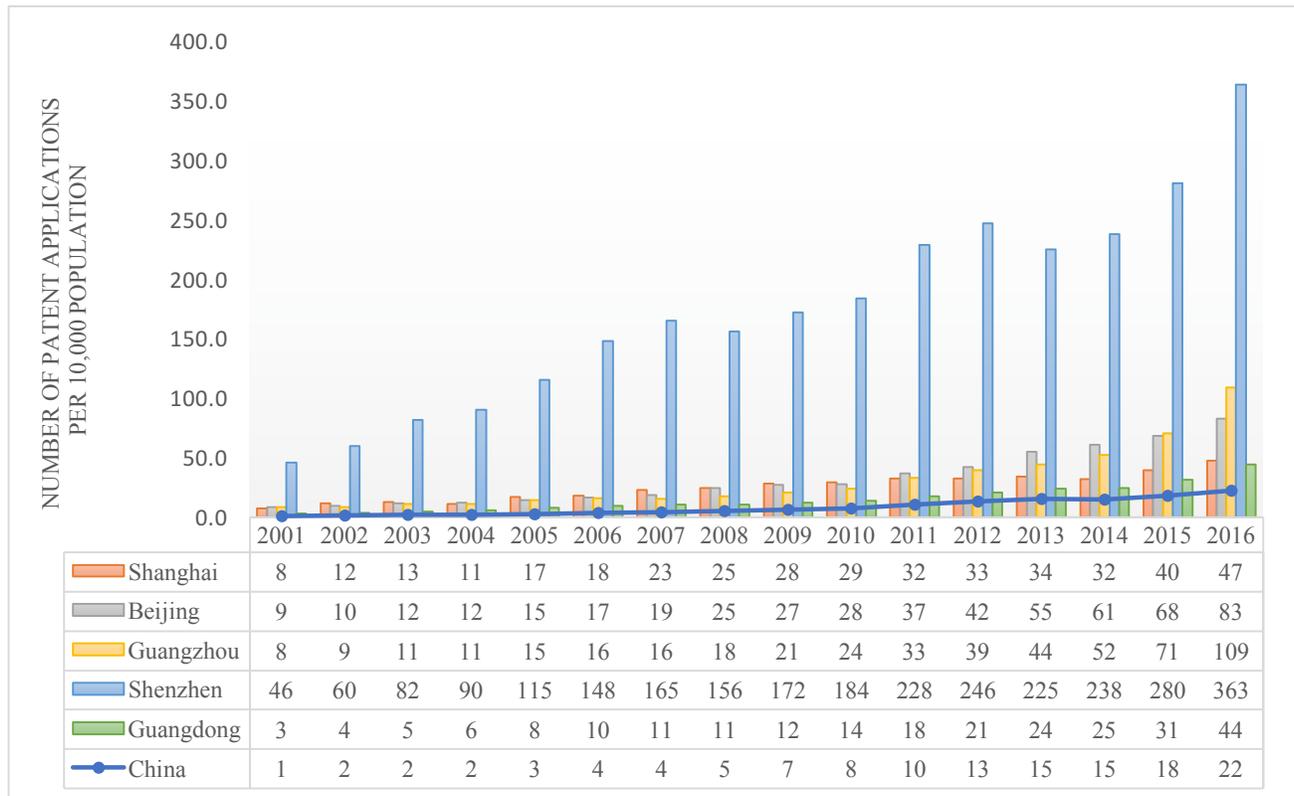
Source: State Intellectual Property Office (SIPO)

When we broke down the numbers per region, at the provincial level, we found that Guangdong, as one of the most populous provinces in China, it has remained as the top region with the most number of domestic applications since 2001. In 2016, Guangdong had a share of 15.6% of all domestic applications in China, which is more than double of the sum of the number of domestic

applications in the next three provinces. While at the city level, Shanghai, as the most economically developed region in China, remained as one of the top regions with the most patent applications. Shanghai remained second until 2012, since when Beijing has overtaken Shanghai. It is noteworthy that Shenzhen, a major city in Guangdong Province and part of the Pearl River Delta megalopolis, saw the fastest growth rate, with an average annual growth rate of 24.2%. It surpassed Shanghai in 2014 and became the region with the second largest number of patent applications. Guangzhou, however, grew slowly compared to other first-tier cities.

Considering the size of different regions, we calculated the number of domestic patent applications per capita (see FIGURE 2). We can see that the numbers of four first-tier cities were well above the national average. Shenzhen had the most number of domestic patent applications, which was more than sixteen times of national average and double of Shanghai in 2016. The number of patent applications per capital in both Shenzhen and Guangzhou, two largest cities in Guangdong Province, far exceeded their provincial average. Combined with what was mentioned above, we can infer that Shenzhen and Guangzhou contributed most to the patent surge of Guangdong Province.

FIGURE 2 Number of Domestic Patent Applications (per 10,000 population)

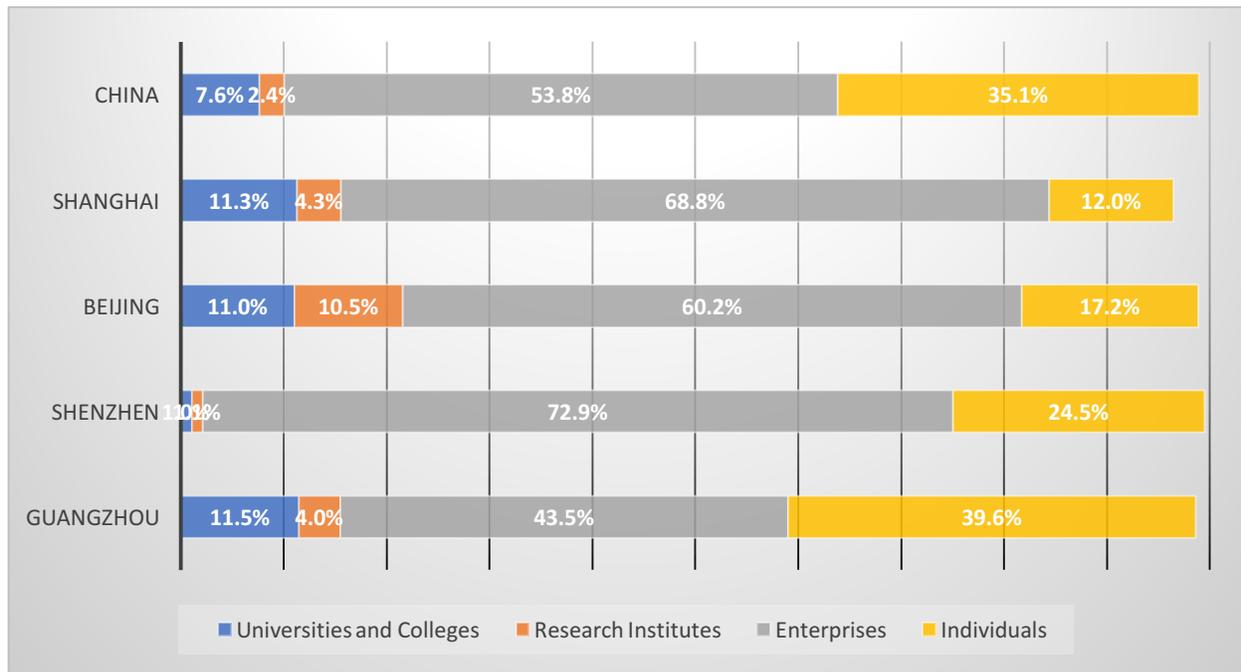


Source: Author's calculation using data from State Intellectual Property Office (SIPO) and National Bureau of Statistics of China

It is not surprising that these four cities remain at the top of the list, as they represent the most economically developed regions in China with the best public resources, educational resources, top universities and research institutes and high-tech enterprises as well. They have more human capital and financial capital to invest in the innovation activities, thus yielding much more patents as research achievements than other regions. When we dug deeper into the data, we discovered that it was not always true that in large cities universities, research institutes and individuals accounted for a large part in patent filings. The total share of applicants from universities, colleges and research institutes in Shanghai, Beijing and Guangzhou was greater than the domestic average (see FIGURE 3). However, those types of applicants only occupied 2.1% in Shenzhen, which was

only one fifth of the domestic average (10.0%). Enterprises are the ones who applied the most patents in Shenzhen, share from 52.9% in 2001 to 81.5% in 2016 (see FIGURE 4). This result partially refuted the Proposition 3 we made earlier.

