Rich on Paper? Chinese Firms' Academic Publications, Patents, and Market Value

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Abstract

By combining various databases of academic publications and patents of China's publicly listed firms, we explore the effects of academic publications on firm values and possible mechanisms. We find that Chinese firms' academic publications are positively associated with their market valuation; more importantly, such a positive relation is more pronounced when these firms have stronger patent records, highlighting a synergy between basic research and applied technologies. Mechanism tests indicate that firm's academic publications promote their market values through enhancing their human capital and sending credible signals to professional investors and the general public. Additional tests show that publications in English-language journals are more value-relevant than in Chinese-language journals.

Keywords: academic publications; firm value; technological innovation; patents; human capital

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1. Introduction

The motivation for corporations to publish their basic research in academic journals has been an intriguing phenomenon due to the costly investment in fundamental science and the difficulty in appropriating the resulting knowledge. While prior studies have examined such motivation and associated consequences (e.g., Tijssen 2004; Simeth and Cincera 2015; Arora et al. 2018), these studies focus on publicly-listed firms in the U.S. or other developed countries.

This study examines the effects of corporations' basic research on their market value using data consisting of Chinese firms' journal publications, patents, and corporate and managerial characteristics. Such an investigation is called for because, despite the increasing influence of their operations, Chinese firms have been characterized as technologically weak but have revealed strong ambition in catching up in globalized innovation competition (White, Gao, and Zhang 2005; Chen, Patton, and Kenney 2016; Appelbaum et al. 2016). Such a pattern is present in Figure 1, which illustrates the trends of R&D investment intensity, patents, and academic publications of Chinese publicly listed manufacturing firms from 2006 to 2015.

[Insert Figure 1]

We first find, consistent with prior studies, that Chinese firms' academic publication records positively influence their market valuation because their upgrading in the value chain requires a transition from adopters to developers of new technologies (Liu and White 2001). That transition often relies on human capital attraction and retention (Chen, Patton, and Kenney 2016), and more generally, resources and attention from (potential) investors and customers (Hicks 1995). Our follow-on analyses are consistent with these mechanisms.

Our second main finding is that there are market value synergies between Chinese firms' academic publications and patents.[1] This result is consistent with the view that while appropriation is challenging on corporate scientific publications, when considered in conjunction with firm patenting, several factors may result in a positive firm market value effect: (1) scientists' capability in basic research may be related to their technology application ability (Gittelman and Kogut 2003); (2) firms with stronger publication experience may have better-quality human capital to commercialize their technologies; and (3) patented technologies based on basic science are more difficult for others to imitate and are thus may be a basis for competitive advantage (Huang and Murray 2009).

Our data cover manufacturing firms listed on the Shanghai and Shenzhen Stock Exchanges during 2006 to 2015 from the CSMAR database, which provides financial and accounting information of all Chinese listed firms. We then collect these sample firms' academic publications using the Scopus Database and China National Knowledge Infrastructure (CNKI, "中国知网") for corporate

[1] While prior studies have collectively suggested that both academic publications and patents are value-enhancing, whether and how these two elements complement each other has been under-explored. Thus far, the potential synergy between academic publications and patents has been briefly discussed in Cassiman, Veugelers, and Zuniga (2008) and Huang (2017), but related empirical evidence is lacking.

papers published in English and Chinese, respectively. We also collect sample firms' patent records from Chinese Innovation Research Database (CIRD) in Chinese Research Data Services Platform (CNRDS). This yields a sample of 1,390 unique firms that have at least one granted patent. Among these firms, 1,077 have at least one academic publication (the majority of which are in Chinese). In addition, an average firm produces 19.3 patents and 7.7 published papers (0.6 published papers in English and 7.1 published papers in Chinese) per year. In robustness checks, we also count the number of academic papers weighted by journal impact factors.

We measure Chinese firms' market values using Tobin's q,[2] and find that it is positively and significantly associated with academic publication and patent counts. Our estimates suggest that when a firm's academic publications count increases from zero to 7.7 (the sample mean), its market value increases by 5.1% (equivalent to 423 million RMB). We empirically examine two main mechanisms, human capital and signaling, through which academic publications enhance firms' market values. We find evidence supporting academic publications enhancing research staff's productivity in creating more and better patents in the future, which is consistent with improved human capital (Gittelman and Kogut 2003; Ho, Wang, and Yeh 2019). As well, firms with more academic publications receive more attention from investors, stock analysts and institutional investors, confirming the signaling effect of academic publications (Audretsch and Stephan 1996; Azoulay 2002; Hicks 1995).

In addition, Chinese firms' market values are positively and significantly associated with the interaction between the number of academic publications and the number of patents. When both values increase from zero to their sample averages, their interaction increases a sample firm's market value by 243 million RMB. Furthermore, when we separate academic publications into publications in English and publications in Chinese, we find that English-language publications and their interaction with patents are more value-relevant.

This paper is related to prior research in the following ways. First, this study, based on Chinese firms' data, offers novel evidence on the value implications of basic research and academic publications from the perspective of emerging markets. Different from prior studies on basic research in China that tend to focus on the roles of governments, universities, and research institutes (e.g., Liu and White 2001; Chen and Kenney 2007; White, Gao, and Zhang 2005), we show that Chinese firms may also play a gradually important role in basic research and such potential is recognized by stock markets. Second, we propose and empirically show the fit of academic publications and patents on market valuation. This is new to the literature to our knowledge, and echoes prior studies based on individual inventor data (Gittelman and Kogut 2003).

The remainder of the paper is organized as follows: Section 2 reviews prior literature on corporate academic publications and develop hypotheses. Section 3 describes data sources and

[2] It is common in the literature to use Tobin's q to measure the effect of technological innovation on firm-level market values, see Griliches (1981), Lanjouw and Schankerman (2004), Hall, Jaffe, and Trajtenberg (2005), and Bloom, Schankerman, and Van Reenen (2013).

collection, variable definitions, and research design. Section 4 presents the empirical results, and Section 5 discusses mechanism analyses. We present all our robustness checks in Section 6 and conclude the paper with offering implications for corporate managers, shareholders, and policy makers in Section 7.

2. Related Literature

2.1. The background of corporate academic publications

While published academic research is the foundation of modern society's technological progress (Mansfield 1991, 1998), it is often costly in terms of both human and financial resources. As discussed in the economics literature (Levin et al. 1987), appropriability has been the core issue in the investment decision of companies in the private sector. Firms with scientists and engineers publishing their research on academic publications cannot appropriate all the benefits associated with those publications. In addition to the appropriability issue, agency issues may also exist: aiming to publish at academic journals may cause scientists to dilute their efforts in patenting and commercializing, and instead engage in activities with more private benefits (Thursby and Thursby 2002; Lacetera 2009). Despite these concerns, we still observe a large number of academic publications authored by scientists affiliated with companies in high-tech industries such as chemistry, electronics, and biology (Gittelman and Kogut 2003; Lim 2004).[3]

Prior studies have proposed several possible explanations for why firms publish academic papers. First, encouraging corporate scientists to publish academic papers promotes the advancement of the company's internal research and development, as well as commercialization capabilities (Cockburn et al. 1999; Gittelman and Kogut 2003).[4] Second, academic paper publications can increase firms' visibility and reputation among the science community, strengthen firms' position in networks and professional associations, promote firms' collaboration with universities, and enhance firms' credibility with the public. These avenues for reputation-building could be particularly important for Chinese firms to incubate and attract talent (Wang and Shapira 2012; Brehm and Lundin 2012; Appelbaum et al. 2016).[5] Third, firms may treat academic publications and dissemination of knowledge as strategic disclosures aimed at promoting the diffusion of particular technologies to effectively exploit their unique assets or to catalyze formal or informal industry standards (Teece 1986; Harhoff *et al.* 2003; Huang 2017).

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[3] In fact, those scientists had made significant contributions to early development of some academic disciplines such as biology, chemistry, life sciences, and physics (Hicks 1995; Cockburn and Henderson 1998).

[4] Such policies facilitate firms' talent recruitment because some scientists prefer reputation and research opportunities over monetary compensation (Stern 2004; Sauerman and Cohen 2010). In addition, scientists' incentive to publish in academic journals motivate them to attend conferences and remain embedded in external scientific networks (Cockburn and Henderson 1998; Cockburn et al. 1999), which help firms absorb new technologies and stay on research frontiers (Gambardella 1992).

[5] Nevertheless, firms are subject to higher competition in keeping scientists who publish on top journals because those are also more visible and appealing to competitors.

2.2. Chinese firms' academic publications and market value

Simeth and Cincera (2016) and Arora et al. (2018) report a positive relation between U.S. public firms' academic publication count and their market valuation, which supports the value relevance of corporate academic research. We argue that such a positive relation also appears and could be even more pronounced in China, especially in the recent past, due to the emergence of Chinese high-tech companies and the globalization of Chinese firms' operations.

In the past, Chinese firms have been characterized as weak in basic research and heavily reliant on universities or global collaboration for knowledge sourcing (e.g., Wang and Shapira 2012; Chen, Patton, and Kenney, 2016; Appelbaum et al. 2016). As Chinese firms gradually shift from technology adopters to developers, investing in more basic research may become more important (Liu and White 2001; Motohashi and Yun 2007). Thus, Chinese firms' academic publication record could reflect their effort and investment in basic research that are conducive to future technological development and product invention, which is particularly informative for shareholders.

Firms' academic publication records also reflect their human capital and absorptive capacity, and are thus informative to stock markets. High-quality human capital is an important determinant of Chinese firms' product invention and productivity (Fleisher et al. 2010), and so is expected to factor in firms' market valuation. Moreover, academic publications are highly regarded by both the scientist community and the governments and the general public including potential customers (Hicks 1995). Strong publication records thus serve as a credible signaling device to customers, and such signals are particularly important for Chinese firms who are latecomers but intend to catch up in high-tech markets. Moreover, Gambardella (1992) suggests that firms' in-house scientific research raises their ability to absorb "public" science. Since Chen, Patton, and Kenney (2016) point out Chinese firms' lack of absorptive capacity in digesting and internalizing innovation generated from universities, the capability of conducting basic science research is a particularly rare asset for Chinese firms. These discussions lead to our first hypothesis:

H1: Chinese firms' academic publication record positively influences their market value.

2.3. The complementarity of Chinese firms' academic publications and patents in market valuation

While prior studies have collectively suggested that both academic publications and patents are value-enhancing, whether there is synergy in these two elements in terms of market valuation is an open question. On the one hand, using inventor-level data, Gittelman and Kogut (2003) show that scientists who are capable in both patenting and publishing tend to produce more influential patents. Mansfield (1991, 1998) also shows an increasingly important role of academic research in

commercialized inventions. These studies highlight the synergy from being capable in both patenting and publishing.[6]

On the other hand, the synergistic effect may result from the broader application of basic research. As pointed out in Cassiman, Veugelers, and Zuniga (2008), patents that are based on academic publication tend to be cited by subsequent patents in a wider range of technology areas. Such diversity in the applications of patents built on basic research is more valuable to shareholders because those patents may generate more different products and to diversify risk (Hirshleifer, Hsu, and Li 2018). In addition, the competitive advantages of such patented technologies may be more sustainable due to the possibly higher entry barrier in accessing basic science knowledge.

Moreover, patenting and academic publication experience suggests an organizational ambidexterity which may aid knowledge creation and commercialization (Huang and Murray 2009),[7] which is a positive signal to stock markets.[8] Brehm and Lundin (2012) confirm a complementary relationship between capabilities of acquiring external knowledge and exploitation capacity of transforming such knowledge among Chinese firms. This suggests:

H2: Chinese firms' academic publications and patents are synergistic in market valuation.

3. Data and Research Designs

3.1. Data sources

We start our data construction by collecting a list of all patenting firms that are in manufacturing industries and are listed on the Shanghai and Shenzhen Stock Exchanges for the period of 2006 to 2015 from the CSMAR database.[9] Our sample consists of 1,632 unique firms (11,183 firm-year observations) in the period 2006-2015. We then collect these firms' academic publications ("papers"), patents, and financial and accounting information in the sample period. Following the literature (Tijssen 2004; Simeth and Cincera 2015, Arora et al. 2018), we use academic publications with coauthors' affiliation with Chinese public firms to construct the publication measure. We collect sample firms' academic publications using the Scopus Database and China National Knowledge

[6] Scientists are, however, subject to time constraints and may face a trade-off between investing in publications and patents/commercialization activity more generally (Kinney et al. 2004; Arora et al. 2018).

[7] The value implication of ambidexterity is similar to the exploitation-exploration concept of Levinthal and March (1993) in that a firm not only needs exploitation of its existing opportunities to maintain its short-run profitability but also needs exploration of new knowledge sources to discover future directions to avoid radical changes in industry and market structures. He and Wong (2004) present the value implication of ambidexterity by showing that the interaction of exploration and exploitation is positively related to sales growth.

[8] Appelbaum et al. (2016) find that Chinese nanotechnology firms tend to focus on short-term improvements of existing products rather than fundamental scientific research, which dampens their long-term development.

[9] We start our sample in 2006 because R&D expenditures reported are sparse before 2006. We focus on manufacturing industries (industry codes C13 to C43 of China Securities Regulatory Commission). We then exclude firms that have *no* patent records in the period 2006-2015, firms in financial distress, and firms with missing values in variables used in our regression analysis. It is common in the literature to focus on patenting firms only (Aghion, Van Reenen, and Zingales 2013; Bloom, Schankerman, and Van Reenen 2013). While there are 31 manufacturing industries in China, two of them do not have patent records and are thus excluded from our sample. Thus, we use the 29 manufacturing industries as defined by China Securities Regulatory Commission.

Infrastructure (CNKI, "中国知网") for corporate papers published in English and Chinese, respectively.[10] We then collect the sample firms' patent data from the Chinese Innovation Research Database (CIRD) in Chinese Research Data Services Platform (CNRDS).[11] We also collect sample firms' patents registered in the U.S., although the number of Chinese firms' U.S. patents is far smaller than their Chinese patents (which is consistent with Huang and Li (2019)). Lastly, we collect the financial and accounting data of our sample firms from the CSMAR Database.

