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Corporate Culture and Innovation: A Tale from an Emerging Market

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We examine the influence of corporate culture on innovation using a unique set of data from Chinese listed companies over the period 2008–2017. Using the competing value framework, we quantify corporate culture using textual analysis of financial statements. We find a positive and significant impact of a creation culture on innovation measured by both patent applications and citations, as well as innovation efficiency. We address endogeneity concerns and conduct a battery of robustness tests, including alternative proxies for both corporate innovation and culture, and conclude that variations in culture have a significant impact on firm-level innovation. We also show that a strong creation culture is more likely to spur innovation for firms in more competitive product markets and firms that are subject to higher managerial career concerns. We provide empirical evidence that corporate culture is an important driver in enhancing innovation. Our results have clear implications for directors and shareholders.

Introduction

Innovation has been considered a vital factor for organizations that aim to achieve and sustain a competitive advantage (Baer, 2012; Nelson and Winter, 1982; Porter, 1992). Undoubtedly, companies with better innovative capabilities can enhance their profitability (Atalay, Anafarta and Sarvan, 2013; Tuan *et al*., 2016) and can lead to a country's economic development (Solow, 1957). Therefore, understanding the drivers of a firm's innovative ability is critical from both academic and industry perspectives. However, innovative projects are often risky, unpredictable, lengthy and involve significant resources (Holmstrom, 1989). Therefore, stimulating innovation needs a strong organizational culture that encourages risk-taking and tolerance for failure in the short term, and rewards long-term success (Manso, 2011). Culture is among the primary levers at managers' disposal to maintain organizational viability in the wake of high uncertainty associated with innovation. Several studies intuitively argue that organizational culture is a key to innovation success and corporate performance (see Büschgens, Bausch and Balkin, 2013; Sackmann, 2002 for a review). The evidence on the nexus between culture and innovation is based on small sample surveys calling into question the generalizability and comparability of the observed findings. Large sample studies beyond developed markets (Fiordelisi *et al*., 2019) are scant.

Corporate culture refers to the values and beliefs that provide norms for expected behaviour by employees (Schein, 1992), and organizations actively promote these values and principles (Guiso, Sapienza and Zingales, 2015). Culture is considered a fundamental asset to boost performance[1] and a key value driver by business managers

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[1]https://www2.deloitte.com/content/dam/Deloitte/global/Documents/HumanCapital/gx-dup-global-human-capital-trends-2016.pdf

(Graham *et al*., 2017). Anecdotal evidence from regulatory reviews and business leaders suggests that the culture of an organization is set at the top management levels (CEO and board)[2] and this view is supported by the academic literature (Kotter and Heskett, 1992). Stakeholders, in contrast, play a remarkable role in shaping and influencing corporate culture, particularly in the post-global financial crisis era. This results in an ever-increasing emphasis not only on promoting ethical and professional standards through governance reform, but also on promoting green innovations for sustainable development. Therefore, understanding the drivers of a firm's innovative ability is critical for sustainable developments in an ever-challenging institutional environment.

The competitive conditions in the global business environment demand firms pursue growth through innovation and creativity for long-term sustainability. Such a strategy requires a consistent and continuous reliance on creative behaviour across all levels within the organization (Bednall *et al*., 2018). Creative culture affects innovation as it shapes the patterns of novelty, individual initiatives and risk-taking behaviours (Kaasa and Vadi, 2010). Moreover, it promotes agility, adaptability and creativity. Organizations with a rich creative culture are likely to be more innovative (Anderson, Potočnik and Zhou, 2014).[3]

We test the culture–innovation relationship on a unique dataset of Chinese listed firms. Our firm-level measure of creation culture is based on the competing value framework (CVF) (Cameron *et al*., 2006). We quantify CVF culture dimensions (create, compete, control and collaborate) using textual analysis of financial reports and measure the intensity of creation culture in an organization following Andreou *et al*. (2019). The basic proposition of textual analysis is that the words and language used in official documents reveal the culture of the organization (Levinson, 2003). Our choice of the Chinese market is motivated by two main reasons. First, China is the largest emerging market and second largest economy in the world. A large part of China's rapid economic growth could be attributed to the innovative capability of Chinese firms.[4] China provides an interesting setting to examine the role of organizational culture in fostering innovation outside developed markets. Our findings may have implications for other emerging economies competing for dominance in the global market (Fana, Weib and Xuc, 2011). Second, there are significant institutional and cultural differences between the Chinese and developed markets (Schneider, 1988). Our study provides a first-hand test of the generalizability, comparability and applicability of the CVF in an emerging market with significant differences in corporate governance regime compared to the developed markets.