FIGURE 3 Average Share of Different Types of Domestic Patent Applicants (2001-2006)

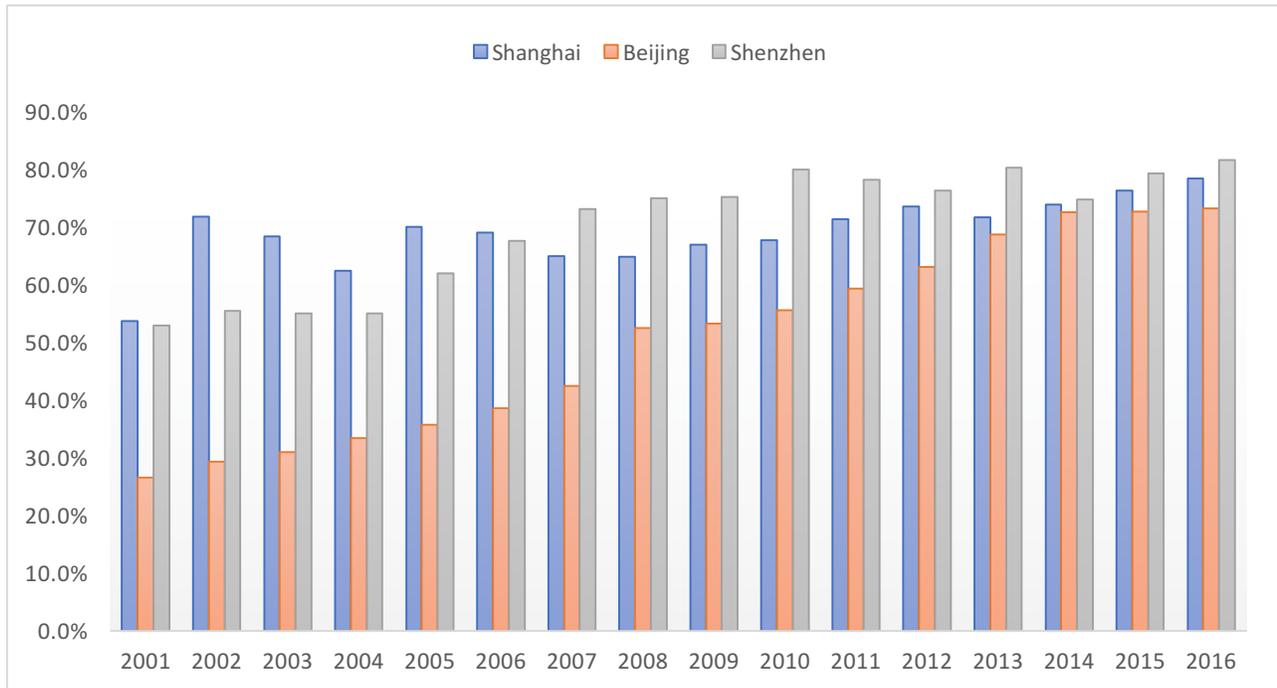


Source: State Intellectual Property Office (SIPO)

Although universities, colleges and research institutes in Shanghai and Beijing made up a relatively higher percentage among all domestic applicants than the national average, enterprises held the biggest proportion in all provinces and municipalities. The overall trend from 2001 to 2016 revealed that the enterprise applicants were becoming more and more dominant, rising from 53.6% in 2001 to 78.3% in 2016 in Shanghai (see FIGURE 4). The upward tendency was even more obvious in Beijing. Enterprises only constituted 26.5% of all domestic applicants in 2001; however, in 2016, they had an overwhelming percentage (73.1%) over other types of applicants. It is reasonable that enterprises might demand more protection of their intellectual property.

Nevertheless, through our further interviews and investigation, we were surprised to discover a more policy-driven motive behind, which has not been discussed by former scholars.

FIGURE 4 Share of Enterprise Patent Applicants in China



Source: State Intellectual Property Office (SIPO)

Despite the fact that individual applicants did not account for a remarkable share compared to enterprises, they presented an even bigger percentage than either universities or research institutes as a type of applicants alone.

Furthermore, we noticed that Shanghai, Beijing and Guangdong Province are also the regions that receive the most immigrants every year. According to the 2010 Census (ShanghaiStatisticalBureau 2010), more than 39% of Shanghai's residents are long-term immigrants, a number that has tripled in ten years. Compared with the fifth census in 2000, a total number of 6.281 million were added over the past ten years, of which 87.8% are immigrants from other provinces.

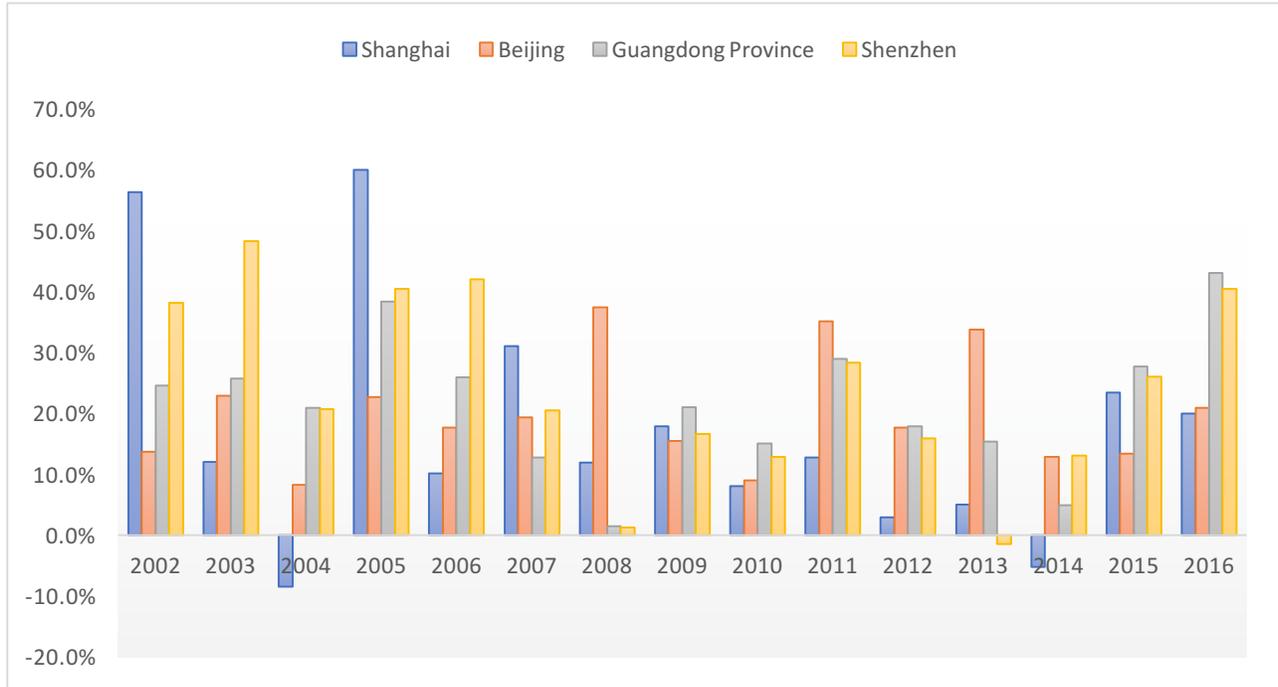
In general, economically developed cities, with their high quality public resources and good job opportunities, will form a strong attraction for immigrants. With the arrival of large numbers of migrant workers in large cities, the big city "magnetic field effect" appear. More and more immigrants are attracted to work, study and live in large cities every year, especially in megapolis.

By comparing population of non-household residents in Shanghai, Beijing, Guangzhou and Shenzhen, we found that Shanghai has the most immigrants, Shenzhen has the highest proportion of immigrants. In the past three years, the number of permanent residents in Beijing and Shanghai has been decreasing while Guangzhou and Shenzhen is showing a great increase. This might account for one of the reasons why the average annual growth rate from 2001 to 2016 of patent applications in Guangzhou (21.1%) and Shenzhen (24.2%) is higher than that of Shanghai (17.2%) and Beijing (20.0%).

We saw a greatly fluctuating growth rate of the top four regions, Guangdong Province, Beijing, Shenzhen and Shanghai (see FIGURE 5). Shanghai experienced its fastest growth in 2005, followed by a second peak in 2007. Then from 2008 to 2014, a weaker volatile downward trend. In 2015, it reached its third peak after 2005 of 23.4%.

Guangdong Province underwent a drop after 2005 but quickly went up from 2009 to 2011. The number of applications has kept going up rapidly since 2014; the growth rate of 2015 is 27.7% and the growth rate of 2016 is close to 50%. Similarly, in Shenzhen, after drop after 2006, it reached its first peak in 2011, and has kept climbing up after it hit the lowest growth rate in 2013.

