The role of controlling shareholder in innovation: Evidence from trademark registrations*

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March 10, 2024

Abstract

We study the effect of controlling shareholder on innovation using the data on newly registered trademarks. We find that the effect depends on the nature of controller. Specifically, if the controller is the government, such as in a state-owned enterprise (SOE), controller has negative impact on innovation output. On the other hand, if the controller is a private shareholder, the authoritative power of the controller has positive impact on innovation. We further find that institutional investors mitigate agency cost of innovation in SOEs, however, the role is limited for non-SOEs.

Keywords: Controlling shareholder, innovation, trademarks

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1 Introduction

Innovation is indispensable for corporate survival in the 21st century. With technologies across all areas evolving fast, resulting in shorter product/service life cycle in every markets, it is clear that there is no room in market for corporations that do not innovate. Corporations seeking growth must pursue costly innovation because innovation is the key to corporate competitiveness (Arrow, 1962; Manyika et al., 2010). Corporations without continuous innovation will eventually lose on competition ("creative destruction").

Jeff Bezos of Amazon, One of the most successful businessperson of our age, underscored the importance of innovation for corporations: "the other thing about competition is that you do not want to play on a level playing field. This is why you need innovation [...] The only way to stay ahead and to keep that unlevel playing field, which is what you certainly want, is to innovate."[1]

Investing in innovation, however, is not an easy task. Innovation requires substantial upfront investment, and it often takes years to realize the innovation output (Holmstrom, 1989; Scherer and Harhoff, 2000; Minetti et al., 2015). The inherent uncertainty of innovation outcomes, coupled with the opaque nature of the innovation process, significantly increases agency costs (Aboody and Lev, 2000; Minetti et al., 2015). The agency cost of innovation is higher for the management team with finite tenure facing pressure from short-term capital markets due to the mismatch between long-term benefits of successful innovation and short-term costs of innovation (Stein, 1988).

In this study, we investigate the role of controlling shareholders in promoting corporate innovation activities. The effect of controlling shareholder on corporate innovation shall depend on the nature of the controlling shareholder. If the controlling shareholder emphasizes non-shareholder values, such as in state-owned enterprises (SOEs), managers are less incentivized to invest in projects that enhance long-term value. On the other hand, in non-SOEs, which prioritize shareholder value, there exists a potential trade-off between short-term and long-term shareholder value.[2] The misaligned incentives of myopic CEOs,

[1] Reagan National Defence Initiative (RNDF) Conference on December 7, 2019.

[2] Given that 'private' can refer to either "non-governement" or "unlisted" in the context of corporate status, we use "non-SOE" to denote the firms owned by non-governmental institutions or individuals.

resulting in underinvestment in innovation, can be alleviated with the endorsement from the controlling shareholder. If the management feels insulated from the capital market pressure on short-term performance, they may be more incentivized to pursue long-term innovative projects (Asker et al., 2015).

Using data of publicly listed Chinese firms from 2003 to 2020, we first test whether government ownership is detrimental to corporate innovations. We find that the innovation activities of SOEs are significantly lower than those of non-state-owned enterprises (non-SOEs). For firms without government control, we adopt a framework from (Finkelstein, 1992), and construct a proxy variable that reflects the authority (power) of controlling shareholders. We find that, among non-SOEs, certain corporate innovation activities increase with the authority of controlling shareholders.

Innovation, and thus the ability to sustain, can manifest in forms beyond technological innovation. The third edition of *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, published in 2005 by the Organization for Economic Co-operation and Development (OECD) and Statistical Office of the European Communities (Eurostat), broadens the definition of innovation. It defined innovation as "the introduction of a new significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relation."[3] Improvements in product or process are technological ("hard") innovations, which are considered early-stage (upstream) innovations since they occur earlier in the innovation value chain. The "new marketing method" or improvement in service mentioned in the definition of innovation is the type of innovation that does not involve significant technological breakthroughs.

Such "soft" (non-technological) innovation, however, only recently gained attention in finance academia. The vast majority of academic literature on innovation focus on technological innovation, which is primarily measured with research and development (R& D) expenses and/or information from patent filings. R&D expenses mainly proxy for corporate input in technological innovation far upstream in innovation value chain, and patents convey information about the output of technological innovation activities at an

[3]Eurostat and O.E.C.D. (2005).

intermediate stage of innovation value chain.

Trademark registration, on the other hand, takes place when those corporate innovations are eventually commercialized in the downstream of innovation value chain. Consumer goods companies, for instance, utilize trademarks to protect their brands and goods, design a distinctive image for customers, and prevent competitors from exploiting their weaknesses in the markets. Similarly, service companies might have clear incentives to protect themselves in markets characterized by strong information asymmetries, like financial, information, and digital services (Castaldi and Giarratana, 2018; Castaldi, 2020). Trademarks are the main outcome of advertising investments, but also reflects R&D investments more proximate to the downstream final markets.[4]

Amazon's two well-known innovations, "1-CLICK" and "Amazon Prime," illustrate the difference between patents and trademarks. The "1-click" refers to easy shopping method offered by Amazon.com. Once payment and shipping details are securely saved by a customer, that customer can check out in future without having to enter payment and shipping details every time he/she shops on Amazon.com website. The "1-click" shopping is definitely one of the innovations that helped Amazon.com become the largest online retailer because "1-click" helps Amazon to improve shopping cart abandonment rate.[5] Another critical innovation that helped Amazon.com grow is "Amazon Prime." "Amazon Prime" provided free unlimited 2nd-day delivery for paid members which closed the gap, not completely but close enough, between shopping online and offline. "Amazon Prime" also helps alleviate cart abandonment problem because, according to the survey, 25% and 47% of customers abandon their cart because delivery is too slow and extra fees including shipping fee is too high, respectively (multiple selection allowed). [6] While "1-click" was granted patent by United States Patent and Trademark Organization (USPTO) in 1999 and registered trademark in 2015, "Amazon Prime" was registered trademark in 2008, and later registered as "Prime" in 2017, but was never granted a patent. Before the patent

[4]Thus, trademark is a better proxy for innovation when linked to corporate performance than R&D expenses, which are premature signal for performance, and patents, which may not timely or accurately capture commercial value or potential.

[5]Cart abandonment rate refers to the rate at which online customers leave without checking out after adding products to their shopping cart. According to Baymard Institute, average cart abandonment rate of online retailers is about 70%, and about 18% of the respondents of their survey (multiple selection allowed) picked the long and complicated check-out process for abandoning their cart. (https://baymard.com/lists/cart-abandonment-rate).

[6]https://baymard.com/lists/cart-abandonment-rate).

expired in US in 2017, "1-click" ordering was only available on Amazon.com or on online retailers like Apple that licensed "1-click" ordering from Amazon. However, even for "1-click" patent, which is a patent on "business method" simplifying the shopping process of online customers, its patentability is controversial and European Patent Office (EPO) rejected granting patent on "1-click" in 2007. As is illustrated by the two innovations of Amazon.com, patent data cannot fully capture corporate innovation activities, especially in service industries: patent data can capture innovation of "1-click" but misses that of "Amazon Prime" while trademark registration data captures innovation of both.