We find overwhelming evidence that creation culture has a positive effect on firm-level innovation for a large sample of Chinese listed firms. Our results are robust to a number of tests, including alternative measures of innovation output, creation culture and endogeneity. We also find that the effect of culture on innovation is more pronounced for firms that operate in more competitive

[2]For instance, a UK Financial Reporting Council (FRC) report: *Corporate Culture and the Role of Boards* (2016) observes that 'it is the board's role to determine the purpose of the company and ensure that the company's values, strategy and business model are aligned to it'. The report further adds that the top leaders, particularly the Chief Executive, 'must embody the desired culture, embedding this at all levels and in every aspect of the business'. Similarly, the UK Corporate Governance Code, in its preface (supporting principle A.1), states that 'one of the key roles for the board includes establishing the culture, values and ethics of the company'. It is important that the board sets the correct 'tone from the top'. The directors should lead by example and ensure that good standards of behaviour permeate throughout all levels of the organization. 'This will help prevent misconduct, unethical practices and support the delivery of long-term success' (FRC 2016). Greg Medcraft, Chairman of the Australian Securities and Investments Commission (ASIC), states that the role of the board is absolutely critical in setting the culture and tone of the organization and one of the ways in which the board sets this tone is by selecting a CEO whose values are aligned with the company's desired culture. Business leaders have similar views as above regarding the role of boards in shaping the corporate culture. For example, John Watson, Chairman of Bellway, states that 'The board sets the values and culture (how people treat each other, how they operate within the supply chain and how they work with employees) and management is then responsible for implementing this' (FRC 2016).

[3]Graham *et al*. (2016) report that more than 50% of CEOs and CFOs in their survey identified culture as an influential factor for creativity.

[4]China filed 1.2 million patents in 2016 – more than the combined total of the USA, Japan, The Republic of Korea and the European Patent Office. It was ranked among the 20 most innovative economies in the world for the first time in 2018 (https://www.wipo.int/pressroom/en/articles/2018/article_0005.html).

industries and are subject to higher managerial career concerns. Our findings imply a strong cultural effect on innovation.

We make several contributions to the literature. First, we extend recent insights on the role of culture and innovation outside the developed world (Fiordelisi *et al*., 2019). In doing so, we provide the first large-sample evidence of the applicability of the CVF to emerging markets and offer a direct comparison of our results with those reported in the developed countries (Hartnell, Ou and Kinicki, 2011). Our results show the generalization of CVF culture values in countries with different institutional, cultural and corporate governance regimes. Second, we contribute to the innovation and culture literature by showing that the effect of culture on innovation might depend on the industry competitiveness and managerial career concerns across firms (Chemmanur and Tian, 2018; Nguyen, 2018). Third, we add to the recent stream of literature studying the determinants of innovation (Amore and Failla, 2018; Kortum and Lerner, 2001; Mazouz and Zhao, 2019).[5] Finally, we contribute to the recent literature that uses text-based analysis on large datasets to measure corporate culture (Fiordelisi and Ricci, 2014; Jiang *et al*., 2017; Nguyen, Nguyen and Sila, 2019), sentiment (Li, 2008; Loughran and McDonald, 2011, 2014; Tetlock, 2007), banking competition (Bushman, Hendricks and Williams, 2016) and financial constraints (Hoberg and Maksimovic, 2014).

Theory and hypotheses

Conceptualization of corporate culture

There is no universally accepted definition of corporate culture, and culture seems to be denoted by a variety of meanings and connotations in the organizational behaviour, economics and finance literature (Fiordelisi *et al*., 2019). Based on the organizational behaviour literature, O'Reilly and Chatman (1996) define corporate culture as 'a set of norms and values that are widely shared and strongly help throughout the organization'. This view suggests corporate culture as a social control mechanism and is in line with Hofstede (1991), who labels corporate culture as 'the collective programming of the mind' of people in an organization. Culture acts as a coordinating mechanism to enable dealing with unforeseen contingencies and events (Kreps, 1996). Every culture contains unspoken beliefs and norms that impact people's behaviour. Schein (2010) ascribes culture as a set of basic assumptions among people to evaluate situations, human relations and activities, and these assumptions form the shared norms and beliefs among a group of people. This concept of culture is also consistent with Martin's (1992) view of the integration perspective, which is based on homogeneity and harmony holding together a diverse group of people in an organization. The literature in economics and finance has viewed culture as a mechanism of explicit and implicit contracts that governs behaviour and comprises shared values, preferences and beliefs of individuals in an organization (Bénabou and Tirole, 2002; Guiso, Sapienza and Zingales, 2015; Van den Steen, 2010). Culture facilitates the complex interactions within the organization as contracts for each relationship do not exist (Audi, Loughran and McDonald, 2016). Guiso, Sapienza and Zingales (2015) define culture as 'principles and values that should inform the behavior of all the firm's employees'. In sum, culture represents rules based on common values and beliefs which determine the interactions within an organization in order to accomplish certain goals.