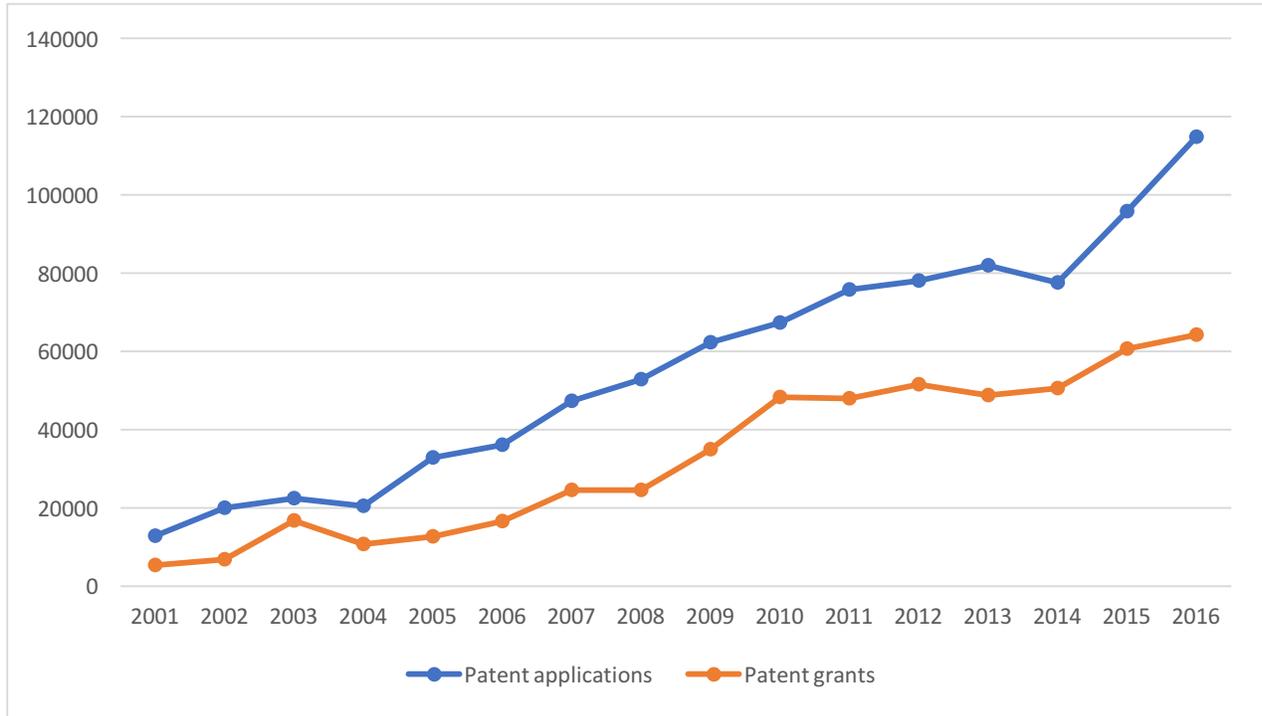
FIGURE 5 Growth Rate of Major Domestic Patent Application Regions



Source: State Intellectual Property Office (SIPO)

As a non-negligible indicator to check the innovative motive of patent application, the percentage of international applications, which means that the number of patents filed internationally, might give us a hint that how many patents were filed with relatively good quality and for innovation purpose. However, take Shanghai as an example, less than 0.3% of patents were filed internationally. FIGURE 6 showed the development of patenting and grants in Shanghai over time. The Figure illustrated the total number of patent applications (897,857) and the number of grants that these applications received by the year of the application (524,133) from 2001 until 2016. The Figure demonstrated rapid growth both in patent applications and grants beginning in 2004.

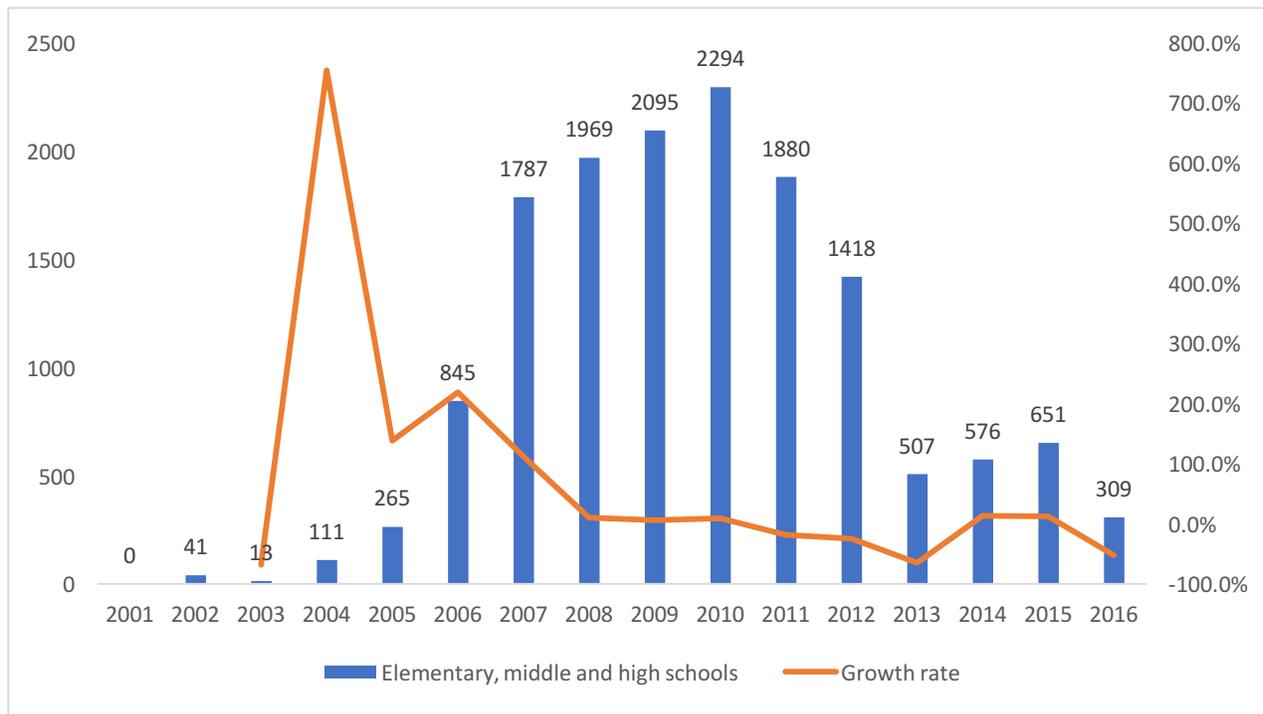
FIGURE 6 Domestic Patent Applications and Grants in Shanghai



Source: State Intellectual Property Office (SIPO)

Fisch, Block et al. (2014) focused on patents filed by universities because they thought that universities played an important role in a country's national innovation system. However, we wondered why there was also an increasing number of patents filed by elementary, middle and high school students in Shanghai starting from 2004 (see FIGURE 7). We found our answer during the interviews on next stage.

FIGURE 7 Number and Growth Rate of School Applicants in Shanghai



Source: State Intellectual Property Office (SIPO)

To summarize, from the available descriptive statistics on Chinese domestic patents, our Proposition 3 was not supported. We observed a patent explosion in Shanghai, Beijing, and Shenzhen and in Guangdong Province as a whole, but not in Guangzhou. Except Shenzhen, other first-tier cities as Shanghai, Beijing and Guangzhou all had an above-average percentage of university and research institute applicants from 2001 to 2016. Besides, the patents filed by enterprises in these cities were soaring fast, especially in Shenzhen. Moreover, we detected several interesting points that deserve further investigation during the interviews. The surge of patent applications and grants in Shanghai started from 2004 but experienced ups and downs in terms of growth rate in 2005, 2007 and 2015. A rapid and nearly exponential growth in patent applications by elementary, secondary and high schools beginning in 2004 reached a peak in 2010 also caught

our attention. To better understand the results of descriptive statistics above, we summed up our findings and doubts in our interview guideline (see Appendix A) to bring up to our interviewees.

4.2 Findings from qualitative interviews

4.2.1 Non-innovative motive of individuals: obtaining an urban household registration

As mentioned earlier, various instruments were employed as immigration policy by government to select desirable immigrants and grant them with the local *hukou*. The number and composition of immigrants were selected based on characteristics the government preferred (Zhang 2012). The first points system adopted in Shanghai was aimed at fresh graduates from universities and colleges, and it continued to be used till now after having undergone several revisions on the rating scheme (see Appendix A and Appendix B). In the points system, points are awarded for the various requirements an applicant meets. Applicants who achieve enough points toward the qualification mark, which is determined by the annual quota, may qualify for immigration.

From the rating scheme, we can see that the type of university/ college the applicant graduated from, his academic performance, proficiency of foreign-language, computer competence, awards and honors, and innovation of scientific research are all taken into account. For a lot of non-Shanghai fresh graduates who want to work and live in Shanghai after graduation, they do their best during period of study in university in order to gain as many points as possible. As the qualification points are not published, the graduates do not know if they pass or not until they submit all the documents and wait for a few months before the final result comes out. The only thing they can do is to “find all possible ways to accumulate points” (Interviewee #1, #2, #3, #4, fresh graduates). From the interviews with college students, we’ve learnt that there was a popular

way spread among college students for scoring higher. They apply for patents to obtain the bonus points under the category of “innovation of scientific research” on the rating scheme.

“I have done everything I can do already, from working hard for the higher academic scores to taking the College English Test- Level 6 and computer test.

I referred to the qualification scores spread from ear-to-month among previous applicants of last year, which was 71 points. It is estimated that the qualification points of this year will be 72. If so, I’m still lacking 3 points. How to make up for the 3 points is the most important thing for me right now. I’ve heard that the most feasible way to make up the deficit within only a few months is to apply for patents through some companies specializing in patent application for college students to apply for hukou.”

-- Interviewee#1

(Fresh graduate of Master’s Degree from a “Project 211” university in Shanghai)

Since 2004, the points system has been implemented in the Shanghai for non-Shanghainese college students with job offer to apply for the Shanghai household registration (*hukou*). If the applicant’s accumulative scores are higher than the qualification scores, they can apply for the Shanghai’s *hukou*; if the scores are lower than the passing scores, they will apply for Shanghai Municipality’s residence permit as a temporary permit to work and live in Shanghai. The qualification points are determined by an official organization of the Shanghai Municipality in accordance with the requirements for mechanical growth control of the Shanghai Municipality's household registration population.