We thus focus on the later-stages (downstream) of the innovation value chain, and utilize data on trademark registration (Castaldi, 2020). Unlike R&D expenses and patents, which proxy for upstream innovations, trademark registration is an effort in commercialization phase of the new technology and products. It is a good proxy for innovations that finally reached the market and put into competition because not all innovations are successful. More R&D expenses doesn't necessarily mean more patent grants because outputs doesn't always match inputs. Similarly, not all patents add competitive edge to firms. Some patents are never introduced to the market, and thus we focus on the final commercialized innovation of corporations. For example, Apple first filed for a patent on foldable phone in 2011, and was first granted a patent on foldable phone in 2014. As of the end of 2023, Apple has yet to introduce any foldable phone to the market. Samsung also filed for its first patent on foldable phones in 2011, the same year as Apple's first patent filing. However, Samsung introduced to the market the world's first foladable phone in 2019. Because trademark is only registered for actual products and services commercialized in market, Apple has no trademark for foldable phones. At least for foldable phones, patent data incorrectly shows Apple is as innovative as Samsung, however, trademark correctly identify Apple being less innovative than Samsung in this area.

This study contributes to literature on ownership structure and corporate innovation. By showing that there are less corporate innovation activities in SOEs, we add support for the literature claiming superior innovation in private sector (Shleifer, 1998; Fang et al., 2017). Most studies on corporate governance claim that concentrated ownership is detrimental to corporate innovation, and outside investors may help alleviate such under-

investment problem (Aghion et al., 2013; Minetti et al., 2015). However, using trademark registration data from China, we show that concentrated ownership can be beneficial to firms in promoting downstream corporate innovations.

Our paper also contributes to the literature on proxies for innovation. In accounting and finance literature, most studies used R&D expenses (Lev and Sougiannis, 1996; Barron et al., 2002; Kothari et al., 2002; Beck et al., 2016), patent data (Gu and Wang, 2005; Kraft et al., 2018; Bernstein, 2015), or or a combination of both (Becker-Blease, 2011; Hirshleifer et al., 2012) as proxies for corporate innovation activities. Bronzini and Piselli (2016) and Howell (2017) show that R&D subsidies increase the number of patent activities. Hagedoorn and Cloodt (2003) tests four different sets of proxies for innovation including R&D inputs, patent counts and citations, and new product announcements, and concludes that all of these variables effectively proxy innovation. By using trademark registration data from China to proxy for corporate innovation, our study adds to smaller school of papers using trademark to proxy for innovation (Mendonça et al., 2004; Sander and Block, 2011; Flikkema et al., 2014, 2019).

The rest of the paper is organized as follows. Section 2 develops our hypotheses, and Section 3 describes data and summary statistics. In Section 4, we present our empirical results, and we conclude in Section 5.

2 Literature Review and Hypotheses Development

2.1 State ownership and corporate innovation

In some companies, the government may be the controlling shareholder. In emerging markets and/or countries with centrally-controlled economy, such as ex-communist countries, a substantial fraction of the largest listed companies are are under government ownership, either directly or indirectly. The top priority of government-held corporations is not to survive in the market place by reducing costs or improving the quality of products, but to provide service or product to as many people as possible. Aligning with such government objectives will likely play a positive role in career development of the management at the government-controlled firms. Consequently, management at the government-owned com-

panies might prioritize political objectives, such as ensuring "stable" supply of services or products, over competing to survive in market by providing "better" services or products (Shleifer, 1998).

Perhaps due to such incentives of the management, state ownership is found to be less effective in corporate innovation than private ownership. The 20th century illustrated the limitations of centrally-controlled economies in less than a century of experiment, and the lack of innovation is certainly one of the causes. Using a global sample of privatization data, Boubakri et al. (2013) find that state ownership is negatively associated with corporate risk taking. After all, as Marshall (1907) pointed out, "A government could print a good edition of Shakespeare's works, but it could not get them written." We thus hypothesize that corporate innovation is less intense in government-controlled firms.

H1: *State-owned enterprises register less trademarks than non-state-owned enterprises*.

2.2 Ownership in non-SOEs and corporate innovation

While the impact of government ownership on corporate innovation is rather clear, the relationship between ownership and corporate innovation is less clear in non-SOEs. In companies with diffused ownership where the management and ownership is separated, one of the main drivers of corporate innovation is the perceived job security of management. Since most shareholders are incapable of evaluating long-term prospect of innovation, the short-term performance may govern the fate of the top management, resulting in managerial myopia. Stein (1988) claims that the threat of potential takeover may lead the managers to be myopic [managerial myopia]. Under this scenario, managers without a concern on her job turnover will be willing to devote to long-term investments, such as corporate innovations (Chemmanur and Tian, 2018). On the other hand, if the manager is entrenched without the concern on job security, she may pursue safety over risk [quiet life]. Using anti-takeover provisions as the proxy for job security, Bertrand and Mullainathan (2003) find evidence supporting the propensity of managers to favor a less ambitious, more secure professional life over aggressive expansion. There are also empirical results showing that the relationship between the job security and corporate innovation is non-linear

(Aghion et al., 2005; Sapra et al., 2014).

Apart from job security, blockholders, or institutional ownership, may also alleviate such underinvestment in innovation problem in firms with diffused ownership (Aghion et al., 2013). Outside blockholders, such as pension funds or hedge funds, are known to intervene with the management by either voicing their opinion (Brav et al., 2008; Clifford, 2008; Greenwood and Schor, 2009) or threatening to exit (Edmans, 2009; Parrino et al., 2003; Bushee and Goodman, 2007). Such intervention of blockholders effectively disincentivizes the management from seeking private benefits over shareholder interests. (Holmstrom, 1989) claims that in the presence of enhanced monitoring of institutional investors, decentralization of decision making and performance reward enhances innovation.

Other aspects of ownership is also found to affect corporate innovation activities. Using German data, Schmid et al. (2014) find that when founding families, especially the founders, actively manage companies, i.e. not indirectly via voting rights, corporate innovation is positively affected. Choi et al. (2011) and Choi et al. (2012) find that in China and South Korea, respectively, foreign ownership is positively associated with corporate innovation.

In emerging markets, ownership is concentrated in many non-SOEs. Coupled with social infrastructure with weak investor protection, such concentrated control structure is considered poor in terms of corporate governance (Dyck and Zingales, 2004; Young et al., 2008). Also, capital markets are not as well developed as in developed markets, and blockholders, competition, or market for corporate control may not effectively alleviate concerns on tunnelling of private benefits. In this regard, it is likely that controlling shareholders interested in extracting private benefits will focus less on long-term growth and impede innovation. On the other hand, controlling shareholders are inherently long-term investors. Whether they are a founder, a founding family member, or a majority shareholder simply in love with the company, controlling shareholders are not in the game for short-term investment return. Due to their long-term orientation, they may care less for short-term performance and value long-term success (Hokisson et al., 2002). In this regard, concentrated ownership may reduce the agency cost of innovation given there are strong support

on innovation from controlling shareholders. The empirical studies find mixed results regarding ownership concentration and innovation activities. Choi et al. (2011) and Choi et al. (2012) find that concentrated ownership is not significantly associated with corporate innovation activities in China and South Korea, respectively. However, Francis and Smith (1995) find that, in the United States, firms with diffused ownership innovate less than firms with concentrated ownership.

We argue that simply measuring ownership stake of the largest shareholder may not precisely capture the dynamics between concentrated ownership and corporate innovation. As is suggested by Schmid et al. (2014), founding families managing a firm directly have different impact on corporate innovation from founding families simply having many voting rights. We thus propose a concept of authority of controlling shareholder. Founders or their families should have special affection attached to their companies, and should have stronger incentive to pursue long-term growth. Furthermore, they should be actively managing the company to positively influence corporate innovation. We argue that controlling shareholders have more authority in the management of non-SOEs if they have more authority by being a founding family member and/or chairman of the board. CEOs may be insulated from such capital market pressure if their post is secured by a powerful authority, such as a controlling shareholder. As such, we hypothesize that innovation activity is higher when the authority of controlling shareholder is stronger.