The competing value framework

For our definition of culture, we rely on the CVF (Cameron *et al*., 2006), an organizational taxonomy widely used in the literature (Hartnell, Ou and Kinicki, 2011). The CVF identifies four culture types (create, compete, control, collaborate) positioned on four quadrants as in Figure 1. These quadrants also represent two distinct dimensions, flexibility–discretion vs. stability–control (vertical axis) and internal vs. external orientation (horizontal axis). The collaborate and control dimensions share an internal orientation with a focus on integration, collaboration and unity. A collaborate-oriented culture focuses on teamwork, employee

[5]This literature also identifies venture capital (Chemmanur, Loutskina and Tian, 2014; Kortum and Lerner, 2001; Tian and Wang, 2014), buyout structure (Cumming *et al*., 2019), CEO characteristics such as age, gender, experience, education and overconfidence (Hirshleifer, Low and Teoh, 2012), board independence (Balsmeier, Fleming and Manso, 2017), analyst coverage (He and Tian, 2013), stock liquidity (Fang, Tian and Tice, 2014) and anti-takeover provisions (Chemmanur and Tian, 2018) as the important determinants of firm-level innovation ability.

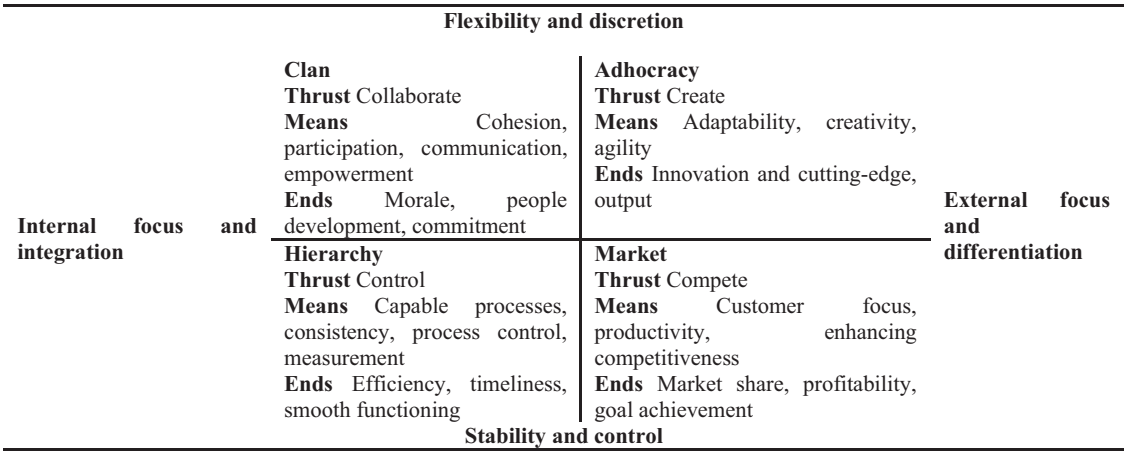

Figure 1. CVF culture dimensions (Cameron et al.*, 2006)*

development and empowerment, supported by a flexible organization structure. A control culture type is characterized by values such as efficiency improvement, predictability and conformity, supported by a stable organizational structure and strong internal controls. The compete and create culture types share an external focus based on differentiation, competition and rivalry. A compete culture is associated with values such as competitiveness, fast response and goal achievement, and an organizational structure based on stability and control. Finally, a create culture focuses on creativity, autonomy and adaptability, and is supported by a flexible organizational structure.