In Figure 2 Panel A, we present the average number of firms' new patents filed in China and the U.S. in each sample year. We observe a persistent increase in both series: an average firm files 7.31 Chinese patents and 0.14 U.S. patents in 2006, and these numbers increase to 22.02 and 1.78 in 2015, respectively. In Figure 2 Panel B, we present the average number of firms' academic publications in Chinese and English in each sample year. We find that a steady increase in academic publications in Chinese, but some fluctuations in academic publications in English.

[Insert Figure 2]

Table 1 lists the sample distribution: Panel A presents the sample distribution of our sample firms with patent records by year (2006-2015), and Panel B presents the sample distribution of all our sample firm-year observations by 29 industries. 353 unique firms in our sample have at least one academic publications in 2006, accounting for 53.2% of all firms (most of those are papers in Chinese). The ratio of firms that have academic publications increases to 892 in 2015, accounting for 57.6% of all firms. Consequently, near half of all firms in our sample published at least one journal article every year. Throughout our sample period, we have 1,390 unique firms in our sample which have at least one granted patent. Among these firms, 1,077 have at least one academic publication (the majority of which are in Chinese).

In addition, we find that firms with academic publications mainly concentrate in capital- and technology-intensive industries such as manufacturing of computers, communications and other electronic equipment (49.6% with at least one publication), pharmaceutical industry (58.1% with at least one publication), chemical raw materials and chemical products manufacturing (59.2% with at

[10] The Scopus Database is the largest abstract and citation database of peer-reviewed literature in scientific journals. The CNKI is a key national information database construction project launched by Tsinghua University and Tsinghua Tong Fang Company in 1996, with the support from PRC Ministry of Education, PRC Ministry of Science, Propaganda Department of the Communist Party of China, and PRC General Administration of Press and Publication. CNKI has developed into a comprehensive knowledge resource system and includes Chinese journals, doctoral dissertations, masters' theses, conference proceedings, newspapers, government reports, statistical yearbooks, e-books, patents, standards, etc. To search a firm's paper records in English, we manually input each sample firm's name and select years and journals in the Scopus Database (detailed search procedure is provided in the Online Appendix Section 1). To search a firm's paper records in Chinese, we manually input each sample firm's name and select years and journals in the CNKI Database (detailed search procedure is provided in the Online Appendix Section 2). We exclude journals in humanities and social sciences.

[11] We include all three types of patents in the Chinese patent system: invention patents, utility model patents, and design patents. However, we acknowledge that design patents may not be as important as the other two types of patents (Wang, Stuart, and Li 2020). We use the number of patents that are applied for and subsequently granted by a firm in a given year measuring a firm's technological innovation capacity. More details about Chinese firms' patent data can be found in Tong et al. (2018) and He et al. (2018).

least one publication), electrical machinery and equipment manufacturing (53.8% with at least one publication), and specialized equipment manufacturing industry (58.9% with at least one publication).

[Insert Table 1]

3.2. Main variables and summary statistics

To examine the effects of corporate papers and patents on a firm's market value, we estimate ordinary least squares regression models for firms' Tobin's q.[12] Our main explanatory variables of interest include *Papers*, *Papers in English*, *Papers in Chinese*, and *Patents* and their interaction with *Patents* based on filing year.[13] While our use of academic publications to measure a firm's science capability follows prior studies (Tijssen 2004, Simeth and Cincera 2015, Arora et al. 2018), our study features a refinement: we separate all papers into papers in Chinese-language journals and papers in English-language journals. In a robustness check, we also count the number of academic papers weighted by journal impact factors.

Table 2 presents the descriptive statistics of all variables used in our regressions. The mean and standard deviation of Tobin's q are 2.8 and 2.3, respectively. The mean and standard deviation of the market value among our sample firms are 8,201 and 16,225 million RMB. The averages of *Papers*, *Papers in English*, and *Papers in Chinese* are 7.7, 0.6, and 7.1, respectively. Moreover, a sample firm has filed 19.4 patents per year.

To isolate the influence of academic publications and patents on a firm's Tobin's q, we also control for a series of firms' and shareholders' characteristics that are related to firms' market value.[14] We winsorize all continuous variables at 1% at both tails to mitigate the influence of outliers. Table 2 also presents the summary statistics of control variables. An average firm in our sample has total assets of 6,350 million RMB, spends 95 million RMB in R&D, is 8.69 years old, has a leverage ratio

[12] It is common in the literature to use Tobin's q to measure a firm's market value, see Griliches (1981), Lanjouw and Schankerman (2004), and Hall, Jaffe, and Trajtenberg (2005), and Bloom, Schankerman, and Van Reenen (2013). In our robustness checks, we replace Tobin's q with market value in logarithm (*Ln(Market value)*) for the dependent variable, following Lerner (1994) and Blundell, Griffith, and Van Reenen (1999), and obtain consistent results.

[13] *Papers* of firm *i* in year *t* is defined as the number of all academic publications we collect in Scopus and CNKI that have at least one coauthor being listed as affiliated with firm *i* and are published in year *t*; *Papers in English* of firm *i* in year *t* is defined as the number of all academic publications we collect in Scopus that have at least one coauthor being listed as affiliated with firm *i* and are published in year *t*; and *Papers in Chinese* of firm *i* in year *t* is defined as the number of all academic publications we collect in CNKI that have at least one coauthor being listed as affiliated with firm *i* and are published in year *t*. *Patents* denotes the number of all patents filed by (and are later granted to) firm *i* in China in year *t*.

[14] We control for *Ln (Assets)*, which is defined as the firm's total assets in logarithm and reflects its size (a necessary component for a Cobb-Douglas function). Other control variables include *Ln (R&D)*, which denotes the firm's R&D expenditures plus one; *Leverage* is a firm's total debts over its total assets and reflects its financial conditions; *Ln (PPE/#employees)* measures a firm's net property, plant, and equipment (PPE) scaled by the number of employees and reflects its capital intensity; *Sales growth* denotes a firm's growth in revenue and reflects its momentum and growth prospects; *Stock volatility* is the standard deviation of daily stock returns over the fiscal year of a firm and reflects its total riskiness; *Ln (Board size)* is the number of board members in a firm and reflects the monitoring intensity, *SOEs* is an indicator variable that equals one if a firm is state-owned and captures the differences of SOEs' and non-state-owned firms' goals, and *QFII* denotes the ratio of qualified foreign institutional investors in a firm and reflects its corporate governance and independence.

of 0.45, has capital intensity (PPE/#employees) of 390, has sales growth of 15%, has stock volatility of 0.50, and has 8.82 board members. In addition, 11.1% of sample firms are foreign institutional investors (QFII). Lastly, 39.8% of sample firms are state-owned.

[Insert Table 2]

4. Papers, Patents, and Market Values

Table 3 reports our estimation results from regressing firms' Tobin's q on their count of academic publications interacted with their patent count and a series of firms' and shareholders' characteristics. We also control for industry and year fixed effects in our empirical models to account for industry heterogeneity and time trends in market valuation.[15] Our statistical inferences are based on standard errors that are clustered at the firm level, which correct the variation in estimation errors within each firm, such as serial autocorrelation.

Column (1) presents the results when we only include *Papers* and *Patents* in addition to control variables, and shows that *Tobin's q* is positively and significantly associated with both variables. The estimated coefficients on *Papers* and *Patents* in Column (1) are both significant at the 1% level, and the implied economic magnitude is as follows: when a firm's number of journal publications increases from zero to 7.7 (sample mean of *Papers*), a firm's market value increases by 5.1%; when a firm's patent count increases from zero to 19.3 (sample mean of *Patents*), a firm's market value increases by 2.1%. These increases in market value correspond to 423 and 174 million RMB given that the mean market value of our sample firms is 8,201 million RMB. This finding is supportive of Hypothesis 1.

[Insert Table 3]

Column (2) presents the results when we further introduce the interaction term, *Papers* × *Patents*, into the model. We find that the coefficient on the interaction term is positive and significant at the 1% level, indicating the synergy of academic publications and patents in enhancing a firm's market value. In terms of economic magnitude, given that a firm's number of academic publications is 7.7 (sample mean of *Papers*) and its number of patents is 19.3 (sample mean of *Patents*), the estimated interaction effect reflects a growth of 3.0% in a firm's market value (i.e., an increase of 243 million RMB). This finding confirms the synergy of firms' scientific capability and industrial applications, and is supportive to Hypothesis 2.

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[15] In a robustness check, we include *lagged Tobin's q* on the right-hand-side of the regression to account for persistence of *Tobin's q* and find consistent results (e.g., Griliches 1981). We do not include firm fixed effects or lagged *Tobin's q* in our main regression for the reasons suggested by Hall, Jaffe, and Trajtenberg (2005): first, firm innovation and market value are persistent and may be highly correlated with individual effects, leading any effect of corporate papers and patents to be absorbed by firm fixed effects. Second, given our wide and short panel of 1,632 firms over 10 years (2006-2015), we are interested in the cross-sectional relation between market value and corporate papers and patents across firms. Third, given the large cross-section in our sample (over 1,000), each firm can reasonably be assumed to be a random draw from the same population (e.g., Petersen 2009).

Column (3) shows the estimation results when we include both *Papers in English* and *Papers in Chinese* and their interaction terms with *Patents* in the same regression. The coefficients on *Papers in English* and *Papers in Chinese* are 0.0052 and 0.0024, respectively, suggesting that global journal publications are more value-enhancing than local journal publications. The increase in market value by publishing one more global journal publication is more than double of that by publishing one more local journal publication.

Moreover, coefficients on *Papers in English* × *Patents* and *Papers in Chinese* × *Patents* are 0.0003 and 0.0001, respectively, suggesting that global journal publications are associated with greater synergy than local journal publications. Moreover, given the same number of patents, the increase in market value by publishing one more global journal publication is more than double that associated with publishing one additional local journal publication.

5. Mechanisms

In this section, we discuss two mechanisms through which corporate papers published in academic journals may affect firms' market values and/or enhance the effect of patents on firms' market value: first, firms with more academic publications may be those which encourage research staff to pursue more fundamental research, which enhances their ability to create more and better patents in the future – a human capital centered mechanism. Second, firms with more academic publications are regarded as having proven records in innovation, which increases the attention and credibility of their patents and technological competence – this is labelled as a "signaling" mechanism.

5.1. The human capital mechanism

We argue that firms with stronger academic publication records reflect their research staff's talent and technology as well as their policies and cultures in encouraging basic science and fundamental research. Thus, firms with stronger publication records are expected to create more and better patents in the future (Gittelman and Kogut, 2003; Ho, Wang, and Yeh, 2019). To examine this human capital mechanism, we regress our primary measure of human capital, number of inventors in logarithm,[16] on firms' academic publications and other control variables used in Table 3.[17] As shown

[16] We also consider three alternative measures of human capital (number of patents per inventor, number of forward citations per inventor, and number of forward citations per patent) and discuss the results in the Online Appendix Section 4. The definitions of these variables are provided in the Online Appendix Section 3.

[17] Citations of a firm's patents can be received for a long period after a patent is granted, so the patent granted near the end of the sample period have less opportunity to receive forward citations. To address this truncation bias, we follow Hall et al. (2001) and Gao et al. (2020) in adjusting our patent citations. First, we calculate the average forward citations of all patents in the same technology class (International Patent Classification, IPC) and grant in the same year, and regard this number as a class-year average. Second, we calculate the average value of forward citations of all patents in the same technology class (a class average). Our adjustment factor for each class-year will be a class-year average scaled by the corresponding class average. Finally, we scale each

in Column (1) in Table 4, *Papers* is positively and mostly significantly associated with these human capital measures, suggesting that firms with academic publications have incubated and attracted more inventors. If a firm's paper count increases from zero to 7.7 (sample mean) per year, its number of inventors increases by 5.79.[18] In Columns (2) of Table 4, we find that the coefficient on *Papers* × *Patents* is significantly positively, confirming the synergy between basic science and applied technologies in human capital. In terms of economic magnitude, given that the sample average of paper count and patent count are 7.7 and 19.35 per year, respectively, their interaction increases the number of inventors by 4.73.[19]

[Insert Table 4]

5.2. The signaling mechanism

Firms' academic publications also serve as signals of their scientific and technical capabilities to investors, analysts, and customers (Audretsch and Stephan 1996; Azoulay 2002; Hicks 1995). Such signaling enhances all stakeholders' (including investors') confidence of the quality of a firm's patents and thus raise their value relevance, or draws more attention to the firm's patents and reduces the likelihood of undervaluation of these patents. To examine this mechanism, we use the number of stock analyst reports following a firm in a year (*analyst coverage*) as our primary proxy for market signaling because it reflects the attention from professionals who are more sophisticated and understand the value of firms' capability in basic science.[20] We regress *analyst coverage* on firms' academic publications and other control variables used in Table 3. The results, reported in Columns (3) and (4) in Table 4, show that corporate academic publications are positively and mostly significantly associated with market attention. If a firm's paper count increases from zero to 7.7 (sample mean) per year, it attracts 0.61 more analyst. The results suggest that corporate publications indeed deliver strong signals to the market because firms with more journal publications receive more attention from analysts. On the other hand, we also find a significantly positive coefficient on *Papers* × *Patents* in Column (4), which suggests a synergistic effect of basic science and applied technologies on the signaling mechanism. In terms of economic magnitude, given that the sample averages of paper count and patent count are 7.7 and 19.35 per year, respectively, their interaction increases the number of analysts by 0.28.

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patent's forward citation count by the corresponding adjustment factor and sum up the adjusted citation counts of all patents filed by a firm in a year.

[18] Since Ln(1+ Inventors) = X and Ln(1+ Inventors + ΔInventors) = X + ΔX where ΔX = 0.0233×7.7 and ΔInventors = (1+ Inventors) × [exp(ΔX) – 1]. When we use the mean of Inventors (28.45), we get 5.79.

[19] Since Ln(1+ Inventors) = X and Ln(1+ Inventors + ΔInventors) = X + ΔX where ΔX = 0.0010×7.7×19.35 and ΔInventors = (1+ Inventors) × [exp(ΔX) – 1]. When we use the mean of Inventors (28.45), we get 4.73.