H2: Private firms with stronger authority of controlling shareholders register more trademarks.

2.3 Corporate innovation and firm value

Due to the importance of innovation in corporate survival, one would expect innovation to be associated with better corporate performance. For example, (Thornhill, 2006) suggests that innovation is associated with growth in revenue. However, it is not as obvious empirically. (Kleinschmidt and Cooper, 1997) suggest that commercial success of innovation takes a U-shaped pattern: firms with low or high innovation succeed while those in the middle do not. Such non-linear association may be why there is a strand of litera-

ture that argue innovation and firm performance is unrelated. For example, (Koellinger, 2008) find no evidence that firm performance is associated with innovation. We suggest R&D expenses and patent information are noisy measures of successful innovation as it is uncertain whether such innovation efforts eventually turned to tangible products.

Instead, we use trademark registration to proxy for corporate innovation activities. Trademarks are the main outcome of advertising investments, but also of R&D investments more proximate to the downstream final markets.[7] Furthermore, trademarks can proxy for innovation that R&D expenses or patent data cannot account for. In his seminal work, (Schumpeter, 1934) suggests five types of innovation: New products, new methods of production, new sources of supply, exploitation of new markets, and new ways to organize business. While the first two of the Schumpeter's five types of innovation are more related to patents, the rest are less likely to be patented types of innovation. Moreover, the number of new trademarks is an important measure to capture the intensity of firm's product innovations. It is the declaration to the world that a corporation has developed a marketable product which is different from other products in the marketplace. Previous studies show that trademarks represent a good proxy for the products and services offered by a firm (Mendonça et al., 2004; Fosfuri and Giarratana, 2009; Castaldi, 2018, 2020). (Faurel et al., 2022) also use trademarks as an output of product innovation and find that reductions in stock option compensation results in reduction in new product innovations. On the other hand, (Heath and Mace, 2020) find that trademark protection negatively influences product innovation and quality. Trademarks may also serve as the screening tool for successful innovation that eventually reached to customers. Many patents do not reach the market at all, and the rate is known to be less than 10% of all patents (Walker, 2014).

Several studies documented that trademarks are correlated with performance measurements and stock market value (Krasnikov et al., 2009; Hsu et al., 2022). (Yang et al., 2023) provide evidence that firms with more registered trademarks enjoy lower cost of equity capital. (Fisch et al., 2022) find that firms with greater trademark breadth are valued higher when going public, and also exhibit better post-IPO performance. We also

[7]Thus, trademark is a better proxy for innovation when linked to corporate performance than R&D investments, which are premature signal for performance, and patents, which may not capture commercial value or potential in a timely manner.

hypothesize that firm value is positively associated with trademarks.

H3: Firm value is positively associated with trademark registrations.

3 Data and main variables

We obtain our data from China Stock Market & Accounting Research (CSMAR), and our sample includes all A-share listed companies between 2003 and 2020. CSMAR provides data on accounting and financial information as well as patents and trademarks. Our final full sample includes 31,668 firm-years with all required information for our analysis (including lagged and forward variables) representing 3,140 unique firms. For our subsample analysis, our sample includes 19,139 non-SOE firm-years with 2,388 unique non-SOEs.

3.1 Proxy for the authority of controlling shareholders

Extant studies on the conflict between the management and shareholders mainly focus on CEO power to examine how powerful CEOs can distract away from the interests of outside diffused shareholders. The literature use different variables to measure CEO power, such as CEO-Chairman duality (Hermalin and Weisbach, 1998; Jackling and Johl, 2009), CEO ownership (Veprauskaitė and Adams, 2013), CEO tenure (Morck et al., 1988; Brookman and Thistle, 2009), and CEO compensation (Grinstein and Hribar, 2004; Florackis and Ozkan, 2009).

In this study, we focus on how controlling shareholders influence management decisions in companies with concentrated ownership. We use the level of authoritative power of controlling shareholder as the proxy for the dominance of controlling shareholder. In the spirit of (Finkelstein, 1992) and (Tang et al., 2011), we construct an index of controlling shareholder power that comprises such dimensions to test the influence of controlling shareholder on innovation output. The dimensions of the index are i) whether the controlling shareholder is the chairman, ii) whether a controlling shareholder is the founder, or iii) whether the controlling shareholder has family association with the founder.[8] To

[8]We do not consider the case when controlling shareholder is the CEO of a company because we focus on the influence of controlling shareholder on CEOs. However, even when we include this in composing the index, results

develop the power index, we first create scores for each of the three power dimensions using a dichotomous procedure; for example, a dummy variable equals 1 if the controlling shareholder holds the position of chairman, and 0 otherwise. Similarly, a dummy variable equals 1 if the controlling shareholder is the company's founder, and 0 otherwise. A dummy variable equals 1 if the company is a family business, i.e., controlling shareholder is a family member of the founder, and 0 otherwise. Controlling shareholder power is then constructed by adding each individual dimension yielding an index with maximum possible value of 3.

3.2 Proxy for corporate innovations

The next variables worth explanation are our variables proxying innovation. Most papers in the literature use patent-related variables or R&D expenditure to proxy for innovation. However, in our paper, we use trademark-related variables as the proxies for innovation. Indeed, the two types of variables complement and/or substitute each other as they represent innovations at different levels of innovation value chain.

Patent-related and R&D expenditure variables proxy for upstream innovation while trademark-related variables proxy for downstream innovation. Unlike patents, which protect the technological components of products and services, trademarks protect the commercialization of products and services. Furthermore, patents are only granted to the inventions of new technology within a jurisdiction while trademarks are issued if certain product or service is new on a firm level. In such sense, trademarks complement patents or R&D expenditures in proxying for firm-level innovation efforts.

Trademarks may also proxy for successful corporate innovation. Because trademarks are registered when a new product or service is introduced to market and not all patents are commercialized, trademarks can be a substitute of patents proxing for innovations that are successful. As is shown with Apple's patents on foldable phone, patents that do not reach consumer market may be considered failed innovation.

Not all trademark registration may be the outcome of innovation efforts. For exam-

are qualitatively similar. Also, due to data limitations, we did not consider compensation to controlling shareholder in constructing the power index.

ple, firms may pursue rebranding strategy by filing a new trademark to market an existing product. Or they may simply register trademarks across many industries to prevent trademark dilution or to enter adjacent markets in the future. These trademark registrations may not indicate innovation, and in light of that, we filter out all trademark registrations with more than ten Nice classes covered (Flikkema et al., 2019).[9]

Our main variable of innovation is Ln(1+Trademarks), where Trademarks is the number of registered trademarks spanning 10 or less NICE industries by a firm in a fiscal year. Trademarks can be registered for logos as well as brand names or slogans. While names or slogans may deliver concise and detailed message on what to expect from products and services, brand logos serves to deliver intuitive image to customers. Often times, customers may not remember the slogan of a brand, but they will remember the logos. We separately count trademarks in the form of logos, create another proxy for innovation, Ln(1+Logos).