The literature has traditionally relied on survey-based instruments using small samples to test CVF propositions. More recently, Fiordelisi and Ricci (2014) operationalized and quantified the CVF culture types by employing a bag-of-words approach and textual analysis of financial reports (10-K reports). The underlying premise of the textual analysis is that the words used in corporate filings depict the cultural norms of a company. Financial reports are the most important documents which could be used by managers to present major attributes and values of the company to the outside world (Audi, Loughran and McDonald, 2016). The CVF-based culture measure is broadly supported by the growing literature within finance and accounting, which provides evidence that textual analysis can be used to extract important aspects of corporate behaviour, tone and sentiment in publicly available official documents (Hanley and Hoberg, 2010; Hoberg and Phillips, 2010; Li, 2008; Loughran and McDonald, 2011). This, however, raises the question of whether text-based measures reliably capture corporate culture. The relevant literature suggests that textual analysis of financial statements provides valid and robust measures of industry competition (Li, Lundholm and Minnis, 2013), banking competition (Bushman, Hendricks and Williams, 2016) and financial constraints (Hoberg and Maksimovic, 2014), and these measures reliably predict firm financial outcomes. Recent studies also provide evidence on the validity of text-based corporate (Fiordelisi and Ricci, 2014; Nguyen, Nguyen and Sila, 2019) and creative (Fiordelisi *et al.*, 2019) culture measures, firms' market orientation (Andreou, Harris and Philip, 2020) and firms' thrust to compete (Andreou *et al.*, 2019). Overall, the evidence suggests that CVF-based text measures reliably capture firms' corporate culture.

Corporate culture and innovation

Culture is manifested in rituals, group norms, habits of thinking and espoused values (Schein, 1992). These attributes, in turn, help build a strong sense of ownership, teamwork and sense of mission among employees (Fey and Denison, 2003). Organizational cultures influence employee attitudes, behaviours and commitment, leading to organizational effectiveness (Gregory *et al.*, 2009; O'Reilly, Chatman and Caldwell, 1991). Culture, as such, can be a powerful means to elicit desired corporate outcomes (Hogan and Coote, 2014). Thus, a large body of literature suggests a

positive association between culture and performance (Denison and Mishra, 1995; Sackmann, 2002; Zuckerman, 2002). Innovation is one of the key drivers of business performance and value creation. Innovation confers a competitive advantage that helps successful organizations to stay ahead in business. Successful innovation determines a firm's future profitability and competitive edge to a large extent (Ettlie, 1998; Scherer, 1984). Given the importance of innovation for an organization's success and performance, previous literature posits that culture plays an important role in enhancing innovation.

The extant literature has identified a variety of cultural values related to innovation. For instance, innovation-supportive cultures and transformational leadership are likely to enhance innovation (Chandler, Keller and Lyon, 2000; Gumusluoğlu and Ilsev, 2009). Organizations with supportive cultures, participative decision-making and higher tolerance for failure are found to be more productive at innovation (Abbey and Dickson, 1983; Danneels, 2008; Hurley and Hult, 1998). While it is widely accepted that culture fosters innovation, some aspects of culture could stifle innovation (Berson, Oreg and Dvir, 2008; Chatman and Flynn, 2001; Jaskyte, 2004). Sørensen (2002) argues that strong culture firms may find it difficult to engage in exploration learning and adapt to changes in the volatile environment. Dougherty and Heller (1994) suggest that organizational preference for stability may impede product innovation. Similarly, Staw and Nemeth (1989) argue that strong culture may stifle innovation as cohesion among organizational members leads to less deviation.

Büschgens, Bausch and Balkin (2013), however, argue that the use of a multitude of culture values leads to a fragmented concept of culture and innovation. The authors show that CVF comprehensively describes corporate cultures. We use CVF and measure the strength of creation culture relative to other culture dimensions. The creation-oriented (adhocracy) culture in the CVF (Cameron *et al*., 2006) suggests that such a culture would encourage idea-sharing, entrepreneurial thinking and vision-building among employees. This type of culture promotes agility, adaptability and creativity, which are key drivers of innovation. The flexibility orientation of the create dimension encourages acceptance of deviation from norms and allows tolerance for failure and greater risk-taking (Büschgens, Bausch and Balkin, 2013; Danneels, 2008). By allowing freedom of thought and action among employees, companies rich in creative culture aim to develop radical new processes and product technologies, innovate in logistics and redefine entire industries (Fiordelisi and Ricci, 2014; Fiordelisi *et al*., 2019). Our primary hypothesis is therefore

H1: Firms with a stronger creation-oriented culture are more likely to engage in innovation.