[20] We also consider three alternative measures of signaling (the internet search volume of a firm; average recommendation ratio of stock analysts; and the ratio of outstanding shares held by institutional investors) in the Online Appendix Section 4. These variables are defined in the Online Appendix Section 3.

6. Robustness Checks

In this section, we briefly discuss robustness checks to address the quality difference in patents, the quality difference in publications, endogeneity concerns, omitted variables, alternative regressions, and alternative explanations. We provide details of these tests and results in the Online Appendix Sections 5 and 6.

Patent quality. Since U.S. patents could be more valuable than Chinese patents, we are interested in analyzing how such heterogeneity in patent quality affects our results. We thus decompose *Patents* into the number of patents that are not filed to the U.S. (*ChPatents*) and the number of patents that are also registered in the U.S. (*USPatents*). When we estimate the regression using these decomposed patent counts, we find that the coefficients on *USPatents* are larger than those on *ChPatents*, confirming that U.S. patents are more valuable. More importantly, the coefficients on *Papers in English* × *USPatents* are much larger than those on *Papers* × *Patents* in Table 3. These results confirm our baseline results and highlight the heterogeneous effects of patent quality.

Journal quality. We further examine the heterogeneity in quality for papers published in journals based on journal impact factors. We replace *Papers in English* with *Papers in English (IF Adj)*, which are defined as the sum of impact factor-weighted number of papers published in journals in English. When we include *USPatents*, *Papers in English (IF Adj)*, and *Papers in English (IF Adj)* × *USPatents* in the regression model, the coefficients on *Papers in English (IF Adj)* and *Papers in English (IF Adj)* × *USPatents* are significantly positive, suggesting that publishing in more influential global journal is associated with higher market valuation. These results remain robust when we include Chinese patents and papers in Chinese adjusted for journal impact factors.

Omitted variables and alternative explanations. We acknowledge that our main regression model may miss important variables. To rule out such a concern, we first include firms' lagged *Tobin's q* as a control variable that reflects persistence in market valuation or firms' market prospects. To further alleviate the concerns about potential omitted variables, we include several sets of control variables that include an extensive list of board and top management teams (TMT) characteristics, financial constraints, corporate governance, and local economic conditions (He, He, and Tong 2020). We find that the coefficients of *Papers*, *Patents,* and *Papers* × *Patents* on Tobin's q remain significantly positive in all panels of both tables.

Alternative model specifications and variable definitions. We further consider the following alternative model specifications: (a) replacing the dependent variable, *Tobin's q*, by a firm's market value in logarithm, *Ln (Market value)*; (b) using one-year lagged *Patents*, *Papers in Chinese*, and *Papers in English* as the main explanatory variables; (c) excluding firm-years without academic publications from our sample; (d) using the sample period of 2009-2015 to explore the effects of papers and patents on firm value after the 2008 subprime crisis; (e) excluding firms engaging in mergers and acquisitions in the previous two years; and (f) excluding firms with their headquarters in the four first-tier cities (Beijing, Shanghai, Guangzhou, Shenzhen) from our sample.

Endogeneity concerns. Finally, we address potential endogeneity issues by proposing two instrumental variables that are related with *Papers* but are not directly related to *Tobin's q*: *Peer Effects* and *Difficulty of Publication*.[21] We then estimate the two-stage least square (2SLS) regression using these instrumental variables and find that instrumented *Papers* and *Papers* × *Patents* positively explain *Tobin's q*, supporting a causal interpretation of our main results.

7. Concluding Remarks

In this study, we explore the effect of a firm's academic publications on its market value using a sample of Chinese public firms over the period of 2006 to 2015. In line with our hypotheses, we find that corporate academic publications do have positive and significant effects on a firm's Tobin's q. Our empirical analyses show that Chinese firms with more academic publications are associated with higher market valuation. More importantly, such an effect is more pronounced when these firms also file more patents, which highlights the important synergy between basic science and industry applications. When we separate these publications into those in English and in Chinese, we find that the value effect of the former is greater than the latter. We also propose and find empirical support for two underlying mechanisms: the human capital mechanism and the signaling mechanism. Chinese firms with more academic publications are associated with more (productive) inventors, supporting the human capital mechanism. In addition, Chinese firms' academic publications offer positive signals to investors and the public, which strengthens outsiders' confidence in these firms' patents and associated technologies.

This study provides new insights to the literature on the value implications of corporate publications. We present novel evidence based on Chinese firms which are attempting to catch up in technologies and play an increasingly important role in the global economy. To our knowledge, the synergy of academic publications and patents in firm market value has *not* been previously empirically tested.

We conclude by discussing policy implications and a few possible future directions. Our results suggest that even in a quickly developing innovation economy such as China's, there is a corporate role for contributing to open science. Doing so may be synergistic with typical appropriation activities such as patenting due to attracting and retaining human capital, as well as signaling to the investment community. Based on these findings, there are a number of avenues which future research may

[21] The first one, *Peer Effects,* is defined as the average number of academic publications that were published in the same journals by all other firms that share the same province and same industry. The second one, *Difficulty of Publication*, is defined as the average journal impact factors of journals in which the firm has published in during fiscal year *t*. We argue that these two instrumental variables satisfy the relevance condition and exclusion restriction: on the one hand, firms with more peers publishing in journals are also more likely to publish (due to peer pressure or learning), and firms that publish in better quality journals are subject to greater difficulty. On the other hand, as these two instrumental variables are specific to academic publications, they are thus unrelated to a firm's market valuation unless through the instrumented explanatory variables *Papers* and *Papers* × *Patents*.

investigate. For example, is it better to recruit and retain technical staff who can individually contribute and span the domains of open and commercial science, or should managers target a division of labor (such as collaboration with university scientists) to operationalize these contributions? As a firm manager, is it better to err on the side of "too much" open science or "too little"? How might the answers to these research questions depend on industry, stage of industry evolution, and more generally business environment? Much work in this domain lies ahead; our hope is that the work presented here will spur these and other future research efforts.

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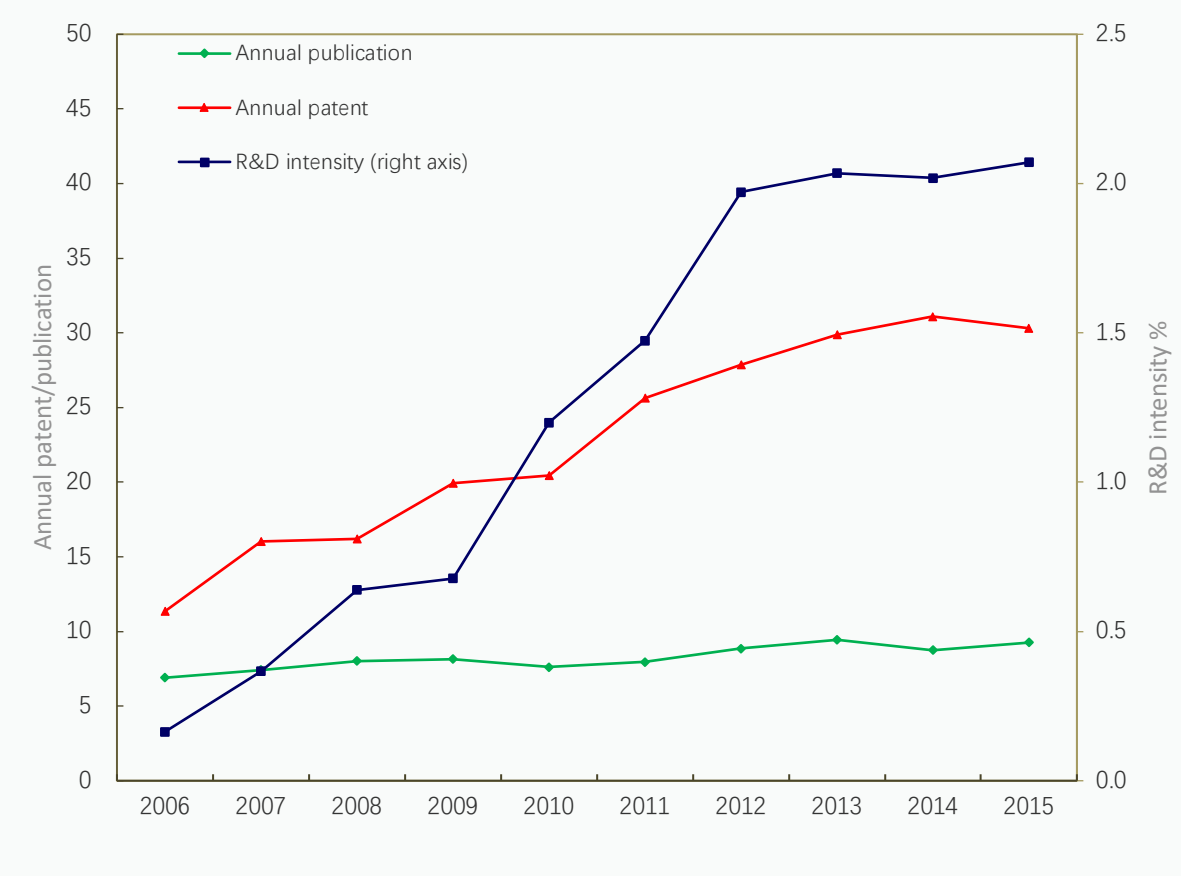
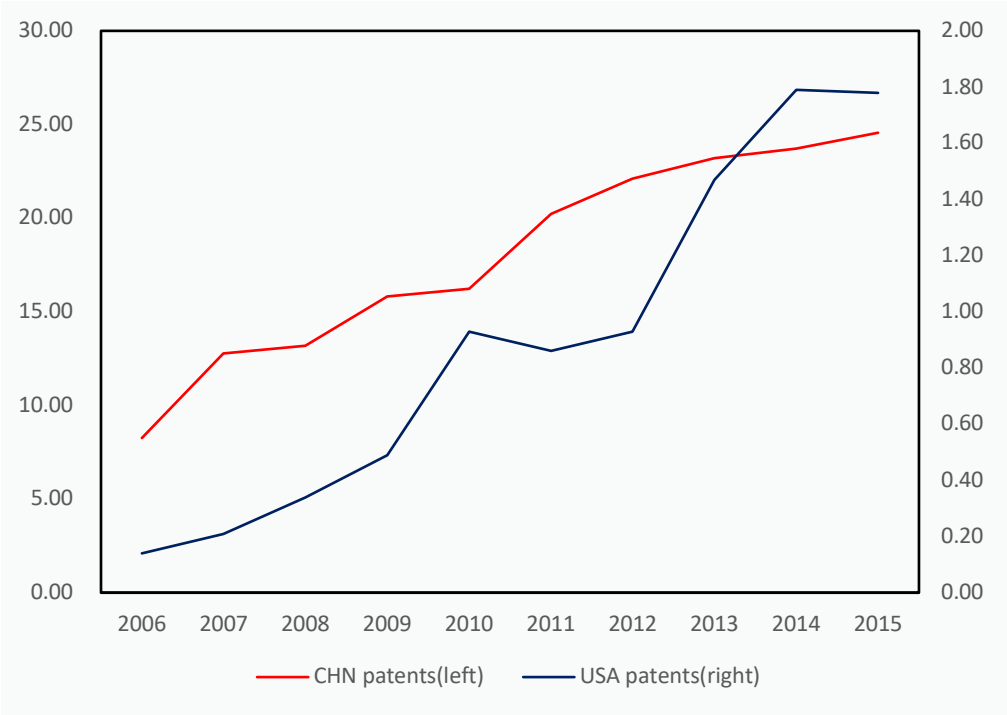
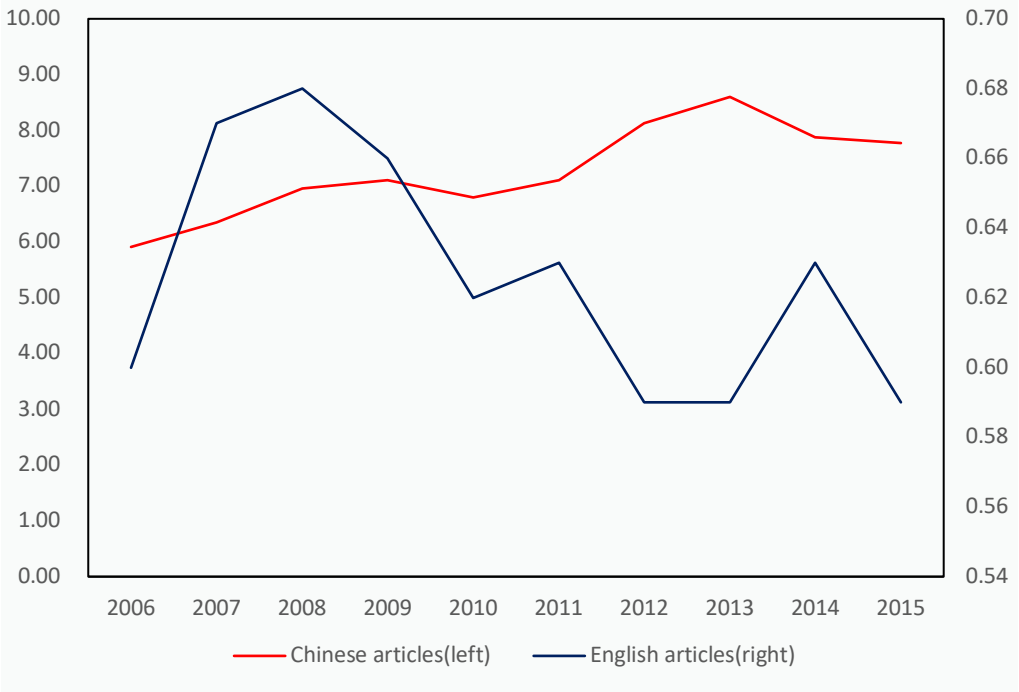


FIGURE 1 Academic publications, patents, and R&D intensity of Chinese publicly listed firms, 2006-2015.