Companies register trademarks by NICE industries, and they may choose to register a trademark across multiple NICE industries. Under NICE classification, there are 34 product industries and 11 service industries. We classify a trademark registration as product innovation if the trademark is registered only within NICE product industries. If a trademark is registered only for NICE service industries, it is considered service innovation. If a trademark is registered for both product and service industries, we consider them not to be innovative (Flikkema et al., 2019).

The number of industries a single trademark is registered for is called trademark "breadth." Our trademark breadth for a given firm-year is the average trademark breadth of trademarks registered in 10 or less NICE industries. Trademarks registered in multiple industries imply the innovation is protected more widely in various industries, which should increase the value of real option of corporate innovations. We thus consider trademark breadth to be the proxy that links corporate innovation to corporate value.

[9] In (Flikkema et al., 2019), the threshold is three industries, however, this is due to European trademark registration procedures where registration fee up to three industries is equal. In China, registration fee is flat up to ten industries, thus we use ten industries as the threshold. In untabulated results, we find that our results are qualitatively similar when we use three industries as the threshold. We are also aware that a product innovation can occur under an already introduced brand name, for instance, firms' product innovations can use existing brand names as in a branded-house strategy (Hay, 2015).

3.3 Control variables

Throughout our analysis, we control for other firm characteristics that may also influence innovation output of firms. Because corporate control by insiders can be mitigated by effective monitoring of external blockholders, e.g. institutional investors, we control for institutional ownership. Institutional investors should guide the management to focus on long-term value creation and innovation, thus we expect positive effect of institutional ownership on corporate innovation (Aghion et al., 2013). Extant literature on trademarks show that trademarks complement patents in measuring innovation (Mendonça et al., 2004; Flikkema et al., 2019), and we control for patents. It is also suggested that larger firms (Zoltan and Audretsch, 1988; Morck and Yeung, 1991) may promote more innovation (firm size measured by log of 1 plus total asset), and firms with more growth opportunities (measured by book-to-market) should exert more effort in innovation. We also control for asset tangibility, research and development expenses, leverage, and liquidity (measured by operating cash flow).

4 Empirical results

In this section, we provide results of our empirical analyses, followed by robustness tests and discussion of our findings.

4.1 Descriptive statistics

Descriptive statistics of our full sample are provided in Panel A of Table 1. All variables are winsorized at the 1st and 99th percentiles. Firms register, on average, 0.702 (exp(0.532)-1) trademarks per year,[10] and those trademarks span 0.425 (exp(0.354)-1) industries on average. 20.2% of firms register for product trademarks (defined as trademarks solely registered for products but not services), 6.9% of firms register for service trademarks (defined as trademarks solely registered for services but not products), and 9.6% of firm-years register logos as trademarks. For patents, on average, 5.554 patents (exp(1.880)-1) are granted for a firm-year. Other control variables are in line with statis-

[10] Again, these are the trademarks that are registered for less than 10 NICE industries.

tics in prior studies. Finally, about 39.5% of firm-years in our sample are state-owned enterprises.

In Panel B of Table 1, we present descriptive statistics for our subsample of non-SOE firms. In the subsample, on average, 0.793 (exp(0.584)-1) trademarks are registered per firm-year, and those trademarks span 0.480 (exp(0.392)-1) industries. 21.9% of firm-years register product trademarks, 7.0% register service trademarks, and 10.6% register logos as trademarks. For patents, the non-SOE firms are granted 6.315 patents (exp(1.990)-1) per firm-year. The statistics on innovation variables are slightly higher in the subsample of non-SOEs when compared to full sample. Finally, the index for controlling shareholder authority in the non-SOE subsample is, on average, 1.362.

4.2 Innovations in SOEs

Our first set of tests investigate how corporate innovation activities of SOEs are different from those of non-SOEs. Specifically, we estimate following model using ordinary least squares (OLS) method:

$$\text{Ln}(1 + \text{Trademarks}_t) = \alpha + \beta \text{D(SOE)}_{t-1} + \Gamma \text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \qquad (1)$$

where Ln(1 + Trademarks$_t$) is the corporate innovation. Considering that innovation takes time and trademark registrations may be the results of years of innovation effort, and also to prevent potential simultaneity, we use lagged values for all independent variables. D(SOE) is the indicator variable taking the value of one for SOEs, and zero otherwise, δ_t is the year fixed effect, and ϕ_i is the firm fixed effect. Control variables include, as discuss above, institutional ownership, patents granted, firm size, growth opportunities, asset tangibility, R&D expenses, leverage, and operating cash flow. The results of the estimation are presented in Table 2.

Consistent with our hypothesis, Table 2 shows that corporate innovation activities are, in general, less intense in SOEs. In Column (1) without any fixed effects, the coefficient on D(SOE) is significantly negative at 1% level, indicating that SOEs register significantly less trademarks than non-SOEs. The mean of Ln(1 + Trademarks) is 0.532,

which corresponds to 0.702 registered trademarks per firm-year. The decrease in Ln(1 + Trademarks) of 0.157 results in 0.455 registered trademarks per firm-year, which corresponds to 35% lower number of registered trademarks in SOEs. This is a substantial decrease in innovation activity just for being an SOE. The coefficients on other control variables are generally consistent with prior literature. In Column (1), for example, we find more intense corporate innovation activities in firms with higher institutional ownership, more patents, larger size, more growth opportunities, more R&D expenditure, lower leverage, and more liquidity. The results on asset tangibility is the opposite of our prior, where we expected to observe more innovations with firms with higher tangibility.

In Column (2), we add year-fixed effects, and the results are qualitatively similar to those in Column (1). Comparing the adjusted-R^2 of Column (2) to that of Column (1), there is only a marginal increase in the goodness-of-fit. However, when we add only firm-fixed effects in Column (3), goodness-of-fit increases significantly to 0.5705. The dramatic increase in adjusted-R^2 using firm-fixed effects suggest that most of the explanatory power of our model comes from time-invariant firm-specific characteristics. Nevertheless, the result shows that SOE indicator variable is still significant in explaining corporate innovation even with firm fixed effects at the 10% level.

In Column (4), results after adding both year- and firm-fixed effects to our baseline regression are presented. Coefficient estimate on D(SOE) is smaller than that in Column (1) or (2), however, the percentage decrease in number of trademarks is still in two digits, which translates to 11% lower number of registered trademarks in SOEs. Furthermore, we find that institutional ownership and patents no longer significantly explain trademark activities when firm fixed effect is included. It may suggest that, in China, outside institutional investors have limited influence on corporate innovation when SOEs are involved.

Overall, these results suggest, consistent with our hypothesis, that corporate innovation is negatively influenced when government is in control.

4.3 Innovations in non-SOEs

Having documented that government control negatively affects corporate innovations, we now turn to non-SOEs to investigate the role of controlling shareholders on corporate

innovation. We use our proxy for the authority of controlling shareholder to analyze the effect of corporate control on corporate innovation in non-SOEs:

$$\text{Ln}(1 + \text{Trademarks}_t) = \alpha + \beta\text{Authority}_{t-1} + \Gamma\text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \qquad (2)$$

where Authority_{t-1} is the sum of three indicator variables on the authority of controlling shareholder. We present the estimation results in Table 3.[11]

Consistent with our hypothesis, as controlling shareholder have higher authoritative power, corporates innovate more in terms of trademarks. In Column (1), a unit increase in controlling shareholder authority increases the number of trademarks by 0.175 from 0.793 to 0.970, a 22% increase. Institutional ownership also significantly increases innovation: a one standard deviation increase in institutional ownership results in 38% increase in number of registered trademarks, which is stronger than the effect of controlling shareholder authority. However, when examining the results in Columns (3) and (4) with firm-fixed effects, institutional ownership loses significance. It implies that considering time-invariant firm characteristics that are associated with higher institutional ownership, institutional owners do not add additional value to corporations with respect to promoting corporate innovations in the presence of agency cost of innovation. The authority of controlling shareholder, on the other hand, is still significant at the 5% level with fixed effects albeit the smaller magnitude. In Column (4), a unit increase in the authority of controlling shareholder translates into 7.6% increase in the number of registered trademarks.