Research design

Sample

Our sample includes all Chinese listed companies on both the Shanghai and Shenzhen stock exchanges (SHSE, SZSE) between 2008 and 2017.[6] Data on firm-level innovation and accounting variables are collected from the China Stock Market & Accounting Research (CSMAR) database. We also match innovation variables (patents and citations) in CSMAR with the China National Intellectual Property Administration (CNIPA)[7] to ensure that our innovation variables are consistent and accurate. In case of conflict between CSMAR and CNIPA, we use the patent data from CNIPA. We use annual reports of Chinese listed firms to construct culture-related variables using textual analysis. We exclude financial firms and firms with missing values from our sample, following Yuan and Wen (2018). All variables are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers. Table A.1 (in the online supporting information) provides definitions of all variables. Our final sample contains 17,259 firm-year observations for 2,583 unique firms.

Innovation measures

We construct innovation variables using data from CSMAR and CNIPA, which contain information on patent application date, application identification, grant date and application institution. The Chinese patents are classified into three categories: invention patents, utility model patents and design

[6]We chose 2008 as our starting year since the Chinese government adopted a new accounting standard in 2007 that required disclosure of R&D information.
[7]See http://english.sipo.gov.cn/ for more details.

patents. Invention patents are granted for a new solution to a product or technical process. Utility model patents are for a new technical solution or improvement with a lower degree of inventiveness, relating to certain features of a product such as shape or structural physical features. Design patents are granted for innovations in external features of a product such as shape, pattern and/or colour, which make the product attractive and fit for industrial application. Given the limited technological innovation involved in design patents, we use only invention and utility model patents to construct our innovation measures following relevant literature (Fang, Lerner and Wu, 2017; Jiang and Yuan, 2018; Tan *et al*., 2015). Consistent with the innovation literature, we use application year rather than grant year for our patent counts, because application year corresponds more closely to the actual time of the innovation (Fang, Tian and Tice, 2014; He and Tian, 2013; Jiang and Yuan, 2018).

Our firm-level innovation output is measured in four ways. First, *Inven* is the raw count of invention patents filed and eventually granted to a firm in a given year. Second, *Inven+Utility* is the raw count of invention and utility patents filed and eventually granted to a firm in a given year. Third, *Innovation Efficiency* is a measure of how efficiently a firm transforms its innovation input (R&D expenditure) into innovation output (patents). We follow Cao, Cumming and Zhou (2020) and Hirshleifer, Hsu and Li (2013) to construct innovation efficiency, which is measured as the number of patents of firm i in year t scaled by firm i's cumulative R&D investment in year t−2 through year t.[8] Fourth, *Citations* is the number of forward citations received by a firm's invention patents. While patent counts measure the raw output of a firm's innovative activities, citations capture the technological and economic importance of patents granted to a firm (Hall, Jaffe and Trajtenberg, 2005). We use the natural logarithm of one plus patent counts (*Inven*, *Inven+Utility*) and *Citations* in our analysis to address the skewness concerns in patent-related variables (Fang, Lerner and Wu, 2017; Jiang and Yuan, 2018).

Creation culture measure

A firm's culture is manifested in its symbols, rituals and values, and those 'symbols are words, gestures, pictures or objects that carry a particular meaning within a culture' (Hofstede *et al*., 1990). Thus, words can be used to convey the values and attributes that are part of a firm's culture. Management's disclosures in financial documents can provide insights into the value system of the firm, as the distinctive features of any firm are mirrored in its written documents (Fiordelisi and Ricci, 2014). Textual analysis is a systematic and objective means to examine the specific features of a text and is widely supported by research in sociology (Atkinson, 1990), communication theory (Mumby and Stohl, 1991), cultural anthropology (Clifford and Marcus, 1986) and lately the finance and management literature (Andreou, Harris and Philip, 2020; Antweiler and Frank, 2004; Hanley and Hoberg, 2010; Hoberg and Phillips, 2010; Li, 2008; Loughran and McDonald, 2011; Nguyen, Nguyen and Sila, 2019). Fiordelisi and Ricci (2014) apply textual analysis on 10-K filings in the USA to measure CVF culture dimensions using a two-step procedure. First, they identify words related to each culture dimension in the CVF (Cameron *et al*., 2006). Second, they use the *Harvard IV-4 Psychosocial Dictionary* to identify synonyms for words selected in the first step to create four bags of words for each culture dimension listed in panel A of Table A.2 (in the online supporting information).