In fact, since 2007, relevant departments in Shanghai have not disclosed what the “Shanghai account score criteria score” is. After the application, the graduates can only know if they passed

or not. On the online forums, there are many posts that ask about the passing scores. The passing scores are so mysterious as Interviewee#8 said “we can only guess the standard points based on the scores of other people on the forums. We discussed how many points were passed score and how many points were not passed”.

Although Shanghai has been vigorously promoting residence permits, and has declared that “enjoying the same treatment as Shanghai citizens,” college students have long studied the differences between the urban *hukou* and residence permits. The differences range from social welfare, pension to the eligibility to apply for the passport and register the marriage in Shanghai. What's more important is that they do not “have a sense of belonging” (Interviewee#8, college student).

The reason why Interviewee#1 thought the most feasible way to gain more points within short time was to apply for patents was that he saw a lot of relevant posts on the online community for college students.

“I saw a lot of posts online claiming that they (some patent agents) could help college students to apply for patent. I also studied the rating scheme. If the student is about to graduate in a year, they could help submit one patent application and obtain the submission certificate, which can add one bonus point for the student. If the student will graduate in more than a year's time, they have enough time to have the patent granted for the student, which can add three to five points.”

-- Interviewee#1

We searched online and found similar posts as what our interviewees said. It was found that many companies were still soliciting customers. These batches of patented companies were called

“patent factories” by students (Interviewee#3, #4). Some interviewees answered evasively when asked whether they innovated the patents themselves and said that “most of the students who filed for patents were out of other purposes such as applying for the *hukou*” (Interviewee#2). In order to gain the trust of those patent agents posted themselves through online advertisements, we disguised ourselves as college students who wanted to obtain more points for applying for *hukou*. After contacting a few patent agents, we were surprised to know that even though the rating scheme is getting strict, patent agents still have their way to make it.

“You will receive the certificate of submission of invention patent within 3 days. We can tailor the patent based on your specialization in the university. You do not need to do anything. We take care of everything from filling the forms for your patent application, preparation of supporting documents to the submission. If your classmates want to do so, their names can also be added as inventors and applicants. It takes some time to have the patent granted. If you urgently need it, there’s a quickest way. You can directly add your name to another case we are handling with right now which is already in the granting process. Your name can be added before the certificate is printed and handed out. We already have successful cases with students from well-known universities in Shanghai. Any specialization will work.”

-- Interviewee#9 (online patent agent)

Instead of waiting for around one year for the invention patent to be granted, some people chose to apply for utility model or design patents as another option to obtain less bonus points than invention patents. Relatively speaking, utility model or design patents are easier to apply for and have them granted since they do not go through the substantive review stage.

“As long as your format is in line with the specifications, authorization will soon be possible. In the case of notifying the examiner (with small benefits) in

advance, it can be achieved within three months. As the invention patents, which can add more points, need to go through the substantive review stage checking the content of your patent, the difficulty is higher. However, it is not impossible to pass. You can narrow the protection scope of your patent so that the reviewer has no reason to refute you. In this case, it is possible to have an invention patent granted within three months. In whichever case, it is for sure that you should give some small benefits to the reviewer in advance.”

--Interviewee#10 (online patent agent)

However, during the past years, the rating scheme is becoming more and stricter every year (see Appendix B). The relevant authorities have noticed some college students have infidelity in patent filing so the review of the "authenticity" of patents has been strengthened. The purpose of the review is to refer directly to the “authenticity” of patents: whether students have directly participated in the project process and whether their contributions are directly related to the patented results. In the period of 2007 to 2009, mere submission of patents with certification was acknowledged. Then in 2010, one requirement was added that the applicant must be included in the name list publicized by his university on the official website stating which students applied for patents this year. In 2012, submission of patents without granting was not acknowledged anymore. What’s more, since 2012, the applicant must gain a written proof from his tutor stating that the research project of the patent was done under supervision. Since 2014 till now, only invention patents are eligible for the bonus points; other types of patents as utility model and product design are no longer included in the categories of rating scheme.

Now that we’ve learnt that one of the non-innovative motives of individuals for patenting is associated with the *hukou* points system in large cities, we can explain the ups and downs of the growth rate of patent application in Shanghai and Guangdong Province, and why the growth rate

in Guangzhou was much slower than other Tier-1 cities. First, let's take a close look at the year when there was a rocketing growth rate in Shanghai: Year 2005, 2007 and 2015 (see FIGURE 5). Year 2005 was one year after the first points system of household registration was promulgated in 2004, and one year was enough to have this policy spread extensively and have college students learnt of. During this year, informed students set out to apply for patents to prepare for the *hukou* application afterwards. Year 2007 was the year when certificate of submission of patent application was included in the rating scheme (see Appendix B). It was a good news for massive students in that having a patent granted required both time and effort. Once a patent without granting was acknowledged, it incentivized more students to apply for patents because of less difficulty to confront, less time and less effort to invest in. Year 2015 was the year when it was noted in the rating scheme that the patents would only be acknowledged if the applicant of *hukou* was among the initial applicants of the patents, meaning that transferred patents became useless for the *hukou* application from now on. A number of patents were filed because in this way they could gain bonus points in the *hukou* selection system.

Similarly, it may also explain the spikes of patent growth rate of Guangdong Province. From FIGURE 5, there were spikes in years 2009 and 2011. Zhongshan City, in Guangdong Province, carried out its *hukou* points system in 2009; while Guangzhou City adopted a similar points system in 2010, which may explain why we observed two spikes in 2009 and 2011, which was exactly the same year and one year after these two cities implemented their rating scheme for migrants who wanted to obtain a local household registration.

The slow growth rate of patent application in Guangzhou and the least patent applications among four Tier-1 cities resulted from the fact that Guangzhou had the least proportion of immigrant population. Less immigrants meant less needs to apply for local *hukou*, thus less needs to gain

bonus points for *hukou* system through patenting. The combination of descriptive statistics and qualitative interviews supported the Proposition 1. Whereas, there weren't available descriptive statistics revealing the percentage of immigrants among the patent applicants in large cities, we asked about the city of their original household registration during the interviews. It turned out that all the interviewees who applied for patents as college students were immigrants to large cities. The result supported the Proposition 2 to some extent.

In addition, we wanted to discover more about the interest chain behind the patenting business and the dynamics of this grey industry. We noted a company based outside Shanghai but had a website called "Consulting website of *hukou*-related bonus points", which was a patent agency specifically aiming at college students. The services provided included applications for all types of patents based on applicant's specialization, and transfer of invention patents as well. In addition, the site also showed off some of their own design patents. On this website, there were various "suggestions" for college students who wanted to settle in Shanghai. In the eye-catching position of the website, there was a paragraph saying

"This year's requirements for patent and professional fit are strict, and many students have been unable to obtain urban hukou for this reason. Therefore, the students who are determined to make a patent must fully communicate with us in advance so that we can design a patent for you that is more aligned with your profession. For example, if you major in Chinese language, we will design an electronic Chinese-language learning machine for you."

The fee for such a "patent" was around 300 CAD. Whereas, three names could be added to the patent thus "splitting the fee into 100 CAD per person" (Interviewee#12). When we talked about our concern that we also needed the written proof from our tutor which was not easy, a patent

agent (Interviewee#12) assured us that our tutor will not disapprove as long as they made the patent look professional and high quality.

“As long as you have money, any students from universities on the list of Project 211 or 985 are 100% sure to successfully obtain a granted patent and finally obtain Shanghai’s household registration. We have several years of practical experience and extensive networks. During the first half of this year, I have already processed more than 100 cases. We will pay extra attention to fit the patent with the name of your specialization. I am 100% sure that you will get a design patent within five months. Don’t worry. Patent Office only checked the documents not the applicants.”

--Interviewee#11 (online patent agent)

Yet, another online patent agent (Interviewee#10) who acknowledged that

“This year’s business is not as easy to do as before since the Patent Office and the relevant authorities responsible for application of the household registration are more cautious with the patents filed by these students. In early years, even if the content of the patents was totally irrelevant to the students’ specialization, there weren’t any problems when they used the patents for bonus points when applying for hukou. If your scores are not sufficient, you’d get an award or honor in the university additionally.”

Despite there were patent agents who had the capability to take care of everything during the patent application process, inevitably, there were also some fraud patent agents only interested in luring money from naïve students, as revealed by Interviewee#4. When asked if worrying about the possibility of being tricked by those so-called patent agents, Interviewee#1 still considered it “worthwhile to spend hundreds of dollars for obtaining a precious *hukou* in Shanghai. Besides, my parents also support me for doing so”.

Not only some parents were aware of such tricks to score higher in the *hukou* points system, some professors or administrative staff in the universities also heard about it. A professor from a well-known university specializing in intellectual property laws told us that some students consulted him about applying for patents in order to obtain the *hukou* after graduation.

“Among them, some will even graduate in three years which is a long time to go. They consider about hukou issue early. To be honest, we cannot deny that quite a part of the filed patents are driven by something other than innovative motive. Even though some of them passed the publicity on college website and got the written proof from their tutor, still, some patents are suspicious. Some universities and colleges even grade their students highly so that they can have more bonus points in the hukou points system. Patenting has become something utilitarian. From my point of view, I hope that the universities and relevant authorities could take some actions to crack down such phenomenon. Otherwise, it is extremely unfair for some other students who work hard on their research projects for innovation purpose.”