It is interesting to note that, with fixed effects, lagged patent grants significantly increase trademark registration in Table 3. Recall that in Table 2, patents did not have significant association with trademarks in SOEs. As discussed earlier, patents are situated in the upstream of innovation value chain relative to trademarks. One could argue that SOEs are protected from market competition for being government organizations in China, a controlled economy. Non-SOEs, however, must innovate with success to compete in the market, and thus should focus more on innovations that can finally be delivered to customers resulting in more granted patents eventually being commercialized. SOEs

[11] In untabulated results, we perform these analyses for the full sample of firms. The results from the full sample are generally stronger than the results presented in tables.

either 1) inefficiently put effort in too many different patents but only some of them reach consumer market or 2) operate only in areas where few technological innovations are required. The results in Table 3 compared with those in Table 2 provide indirect evidence that corporate innovative efforts are more focused in non-SOEs.

Overall, the results in Table 3 supports our hypothesis that the authority of controlling shareholder mitigates the agency cost in corporate innovation process.

4.4 The role of institutions

Both theoretically and empirically, extant literature show that institutional investors mitigate agency problems in corporations. In Tables 2 and 3, however, institutional ownership did not significantly increase corporate innovation activities when fixed effects were included in our estimation. To further investigate the role of institutional investors, we estimate the following models with interaction terms with institutional ownership:

$$\begin{aligned} \text{Ln}(1+\text{Trademarks}_t) &= \alpha + \beta \text{D(SOE)}_{t-1} + \gamma \text{D(SOE)}_{t-1} \times \text{Institutional ownership}_{t-1} \\ &+ \Gamma \text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \end{aligned} \tag{3}$$

and

$$\begin{aligned} \text{Ln}(1+\text{Trademarks}_t) &= \alpha + \beta \text{Authority}_{t-1} + \gamma \text{Authority}_{t-1} \times \text{Institutional ownership}_{t-1} \\ &+ \Gamma \text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \end{aligned} \tag{4}$$

where all variables are as defined in the previous analyses. The results are presented in Table 4.

In Column (1) of Table 4 without any fixed effects, the coefficients on D(SOE) as well as on the interaction term with institutional ownership are insignificant. However, in Column (2) with year- and firm-fixed effects, the coefficient on D(SOE) is negatively significant, and that on the interaction with institutional ownership is positively significant. Controlling for firm-fixed effects, institutional ownership enhances corporate innovation in SOEs but not in non-SOEs. It implies that in SOEs, one standard deviation increase

in institutional ownership results in 9.2% higher number of registered trademarks relative to firm-years with average level of institutional ownership. In Chinese SOEs with agency problem of innovation, outside institutional investors do mitigate the agency problem and promote corporate innovation.

In Columns (3) and (4), we repeat the analysis with the subsample of non-SOEs. We investigate the moderating effect by different level of the controlling shareholder authority. Interestingly, the coefficients on interaction terms of the authority of controlling shareholder and institutional ownership are insignificant in all levels of the authority. As with in Table 3, the coefficient on institutional ownership is also insignificant. It implies that unlike in private sector in developed markets, outside institutional owners do not positively influence corporate innovation. Taken together, the results in Table 4 show that institutional ownership effectively mitigates agency problems in corporate innovation in SOEs, however, in non-SOEs, such role of addressing agency problems in corporate innovation is taken over by controlling shareholders.

4.5 Corporate innovation and firm value

In the previous subsections, we showed that corporate innovation measured by trademark registration is more intense in non-SOEs, and in firms with stronger authority of controlling shareholders. In this subsection, we examine how corporate innovation affects future firm value in non-SOEs.

When firms register trademarks, they register trademarks by NICE industry classification. Having a trademark registered for multiple industries means the company can potentially protect their innovation in more market classes, and thus more real option to enter more markets in the future. Fisch et al. (2022) show that trademark breadth is positively affects firm valuations at the time of IPO and also the post-IPO performance. Following Fisch et al. (2022), we use forward Tobin's Q to measure firm value following trademark registration. Considering the potential delay between trademark registration and value realization, we allow up to three years after trademark registration for the trademark value

to materialize. Specifically, we estimate following models:

$$\text{Ln}(1 + \text{Breadth}_t) = \alpha + \beta\text{Authority}_{t-1} + \Gamma\text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \tag{5}$$

and

$$\begin{aligned} \text{Tobin's Q}_{t+n} &= \alpha + \beta\text{Authority}_{t-1} + \gamma\text{Authority}_{t-1} \times \text{Ln}(1 + \text{Breadth}_t) \\ &+ \Gamma\text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \end{aligned} \tag{6}$$

where Tobin's Q_{t+n} is measured as market value of assets n years after year t divided by book value of assets n years after year t. The interaction term, $\text{Authority}_{t-1} \times \text{Ln}(1 + \text{Breadth}_t)$, captures the moderating effect of trademark breadth on future firm value measured by Tobin's Q.

Table 5 Column (1) presents the results from estimating Equation (5). The trademark breadth is positively and significantly affected by the authority of controlling shareholders. Since the trademark breadth of firm-years without any trademark registrations is zero, the positive and significant coefficient implies firms with stronger authority of controlling shareholders are more likely to register trademarks, and when they do, they are more likely to register for wider range of market classes.

In Columns (2) to (3), we use forward Tobin's Qs for up to three years after trademarks are registered. In all three columns, the authority of controlling shareholder does not affect future firm value measured by Tobin's Q. However, the coefficients on the interaction terms becomes positive and significant starting from the third year after trademarks are registered. The results imply that at all levels of controlling shareholder authority, Tobin's Q is higher when trademark breadth is higher. Because the authority of controlling shareholder positively affects trademark breadth, and trademark breadth strengthens the effect of controlling shareholder on future Tobin's Q, one could conclude the authority of controlling shareholder positively affects future firm value through broader trademark breadth.

5 Robustness tests

In this subsection, we provide additional analyses to check the robustness of our findings presented in the previous section.

5.1 Change in the authority of controlling shareholder

Previous analyses used the level of the authority of controlling shareholders to identify association between the authority of controlling shareholder and corporate innovations in non-SOEs. However, if the level of authority is sticky over time within a firm, such regression on levels may simply pick up differences across firms. To address the issue, we use regression on changes in the authority of controlling shareholders within a firm as in the following model:

$$\text{Ln}(1 + \text{Trademarks}_t) = \alpha + \beta \Delta\text{Authority}_t + \Gamma\text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon,$$

where $\Delta\text{Authority}_t$ is the year-over-year change in the authority of controlling shareholders. The estimation results are presented in Table 6.