We operationalize CVF culture dimensions by applying textual analysis to annual reports of Chinese listed firms following the bag of words developed by Fiordelisi and Ricci (2014). Specifically, we translate authors' bags of words into Chinese using *The Oxford English–Chinese Dictionary* and *The Oxford English Dictionary* following Jiang *et al*. (2017).[9] We further validate our translated keywords for their appropriateness in the Chinese context by using *The Contemporary Chinese Dictionary* and only choose the first explanation of each word in the dictionary to avoid double-counting. To further authenticate our approach, we use external verification of our

[8] Innovation efficiency is measured following Cao, Cumming and Zhou (2020). The equation is as follows: $\text{Innovation Efficiency}_{i,t} = \frac{\text{NumPatent}_{i,t}}{\text{R\&D}_{i,t}+\frac{2}{3}\text{R\&D}_{i,t-1}+\frac{1}{3}\text{R\&D}_{i,t-2}}$.

[9] The Chinese 'bag of words' can be found in panel B of Table A.2 (in the online supporting information).

approach by an expert Chinese linguist.[10] We quantify each CVF culture dimension, using the Chinese bag of words, by counting the occurrences of keywords (synonyms) associated with that culture in each annual report. We obtain four values for each of the culture dimensions for our firm-years. Using raw counts of each CVF culture dimension, we construct our *Creation Culture* variable as follows:[11]

$$\text{Creation Culture} = \frac{\text{Number of keywords describing the creation culture}}{\text{Total number of keywords for all CVF cultures}} \quad (1)$$

We scale the frequency of creation culture words by the total number of words in all culture dimensions to capture the relative emphasis or intensity of the creation culture compared to other cultures. Our measure reflects the relative importance that firms place on their creative values leading to a creation culture. We also use an alternative approach where the creation culture keyword count is scaled by the total number of words in the annual report (*Creation Culture-Alternative*), consistent with prior literature (Fiordelisi and Ricci, 2014; Nguyen, Nguyen and Sila, 2019). The higher ratio indicates a higher emphasis on the creation culture in a firm.[12]

Although our measurement of creation culture follows the extant literature (Andreou *et al*., 2019; Fiordelisi and Ricci, 2014), there might be concerns regarding the applicability of the CVF in the Chinese context. The CVF has been developed and applied in western countries (predominantly the USA) and might not be applicable to Chinese firms due to institutional differences between China and the developed countries (You, Zhang and Zhang, 2017). The relevant literature, however, suggests the validity and applicability of the CVF model across different countries. For instance, van Muijen and Turnipseed (1999) apply the CVF model to construct an international instrument for measuring organizational culture across 12 European countries. Other studies prove the validity of the CVF for Hong Kong (Kwan and Walker, 2004; Lau and Ngo, 2004), South Korea (Dastmalchian, Lee and Ng, 2000), Australia (Lamond, 2003), China and other Asian countries (Deshpandé and Farley, 2004; Lau, David and Zhou, 2002; Ralston *et al*., 2006). More recently, Zhang, Li and Wei (2008) use the CVF to investigate the relationship between corporate culture and performance of Chinese firms, and Yu and Wu (2009) argue that the CVF provides better validity and reliability in the Chinese context. Overall, the CVF is a widely applicable model for corporate culture across different countries and institutional contexts, including China, and the western origin of the CVF is not a weakness of the model (Büschgens, Bausch and Balkin, 2013).

Firm controls

Following the innovation literature, we control for an array of well-known firm-level characteristics that may affect firms' innovation. We include firm size following Hall and Ziedonis (2001), who argue a positive relation between firm size and the number of patents and citations. Firm age is included to control for differences in the stages of development across firms (Amore and Failla, 2018). We also include leverage and return on assets (ROA) to control firms' debt and profitability (He and Tian, 2013; Mazouz and Zhao, 2019). We also include book-to-market ratio to account for growth opportunities (Lev and Sougiannis, 1999) and state ownership (SOE) following Cao, Cumming and Zhou (2020). A detailed definition of these control variables is provided in Table A.1 (in the online supporting information). In robustness tests, we also include a number of board and CEO characteristics as additional controls.

[10]We thank and appreciate Professor Zhiyang Sun, a linguist from Jiangnan University, for his help in authenticating our approach.
[11]Andreou *et al*. (2019) use a similar approach for constructing their *thrust to compete* measure.
[12]The CVF argues that although all culture dimensions are typically present in an organization, one or two typically are dominant.