-- Interview #13 (university professor specializing in intellectual property laws)

The original initiative of government to include bonus points for patent holders in the rating scheme was to filter and retain more talents in large cities to contribute to the development of the society. When too many people file for low-quality patents for non-innovative purpose, it has deviated from its original good purpose.

4.2.2 Non-innovative motive of individuals: easier admission to a higher-ranked school

In the past fifteen years, a group of young patent applicants has risen. They were still studying at secondary school or high school, or even elementary school. Did it mean that the innovative capability of our juniors had been enhanced? Not necessarily.

The Ministry of Education has made two major moves in the past two years to standardize the independent recruitment of the college entrance examination and ensure that all candidates compete fairly: one is to cancel a few categories of bonus points to college entrance examination; the other is to strictly regulate patent-related bonus points to college entrance examination. The Ministry of Education issued a notice requesting the strict examination and assessment of qualifications during independent recruitment period of universities, severely cracking down on the sale and falsification of patents and dissertations, and resolutely cutting off the “interest chain”.

The independent recruitment examinations started in 2003 was one of the major reforms of the enrollment system of Chinese universities. Hereafter, the National College Entrance Examination was no longer the only assessment for high school graduates. Through independent recruitment, universities can independently select students based on their own written exams and face-to-face interviews to comprehensively assess the candidates. The candidates finally selected can get extra entrance scores, usually ten or dozens of points, or other favorable terms for the National College Entrance Examination.

Specifically speaking, the independent recruitment exams generally require candidates to have outstanding abilities and strengths in certain aspects. For example, extraordinary innovation and practical abilities, or outstanding performance in literature, art, sports, etc., as well as awards for

academic competitions. In general, candidates who participate in independent recruitment exams can be divided into the following three categories:

- (1) High school graduates with excellent academic performance during study in high school, strong comprehensive strength, or outstanding honorary titles;
- (2) Candidates who have academic specialty in certain fields and have won awards in various competitions and competitions;
- (3) Candidates who have outstanding performance in technological innovations and inventions in the high school stage.

To be eligible for these independent recruitment exams, high school students are either enrolled through recommendation letter from their own school or through self-recommendation. Those who are recommended by school can be 100% received as candidates for following screening tests; however, those who recommend themselves have to pass a preliminary screening of CV. Some universities clearly put forward the content of patent inventions, some listed holding patents as one of the conditions for registration. If the students meet this requirement, they are eligible to enroll and take the following exams (see Appendix E). However, this condition also gave birth to a market for “patent sale” and “patent application”. The market demand has made some patent agencies discover business opportunities from the group of high school students. Searching the keywords such as “patents for independent recruitment”, we found that many online stores of intellectual property service agencies stating that they provided services such as “patent application” and “patent transfer”, and that patents are the key to the college independent recruitment.

The purpose of introducing patents as one of the categories of bonus point to the college entrance examination was to encourage high school students to apply what they had learned in classroom to innovation, and help those students who were expert in one subject to enter an ideal university. Unexpectedly, the market for patenting bonus points came into being and has put the selection instrument in a state of disorder.

However, parents instead of assailing this phenomenon, parents seemed to accept it and even became customers of this ignominious business. One of those parents (Interviewee #5) disclosed that

“One day my daughter came home and asked me to buy an invention patent for her. A lot of her classmates had bought the patents from online agencies because holding a patent could grant her with more bonus points for the college entrance exam. However, the filing time for invention patents is relatively long. Generally, it takes around two years to get a certificate. Therefore, it needs to be prepared in advance. It is important to choose a reliable agency to set out doing it when the kid is still in junior year. Remember to choose an agency that guarantees 100% pass rate not to waste two years since the patent application has a certain risk to be rejected.”

Not only do high school students benefit from holding a patent, students from elementary school and secondary schools are also the beneficiaries. Perhaps it’s unbelievable for people from other countries that children in China have to pass such competitive selections to be admitted to a key elementary and secondary school even though it’s compulsory education. However, it is the fact in China. It is often heard that many parents, including teachers, whisper: “We cannot let our children lose at the starting line.” Then, in order not to let their children left behind by peers, many parents send their children to various cram schools and interest classes to improve their academic

scores and other artistic talents even when their children are still in kindergarten. The selection of key elementary and secondary schools are already very competitive, evaluating the comprehensive quality of candidates such as maths, English, playing a musical instrument or not, awards and honors etc. The admission rate of some prestigious schools could be as low as 3%. If the children hold any patents, they have the privilege and more possibilities to be admitted to key schools because this is a symbol of their innovation capability. Parents are willing to pay for the patents and teachers are willing to help students to apply for patents if patents can facilitate their children and students to enter a leading school. What's more, with the possession of a patent allows some students to skip the interview stage when applying for graduate program. The starting year of the independent recruitment exams was in 2003. This explained the explosive growth rate (753.8%) of patents filed by students from elementary, secondary and high schools in 2004. Before 2004, the number of junior applicants was from zero to less than fifty. Starting from 2004, the number of junior applicants rose sharply and reached a peak of more than two thousand in 2010. With the stricter regulation by Minister of Education, the number dropped gradually in recent years.

4.2.3 Non-innovative motive of individuals: awards and honors

In some Chinese universities, as one of the graduation requirements, master's student must publish a dissertation in one of the national core journal or holding a patent. Some students found it much easier to file for patents than having a dissertation published in core journals, thus giving rise to the number of patent applications by universities or individuals in China. During our interviews with university students, we were impressed by one interviewee from one of the top universities

in China who applied for about seventy patents within a year. When asked about his motivation to do so, the interviewee#15 answered:

“The first patent I filed was for my research project. After the first patent application, I found it easy to file for patents since I know how to write the patent application document to pass the review. It’s not difficult to have it granted. You just need to search for similar patents in the patent database, and adjust the wording of your patent explanation to avoid being suspected of duplicates. I can just stay in my dorm and finish a patent application every five days. I want to impress my classmates and teachers. With the impressive number of patents, I got the scholarship every year and was awarded Outstanding Student Prize.”

We were astonished by the speed that he “invented” a patent without doing any research in the lab. Although the content of the patents he applied were related to his specialization at university, we cannot help but challenge the quality of those patents in view of his patenting speed. Maybe he was an extreme example, but the phenomenon that university students applied for patents in order to get scholarships, awards and honors were not rare. Chinese universities have invented a rating scheme on comprehensive assessment of students’ quality development. The assessment normally comprehends several parts such as moral assessment, academic performance, capability assessment and innovation assessment. Innovation assessment scores based on different categories related to students’ innovation achievement including patent applications (see Appendix D). An interviewee (Interviewee#7, college student) complained about this phenomenon:

“It’s really unfair. We only get one bonus point for participating in social practice or volunteer work, three points for top 30% academic performance, while some get eight to fifteen points for a patent application. To be top 30%, we need to work hard for a whole semester but only get 3 points at the end.”

Some students did nothing but bought a patent from agencies. As a result, they had much higher total scores and got the scholarship. My family is not wealthy so I won't spend 200 CAD as those students did to buy a patent for the quality assessment."

On the contrary, some students were not in favor of Interviewee#7's opinion. They thought it was not unfair since they spent the effort and money on purchasing a patent to score higher in the assessment.

"Others are buying a patent so why don't you buy one as well? There's nothing to complain about. Either change the environment or adapt to the environment. Since there are unspoken rules, others can obey the unspoken rules, you can do the same. It is useless to complain while it's more useful to study more about the unspoken rules. Buying a patent is a rewardable business after all; you can reimburse your expense on purchase of patents through the scholarship you earned afterwards."

-- Classmate of Interviewee#7 (college student)

From the arguments above, we can see that students held different opinions and attitudes towards utilitarian patenting behavior. Considering it's not difficult to buy a patent as there are quite a few online patent agencies making money from this, a part of the students were attracted by the reasonable price to buy patents from those agencies. Some did not care the content of the patents they bought from agencies, all they wanted was to benefit from the ownership of patents since it's common; they felt that if they did not do so, they would be left behind. A student remarked

"A problem that money can solve is not a problem".

Apparently, universities which were supposed to be the source of innovation were not exactly the same as what we assumed, a sad fact. Students are filing patents for more utilitarian purposes.

Sometimes, even schools were playing a role in this process and helped students make full use of the patents they applied for.

“I worked on a scientific research project with my tutor and other colleagues at our lab. We did work hard and seriously, having spent a lot of effort and time on it. Upon the completion of our project, our tutor suggested us apply for a patent for our research result. However, he knew that I intent to apply for national scholarship that year but I wouldn’t have my patent granted before I applied for the scholarship. So he suggested that I add my name to the patent filed by his former students who already graduated. In return, I filed for my patent in the name of our lab so that they could transfer my patent to my next fellow students in case they wanted to apply for the national scholarship, too.”

-- Interviewee#14 (graduate student from a “Project 211” university)

Yet, we know there are lots of students working hard on research activities and file for innovative patents, but still, with the existence of quite a number of students “making up” patents or buying patents from agencies, though the percentage is not clear, we have reason to challenge the quality of Chinese recent patent surge despite its large quantity.