In Columns (1) and (2), we use the subsample of firm-years with change in the authority of controlling shareholders. There are in total 886 firm-years in which our measure of the authority changed from the previous year. That's 4.6% of all non-SOE firm-years, which is not common but still nontrivial. In Column (1), the coefficients on $\Delta\text{Authority}_t$ is positive and statistically significant. It is also economically significant as a unit change in the authority of controlling shareholder results in 12% more trademark registrations. In Column (2), we add year-fixed effect to the model, and find that the association between the change in the authority of controlling shareholder and trademark registrationis still statistically significant with slightly smaller magnitude.

In Columns (3) and (4), we use all non-SOE firm-years instead of only those years with change in the authority. The coefficient on $\Delta\text{Authority}_t$ in Column (3) is strongly significant with 60% larger magnitude than that in Column (1). Adding both firm- and year-fixed effects, the coefficient becomes smaller in Column (4), but statistically, it is still highly significant.

The results in Table 6 confirm our previous findings that in non-SOEs, higher level of the authority of controlling shareholder should positively affect corporate innovation activities.

5.2 Other proxies for innovation

In this section, we try other proxies of corporate innovation activities to check the robustness of our earlier findings using total count of registered trademarks. Specifically, we estimate the following model:

$$\text{Innovation}_t = \alpha + \beta \text{Authority}_{t-1} + \Gamma \text{Controls}_{t-1} + \delta_t + \phi_i + \varepsilon, \tag{7}$$

where three different measures of Innovation_t are used. Specifically, we use product innovation, service innovation, and logo innovation. Product innovation is one if a firm-year registered at least one trademark only in product industries, and zero otherwise, Service innovation is one if a firm-year registered at least one trademark only in service industries, and zero otherwise, Logo innovation is one if a firm-year registered at least one image trademark, and zero otherwise. Since the three dependent variables are dichotomous variables, we use logistic model to estimate parameters. For the logistic models, we report marginal effects, and we do not include fixed effects for known biases in including fixed effects in non-linear models.[12]

We present results of the above estimation in Table 7. Consistent with our results in Table 2, SOE dummy is negatively significantly associated with innovation proxies based on trademark registrations in Columns (1) to (3). Interestingly, lagged patent grants have positive and statistically significant effect on registration of product trademarks in Column (1), while lagged patent grants are negatively and significantly associated with service trademark registrations in Column (2). Patents are typically granted on technological innovations, and thus may have nontrivial association with future product developments. However, service-related innovations are hardly patentable, and many innovations in service may occur without associated patents.

[12] In untabulated results, we confirm that the results are qualitatively similar when we include fixed effects to the logistic models in Columns (1) to (3).

We use logo trademarks as the proxy for corporate innovation in Column (3). Logos provide quick, strong, and lasting impact on consumer recognition of brands. It is easier for customers to associate an image to certain product and service beyond language barrier than to associate names or words (Park et al., 2013). We thus argue it requires more innovative effort to develop a logo trademark than simple names or phrases. In Column (3), we find that SOEs negatively significantly influences logo trademark registrations.

In Columns (4) to (6), we repeat the analyses in Columns (1) to (3) with the subsample of non-SOE firms. Consistent with our prior results and our intuition, the authority of controlling shareholders positively and significantly influences trademark registrations.

Overall, our results support our hypothesis that innovation activities significantly depend on the control environment of firms. Specifically, if government controls a firm, it is detrimental to innovation. If government is not in control, innovation is more prevalent in companies with higher authoritative power of controlling shareholders.

6 Conclusions

In this paper, we studied how controlling environment of firms affects corporate innovation activities. As was hypothesized, we find that corporate innovation activities are dampened by government control when we compare innovation of SOEs versus non-SOEs. Furthermore, among private sector firms, corporate innovation activities are significantly positively associated with authoritative power of controlling shareholders.

We used measures based on trademark registration to measure corporate innovation activities in this study. However, when we used patent filings to proxy for innovation, we failed to find significant association between authoritative power of controlling shareholder and innovation. As was discussed in our paper, patents and trademarks both proxy for innovation but at different levels: upstream versus downstream innovations. As such, our paper complements studies on corporate innovation using patent data by showing controlling shareholders influence downstream innovations by using trademark registration data.

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Table 1: **Descriptive statistics**

This table provides descriptive statistics of the variables used in this study. Panel A presents the statistics for the full sample of 3,140 unique firms, and Panel B presents the statistics for the sub-sample of 2,388 unique non-SOE firms. Detailed description on variable construction is provided in the Appendix.

Variables	N	Mean	Std. Dev.	Min	Max
Panel A Full sample					
Ln(1+Trademarks)	31,668	0.532	0.890	0.000	3.714
Ln(1+Breadth)	31,668	0.354	0.538	0.000	2.398
D(Product Innovation)	31,668	0.202	0.401	0.000	1.000
D(Service Innovation)	31,668	0.069	0.253	0.000	1.000
D(Logo Innovation)	31,668	0.096	0.294	0.000	1.000
D(SOE)	31,668	0.395	0.489	0.000	1.000
Institutional ownership	31,668	0.461	0.244	0.001	0.926
Ln(1+Patents)	31,668	1.880	1.690	0.000	6.238
Ln(Total asset)	31,668	21.930	1.410	19.310	27.180
Book-to-market	31,668	0.613	0.265	0.000	1.123
Tangibility	31,668	0.221	0.165	0.002	0.695
R&D	31,668	0.004	0.011	0.000	0.070
Leverage	31,668	0.444	0.221	0.051	1.011
Operating cash flow	31,668	0.045	0.075	-0.196	0.261
Panel B Non-SOEs					
Ln(1+Trademarks)	19,172	0.584	0.916	0.000	3.714
Ln(1+Breadth)	19,172	0.392	0.557	0.000	2.398
D(Product Innovation)	19,172	0.219	0.414	0.000	1.000
D(Service Innovation)	19,172	0.070	0.256	0.000	1.000
D(Logo Innovation)	19,172	0.106	0.308	0.000	1.000
Controlling SH authority	19,172	1.362	1.216	0.000	3.000
Institutional ownership	19,172	0.381	0.251	0.001	0.926
Ln(1+Patents)	19,172	1.990	1.596	0.000	6.238
Ln(Total asset)	19,172	21.650	1.222	19.310	27.180
Book-to-market	19,172	0.567	0.256	0.000	1.123
Tangibility	19,172	0.196	0.143	0.002	0.695
R&D	19,172	0.005	0.013	0.000	0.070
Leverage	19,172	0.396	0.215	0.051	1.011
Operating cash flow	19,172	0.044	0.075	-0.196	0.261

Table 2: **Effect of SOE on innovation activities**

This table presents the results of regression of the number of trademark registration on the indicator variable of SOE. D(SOE) is one if a company is a state-owned enterprise, and zero otherwise. All independent variables are lagged values. Detailed description on variable construction is provided in the Appendix. Numbers in parenthesis are standard errors and ***, **, and * indicate 1%, 5%, and 10% statistical significance, respectively. All standard errors are clustered by firm.