Empirical model

We use the following model to estimate the relationship between corporate culture and innovation:

$$\text{Innovation}_{i,t} = \beta_0 + \beta_1 \text{Creation Culture}_{i,t} + \sum \beta_l \text{Firm Controls}_{i,t} + \varepsilon_{i,t} \quad (2)$$

where i indexes firms and t indexes time. The *Innovation* variables are the natural logarithm of one plus the number of invention patents filed (and subsequently granted), the natural logarithm of one plus the number of invention and utility patents, innovation efficiency and the natural logarithm of one plus the number of citations per invention patent. Our *Innovation* variables account for both the quantity (patent numbers) and quality (citations) of the innovation. The key explanatory variable is our *Creation Culture*, measured as in Eq. (1). *Firm Controls* include firm size, firm age, leverage ratio, ROA, book-to-market ratio and SOE. Finally, we include industry and province fixed effects to control industry and province-specific time-invariant heterogeneity and year fixed effects to control overall trends in innovation. Robust standard errors are clustered at the firm level.

Results and discussion

Summary statistics

Table 1 presents various summary statistics. Panel A provides means of *Creation Culture* and all *Innovation* variables across industry sectors. Panel B shows the mean value of *Creation Culture* across industries and sample years. Panel C reports descriptive statistics of the variables used in our regressions. Panel A shows that manufacturing and high-tech industries have a more creative culture compared to other industries. Consistent with our prediction, these industries also rank higher in terms of innovation outputs. Although there is a substantial variation in creation culture across industries, the variation across sample years is small (Panel B). This is consistent with the general notion that culture is persistent over time and changes slowly (Fiordelisi *et al*., 2019). Panel C shows that our sample firms apply, on average, 8.03 invention patents each year, which subsequently receive 5.57 citations.

In Table 2, we present correlations between variables. All our innovation-related variables are significantly positively correlated with *Creation Culture*. This indicates that a higher creative culture increases the innovation output, consistent with our expectations.

Multivariate results

Table 3 presents estimation results of our baseline regression in Eq. (2) with all four proxies of innovation in columns (1)–(4), respectively. *Creation Culture* is positively and significantly associated with all innovation proxies across all the models. These results suggest that firms with a stronger creation culture generate more patents, which subsequently receive higher citations and are more efficient in terms of innovation activity. In terms of economic significance, a one standard deviation increase in creation culture increases invention patents (invention plus utility) by 6.44% (11.15%) and improves citations by 4.67%. Given that our creation culture measure is based on individual word counts, the observed effect is economically significant.[13]

The results for control variables are also consistent with prior literature. *Firm Size* is positive and statistically significant in models 1, 2 and 4, suggesting that larger firms produce more patents and are associated with higher patent citations, consistent with Mazouz and Zhao (2019). However, the coefficient of *Firm Size* becomes negative when we use *Innovation Efficiency* (Model 3) as the dependent variable. This indicates that larger firms' innovation efficiencies decrease, even if they are producing more innovation (Janz, Lööf and Peters, 2003) due to economies of scale consistent with Cao *et al*. (2016). *Firm Age* is negatively related to innovation in all models, showing that younger firms generate more patents than mature firms (Coad, Segarra and Teruel, 2013). Both *Leverage* and *ROA* indicate a positive and statistically significant relationship with innovation, while *Book to Market* negatively affects innovation. These results are largely consistent with previous studies

[13]We also re-estimate Eq. (2) using one-period-ahead innovation measures ($\text{Innovation}_{i,t+1}$) and our results are consistent with those reported in Table 3. Results are not reported but are available upon request.

Table 1. Summary statistics

Panel A. Creation culture and innovation across industry sectors

	Creation Culture	*Inven*	*Inven+Utility*	*Innovative Efficiency*	*Citations*
Manufacturing	0.195	8.705	19.756	0.084	5.567
Public Utility	0.147	2.074	5.115	0.014	0.917
Mining	0.149	7.403	17.744	0.023	8.401
Business	0.159	0.886	1.983	0.012	0.218
High-Tech	0.259	7.801	12.901	0.066	5.809

Panel B. Average yearly creation culture across industry sectors

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Manufacturing	0.177	0.179	0.192	0.195	0.197	0.199	0.201	0.205	0.205	0.204
Public Utility	0.138	0.141	0.143	0.141	0.146	0.148	0.153	0.153	0.154	0.153
Mining	0.148	0.148	0.148	0.148	0.149	0.149	0.149	0.150	0.149	0.148
Business	0.157	0.157	0.159	0.158	0.159	0.158	0.161	0.159	0.162	0.162
High-Tech	0.234	0.232	0.254	0.256	0.263	0.266	0.257	0.260	0.288	0.281
Average	0.171	0.171	0.179	0.180	0.183	0.184	0.184	0.186	0.192	0.190