The green line denotes the average number of academic articles published by Chinese firms; the red line denotes the average number of patents filed by Chinese firms; and the blue line denotes the ratio of R&D expenditure to sales of Chinese firms. All Chinese firms in our sample are those with at least one patent.



Panel A: Average annual number of Chinese firms' patent filed



Panel B: Average annual number of Chinese firms' publications in Chinese and English

FIGURE 2 Patenting and publishing activities of Chinese listed firms, 2006-2015.
This figure presents average firm-year publications (in Chinese and English) and patents over time for publicly listed firms with at least one patent.

Table 1
Distribution of the sample by year and industry.
This table provides the number of firms, the number of publishing firms, and the percentage of publishing firms in the sample by year (Panel A) and by industry (Panel B).

Panel A: sample distribution by year

Year	No. of firms	No. of publishing firms	Publishing firms (%)
2006	664	353	53.16
2007	719	380	52.85
2008	789	436	55.26
2009	848	467	55.07
2010	1102	582	52.81
2011	1291	681	52.75
2012	1403	760	54.17
2013	1391	802	57.66
2014	1435	838	58.40
2015	1541	887	57.56

Panel B: sample distribution by industry

Industry	No. of firms	No. of publishing firms	Publishing firms (%)
Specialized equipment manufacturing industry	992	584	58.87
Instrumentation industry	132	64	48.48
Other manufacturing	106	8	7.55
Agricultural and sideline food processing industry	299	136	45.48
Chemical raw materials and chemical products manufacturing	1442	854	59.22
Chemical fiber manufacturing	244	124	50.82
Pharmaceutical industry	1470	854	58.10
The printing and recording media reproduction industry	65	29	44.62
Furniture manufacturing	43	20	46.51
Comprehensive utilization of abandoned resources	23	6	26.09
Culture, education, art, sports and entertainment products manufacturing	52	8	15.38
Nonferrous metal smelting and rolling industry	574	332	57.84
Wood processing and wood, bamboo, rattan, brown, grass products industry	96	33	34.38
Rubber and plastic products industry	334	169	50.60
Automobile industry	777	477	61.39
Electrical machinery and equipment manufacturing	1308	703	53.75
Leather, fur, feather and its products and footwear industry	43	15	34.88
Petroleum processing, coking and nuclear fuel processing industries	173	108	62.43
Textile industry	371	175	47.17
Textile clothing, clothing industry	179	41	22.91
Manufacturing of computers, communications and other electronic equipment	1917	950	49.56
General equipment manufacturing	733	441	60.16
Paper and paper products industry	266	165	62.03
Wine, beverage and refined tea manufacturing	440	299	67.95
Metal products industry	334	173	51.80
Manufacturing of railways, ships, aerospace and other transport equipment	373	112	30.03
Non-metallic mineral products industry	565	292	51.68
Food manufacturing	283	159	56.18
Ferrous metal smelting and rolling industry	361	275	76.18

Table 2
Descriptive statistics.
This table reports descriptive statistics of the main variables defined in Appendix A. during the sample period 2001-2015. All continuous variables are winsorized at 1% at both tails. All variables are defined in the Online Appendix Section 3.

Variables	N	Mean	Std	Median	Min	Max
Panel A: Dependend variables						
Tobin's q	11183	2.8234	2.3068	2.1719	0.7647	32.3522
Market value (millions RMB)	11183	8201.37	16224.68	4082.00	101.23	507603.48
Panel B: Tested variables						
Papers	11183	7.7447	22.4856	1.0000	0.0000	203.0000
Papers in Chinese	11183	7.1266	21.9925	1.0000	0.0000	223.0000
Papers in English	11183	0.6181	7.9051	0.0000	0.0000	272.0000
Panel C: Control variables						
Patents	11183	19.3461	81.8646	3.0000	0.0000	1488.0000
R&Dexp (millions RMB)	11183	94.70	396.22	23.10	0.00	12200.00
Assets (millions RMB)	11183	6350.38	17633.92	2226.73	17.96	511630.69
Firm age (years)	11183	8.6896	5.8538	8.0000	1.0000	26.0000
Leverage	11183	0.4522	1.3071	0.4150	0.0071	96.9593
PPE/#employees (1000 RMB)	11183	390.22	1088.19	239.99	2.20	46569.82
Sales growth	11183	0.1504	0.2961	0.1165	-0.4951	1.5289
Stock volatility	11183	0.5006	0.1505	0.4655	0.2307	0.9315
Board size	11183	8.8230	1.6963	9.0000	3.0000	19.0000
SOEs	11183	0.3982	0.4895	0.0000	0.0000	1.0000
QFII	11183	0.1114	0.4234	0.0000	0.0000	2.7400
Panel D: Other variables						
Hadlock and Pierce's (2010) financial constraints index	11183	-3.4262	0.2536	-3.3950	-3.9812	-2.9342
G index	11183	0.0239	1.0650	-0.1819	-3.2453	5.7604
TMT quality	11183	0.1652	2.3929	-0.1513	-7.0393	15.7535
Board diversity	11183	0.2325	2.5588	0.1349	-12.5113	13.0722
University firm	11183	0.0111	0.1047	0.0000	0.0000	1.0000
CEO duality	11183	0.2464	0.4309	0.0000	0.0000	1.0000
CEO political connection	11183	0.4068	0.4913	0.0000	0.0000	1.0000
CEO age	11183	48.5161	6.5918	48.0000	25.0000	79.0000
CEO male	11183	0.9472	0.2237	1.0000	0.0000	1.0000
CEO tenure	11183	33.6684	32.6523	23.0000	0.0000	216.0000
Founder CEO	11183	0.7021	0.4573	1.0000	0.0000	1.0000
Inventor CEO	11183	0.3927	0.4884	0.0000	0.0000	1.0000
Academic CEO	11183	0.0630	0.2430	0.0000	0.0000	1.0000
CEO GSI	11183	-0.0343	0.8835	-0.2164	-1.2867	3.6446
CEO foreign experience	11183	0.0438	0.2047	0.0000	0.0000	1.0000
Outside CEO	11183	0.1879	0.3906	0.0000	0.0000	1.0000
Financial CEO	11183	0.0464	0.2104	0.0000	0.0000	1.0000
Ln(locgdppp)	11183	10.6759	0.5423	10.7650	8.6570	11.5895
LocUniversityNum	11183	103.4908	34.5190	104.0000	6.0000	162.0000
LocLotterypp	11183	244.2345	114.9416	244.0000	33.5026	684.2466
Inventions	11183	7.7074	81.6035	0.0000	0.0000	3667.0000
Utilities	11183	11.7555	66.9851	0.0000	0.0000	3979.0000
Citations	11183	27.6718	235.4744	1.6639	0.0000	9363.7231
Inventor Num	11183	28.4501	131.2193	4.0000	0.0000	3618.0000
Patents/Inventors	11183	0.5739	2.9307	0.2500	0.0000	188.0000
Citations/Inventors	11183	0.7131	2.9904	0.1780	0.0000	154.2902
Citations/Patents	11183	1.1703	3.6984	0.0000	0.0000	129.9043
Standards Num	11183	0.7429	4.0523	0.0000	0.0000	206.0000
Government Subsidies	11183	26.9464	60.9225	7.6866	0.0000	403.6580
Analyst coverage	11183	13.7562	18.0362	7.0000	0.0000	83.0000
Internet search	11183	10.7181	14.7514	7.9713	0.0000	345.5299
Analyst recommendation	11183	1.9496	0.4696	2.0000	1.0000	4.0000
Institutional ownership	11183	32.7518	23.8294	30.3379	0.0000	84.8243
M&A	11183	0.1049	0.3064	0.0000	0.0000	1.0000
Peer Effects	11183	6.2952	16.6384	1.0000	0.0000	260.0472
Difficulty of Publication	11183	1.0626	2.7703	0.0000	0.0000	53.5460

Table 3: Corporate publications, patents and market value.
This table presents the results of the impact of corporate publications on market value. Also included in each regression, but unreported, are the control variables listed in Table 2. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

	Tobin's q		
	(1)	(2)	(3)
Papers	0.0067***	0.0045***	
	(0.0013)	(0.0013)	
Patents	0.0011***	0.0007**	0.0004*
	(0.0003)	(0.0003)	(0.0003)
Papers × Patents		0.0002***	
		(0.0001)	
Papers in Chinese			0.0024*
			(0.0014)
Papers in Chinese × Patents			0.0001***
			(0.0000)
Papers in English			0.0052***
			(0.0015)
Papers in English × Patents			0.0003**
			(0.0001)
Constant	7.5923***	7.6156***	7.6088***
	(0.5333)	(0.5326)	(0.5324)
Control variables	YES	YES	YES
Year fixed effects	YES	YES	YES
Industry fixed effects	YES	YES	YES
Observations	11183	11183	11183
Adjusted R^2	0.4383	0.4392	0.4392

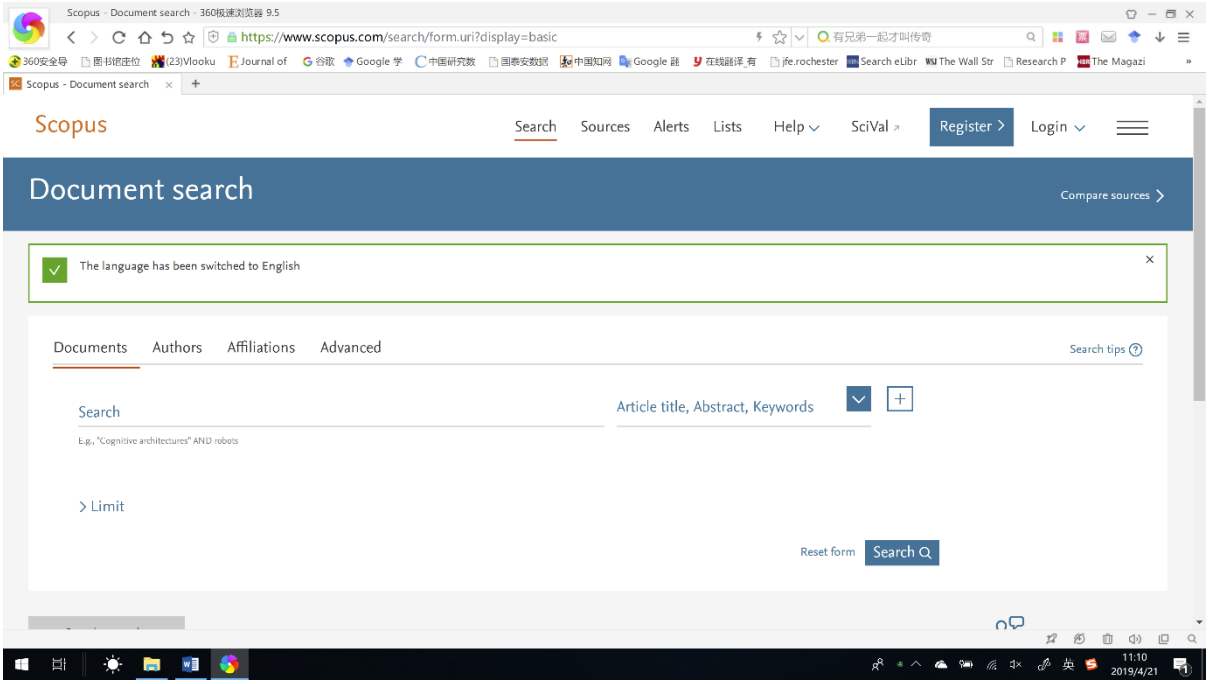
Table 4: Mechanism tests: human capital and signaling.
This table presents the results of the human capital and signaling effects of corporate publications. Also included in each regression, but unreported, are the control variables listed in Table 2. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Ln (1 + Inventor Num)		Analyst Coverage	
	(1)	(2)	(3)	(4)
Papers	0.0233***	0.0079***	0.0793***	0.0314***
	(0.0010)	(0.0010)	(0.0101)	(0.0119)
Patents		0.0014***		0.0197***
		(0.0003)		(0.0037)
Papers × Patents		0.0010***		0.0019***
		(0.0000)		(0.0006)
Constant	-0.4475**	-0.0195	-38.1438***	-36.1351***
	(0.2205)	(0.2070)	(2.2560)	(2.2272)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Observations	11183	11183	11183	11183
Adjusted R^2	0.3245	0.3894	0.3134	0.3269

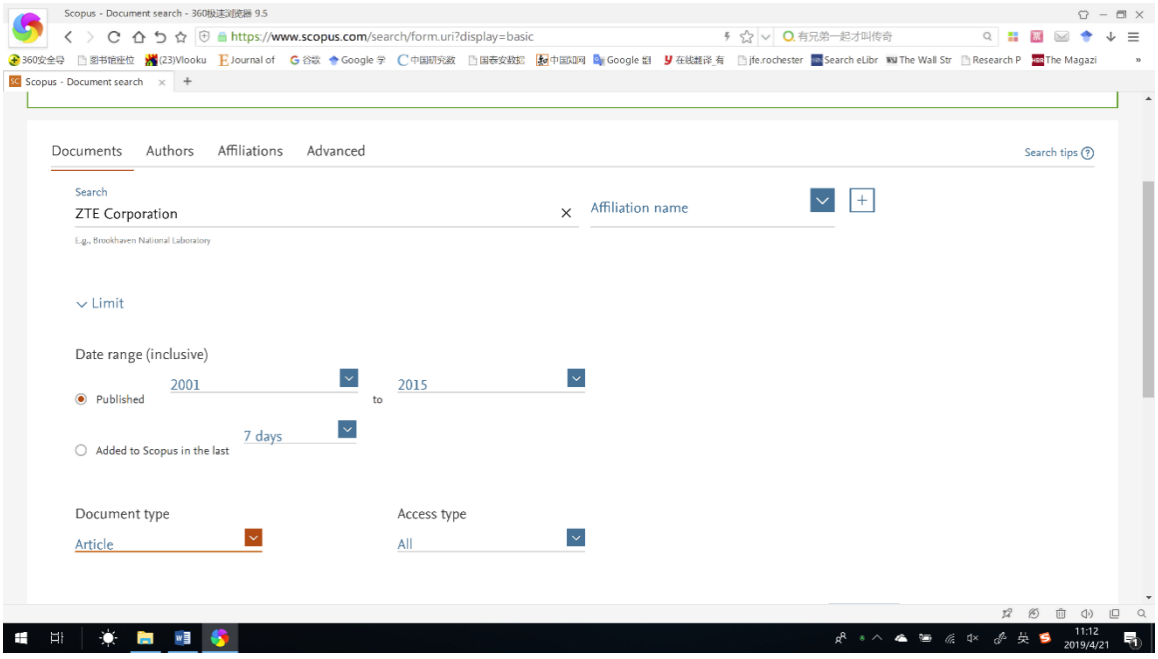
Online Appendix for "Rich on Paper? Chinese Firms' Academic Publications, Patents, and Market Value"