	Ln(1+Trademarks)			
	(1)	(2)	(3)	(4)
D(SOE)	-0.157***	-0.172***	-0.043*	-0.047*
	(0.0280)	(0.0279)	(0.0255)	(0.0254)
Institutional ownership	0.151***	0.088*	0.006	0.014
	(0.0526)	(0.0534)	(0.0427)	(0.0477)
Ln(1+Patent)	0.023***	0.027***	0.006	0.003
	(0.0081)	(0.0084)	(0.0052)	(0.0053)
Ln(1+Total asset)	0.152***	0.183***	0.091***	0.079***
	(0.0116)	(0.0146)	(0.0086)	(0.0124)
Book-to-Market	-0.292***	-0.464***	-0.077***	-0.100***
	(0.0346)	(0.0525)	(0.0198)	(0.0269)
Tangibility	-0.363***	-0.371***	-0.080*	-0.099**
	(0.0647)	(0.0653)	(0.0462)	(0.0474)
R&D	4.128***	4.923***	2.040***	2.147***
	(0.5990)	(0.8904)	(0.4969)	(0.6899)
Leverage	-0.306***	-0.340***	-0.082**	-0.062*
	(0.0477)	(0.0494)	(0.0351)	(0.0356)
Operating cash flow	0.827***	0.769***	-0.094*	-0.094*
	(0.1118)	(0.1094)	(0.0557)	(0.0560)
Constant	-2.509***	-3.031***	-1.357***	-1.090***
	(0.2338)	(0.2848)	(0.1832)	(0.2541)
Observations	31,668	31,668	31,668	31,668
Adjusted-R^2	0.0788	0.0844	0.5705	0.5720
Firm FE	No	No	Yes	Yes
Year FE	No	Yes	No	Yes

Table 3: **Effect of control on corporate innovation activities in non-SOEs**

This table provides the results of regression of the number of trademark registration on the authority of controlling shareholder in non-SOEs. Controlling SH authority is the measure of the authority of controlling shareholder ranging from 0 to 3. All independent variables are lagged values. Detailed description on variable construction is provided in the Appendix. Numbers in parenthesis are standard errors and ***, **, and * indicate 1%, 5%, and 10% statistical significance, respectively. All standard errors are clustered by firm.

	Ln(1+Trademarks)			
	(1)	(2)	(3)	(4)
Controlling SH Auhority	0.094***	0.101***	0.030**	0.033**
	(0.0157)	(0.0157)	(0.0152)	(0.0156)
Institutional ownership	0.409***	0.379***	0.010	0.022
	(0.0720)	(0.0732)	(0.0579)	(0.0651)
Ln(1+Patent)	0.009	0.012	0.017**	0.016**
	(0.0102)	(0.0105)	(0.0073)	(0.0074)
Ln(1+Total asset)	0.214***	0.243***	0.112***	0.105***
	(0.0158)	(0.0191)	(0.0124)	(0.0173)
Book-to-Market	-0.363***	-0.518***	-0.118***	-0.125***
	(0.0410)	(0.0610)	(0.0258)	(0.0349)
Tangibility	-0.271***	-0.279***	-0.018	-0.043
	(0.0870)	(0.0877)	(0.0725)	(0.0737)
R&D	4.193***	5.212***	1.784***	2.794***
	(0.6508)	(1.0533)	(0.5431)	(0.7987)
Leverage	-0.349***	-0.393***	-0.152***	-0.140***
	(0.0609)	(0.0631)	(0.0477)	(0.0486)
Operating cash flow	0.943***	0.881***	-0.094	-0.098
	(0.1411)	(0.1408)	(0.0743)	(0.0748)
Constant	-4.011***	-4.535***	-1.787***	-1.652***
	(0.3239)	(0.3815)	(0.2687)	(0.3576)
Observations	19,139	19,139	19,139	19,139
Adjusted-R^2	0.0973	0.1019	0.5759	0.5770
Firm FE	No	No	Yes	Yes
Year FE	No	Yes	No	Yes

Table 4: **The role of institutional investors**

This table presents the results of the analyses on the role of institutional investors in promoting corporate innovation activities. We include interaction term of institutional ownership with SOE indicator in Columns (1) and (2), and with the authority of controlling shareholders in non-SOEs in Columns (3) and (4). All independent variables are lagged values. Detailed description on variable construction is provided in the Appendix. Numbers in parenthesis are standard errors and ***, **, and * indicate 1%, 5%, and 10% statistical significance, respectively. All standard errors are clustered by firm.

	Full sample		Non-SOEs	
	(1)	(2)	(3)	(4)
D(SOE)	-0.108	-0.124***		
	(0.0682)	(0.0467)		
Controlling SH Auhority			0.088***	0.038*
			(0.0226)	(0.0195)
Institutional ownership	0.170***	-0.036	0.362***	0.050
	(0.0590)	(0.0548)	(0.1172)	(0.0862)
D(SOE)×Institutional ownership	-0.091	0.153*		
	(0.1344)	(0.0803)		
Authority=1×Institutional ownership			0.041	-0.044
			(0.0925)	(0.0969)
Authority=2×Institutional ownership			-0.129	-0.312
			(0.3480)	(0.1969)
Authority=3×Institutional ownership			0.050	-0.041
			(0.2564)	(0.1699)
Ln(1+Patent)	0.023***	0.003	0.009	0.016**
	(0.0081)	(0.0053)	(0.0104)	(0.0074)
Ln(1+Total asset)	0.153***	0.078***	0.215***	0.105***
	(0.0114)	(0.0124)	(0.0157)	(0.0173)
Book-to-Market	-0.292***	-0.099***	-0.363***	-0.128***
	(0.0347)	(0.0269)	(0.0421)	(0.0349)
Tangibility	-0.362***	-0.099**	-0.274***	-0.045
	(0.0647)	(0.0473)	(0.0870)	(0.0736)
R&D	4.134***	2.125***	4.191***	2.796***
	(0.5989)	(0.6904)	(0.6533)	(0.7982)
Leverage	-0.312***	-0.058	-0.346***	-0.141***
	(0.0473)	(0.0356)	(0.0625)	(0.0486)
Operating cash flow	0.832***	-0.096*	0.950***	-0.097
	(0.1111)	(0.0561)	(0.1396)	(0.0748)
Observations	31,668	31,668	19,139	19,139
Adjusted-R^2	0.0789	0.5721	0.0973	0.5770
Firm FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes

Table 5: **Corporate innovation and future firm value**

This table provides the results of the analyses on how corporate innovation may affect future firm value of firms. Column (1) regresses log of trademark breadth on the authority of controlling shareholders and other control variables. Columns (2) to (4) regresses forward Tobin's Q on the authority of controlling shareholder, log of trademark breadth, and their interaction terms along with other control variables. Detailed description on variable construction is provided in the Appendix. Presented estimates are marginal effects, and standard errors are presented in the parenthesis. ***, **, * represent 1%, 5%, and 10% significance, respectively. All standard errors are clustered by firm.