4.2.4 Non-innovative motive of individuals: job promotion

During our interviews with college students, more than half of them mentioned that their tutors encouraged them to file patents. Generally, graduate students are assigned by their tutor to work together on some research projects, and they are required to write a dissertation and file for a patent as the end product and proof of their innovative research. When applying for the patent, the name of the tutor is always listed as first applicant and inventor. A university tutor usually has about ten

master's students under his supervision every year. If every of his students file for a patent each year, the tutor will end up with at least ten patents under his name every year. Thus, it is not surprising that some university professors have a possession of almost fifty patents as his research products. But why do those professors strongly encourage their students to file patents? We got the answer from some interviewees.

“Every time my classmates and I completed a research project, our tutor encouraged us to apply for patents. The name of the tutor is always listed as first applicant and tutor, meaning that we own the patent together. As a result, we can use the patents for applying for the hukou, and our tutor can boost how many research projects he has done and how many patents he has filed in a year as his innovative achievement. The next time he applies for funding for his research projects, the university will grant him more based on his previous research achievements. What’s more, to promote to higher title, the tutor also needs a certain amount of patents and published dissertation. It is a win-win solution for both our tutor and us.”

-- Interview #16 (college student from a leading “Project 985 &211” university in Shanghai)

Innovation do exist in the patents bred from the research projects done by some college students and their tutors. Yet, their motives are not purely for innovation anymore but for personal interests as well. An interviewee (Interviewee#17, college student majoring in industrial design) told us that

“The most impressive point I had after exchange program in Italy was that the product born from the research project of Italian students were much more practical than ours in China. Most of the times, we do projects for projects, we do innovation for innovation, without considering its practical usage and whether this innovation will bring change and development to our lives.”

Some patents that bear practical innovation are usually collaborating project between university and enterprise, and those patents are owned by the enterprise since the enterprise provides the funding.

Holding patents not only helps university professors to get promotion, in some technology enterprises, employees are also assigned a target of patent filing.

“Our supervisor assign us with a quota of patents to file each year. If we reach the target, we have more chances to get promoted. We do have achieved some innovation in our work every year, but not everything deserves to be filed for patents. However, with the quota we are assigned with, we will try our best to relate our daily work to patenting. Otherwise, we will be considered as no contribution to the company and will not be promoted.”

-- Interview #18 (technical clerk from a medium-sized technology enterprise)

As for the reason why the company required the employees to file for patents, the interviewee answered that because the scale of their company was not big and not well-known in the market, with the number of patents, the company could quickly build their reputation, create a good professional image and improve their competitiveness. For employees, the number of patent applications was regarded as one of the categories in the year-end review that determined their bonus and job promotion.

4.2.5 Non-innovative motive of enterprises: certification as national high-tech enterprises

Different types of patentees have different motives. For enterprises, patenting is a common practice since it is a very important mechanism to protect their intellectual property (Amara, Landry et al. 2008). Empirical studies have concluded that patenting also signals an enterprise's entry into innovative area (Harabi 1995), apart from blocking competitors from duplicating research products and technologies (Kingston 2001), facilitating cross-licensing activities (Kingston 2001), increasing its business evaluation required for mergers or acquisitions (Puranam and Srikanth 2007) and securing operation freedom (J.P. Walsh 2003).

There are two factors that may affect an enterprise's propensity to file for patents: capability factors and willingness factors (Huang and Cheng 2015). The higher the degree of willingness an enterprise has, the more likely it will file for patents (Huang and Cheng 2015) What we investigated about enterprises' non-innovative motives for patenting belongs to this category, willingness. It suggested that some enterprises filed for patents regardless of their own organization size, R&D resources and research funds, etc. were driven by non-innovative motivation factors. For the moment, the latest explanation to these non-innovative motivations was about government subsidies (Li 2012, Dang and Motohashi 2015, Prud'homme 2015, Yan, Liu et al. 2016, Eberhardt, Helmers et al. 2017, Hu, Zhang et al. 2017). From our interviews with patent agents, we found out a new explanation that has not been hinted at by our original propositions.

As what we saw in FIGURE 3, of all types of patent applicants, enterprises were the most, occupying the highest percentage in all provinces. The number of patents filed by enterprises were on the rise every year. During our talk with one certified patent agent (Interviewee#6) who worked

mostly for enterprises, we learnt that nationally quite a number of enterprises put a lot of emphasis on patent filing. Every year, the top management team of those enterprises set a goal of the number of patents to file within the year. The goal thing was aligned with our descriptive statistics (see Appendix F). We aggregated the number of applications from 2001 to 2016 and broke them down per month. We can see an obvious spike at year end, between November and December, when applicants including enterprises were rushing to file patents to meet their yearly goal. The drop in Feb every year is due to the public holidays of Chinese Spring Festival when the patent office do not work. With the qualified number of patents and other conditions met, the enterprises are eligible to be certified as national high-tech enterprises so that they can greatly benefit from lots of preferential policies such as tax reduction and government funding support (see Appendix G). Applying for certification of national high-tech enterprises to enjoy a tax reduction of 15% and financial subsidies of 60,000 CAD to 100,000 CAD annually has become a top priority for technology companies in China. This explanation was supported by Liu, Tan et al. (2013) that high-tech enterprises certification was one of the most important factors that motivated Chinese enterprises to apply for patents, thus leading to the patent explosion in China.

According to the Regulations on the Certification of High-tech Enterprises, the national high-tech enterprises refer to the resident enterprises registered in mainland China (excluding Hong Kong, Macau and Taiwan) for more than one year that continuously contribute to the R&D and technological achievements transformation in the high-tech fields supported by the state. During this process, the enterprises form its core independent intellectual property rights based on which they conduct business activities. The certification scheme of national high-tech enterprises was first issued by Chinese State Council in early 1990s with intent to establish high-tech industry and promote the rapid development of high-tech enterprises in China. The national high-tech enterprise

evaluation system also adopts a points system based on a hundredth (see Appendix H), including four scoring categories: core independent intellectual property (30 points), capability of technological achievements transformation (20 points), organization and management level of R&D (30 points) and growth indicators (20 points). Core independent intellectual property is the primary indicator, referring to the ownership of intellectual property that was acquired through R&D, transfer, grants, mergers and acquisitions etc., and that the intellectual property must play a core supportive role on the enterprise's major products or services. The qualified points are 70 points in total. To reach that passing score, normally an enterprise needs to achieve 24 to 30 points in the first category, which requires an invention patent or six patents of other types (utility model/design patents). Patents that are recognized and can be counted for points include: inventions, utility models, and designs that used science and engineering techniques and obtained through R&D activities, software copyrights, exclusive rights of integrated circuit layout design, and new plant varieties. All of the above types of patents must be applied for and registered within China. Even though the enterprise has obtained the certification, it does not mean it will cease its patenting since the certification is valid only for three years. If the enterprise still wants to enjoy the beneficial policies exclusive to certified national high-tech enterprises, it will also need to make continuous effort to apply for patents.

According to the updated "Measurement for the High-tech Enterprise Certification", whether or not the company has its own patents is a hard standard for recognition. Apparently, the number of core independent patents has a significant impact on the enterprises applying for high-tech enterprises. Enterprises have an urgent need for patents to pass the recognition. Nevertheless, the waiting time for obtaining a patent grant approval is too long for them. When there is demand, there is market. For companies with zero patents, the most direct way is to fill gaps by purchasing

patents, that is, to find patent resources with high correlation between the technology content and the company's core products, reach a cooperation consensus with the patentee, and obtain the patent transfer record proof. This kind of patent transaction only promotes the transformation of patent technology, but also help companies applying for the certification of high-tech enterprises to meet the requirements. Whether it has its own patents is "one-vote veto" in the certification evaluation. Of course, enterprises that have strong R&D capability on their own like Huawei do not need to file for patents solely for this certification. However, other small or medium size firms might need this certification to take advantage of the following preferential policies while they are not capable to meet the requirements due to lack of research funding or R&D personnel or other reasons.

The behavior of companies purchasing patents for enriching their "patent reserve" for certification assessment are agreed by local governments and relevant departments. The government's opinion is that although there are special reasons for the current increase in the volume of patent transactions, it is through the purchase of patents that companies have virtually increased their awareness of proprietary patents. This is also a manifestation of the company's focus on the cultivation of proprietary patented products, and has corrected the original blind spots of awareness. Moreover, with the increasing awareness of proprietary patents, companies will realize that their self-development of patents is more cost-effective than the purchase of patents, thereby strengthening research and development and gradually shifting from purchasing patents to developing patents.

5 Conclusion

The number of patent applications and grants is an important indicator to examine the innovation level of one country. However, it should not be the only and determining indicator considering the complicated drivers and motives behind the patenting behavior.

5.1 Conclusion and implications

In our study, we revealed a series of non-innovative motives that prompted individuals and enterprises to apply for patents, which contributed to the most recent domestic patent surge in China. Our three propositions were supported. Besides the initial propositions, we've discovered new explanations from field evidence and data. Chinese filed for patents for obtaining the local household registration (*hukou*) in large cities, easier admission to a prestigious school, awards and honors, job promotion and certification of national high-tech enterprise, to name a few.