Section 1. Searching procedure of papers in English

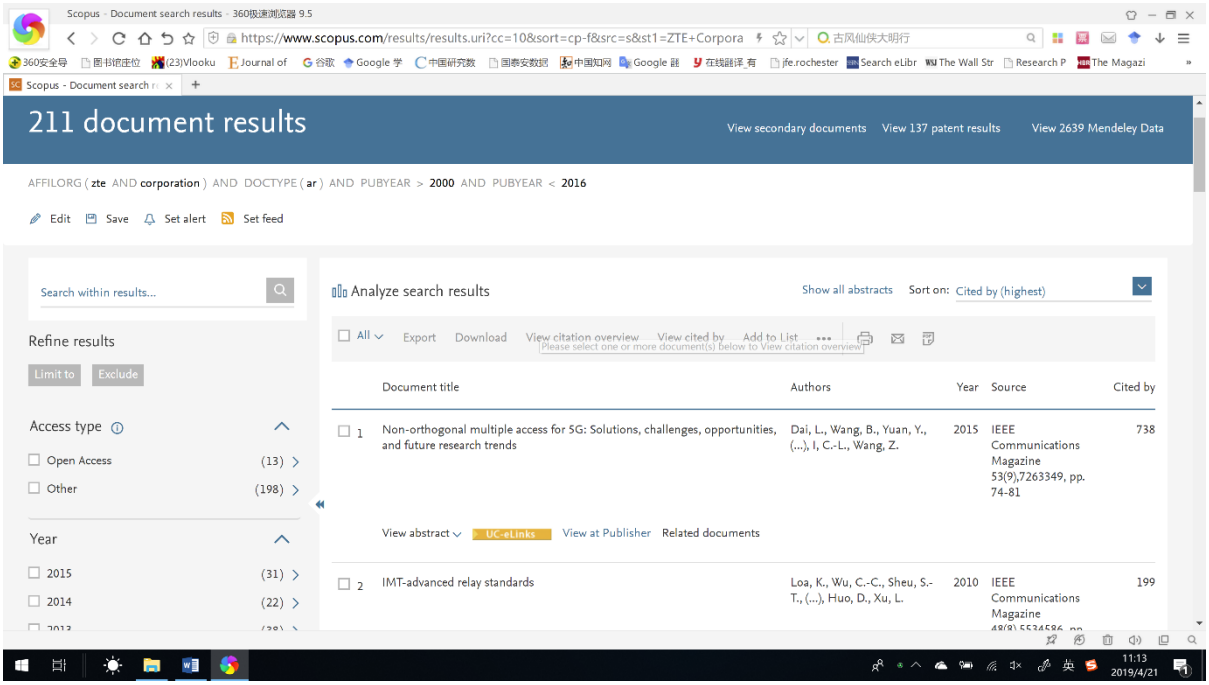
Step one: open the home page of Scopus.



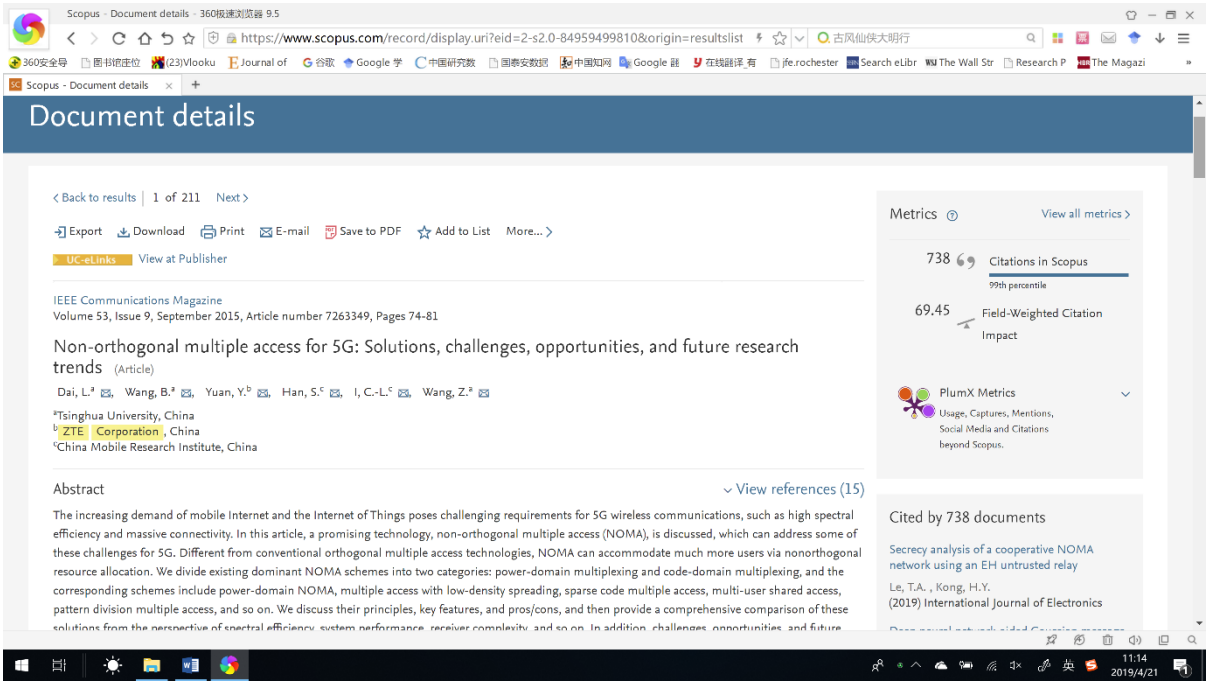
Step two: Setting search conditions.
Affiliation name: e.g. ZTE Corporation (中兴通讯股份有限公司).
Date range: Published 2001 to 2015.
Document type: Article (Journal).
Note: we also searching the articles using the used full name of a firm.



Step three: searching results (211 journal articles in English for ZTE Corporation).



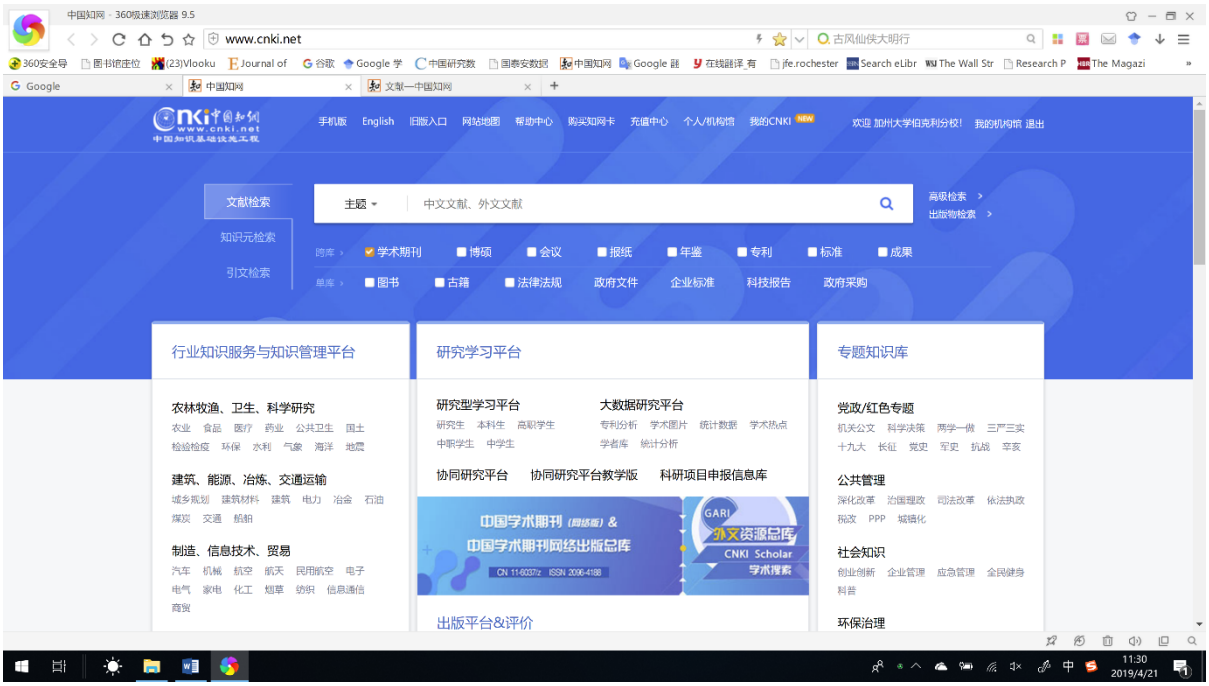
Step four: article details.



Step five: collating and summarizing papers published by a firm.

Section 2. Searching procedure of papers in Chinese

Step one: open the home page of CNKI (中国知网).



Step two: Setting search conditions.
Affiliation name: e.g. 中兴通讯股份有限公司 (ZTE Corporation).
Date range: Published 2001 to 2015.
Document type: Article (Journal).
Note: we also searching the articles using the used full name of a firm.

Step three: searching results (2530 journal articles in Chinese for ZTE Corporation).

Step four: article details.

Step five: collating and summarizing papers published by a firm.

Section 3: Variable definitions

Variables	Definitions
Panel A: dependent variables	
Tobin's q	Firm *i*'s market-to-book ratio during the fiscal year *t*, calculated as market value divided by book value of assets. The market value of equity is calculated by the number of outstanding shares multiplied by the stock price at the end of the fiscal year. The market value of the debts is calculated applying the book value of liabilities (Blundell et al., 1999; Hall and Oriani, 2006; Ceccagnoli, 2009). The firm's book value is represented by its assets at the end of the fiscal year. (China Stock Market & Accounting Research Database, CSMAR)
Market value (¥ millions)	Firm *i*'s market value, which equals the product of the total number of shares issued by a stock and the annual closing price. (China Stock Market & Accounting Research Database, CSMAR)
Panel B: tested variables	
Papers	The number of firm *i*'s academic publications in Chinese and English journals during year *t*. (China National Knowledge Infrastructure, CNKI; Scopus database)
Papers in Chinese	The number of firm *i*'s academic publications in Chinese journals during year *t*. (China National Knowledge Infrastructure, CNKI)
Papers in English	The number of firm *i*'s academic publications in English journals during year *t*. (Scopus database)
Patents	Firm *i*'s total number of patents filed and eventually granted in year *t*. (Chinese Innovation Research Database, CIRD)
Chpatents	Firm *i*'s total number of patents filed and eventually granted only in China in year *t*. (Chinese Innovation Research Database, CIRD)
USpatents	Firm *i*'s total number of patents filed and eventually granted both in China and US in year *t*. (Chinese Innovation Research Database, CIRD)
Panel C: control variables	
R&D (¥ millions)	Firm *i*'s research and development (R&D) expenditure (¥ millions). (Chinese Innovation Research Database, CIRD)
Assets (¥ millions)	The total assets of firm *i* during year *t* (¥ millions). (China Stock Market & Accounting Research Database, CSMAR)
Firm age (years)	Firm *i*'s age, which equals to the difference of fiscal year *t* minus the year when the firm was established. (China Stock Market & Accounting Research Database, CSMAR)
Leverage	Firm *i*'s book value of total debts divided by the book value of total assets during year *t*. (China Stock Market & Accounting Research Database, CSMAR)
Cash/Assets	Firm *i*'s cash-to-assets ratio during year *t*. (China Stock Market & Accounting Research Database, CSMAR)
ROA	Firm *i*'s return on assets, which equals to net income divided by total assets during year *t*. (China Stock Market & Accounting Research Database, CSMAR)
PPE/#employees	Firm *i*'s net property, plant, and equipment (PPE) scaled by the number of employees during year *t* (in 1,000 RMB). (China Stock Market & Accounting Research Database, CSMAR)
Stock volatility	Stock volatility is standard deviation of daily stock returns over a given year. (China Stock Market & Accounting Research Database, CSMAR)
Board size	Number of Board members. (Chinese Research Data Services Platform, CNRDS)
QFII	Firm *i*'s QFII (Qualified Foreign Institutional Investor) holdings during the fiscal year *t*. (Institutional Ownership Research Database, IORD)