		Future firm value		
	Ln(1+Breadth)	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_{t+3}
	(1)	(2)	(3)	(4)
Controlling SH Auhority	0.024**	0.016	-0.041	-0.159
	(0.0115)	(0.0909)	(0.0892)	(0.0988)
Ln(1+Breadth)		0.169	-0.019	-0.199*
		(0.3197)	(0.1862)	(0.1111)
Authority=1×Ln(1+Breadth)		-0.174	0.006	0.288**
		(0.3207)	(0.1942)	(0.1353)
Authority=2×Ln(1+Breadth)		-0.206	0.072	0.377***
		(0.3170)	(0.2031)	(0.1417)
Authority=3×Ln(1+Breadth)		-0.213	0.056	0.301**
		(0.3330)	(0.2210)	(0.1337)
Institutional ownership	0.028	0.235	-0.175	-0.546
	(0.0465)	(0.4431)	(0.3922)	(0.4399)
Ln(1+Patent)	0.005	-0.028	-0.029	-0.032
	(0.0048)	(0.0551)	(0.0521)	(0.0584)
Ln(1+Total asset)	0.063***	-0.955***	-0.794***	-0.395
	(0.0109)	(0.1563)	(0.1918)	(0.2594)
Book-to-Market	-0.055**	-0.270	0.427	0.646*
	(0.0243)	(0.1790)	(0.3789)	(0.3550)
Tangibility	-0.034	-0.799	-0.963	0.185
	(0.0516)	(0.8972)	(0.8154)	(1.5719)
R&D	0.827	7.556***	3.321	-11.972
	(0.5186)	(2.8974)	(16.9418)	(24.7123)
Leverage	-0.072**	1.802**	1.894**	1.391
	(0.0363)	(0.8791)	(0.8836)	(0.8769)
Operating cash flow	-0.074	0.368	0.183	1.455**
	(0.0569)	(0.6254)	(0.9463)	(0.7327)
Observations	19,139	12,056	10,412	8,927
Adjusted-R^2	0.3291	0.4201	0.3690	0.3382
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 6: **Change in controlling shareholder authority**

This table provides regression results of the number of trademark registration on the change in controlling shareholder authority and other control variables. The change in controlling shareholder authority is yeor-on-year change of the our index for the authority of controlling shareholders, and all other variables are lagged values. Detailed description on variable construction is provided in the Appendix. Presented estimates are marginal effects, and standard errors are presented in the parenthesis. ***, **, * represent 1%, 5%, and 10% significance, respectively. All standard errors are clustered by firm.

	Years with change		All years	
	(1)	(2)	(3)	(4)
ΔControlling SH Authority	0.051***	0.048**	0.082***	0.044***
	(0.0182)	(0.0189)	(0.0151)	(0.0121)
Institutional ownership	0.027	0.000	0.111*	-0.029
	(0.1581)	(0.1582)	(0.0584)	(0.0622)
Ln(1+Patent)	-0.023	-0.019	0.018*	0.016**
	(0.0227)	(0.0230)	(0.0103)	(0.0074)
Ln(1+Total asset)	0.172***	0.212***	0.212***	0.108***
	(0.0429)	(0.0499)	(0.0158)	(0.0174)
Book-to-Market	-0.196	-0.386**	-0.356***	-0.127***
	(0.1227)	(0.1611)	(0.0408)	(0.0349)
Tangibility	-0.115	-0.085	-0.323***	-0.039
	(0.1902)	(0.1917)	(0.0870)	(0.0736)
R&D	0.975	0.424	4.392***	2.804***
	(2.1269)	(3.1366)	(0.6517)	(0.7988)
Leverage	-0.371**	-0.427***	-0.452***	-0.148***
	(0.1471)	(0.1513)	(0.0581)	(0.0484)
Operating cash flow	0.553	0.562	0.985***	-0.089
	(0.4293)	(0.4306)	(0.1412)	(0.0749)
Observations	886	885	19,139	19,139
Adjusted-R^2	0.0332	0.0348	0.0907	0.5771
Firm FE	No	No	No	Yes
Year FE	No	Yes	No	Yes

Table 7: **Other proxies for corporate innovation**

This table provides logit regression results of different proxies of innovation on SOE indicator (SOE) and controlling shareholder authority (non-SOEs) and other control variables. Columns (1) to (3) presents results on the full sample and Columns (4) to (6) present results on non-SOEs. Columns (1) and (4) uses a dummy variable taking value of one if a trademark is registered only for product industries, and zero otherwise; Columns (2) and (5) uses a dummy variable taking value of one if a trademark is registered only for service industries; and Columns (3) and (6) uses a dummy variable taking value of one when a trademark is on a logo of a brand. Because of biases in non-linear models with fixed effects, we do not add fixed effects to the logit regressions. All independent variables are lagged values. Detailed description on variable construction is provided in the Appendix. Presented estimates for logit regressions are marginal effects, and standard errors are presented in the parenthesis. ***, **, * represent 1%, 5%, and 10% significance, respectively. All standard errors are clustered by firm.

	Full sample			Non-SOEs		
	D(Prod. Inn.)	D(Svc. Inn.)	D(Logo Inn.)	D(Prod. Inn.)	D(Svc. Inn.)	D(Logo Inn.)
	(1)	(2)	(3)	(4)	(5)	(6)
D(SOE)	-0.041***	-0.013***	-0.037***			
	(0.0110)	(0.0045)	(0.0069)			
Institutional ownership				0.025***	0.008***	0.016***
				(0.0062)	(0.0026)	(0.0039)
Controlling SH Auhority	0.060***	-0.006	0.026**	0.145***	0.008	0.061***
	(0.0183)	(0.0084)	(0.0123)	(0.0255)	(0.0129)	(0.0183)
Ln(1+Patent)	0.026***	-0.012***	0.003*	0.021***	-0.011***	0.002
	(0.0026)	(0.0012)	(0.0016)	(0.0033)	(0.0015)	(0.0020)
Ln(1+Total asset)	-0.005	0.028***	0.033***	0.018***	0.029***	0.047***
	(0.0037)	(0.0016)	(0.0024)	(0.0049)	(0.0021)	(0.0034)
Book-to-Market	0.017	-0.047***	-0.062***	0.006	-0.053***	-0.070***
	(0.0131)	(0.0063)	(0.0094)	(0.0163)	(0.0082)	(0.0121)
Tangibility	0.103***	-0.149***	-0.116***	0.204***	-0.187***	-0.096***
	(0.0246)	(0.0164)	(0.0186)	(0.0334)	(0.0213)	(0.0269)
R&D	0.025	0.305**	0.768***	0.122	0.214	0.835***
	(0.2167)	(0.1364)	(0.1368)	(0.2526)	(0.1441)	(0.1671)
Leverage	-0.120***	-0.020**	-0.069***	-0.177***	-0.015	-0.098***
	(0.0205)	(0.0093)	(0.0125)	(0.0272)	(0.0123)	(0.0172)
Operating cash flow	0.235***	0.041*	0.162***	0.286***	0.031	0.178***
	(0.0456)	(0.0209)	(0.0302)	(0.0611)	(0.0275)	(0.0399)
Observations	31,668	31,668	31,668	19,139	19,139	19,139
Pseudo-R^2	0.0242	0.0868	0.0581	0.0314	0.0745	0.0645

Appendix

Table A.1: **Variable definitions**

This table provides definition of variables used in this study.

Variable definition	
Ln(1+Trademarks)	Natural logarithm of one plus number of registered trademarks for a firm-year
Ln(1+Breadth)	Natural logarithm of one plus the average number of industries a trademark is registered for
D(Product Innovation)	One for firm-years with at least one trademarks registered solely in product industries, and zero otherwise
D(Service Innovation)	One for firm-years with at least one trademarks registered solely in service industries, and zero otherwise
D(Logo Innovation)	One for firm-years with at least one image trademarks registered, and zero otherwise
D(SOE)	One for state-owned enterprises, and zero otherwise
Controlling SH authority	Sum of three indicator variables on the authority of controlling shareholders; whether controlling shareholder is the founder, is a chairman, and is family member of the founder
Institutional ownership	Shares owned by institutional investors
Ln(1+Patents)	Natural logarithm of one plus the number of patents granted
Ln(Total asset)	Natural logarithm of total assets
Book-to-market	The ratio of book value of equity to market value of equity
Tangibility	The ratio of tangible assets to total assets
R&D	The ratio of R&D to total assets
Leverage	The ratio of debt to total assets
Operating cash flow	The ratio of operating cash flow to total assets