Distinct from latest studies highlighting the role of government subsidies on the patent application, the answers we obtained from our interviewees who applied for patents as college students were not aligned with the subsidy theory. Some interviewees didn't even know about the subsidies since they already got a student discount of 85% deduction which ended up in an application fee of only 15 to 27 CAD.

Through qualitative interviews, we found that the various non-innovative motivations all relate to the corresponding rating schemes of government-level or institution-level. Therefore, we recommend related departments consider more when formulating the policies not to allow people

making use of the loopholes and playing around the rules; otherwise, they will result in unexpected situations against their original intention. Government should not only pay attention to the quantity of patents as the innovation capability evaluation indicator but instead improve innovation incentive mechanism, and pursue more virtual and fundamental innovation that will veritably promote the scientific development worldwide.

Therefore, we should consider more underlying factors when we comprehensively evaluate the innovativeness, and include various measurement indicators than merely from sole quantified data.

5.2 Contributions

The contribution of our study not only lies in the series of novel and interesting facts unraveled about the non-innovative motives of patent applicants in China, but also in the methodology we employed to explore the underlying facts behind the statistical data. No previous study included qualitative data from interviews to explain the Chinese patent surge before, while our study, conducted from the patent perspective with the involvement of patent statistics and individual interviews, supplements previous studies with alternative and novel explanations for China's patent surge. A major strength of qualitative research is the possibility of discovering or revealing new ideas and explanations not hinted at by the original propositions and theories. As far as we know, no such explanation presented previously has related the patent surge to the various points systems in China. Second, our database bridges the gap of period from 2011 to 2015, which was not covered in prior studies. In addition, our database also included data on utility models, which were rarely taken into consideration by previous researchers.

As a born Chinese, the researcher's language privilege and inherent familiarity with local culture both enabled us to better interact with the interviewees in China, understand the obscure meaning behind their answers, and acquire more relevant information from Chinese websites.

Overall, our study broadens the literature on the innovation and government policy in a developing-country context.

5.3 Limitations and recommendation for future research

Despite the contribution, there are still limitations in our study. First, we are not able to calculate an approximate percentage of migrants versus all patent applicants due to the limited information provided by the SIPO patent database. This resulted in limitation that we validated our Proposition 2 merely through the qualitative interviews we conducted, rather than double verification through both descriptive statistics and qualitative data.

Second, by the time of our research, Beijing has practiced its *hukou* points system for less than one year thus we did not do a deep investigation in the effect of its *hukou* points system on the patent applications in Beijing. What's more, Tianjin Municipality has also implemented a points system to select qualified migrants and grant them with the local *hukou* since 2014. Therefore, we call for more future research on two cities to further validate our propositions and give us more insights on the Chinese patent surge.

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7 Appendixes

A . Interview Guidelines (English version)

Date: _____ Location: _____ Duration: _____
Interviewee#: _____ Occupation: _____

Part 1: Interviewee's background

1. In which city, do you live currently?
2. Do you have a local household registration (*hukou*) of the city you live now? If not, where is your *hukou*?
3. When and where did you file for the patent?
4. What was your occupation by the time you filed for the patent?

Part 2: Information about patent application

5. What was the type (scientific invention/ utility model/ Industrial design) and content of the patent?
6. Why did you file for the patent?
7. To whom the patent belongs to currently?
8. Will you transfer the patent to others in the future? If so, to whom you might transfer the patent? If not, explain the reason.
9. Has the patent been granted yet? If so, will you consider renewing it after it expires?

Part 3: Motivation

10. Did you apply for/ obtain government subsidies after you filed for the patent?
11. Do you think government subsidies really incentives you or others to file for patents?

12. Has anyone around you (at your school/ company) also filed for patents? Is it popular to file for patents at your school/ company?
13. Does your school/ company incentive you to file for patents?
14. Could you tell me the reasons why you applied for patents?
15. Does holding a patent enable you to score higher when apply for local *hukou*/ higher educational institution/ higher position at your company?
16. Has holding a patent brought you any economic benefits?

B. TABLE 3 Rating Scheme for College Graduates with Job Offer to Apply for an urban hukou in Shanghai, promulgated in 2010 (partial)

Category	Points
QUALIFICATIONS OF CANDIDATE	
Highest education	
Ph.D.	27
Master's degree	24
Bachelor's degree	21
Graduate from	
Universities located in Shanghai and on the "Project 985" or "Project 211" list, research institutes affiliated with the Chinese Academy of Sciences and with the authority to award Master's degrees	15
Other universities on the "Project 211" list, institutions directly under the administration of the central government, universities and research institutes under the administration of the Shanghai government and with the authority to award Master's degrees	12
Other universities and research institutes	8
Academic performance (per comprehensive ranking of academic scores during the period of university study)	
Tier 1 (Top 25%)	8
Tier 2 (26% - 50%)	6
Tier 3 (51% - 75%)	4
Tier 4 (76% - 100%)	2
Foreign-language proficiency	
Passed College English Test Level 6 with a score over 425 or Professional English Test Level 8	8
Passed College English Test Level 4 with a score over 425 or Professional English Test Level 4	7
Passed foreign-language courses for those specializing in foreign languages, arts and sports	7
Computer competence	
Post-graduates	7
Science graduates with advanced computer competence; exemption for those specializing in mathematics, electronic information, electric information, management science, and engineering with admission prior to Year 2013; exemption for those specializing in mathematics, electronic information, electrics, computer science, management science, and engineering with admission in/ after Year 2013	7

TABLE 3 (continued)

Category	Points
Arts or social science graduates with intermediate computer competence or with Level 2 in provincial test	7
Science graduates with intermediate computer competence or with Level 2 in provincial test	6
Arts or social science graduates with elementary computer competence or with Level 1 in provincial test	6
With grades qualified for those specializing in arts or sports	6
Awards and honors	
Granted Outstanding Student/ graduates Award by national authorities	10
Granted Outstanding Student/ graduates Award by provincial/ municipal authorities	5
Granted Outstanding Student/ graduates Award by college	2
Awards from certified national competitions	
Winners of certified national competitions	
First prize	10
Second prize	8
Third prize	6
Winners of local area for certified national competitions	
First prize	5
Second prize	3
Third prize	1
Innovation of scientific research	
Holding a patent for scientific invention (obtained during the period of highest education)	5
Holding a patent for utility model (obtained during the period of highest education)	3
Holding a patent for product design	3
Submission of an application for a patent for invention/ utility model/ product design during the period of highest education	1
Establishment of own business	
Legal representative of a self-established firm with technology venture fund	5
Member of a self-established firm with technology venture fund	2
Legal representative of other types of self-established firm	5
Member of other types of self-established firm	2
Graduates from colleges in Shanghai with completion of volunteer work in government-led projects serving Western China	
	5

Source: Shanghai Education Committee (<http://www.shmec.gov.cn/html/xxgk/201002/405012010002.php>)

C. TABLE 4 Patent-related Categories of Rating Scheme for College Graduates with Job Offer to Apply for an urban *hukou* in Shanghai

Year	Patent							Award
	Patent Type		Patent Ownership Type		Other Supporting Documents Needed			Outstanding Student Award (above& including college level)
	Scientific invention	Utility models, or design patents	Having been granted	Having been submitted but not granted yet	Publicity on college website and no objection	Original written proof of the instructor's signature	List of confirmed graduates with patent(s) in the Year	
2004	√		√					√
2005	√	√	√					√
2006	√	√	√					√
2007	√	√	√	√				√
2008	√	√	√	√				√
2009	√	√	√	√				√
2010	√	√	√	√	√			√
2011	√	√	√	√	√			√
2012	√	√	√		√	√		√
2013	√	√	√		√	√	√	√
2014	√		√		√	√		√
2015	√		√		√	√		√
2016	√		√		√	√		√

Source: Shanghai Education Committee (http://www.shmec.gov.cn/web/xgk/rows_list.php?node_code=40501&page=1)

**D. TABLE 5 Comprehensive Assessment of College Student Quality Development Scale
(partial, innovation related)**

I. Bonus points for academic competitions

(including competitions in mathematical modeling, advanced mathematics, physics, English, web design, electronical design, mechanics, etc.)

	First Prize	Second Prize	Third Prize	Encouragement Prize
National competition	15	11	9	5
Provincial competition	9	7	5	3
City or college-level competition	5	4	3	1
Faculty level competition	3	2	1	0.5

II. Bonus points for achievements in scientific research

A. Prizes achieved for scientific research: scale referred to above academic competition multiplied by 1.2.

B. Scale for patent holders

	First applicant	Second applicant	Third applicant
Granted invention patent	15	10.5	7.35
Utility model patent	10	7	4.9
Product design patent	8	5.6	3.92

Note: Maximum total points for utility model and product design are 30 points; no total points limit for granted patents of scientific invention.