SOEs	Dummy variable equals to one if a firm is a state-owned enterprise, otherwise equals to zero. (China Stock Market & Accounting Research Database, CSMAR)
Sales growth	Sales growth is change in sales scaled by lagged sales. (Financial Indicator Database of Listed Companies, CNFI)
Panel D: other related variables	
Hadlock and Pierce's (2010) financial constraints index	Hadlock and Pierce's (2010) index is defined as -0.737×Ln (Assets)+0.043×Ln (Assets)^2-0.04×Firm age. By construction, higher scores of Hadlock and Pierce's (2010) index indicate that firms are more financially constrained. (China Stock Market & Accounting Research Database, CSMAR)
G index	The corporate governance G-index is measured by a principal component analysis using eight individual proxies of corporate governance refer to Gompers, Ishii, and Metrick (2003). The proxies include: (1) whether the CEO is also chairman or vice chairman of the board; (2) the percentage of outside directors; (3) the stock share of the top five executives; (4) the share holdings of the largest shareholder; (5) the concentration ratio of the second to the tenth largest shareholders; (6) dummy variable about whether the firm has a parent company; (7) dummy variables about whether the firm listed in other markets; (8) dummy variable about whether the firm is controlled by the government. (Chinese Research Data Services Platform, CNRDS; Baidu search)
TMT quality	The top management team quality index is measured by a principal component analysis using seven individual proxies of top management quality refer to Chemmanur, Paeglis, and Simonyan (2011). These seven individual proxies include: (1) the number of executive officers and vice presidents on a firm's management team; (2) the percentage of the management team with a MBA degree; (3) the percentage of management team members who are certified accountants; (4) the percentage of management team members who have served as executive officers and/or vice presidents at other firms prior to joining the firm; (5) the percentage of team members who have previously been partners in a law or accounting firm; (6) the ratio of CEO salary and bonus to the average salary and bonus of other team members; (7) the median tenure of the management team, defined as the median number of years that team members have served with a firm; (8) the tenure heterogeneity, defined as the coefficient of variation of the team members' tenures. (Chinese Research Data Services Platform, CNRDS; Baidu search)
Board diversity	The Board diversity index is measured by a combination of six individual proxies of Board members refer to Bernile et al. (2018). The six director characteristics include: (1) the fraction of female directors (pct_female); (2) the mean number of other boards in the China's stock market firms on which current members serve (num_boards); (3) the standard deviation of directors' age (stdev_age); (4) the Herfindahl concentration indexes for director ethnicity (HHI_ethnicity); (5) the Herfindahl concentration indexes for institution where the directors received their Bachelor's degree (HHI_bachelor); (6) the Herfindahl concentration indexes for director financial expertise (HHI_finexpert). We normalize each diversity component by its mean and standard deviation, so that their scale is comparable, and then equally weight each factor to construct the board diversity index: Board diversity = std(pct_female) + std(stdev_age) + std(num_boards) − std(HHI_ethnicity) − std(HHI_bachelor)−std(HHI_finexpert). (Chinese Research Data Services Platform, CNRDS; Baidu search)
University firm	Dummy variable equals to 1 if the firm belongs to the university, otherwise equals to 0. (Baidu search)
CEO duality	Dummy variable equals to one if firm *i*'s CEO and Board Chair are the same one, otherwise equals to zero. (Chairman and CEO Research Database, CCEO)
CEO patents	The number of patents that held by a firm's CEO over the fiscal year. (National Intellectual Property Administration, PRC, CNIPA)

CEO salaries	The salary (10, 000) of a firm's CEO over the fiscal year. (Chairman and CEO Research Database, CCEO)
CEO political connection	Dummy variable equals to 1 if the firm's CEO has political connections, otherwise equals to 0. (Chairman and CEO Research Database, CCEO)
CEO age	The age of a firm's CEO at the end of the fiscal year. (Chairman and CEO Research Database, CCEO)
CEO male	Dummy variable equals to one if the CEO's gender is male, otherwise equals to zero. (Chairman and CEO Research Database, CCEO)
CEO tenure	CEO tenure, defined as the number of months a CEO is in office. (Chairman and CEO Research Database, CCEO)
Founder CEO	Dummy variable equals to 1 if the firm's CEO is the firm's founder, otherwise equals to 0. (Chairman and CEO Research Database, CCEO; Baidu search)
Inventor CEO	Dummy variable equals to 1 if the firm's CEO holding patents, otherwise equals to 0. (National Intellectual Property Administration, PRC, CNIPA; Chairman and CEO Research Database, CCEO; Baidu search)
Academic CEO	Dummy variable equals to 1 if the firm's CEO has worked in the university and other scientific research institutions, otherwise equals to 0. (Chairman and CEO Research Database, CCEO; Baidu search)
CEO GSI	We calculate the general skill index of a firm's CEO (*CEO GSI*) referring to Custódio et al. (2013) and Custódio et al. (2017). The general skill index of CEO captures the generality of a CEO's human capital based on lifetime work experience in publicly traded firms prior to the current CEO position. A CEO who worked in different organizational areas, for multiple firms, in different industries, or in a conglomerate firm or who has served as CEO previously is classified as having more general skills. (Chairman and CEO Research Database, CCEO; Baidu search)
CEO foreign experience	CEO foreign experience is an indicator variable that equals one if the current CEO has been studying or working abroad and zero otherwise (Yuan and Wen 2018). (Chairman and CEO Research Database, CCEO; Baidu search)
Outside CEO	Dummy variable equals to 1 if a firm's current CEO comes from the outside of the firm, otherwise equals to 0 (Zhu and Shen 2016). (Chairman and CEO Research Database, CCEO; Baidu search)
Financial CEO	Dummy variable equals to 1 if a firm's current CEO has past experience in either banking or investment firms, in a finance-related role, or in an auditing firm and zero otherwise (Custódio and Metzger 2014). (Chairman and CEO Research Database, CCEO; Baidu search)
Ln(locgdppp)	Natural logarithm of local GDP per person of the province that a firm located. (Chinese Regional Economy Database, CRED)
LocUniversityNum	The number of local universities of the province that a firm located. (Chinese Regional Economy Database, CRED)
LocLotterypp	The local average lottery sales per person of the province that a firm located. (Website of Ministry of Civil Affairs of the People's Republic of China)
Inventions	Firm *i*'s total number of invention patents filed and eventually granted in year *t*. (Chinese Innovation Research Database, CIRD)
Utilities	Firm *i*'s total number of utility model patents filed and eventually granted in year *t*. (Chinese Innovation Research Database, CIRD)
Citations	The sum of forward citation counts received by patents applied for by firm *i* in a given year *t*, which captures the significance of its patent output. Following Hall et al. (2001) and Gao et al. (2020) to adjust patent citations. In the first step, we calculate the average of forward citations of all patents in the same technology class and filed in the same year, and name this number as a class-year average. In the second step, we calculate the average of forward citations of all patents in the same technology class, and name this number as a class average. The adjustment factor for each class in each filing year will then be a class-year average scaled by the corresponding class average. This adjustment factor thus captures the variation across years but not across classes. In the third step, we

	scale each patent's forward citation count by the corresponding adjustment factor. Since the adjustment factor only captures yearly variation, the adjusted citation count still contains class variation but is purged of yearly variation. In the last step, we sum up the adjusted citation counts of all patents filed by a firm in a year. (Chinese Innovation Research Database, CIRD)
Inventor Num	Firm *i's* number of inventors (holding at least one patents) in year *t*. (Chinese Innovation Research Database, CIRD)
Patents/Inventors	The number of patents divided by the number of inventors of firm *i* in year *t*. (Chinese Innovation Research Database, CIRD)
Citations/Inventors	The number of citations divided by the number of inventors of firm *i* in year *t*. (Chinese Innovation Research Database, CIRD)
Citations/Patents	The number of citations divided by the number of patents of firm *i* in year *t*. (Chinese Innovation Research Database, CIRD)
Analyst Coverage	The number of reports that follow firm *i* in year t. (China Stock Market & Accounting Research Database, CSMAR)
Internet Search	Sum the search values of keywords with stock code, company abbreviation, and company full name. (Web Search Volume Index of Chinese Listed Companies, WSVI)
Analyst Recommendation	The average value of standardized rating of all analysts that follow firm *i* in year t. including a total of 5 levels: buy, overweight, neutral, underweight, sell. The higher the standardized rating value, the stronger of the recommendation of analysts. (China Stock Market & Accounting Research Database, CSMAR)
Institutional Ownership	The percentage of share hold by institutional investors over the fiscal year t. (Chinese Research Data Services Platform, CNRDS)
M&A	Dummy variable equals to one if the firm *i* engaging in mergers and acquisitions during year *t*. (Mergers and Acquisitions Database, CMAD)

Section 4. Mechanisms

In this section, we discuss two mechanisms through which corporate papers published in academic journals may affect firms' market values and/or enhance the effect of patents on firms' market value. All tables in these analyses are provided in the Online Appendix Section 6.

4.1. The human capital mechanism

To examine this human capital mechanism, we regress four measures of human capital (number of inventors; number of patents per inventor; number of forward citations per inventor; number of forward citations per patent) on firms' academic publications and other control variables used in Table 3.[1] The detailed definitions of these variables are provided in the Online Appendix Section 3. As shown in Columns (1), (3), (5), and (7) in Table OA1, *Papers* is positively and mostly significantly associated with these human capital measures, suggesting that firms with academic publications have more inventors and these inventors are more productive and are able to produce more influential patents. These results confirm the merit of encouraging more basic science among research staff. In Columns (2), (4), and (6) of Table OA1, we find that the coefficients on *Papers* × *Patents* are mostly positive, confirming the synergy between basic science and applied technologies in human capital.

4.2. The signaling mechanism

To examine this mechanism, we propose the following four measures of market signaling: the number of stock analyst reports following a firm in a year (*analyst coverage*); the internet search volume of a firm (*internet search)*; average recommendation ratio of stock analysts (*analyst recommendation*); and the ratio of outstanding shares held by institutional investors (*institutional ownership*). We regress these signaling variables on firms' academic publications and other control variables used in Table 3. These variables are defined in the Online Appendix Section 3. The first two measures, *analyst coverage* and *internet search*, reflect the attention from professionals and the general public to a firm. The last two measures, *analyst recommendation* and *institutional ownership*, reflect a positive

[1] Citations of a firm's patents can be received for a long period after a patent is granted, so the patent granted near the end of the sample period have less opportunity to receive forward citations. To address this truncation bias, we follow Hall et al. (2001) and Gao et al. (2020) in adjusting our patent citations. First, we calculate the average forward citations of all patents in the same technology class (International Patent Classification, IPC) and grant in the same year, and regard this number as a class-year average. Second, we calculate the average value of forward citations of all patents in the same technology class (a class average). Our adjustment factor for each class-year will be a class-year average scaled by the corresponding class average. Finally, we scale each patent's forward citation count by the corresponding adjustment factor and sum up the adjusted citation counts of all patents filed by a firm in a year.

feedback to signals from stock analysts and institutional investors who are more sophisticated and understand the value of firms' capability in basic science. The results, reported in all columns in Table OA2, show that corporate academic publications are mostly positively and significantly associated with all the four attention measures. The results suggest that corporate publications indeed deliver strong signals to the market because firms with more journal publications receive more attention from analysts and the public, receive more recommendation from analysts, and attract more institutional investors. On the other hand, we do not find significantly positive coefficients on *Papers* × *Patents* except Column (2), which suggests a weaker synergy in the signaling mechanism.

Section 5: Robustness checks

In this section, we discuss an extensive list of robustness checks to address the quality difference in patents, the quality difference in publications, endogeneity concerns, omitted variables, alternative regressions, and alternative explanations. All tables in these analyses are provided in the Online Appendix Section 6. For the sake of brevity, we only tabulate the coefficients of *Papers*, *Patents*, *Papers in Chinese*, *Papers in English*, and their interaction terms.

5.1. Quality of patents

Since U.S. patents could be more valuable than Chinese patents, we are interested in analyzing how such heterogeneity in patent quality affects our results. In our sample, an average firm files 18.29 Chinese patents (among them, 1.05 are also filed for U.S. patents) per year in our sample period in 2006- 2015. We thus decompose *Patents* into the number of patents that are not filed to the U.S. (*ChPatents*) and the number of patents that are also registered in the U.S. (*USPatents*), filed by each firm in a year, and re-estimate the effect of academic publications on firms' market values. As shown in Table OA3, the coefficients on *USPatents* are larger than those on *ChPatents*, confirming that U.S. patents are more valuable. More importantly, the coefficients on *Papers in English* × *USPatents* are 0.0204 and 0.0292 in Columns (1) and (2), respectively, which are much larger than those on *Papers* × *Patents* in Table 3. These results not only confirm our baseline results, but also highlight the heterogeneous effects of patents on firm values that can be attributed to quality differences.

5.2. Impact factor-adjusted journal counts

We further examine the heterogeneity in quality for papers published in journals based on journal impact factors.[2] We replace *Papers in English* with *Papers in English (IF Adj)*, which are defined as the sum of impact factor-weighted number of papers published in journals in English. Table OA4 reports the results. Column (1) shows the estimation results when we include *USPatents*, *Papers in English (IF Adj)*, and *Papers in English (IF Adj)* × *USPatents* in the model. The coefficients on *Papers in English (IF Adj)* and *Papers in English (IF Adj)* × *USPatents* are 1.0604 and 0.3922, respectively, both significant at the 1% level. The significantly positive coefficient on *Papers in English (IF Adj)* suggests that publishing in more influential global journal leads to higher market valuation. In addition, significantly positive coefficient on *Papers in English (IF Adj)* × *USPatents* confirms a greater synergy between influential publications and high-quality patents. These results

[2] Since the impact factors of journals in English and those in Chinese are different, we discount the latter by a factor of 0.6. Our results remain robust when we consider other discount factors.

remain consistent when we include *Papers in Chinese* and *Papers in Chinese* × *ChPatents* in the model.

5.3. Omitted variables

We acknowledge that our estimation results may be potentially subject to endogeneity issues, such as omitted variables. For example, when a firm has great market prospects or technology opportunities, it may reveal both better innovation performance and higher market value appreciation in the same time. To rule out such a concern, we first include firms' *Tobin's q* in year *t*-1 as a control variable because all omitted variables should be reflected in stock prices faster before they enhance academic publications and papers. The results presented in Table OA5 suggest that even after we control for lagged *Tobin's q*, the positive effects of *Papers*, *Patents* and *Papers* × *Patents* on Tobin's q remain significant (albeit weaker in terms of coefficient magnitudes). In addition, the effect of *Papers in Chinese* becomes insignificant.

To further alleviate the concerns about potential omitted variables, we include several sets of control variables in Tables OA6 and OA7 which include an extensive list of board and top management teams (TMT) characteristics,[3] financial constraints,[4] corporate governance,[5] and local economic conditions.[6] We find that the coefficients of *Papers*,

[3] In particular, we include an indicator variable *University firm* that equals one if a firm is affiliated to a university and zero otherwise in Panel A; an indicator variable *Academic CEO* that equals one if a CEO has academic working experience and zero otherwise (White *et al.* 2014) in Panel B; an indicator variable *Inventor CEO* that equals one if the CEO has been listed as an inventor of a patent and zero otherwise in Panel C (Islam and Zein 2018); *Board diversity*, an index that reflects the diversity of directors in gender, age, ethnicity, educational background, financial expertise, and breadth of board experience dimensions (Bernile *et al.* 2018) in Panel D; *TMT quality*, a variable reflecting top management team quality (Chemmanur *et al.* 2018) in Panel E; *CEO GSI*, the general skill index of CEO captures the generality of a CEO's human capital based on lifetime work experience in publicly traded firms prior to the current CEO position (Custódio *et al.* 2017) in Panel F; an indicator variable *Founder CEO* that equals one if the current CEO is the founder of the firm and zero otherwise (Adams *et al.* 2009; Fahlenbrach 2009) in Panel G; an indicator variable *CEO political connection* that equals one if the current CEO has any political connection and zero otherwise (Faccio 2006; Xu *et al.* 2015) in Panel H; *TMT tech positions*, a variable that reflects the work experience of TMT in technology-related positions, in Panel I; *CEO foreign experience* is an indicator variable that equals one if the current CEO has been studying or working abroad and zero otherwise (Yuan and Wen 2018) in Panel J; *Outside CEO* is an indicator variable that equals one if the current CEO who comes from the outside of the firm and zero otherwise (Zhu and Shen 2016) in Panel K; and *Financial CEO* is an indicator variable that equals one if the current CEO has past experience in either banking or investment firms, in a finance-related role, or in a auditing firm and zero otherwise (Custódio and Metzger 2014) in Panel L; CEO age, gender, and tenure (*CEO age*, *CEO male*, and *CEO tenure*) in Panel M.

[4] Hadlock and Pierce (2010) financial constraints index is defined as -0.737×*Ln (Assets)* + 0.043×*Ln (Assets)*^{2}-0.04× *Firm age*. Higher scores of Hadlock and Pierce (2010) index indicate that firms are more financially constrained.

[5] Corporate governance is also another possible omitted variable as it has been shown to affect both firm value (Bebchuk and Weisbach 2010, Nini et al. 2012) and corporate innovation (O'Connor and Rafferty 2012, Sapra et al. 2014). To ensure our findings are not driven by corporate governance, we

Patents, and *Papers* × *Patents* on Tobin's q remain significantly positive in all panels of both tables. When we decompose *Papers* into *Papers in English* and *Papers in Chinese*, their interactions with *Patents* continue to have positive coefficients. Our consideration of an extensive list of control variables confirms that our main finding cannot be simply attributed to omitted variables.

5.3. Alternative model specifications and variable definitions

We further conduct a number of additional tests to ensure that our main results are robust to alternative model specifications and variable definitions. Our main conclusions remain in the following tests as shown in Table OA8: (a) replacing Tobin's q by a firm's market value in logarithm, *Ln (Market value),* to measure a firm's value in stock market (the coefficients are multiplied by 100); (b) using one-year lagged *Patents*, *Papers in Chinese*, and *Papers in English* to account for the possibility that it may take one year for corporate academic publications to influence market valuation; (c) excluding firm-years without academic publications from our sample because those firms may not need to publish papers at all; (d) using the sample period of 2009-2015 to explore the effects of papers and patents on firm value after the 2008 subprime crisis; (e) excluding firms engaging in mergers and acquisitions in the previous two years to mitigate the concern that firms may acquire papers through takeovers rather than basic research activities within the firm; and (f) excluding firms with their headquarters in the four first-tier cities (Beijing, Shanghai, Guangzhou, Shenzhen) from our sample to mitigate the concern that our results are dominated by innovative firms and innovators are concentrated in the first-tier cities.

5.4. Endogeneity concerns: Instrumental variable regressions

Finally, we further address potential endogeneity issues by proposing instrumental variables and implementing two-stage least squares regressions. In particular, we propose two instrumental variables that are related with *Papers* but unrelated to *Tobin's q*: *Peer Effects* and *Difficulty of Publication*.[7] In addition to those two instrumental variables, we

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add to our baseline model the corporate governance index (G index) using the method of principal component analysis (PCA).

[6] We consider the following local variables including economic development (the natural log of local GDP per person, *Ln(locgdppp)*), the number of local universities (*LocUniversityNum*), and local gambling culture (the average sales of lotteries per person, *Loclotterypp*).

[7] The first one, *Peer Effects,* is defined as the average number of academic publications that published in the same journals by all other firms that share the same province and same industry. The second one, *Difficulty of Publication*, is defined as the average impact factors of journals in which the firm has published in during fiscal year *t*. We argue that these two instrumental variables satisfy the relevance condition and exclusion restriction: on the one hand, firms with more peers publishing in journals are also more likely to publish (due to peer pressure or learning), and firms that publish in better quality journals are subject to greater difficulty. On the other hand, as these two instrumental

also introduce two interaction terms of *Peer Effects* × *Patents* and *Difficulty of Publication* × *Patents* as another two instrumental variables because our baseline model also includes the interaction term between *Papers* and *Patents*.[8] We then introduce these four instrumental variables to the two-stage least square (2SLS) regression and present the results in Table OA9. The first-stage regression results are presented in Column (1) and Column (2), in which we regress *Papers* and *Papers* × *Patents* on these four instrumental variables and all control variables in our baseline regression.[9] Column (3) reports the second-stage results of the 2SLS regressions, in which we regress *Tobin's q* on instrumented *Papers* and *Papers* × *Patents* (i.e., the predicted values of these two variables based on the first-stage regressions). Since these two main explanatory variables are now based on the first-stage regressions, they do not include any omitted variables and their explanatory ability for market value will be free from the omitted variable issue. We find that instrumented *Papers* and *Papers* × *Patents* positively explain *Tobin's q*, supporting a causal interpretation of our main results.

variables are specific to academic publications, they are thus unrelated to a firm's market valuation unless through the instrumented explanatory variables *Papers* and *Papers* × *Patents*.

[8] The use of the interaction between an instrumental variable and another variable as an additional instrumental variable follows Angrist and Pischke (2008), Balli and Sørensen (2013), Popova (2014), and Heimer (2016).

[9] The Sargan test does not reject the null hypothesis and suggests that our instrumental variables are valid.

Section 6: Tables

Table OA1: Mechanism test: human capital.
This table presents the results of the human capital effects of corporate publications. Also included in each regression, but unreported, are the control variables listed in Table 2. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Ln (1 + Inventor Num)		Ln (1 + Patents/Inventors)		Ln (1 + Citations/Inventors)		Ln (1 + Citations/Patents)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Papers	0.0233***	0.0079***	0.0006***	-0.0010***	0.0012***	-0.0005***	0.0038***	0.0051***
	(0.0010)	(0.0010)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0003)	(0.0005)
Patents		0.0014***		0.0005***		0.0005***		-0.0005***
		(0.0003)		(0.0001)		(0.0001)		(0.0001)
Papers × Patents		0.0010***		0.0001***		0.0001***		-0.0001***
		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Constant	-0.4475**	-0.0195	0.3864***	0.4464***	0.2740***	0.3348***	-0.2565**	-0.3650***
	(0.2205)	(0.2070)	(0.0580)	(0.0577)	(0.0667)	(0.0667)	(0.1256)	(0.1273)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	11183	11183	11183	11183	11183	11183	11183	11183
Adjusted R^2	0.3245	0.3894	0.1262	0.1488	0.1190	0.1362	0.1520	0.1638

Table OA2: Mechanism test: market signal.
This table presents the results of the market signal effects of corporate publications. Also included in each regression, but unreported, are the control variables listed in Table 2. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Analyst Coverage		Internet Search		Analyst Recommendation		Institutional Ownership	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Papers	0.0793***	0.0314***	0.0353***	0.0234	0.0006***	0.0009***	0.0457***	0.0545***
	(0.0101)	(0.0119)	(0.0123)	(0.0153)	(0.0002)	(0.0003)	(0.0089)	(0.0113)
Patents		0.0197***		0.0124***		-0.0001***		-0.0040
		(0.0037)		(0.0036)		(0.0000)		(0.0026)
Papers × Patents		0.0019***		-0.0001		-0.0000		-0.0003
		(0.0006)		(0.0006)		(0.0000)		(0.0006)
Constant	-38.1438***	-36.1351***	-26.3008***	-25.4683***	2.5458***	2.5311***	-30.1993***	-30.5858***
	(2.2560)	(2.2272)	(2.2527)	(2.1997)	(0.0681)	(0.0683)	(3.0570)	(3.0608)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	11183	11183	11183	11183	11183	11183	11183	11183
Adjusted R^2	0.3134	0.3269	0.4192	0.4253	0.1759	0.1799	0.2757	0.2790

Table OA3
Corporate publications, Chinese patents, US patents and market value.
This table presents the results of the impact of corporate publications on market value. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Tobin's q		
	(1)	(2)	(3)
Papers_English	0.0117***		0.0075***
	(0.0022)		(0.0016)
USpatents	0.2220***		0.2136***
	(0.0354)		(0.0417)
Papers_Chinese		0.0049***	0.0039***
		(0.0009)	(0.0009)
ChPatents		0.0006***	0.0001
		(0.0002)	(0.0002)
Papers_English × USpatents	0.0204**		0.0292**
	(0.0086)		(0.0119)
Papers_English × ChPatents			0.0004***
			(0.0001)
Papers_Chinese × USpatents			0.0013
			(0.0025)
Papers_Chinese × ChPatents		0.0001***	0.0001***
		(0.0000)	(0.0000)
Ln (R&D)	0.0050	0.0053	-0.0048
	(0.0143)	(0.0145`)	(0.0146)
Ln (Assets)	-0.8296***	-0.8623***	-0.8797***
	(0.0307)	(0.0329)	(0.0333)
Leverage	0.4029***	0.4000***	0.3996***
	(0.0644)	(0.0640)	(0.0641)
Ln (PPE/#employees)	-0.1675***	-0.1691***	-0.1632***
	(0.0312)	(0.0311)	(0.0312)
Sales growth	0.5999***	0.6338***	0.6209***
	(0.0825)	(0.0821)	(0.0820)
Stock volatility	1.4997***	1.5300***	1.5156***
	(0.3210)	(0.3198)	(0.3194)
Ln (Board size)	0.1316	0.0979	0.1115
	(0.1100)	(0.1093)	(0.1095)
SOEs	-0.0715**	-0.1078***	-0.0960***
	(0.0345)	(0.0345)	(0.0345)
QFII	0.2054***	0.1924***	0.1935***
	(0.0343)	(0.0340)	(0.0340)
Constant	7.6457***	7.9556***	8.0223***
	(0.3963)	(0.4084)	(0.4101)
Year fixed effects	YES	YES	YES
Industry fixed effects	YES	YES	YES
Observations	11183	11183	11183
Adjusted R^2	0.3831	0.3844	0.3875

Table OA4

Corporate publications, patents and market value.

This table presents the results of the impact of corporate publications on market value. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Tobin's q	
	(1)	(2)
USpatents	0.2501***	0.2332***
	(0.0312)	(0.0315)
Papers in English (IF Adj)	1.0604***	1.0181***
	(0.1273)	(0.1275)
Papers in English (IF Adj) × USpatents	0.3922***	0.4581***
	(0.1295)	(0.1304)
ChPatents		0.0008***
		(0.0002)
Papers in Chinese (IF Adj)		0.0740**
		(0.0354)
Papers in Chinese (IF Adj) × ChPatents		0.0005
		(0.0008)
Ln (R&D)	-0.0037	-0.0051
	(0.0051)	(0.0051)
Ln (Assets)	-0.8425***	-0.8581***
	(0.0176)	(0.0180)
Leverage	0.0954***	0.0941***
	(0.0119)	(0.0119)
Ln (PPE/#employees)	-0.1379***	-0.1301***
	(0.0191)	(0.0192)
Sales growth	0.6271***	0.6296***
	(0.0547)	(0.0547)
Stock volatility	1.5939***	1.6002***
	(0.1661)	(0.1659)
Ln (Board size)	0.1347	0.1274
	(0.0853)	(0.0852)
SOEs	-0.2205***	-0.2188***
	(0.0371)	(0.0371)
QFII	0.2297***	0.2149***
	(0.0369)	(0.0370)
Constant	7.5808***	7.6692***
	(0.2447)	(0.2451)
Year fixed effects	YES	YES
Industry fixed effects	YES	YES
Observations	11183	11183
Adjusted R^2	0.4122	0.4134

Table OA5
Controlling for lagged Tobin's q
This table presents the results of the impact of corporate publications on market value. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	Tobin's q				
	(1)	(2)	(3)	(4)	(5)
Papers	0.0029***	0.0017***			
	(0.0006)	(0.0006)			
Patents	0.0007***	0.0005***	0.0005***	0.0006***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
Papers × Patents		0.0001***			
		(0.0000)			
Papers in Chinese			0.0011		0.0006
			(0.0007)		(0.0007)
Papers in Chinese × Patents			0.0001***		0.0000***
			(0.0000)		(0.0000)
Papers in English				0.0026***	0.0026***
				(0.0006)	(0.0006)
Papers in English × Patents				0.0003***	0.0002**
				(0.0001)	(0.0001)
Tobin's q (lag one year)	0.6977***	0.6971***	0.6976***	0.6985***	0.6970***
	(0.0231)	(0.0231)	(0.0231)	(0.0231)	(0.0231)
Ln (R&D)	0.0031	0.0010	0.0025	0.0042	0.0019
	(0.0113)	(0.0113)	(0.0113)	(0.0113)	(0.0113)
Ln (Assets)	-0.3851***	-0.3890***	-0.3833***	-0.3773***	-0.3859***
	(0.0274)	(0.0276)	(0.0272)	(0.0265)	(0.0273)
Leverage	0.0680***	0.0678***	0.0682***	0.0689***	0.0684***
	(0.0075)	(0.0076)	(0.0076)	(0.0073)	(0.0074)
Ln (PPE/#employees)	-0.0473*	-0.0461*	-0.0465*	-0.0484*	-0.0488*
	(0.0249)	(0.0248)	(0.0248)	(0.0249)	(0.0249)
Sales growth	0.1438**	0.1451**	0.1437**	0.1370**	0.1438**
	(0.0590)	(0.0589)	(0.0590)	(0.0590)	(0.0590)
Stock volatility	1.9938***	2.0037***	1.9975***	1.9811***	1.9937***
	(0.2197)	(0.2198)	(0.2197)	(0.2199)	(0.2197)
Ln (Board size)	-0.0301	-0.0297	-0.0294	-0.0161	-0.0265
	(0.0822)	(0.0820)	(0.0821)	(0.0829)	(0.0825)
SOEs	-0.0572**	-0.0602**	-0.0545*	-0.0404	-0.0504*
	(0.0280)	(0.0279)	(0.0279)	(0.0275)	(0.0280)
QFII	0.0787***	0.0778***	0.0777***	0.0814***	0.0800***
	(0.0249)	(0.0248)	(0.0248)	(0.0250)	(0.0248)
Constant	2.8896***	2.9008***	2.8716***	2.8350***	2.9067***
	(0.2955)	(0.2951)	(0.2934)	(0.2930)	(0.2954)
Year fixed effects	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES
Observations	9912	9912	9912	9912	9912
Adjusted R^2	0.6527	0.6530	0.6528	0.6526	0.6530

Table OA6

Tests for potential alternative explanations.