III. Bonus points for “Challenge Cup” Competition and Business Plan competition

A. Scale referred to above academic competition multiplied by 1.5 if winners of above college-level competition;

B. The same scale as academic competition if winners of below college-level competition.

IV. Bonus points for published research papers

A. Scale for author of published research papers

TABLE 5 (continued)

Published in	Points
National core journals, or investigation reports used by above city-level government/organization	10
General publication (with official serial number and book number)	4
College publication (no serial number or book number)	1
Faculty publication (no serial number or book number)	0.5

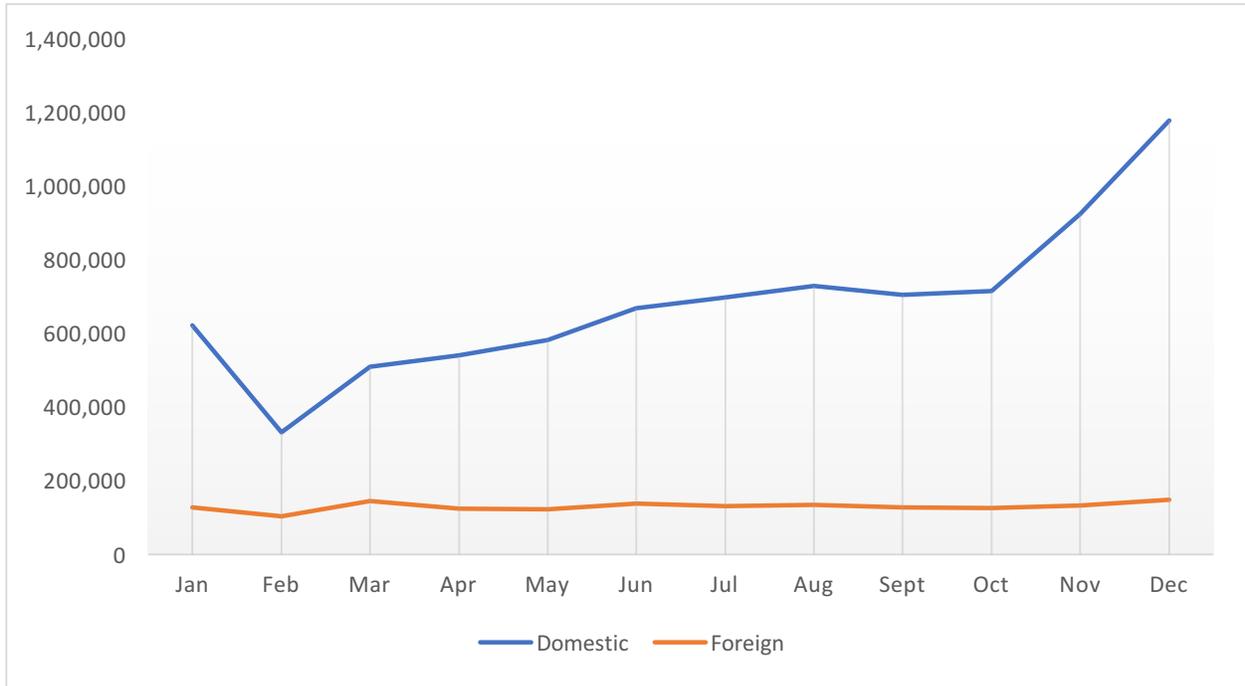
Source : <http://xgc.cumt.edu.cn/13/33/c290a4915/page.htm>

E. TABLE 6 Desired qualifications of candidates for college independent recruitment, promulgated 2012

Name of university	Innovative qualifications
Beijing University of Aeronautics and Astronautics	Students with outstanding performance in scientific innovation and invention, and first-prize winner of provincial-level competitions in high school, or patent holder;
Beijing Institute of Technology	Winners of above provincial-level knowledge competition, or winners of above provincial-level competition in scientific innovation, computer science, social practice, and invention in high school, or patent holders;
Northwestern Polytechnic University	Students with outstanding innovation and practical capability who have obtained invention patents or utility model patents in high school, or students who have published high-quality academic papers, or students who have obtained national professional grade certificates and have been approved by our university;
Beijing University of Science and Technology	Students with outstanding performance in scientific innovation and invention, and has won the provincial second prize or above, or holders of granted patents;
Beijing University of Posts and Telecommunications	Winners of above provincial-level competition in scientific innovation, computer science, social practice, and invention in high school, or patent holders, with outstanding academic and comprehensive performance in high school;
Nanjing University of Aeronautics and Astronautics	Holders of granted invention patents, or winners of above provincial-level technological innovation competitions;
Southwest Jiaotong University	Students with outstanding expertise in certain areas (except art and sports), or patent holders;

Source: China Education and Scientific Research Website
 (www.cnjyky.com/kejizhuanli/zhuanlishengxue/2015/0516/787.html)

F. FIGURE 8 Number of Patent Applications Received per Month (2001-2016)



Source: State Intellectual Property Office (SIPO)

G. TABLE 7 Summary of Preferential Policies for Certified National High-Tech Enterprises, promulgated 2016

Policy Summary

STATE-LEVEL

Preferential income tax rate

Certified high-tech companies enjoy a preferential income tax rate of 15%, which is equivalent to a 40% reduction from the original 25%.

Deduction of the R&D expenses

For R&D expenses incurred by an enterprise for the development of new technologies, new products, or new processes, the deduction shall be made based on 50% of R&D expenses if no intangible assets are formed and counted in the current profit or loss; assets are amortized at 150% of the cost of intangible assets if intangible assets are formed.

Accelerated depreciation of fixed assets

The fixed assets allowed to accelerate depreciation include: fixed assets with faster product replacement due to technological progress; fixed assets that are in strong vibration and high corrosion all year round. If the accelerated depreciation method is adopted, the accelerated depreciation can use the double-declining balance method or the annual sum method.

Conditional reduction and exemption from income taxes

The income from technology transfer that meets the conditions for high-tech enterprises shall be exempted or reduced. Within a tax year, the portion of the income from technology transfer of a resident enterprise shall not be exempted from enterprise income tax for any portion that exceeds 5 million yuan; half of the amount exceeding 5 million yuan will be levied on half of the enterprise income tax.

The enterprise shall be exempt from corporate income tax for the first two fiscal years since its first production and operation income is acquired, and will be levied at half the statutory tax rate of 25% for the third to the fifth year.

Priority to be listed

Certification of national high-tech enterprises is a prerequisite for the listing of the New Third Board, and priority shall be given to the listing of shares of high-tech joint-stock companies that meet the conditions for listing.

Preferential access to office and industrial land

TABLE 7 (continued)

PROVINCE-LEVEL

Beijing

Equity financing

A one-time capital allowance of 40,000 CAD, 100,000 CAD, and 0.4 million CAD respectively to high-tech enterprises in Zhongguancun Technology Park for their restructuring, agency system listing, and domestic and overseas listings.

The graduates of institutions of higher learning or scientific research institutions in the administrative area of Beijing, and are employed by high-tech enterprises in the Zhongguancun Technology Park can be granted Beijing's household registration (permanent residence).

Senior management personnel of certified enterprises that invested in Beijing can apply for a one-time rewards for home purchase.

Children of senior management personnel of enterprises that invested in Beijing are allowed to enroll in the Beijing college entrance examination, and can be treated in the same way as candidates with Beijing's household registration. Children of employees of enterprises that invested in Beijing can participate in the Beijing high school graduation exam.

Shenzhen

Home purchase subsidies

High-tech enterprises can recommend one of their high-level talents to apply for incentive subsidies for home purchase. The subsidy standards are: Longhua New District 448,000 CAD, Bao'an District 640,000 CAD, and other regions are all 320,000 CAD.

Direct rewards

After obtaining the certificate, enterprises can enjoy the corresponding accredited subsidies from the city government and government of the district it belongs to. For example, Shenzhen Municipality rewards 10,000 CAD; Longhua New District rewards 20,000 CAD, Longgang District rewards 40,000, Nanshan District rewards 20,000 CAD, Futian District rewards 40,000 CAD, etc.

High-tech enterprises entering the high-tech zone stock agency system for transfer of share prices will be subsidized up to 0.36 million CAD.

Other benefits

The government of Shenzhen allocates 20% of the total amount of bond issuance each year to certified high-tech companies that meet the issuing conditions.

In 2008-2020, Shenzhen will build 5 million to 6 million square meters of innovative industrial housing to support the development of high-tech industries.

Source: Official Website of High-tech Enterprise Certification Work (<http://www.innocom.gov.cn/>)

H. TABLE 8 Rating Scheme for Certification of National High-tech Enterprises, promulgated 2016 (partial, intellectual property related)

Intellectual Property Related Evaluation Indicator	Points
Technological advanced degree	
Advanced	7 - 8
Relatively advanced	5 - 6
Average	3 - 4
Low	1 - 2
None	0
Core technical support to major products/services	
High	7 - 8
Relatively high	5 - 6
Average	3 - 4
Low	1 - 2
None	0
Quantity of intellectual property	
1 and above (Type I, e.g. invention patent)	7 - 8
5 and above (Type II, e.g. utility model and design patent)	5 - 6
3 to 4 (Type II, e.g. utility model and design patent)	3 - 4
1 to 2 (Type II, e.g. utility model and design patent)	1 - 2
None	0
Acquisition mode	
Through independent research and development	≤ 6
Through transfer, gift, merger and acquisition	≤ 3
Reference factor: The enterprise has set national standards, industrial standards, testing methods, and technical specifications.	
Yes	1 - 2
No	0

Source: Official Website of High-tech Enterprise Certification Work (<http://www.innocom.gov.cn/>)