This table presents the results of regressions controlling for potential alternative explanations. All regressions include the same control variables as those used in Table 3, but the coefficients on these variables are not tabulated. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively.

Panel A: Controlling for university firms.					
	Tobin's q				
University firm	-0.1866	-0.1751	-0.1892	-0.1377	-0.1645
	(0.1235)	(0.1225)	(0.1227)	(0.1230)	(0.1227)
Papers	0.0069***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0005***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0025***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel B: Controlling for academic CEO.					
	Tobin's q				
Academic CEO	0.3815***	0.3807***	0.3874***	0.3920***	0.3878***
	(0.0723)	(0.0722)	(0.0723)	(0.0725)	(0.0724)
Papers	0.0068***	0.0044***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0032***		0.0023***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0058***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel C: Controlling for inventor CEO.					
	Tobin's q				
Inventor CEO	0.0671**	0.0529*	0.0678**	0.1088***	0.0789**
	(0.0315)	(0.0318)	(0.0315)	(0.0310)	(0.0316)
Papers	0.0066***	0.0044***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0009***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0032***		0.0022***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0060***	0.0055***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel D: Controlling for board diversity.					
	Tobin's q				
Board diversity	0.0480***	0.0477***	0.0477***	0.0451***	0.0463***
	(0.0068)	(0.0068)	(0.0069)	(0.0068)	(0.0069)
Papers	0.0070***	0.0047***			
	(0.0007)	(0.0007)			

Patents	0.0010***	0.0006***	0.0006***	0.0009***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0038***		0.0030***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0054***	0.0048***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel E: Controlling for top management team quality.					
	Tobin's q				
TMT quality	0.0476***	0.0464***	0.0477***	0.0508***	0.0465***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
Papers	0.0062***	0.0040***			
	(0.0007)	(0.0007)			
Patents	0.0010***	0.0006***	0.0006***	0.0009***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0029***		0.0020**
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0051***	0.0048***
				(0.0017)	(0.0017)
Papers in English × Patents				0.0005***	0.0003***
				(0.0001)	(0.0001)
Panel F: Controlling for the general skills of a CEO.					
	Tobin's q				
CEO GSI	0.0373**	0.0335**	0.0329**	0.0359**	0.0314*
	(0.0167)	(0.0167)	(0.0167)	(0.0168)	(0.0167)
Papers	0.0068***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0025***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel G: Controlling for Founder CEO.					
	Tobin's q				
Founder CEO	-0.0341	-0.0351	-0.0354	-0.0364	-0.0324
	(0.0405)	(0.0405)	(0.0405)	(0.0405)	(0.0404)
Papers	0.0068***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0025***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0058***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)

Panel H: Controlling for political connected CEOs.					
	Tobin's q				
CEO political connection	0.1192**	0.1186**	0.1218**	0.1372**	0.1243**
	(0.0533)	(0.0533)	(0.0534)	(0.0534)	(0.0534)
Papers	0.0068***	0.0044***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0004***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0033***		0.0024***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0058***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel I: Controlling for TMT tech positions.					
	Tobin's q				
TMT tech positions	0.0442	0.0417	0.0449	0.0533	0.0479
	(0.0340)	(0.0340)	(0.0340)	(0.0340)	(0.0341)
Papers	0.0068***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0024***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0060***	0.0055***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel J: Controlling for CEO foreign experiences.					
	Tobin's q				
CEO foreign experience	0.1412*	0.1401*	0.1395*	0.1263*	0.1379*
	(0.0765)	(0.0767)	(0.0766)	(0.0766)	(0.0766)
Papers	0.0069***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0035***		0.0025***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel K: Controlling for outside CEO.					
	Tobin's q				
Outside CEO	-0.0482	-0.0470	-0.0464	-0.0497	-0.0456
	(0.0432)	(0.0431)	(0.0432)	(0.0432)	(0.0432)
Papers	0.0068***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0025***
			(0.0008)		(0.0008)

Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel L: Controlling for CEO financial experience.					
	Tobin's q				
CEO finance	0.0328	0.0296	0.0242	0.0107	0.0164
	(0.0863)	(0.0862)	(0.0862)	(0.0862)	(0.0861)
Papers	0.0069***	0.0045***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0034***		0.0025***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel M: Controlling for CEO personal characteristics.					
	Tobin's q				
Ln (CEO age)	0.3852***	0.4036***	0.4089***	0.4146***	0.4033***
	(0.1169)	(0.1169)	(0.1170)	(0.1171)	(0.1169)
CEO male	-0.0679	-0.0755	-0.0666	-0.0787	-0.0738
	(0.0655)	(0.0654)	(0.0654)	(0.0654)	(0.0654)
Ln (CEO tenure)	-0.0251*	-0.0267**	-0.0266**	-0.0254**	-0.0261**
	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
Papers	0.0067***	0.0043***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0007***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0033***		0.0024***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0055***	0.0050***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)

Table OA7
Further control variables
This table presents the results of tests for potential omitted variables. All regressions include the same control variables as those used in Table 3, but the coefficients on these variables are not tabulated. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively.

Variables	Tobin's q				
	(1)	(2)	(3)	(4)	(5)
Panel A: Controlling for financial constraints.					
Hadlock and Pierce's (2010) financial constraints index	0.7679***	0.7646***	0.7734***	0.7885***	0.7528***
	(0.0817)	(0.0816)	(0.0814)	(0.0815)	(0.0819)
Papers	0.0058***	0.0035***			
	(0.0007)	(0.0007)			
Patents	0.0009***	0.0004***	0.0004***	0.0008***	0.0003*
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0025***		0.0018**
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0050***	0.0048***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0005***	0.0002***
				(0.0001)	(0.0001)
Panel B: Controlling for corporate governance measures.					
G index	0.0503***	0.0508***	0.0514***	0.0520***	0.0499***
	(0.0162)	(0.0161)	(0.0161)	(0.0161)	(0.0162)
Papers	0.0067***	0.0044***			
	(0.0007)	(0.0007)			
Patents	0.0011***	0.0007***	0.0006***	0.0010***	0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0033***		0.0024***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0054***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
Panel D: Controlling for local characteristics.					
Ln (locgdppp)	0.2647***	0.2666***	0.2682***	0.2649***	0.2573***
	(0.0684)	(0.0684)	(0.0686)	(0.0688)	(0.0686)
LocUniversityNum	-0.0019***	-0.0019***	-0.0020***	-0.0019***	-0.0019***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Ln (loclotterypp)	-0.0863	-0.0777	-0.0834	-0.0985	-0.0824
	(0.0659)	(0.0659)	(0.0660)	(0.0661)	(0.0659)
Papers	0.0066***	0.0042***			
	(0.0007)	(0.0007)			
Patents	0.0012***	0.0007***	0.0007***	0.0010***	0.0005***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0032***		0.0024***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0050***	0.0046***
				(0.0016)	(0.0016)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)

Table OA8

Robustness checks on alternative model specifications and variable definitions.

This table presents the results of robustness checks on alternative model specifications and variable definitions. All regressions include the same control variables as those used in Table 3, but the coefficients on these variables are not tabulated. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively.

(a) Replacing Tobin's q by Ln (Market value) *Note.* the coefficients are multiplied by 100.

	Ln (Market value)				
Papers	0.2169***	0.1684***			
	(0.0301)	(0.0353)			
Patents	0.0336***	0.0248***	0.0244***	0.0265***	0.0145*
	(0.0068)	(0.0070)	(0.0073)	(0.0076)	(0.0075)
Papers × Patents		0.0040**			
		(0.0016)			
Papers in Chinese			0.1323***		0.0892**
			(0.0414)		(0.0413)
Papers in Chinese × Patents			0.0021**		0.0018**
			(0.0009)		(0.0009)
Papers in English				0.2777***	0.2586***
				(0.0722)	(0.0698)
Papers in English × Patents				0.0205***	0.0137***
				(0.0043)	(0.0044)

(b) Using Papers, Papers Chinese, Papers English for one-year lag.

	Tobin's q				
Papers	0.0060***	0.0042***			
	(0.0007)	(0.0007)			
Patents	0.0009***	0.0006***	0.0006***	0.0008***	0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0001***			
		(0.0000)			
Papers in Chinese			0.0033***		0.0022***
			(0.0008)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0056***	0.0052***
				(0.0013)	(0.0014)
Papers in English × Patents				0.0005***	0.0003***
				(0.0001)	(0.0001)

(c) Excluding firm-years with zero papers.

	Tobin's q				
Papers	0.0052***	0.0036***			
	(0.0006)	(0.0007)			
Patents	0.0008***	0.0004**	0.0003*	0.0006***	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0024***		0.0016**
			(0.0007)		(0.0008)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0048***	0.0045***
				(0.0015)	(0.0015)
Papers in English × Patents				0.0004***	0.0002***
				(0.0001)	(0.0001)

(d) Using sample period of 2009~2015 that after 2008 international financial crisis.

	Tobin's q				
Papers	0.0066***	0.0036***			
	(0.0008)	(0.0009)			
Patents	0.0014***	0.0009***	0.0008***	0.0013***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0028***		0.0021**
			(0.0010)		(0.0010)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)

Papers in English				0.0039**	0.0035**
				(0.0017)	(0.0017)
Papers in English × Patents				0.0006***	0.0003***
				(0.0001)	(0.0001)
(e) Excluding firms engaging in mergers and acquisitions in the previous two years.					
	Tobin's q				
Papers	0.0065***	0.0038***			
	(0.0007)	(0.0008)			
Patents	0.0011***	0.0006***	0.0006***	0.0011***	0.0005***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0029***		0.0020**
			(0.0009)		(0.0009)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0059***	0.0055***
				(0.0017)	(0.0017)
Papers in English × Patents				0.0005***	0.0002**
				(0.0001)	(0.0001)
(f) Excluding firms that located in Beijing, Shanghai, Guangzhou and Shenzhen (the first-tire city in China).					
	Tobin's q				
Papers	0.0053***	0.0030***			
	(0.0008)	(0.0009)			
Patents	0.0012***	0.0008***	0.0008***	0.0013***	0.0008***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Papers × Patents		0.0002***			
		(0.0000)			
Papers in Chinese			0.0020**		0.0015
			(0.0009)		(0.0009)
Papers in Chinese × Patents			0.0001***		0.0001***
			(0.0000)		(0.0000)
Papers in English				0.0167***	0.0167***
				(0.0033)	(0.0033)
Papers in English × Patents				0.0003***	0.0002
				(0.0001)	(0.0001)

Table OA9
Instrumental variable analysis (2SLS).
This table presents the results of the impact of corporate publications on market value. Standard errors in the brackets are corrected for clustering at the firm level. *, ** and ***indicate significance at the 0.10, 0.05 and 0.01 level (two-tailed), respectively. All variables are defined in the Online Appendix Section 3.

Variables	First Stage		Second Stage
	Papers	Papers X Patents	Tobin's q
	(1)	(2)	(3)
Papers	N/A	N/A	0.0040**
			(0.0020)
Papers X Patents	N/A	N/A	0.0001*
			(0.0001)
Peer Effects (IV-1)	0.1465***	1.4482***	N/A
	(0.0161)	(0.3335)	
Peer Effects X Patents (IV-2)	0.0013***	-0.0364***	N/A
	(0.0004)	(0.0081)	
Difficulty of Publication (IV-3)	3.9802***	-6.2267***	N/A
	(0.0807)	(1.6749)	
Difficulty of Publication X Patents (IV-4)	0.0102***	4.7228***	N/A
	(0.0023)	(0.0480)	
Ln (R&D)	-0.0570	0.3974	0.0891***
	(0.0351)	(0.7295)	(0.0069)
Patents	0.0131***	0.1952***	0.0004**
	(0.0020)	(0.0422)	(0.0002)
Ln (Assets)	0.3130	9.8222*	-0.8882***
	(0.2512)	(5.2172)	(0.0780)
Leverage	0.1102	1.9131	0.0052
	(0.1031)	(2.1415)	(0.0691)
Ln (PPE/#employees)	-0.0644	-7.1535	-0.1188**
	(0.2374)	(4.9298)	(0.0557)
Sales growth	-1.4133***	-5.6573	0.2453***
	(0.3683)	(7.6478)	(0.0729)
Stock volatility	-2.5399***	-36.4165**	3.3333***
	(0.7367)	(15.2981)	(0.1488)
Ln (Board size)	1.3337	34.8398	-0.2608
	(1.0366)	(21.5243)	(0.1796)
SOEs	-0.0758	21.2883	-0.7648***
	(0.6992)	(14.5183)	(0.1538)
QFII	0.1022	-10.9691**	0.0087
	(0.2580)	(5.3571)	(0.0375)
Year fixed effects	YES	YES	YES
Industry fixed effects	YES	YES	YES
Observations	9133	9133	9133
Adjusted R^2	0.4451	0.6851	0.1802
F-value (P-value)	1168.05	3016.51	N/A
	(0.0000)	(0.0000)	
Sargan test (P-value)	2.0270	2.0270	N/A
	(0.3629)	(0.3629)	

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