Panel C. Sample summary statistics

Variable	Observations	Mean	Median	Min	Max	Std dev.
Dependent variables						
Invention Patent	17,295	8.033	2.000	0.000	110.000	14.227
Invention and Utility Patent	17,295	16.635	5.000	0.000	234.000	30.600
Innovation Efficiency	17,295	0.063	0.010	0.000	0.705	0.110
Citation	17,295	5.574	1.000	0.000	139.000	13.260
Independent variables						
Creation Culture	17,295	0.224	0.233	0.000	0.583	0.074
Creation Culture (Alternative)	17,295	0.006	0.005	0.001	0.019	0.002
Firm controls						
Firm Size	17,295	8.146	7.947	4.872	14.693	1.291
Firm Age	17,295	2.806	2.833	0.693	4.094	0.316
Leverage	17,295	0.402	0.394	0.007	1.256	0.204
ROA	17,295	0.054	0.047	−1.324	0.598	0.060
Book to Market	17,295	0.808	0.541	0.032	11.005	0.875
SOE	17,295	0.443	0.358	0.276	0.724	0.156

This table presents various summary statistics. Panel A reports the overall *Creation Culture* and *Innovation* proxies in five different industries. Panel B presents average creation culture across industries and years. Panel C presents the summary statistics for the full sample, which comprises 17,295 firm-year observations with 2,583 unique firms between 2008 and 2017. All variables are defined in Table A.1.

(David and O'Brien, 2006). Overall, the above results strongly support our hypothesis that creation culture is positively associated with firms' innovation output.[14]

Robustness tests

In this section, we check the robustness of our key conclusion that a creation culture enhances innovation by conducting additional tests.

Additional controls

Although we control for a comprehensive set of firm characteristics that may affect firm-level innovation, the literature suggests that board and CEO characteristics are also important determinants of innovation (Balsmeier, Fleming and Manso, 2017; Bertrand and Schoar, 2003; Huang and Kisgen,

[14]In order to further strengthen our results, we use simultaneous quantile regressions as robustness test to check whether the relationship between corporate culture and innovation is persistent. Specifically, we bootstrap the regression 500 times at 50%, 75% and 90% quantile points. The unreported results are consistent with our baseline regression results and support our hypothesis. Unreported results are available from the authors upon request.

Table 2. Correlations matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ln(Inven+1)	(1)	1										
Ln(Inven+Utility+1)	(2)	0.899*	1									
Innovation Efficiency	(3)	0.577*	0.523*	1								
Ln(Citations+1)	(4)	0.594*	0.513*	0.348*	1							
Creation Culture	(5)	0.313*	0.349*	0.226*	0.055*	1						
Firm Size	(6)	0.091*	0.060*	−0.104*	0.097*	−0.056*	1					
Firm Age	(7)	0.016*	0.0042	−0.016*	−0.076*	0.075*	0.168*	1				
Leverage	(8)	−0.033*	−0.044*	−0.115*	0.009	−0.178*	0.543*	0.163*	1			
ROA	(9)	0.052*	0.044*	0.045*	0.074*	0.021*	−0.115*	−0.145*	−0.373*	1		
Book to Market	(10)	−0.051*	−0.061*	−0.117*	0.006	−0.159*	0.606*	0.095*	0.582*	−0.295*	1	
SOE	(11)	0.152*	0.164*	0.103*	−0.059*	0.346*	−0.100*	−0.008	−0.075*	0.045*	−0.140*	1

This table reports the correlation matrix for the variables used in our base regression model. The full sample comprises 17,295 firm-year observations with 2,583 unique firms between 2008 and 2017. All variables are defined in Table A.1.
*Represents significance at the 5% level.

2013; Islam and Zein, 2020; Simsek, 2007). We control for CEO characteristics, including gender, age, education, tenure and whether a CEO is politically connected. In addition, we also control for board size, board independence and whether the CEO is also chairman of the board.[15] The results presented in Table 4 show that the coefficient for creation culture is positive and statistically significant across all innovation variables, and therefore our baseline results are robust to these additional controls.[16]

Endogeneity

Although the results of our baseline models suggest that creation culture has a positive effect on firm innovation, the endogeneity issues between culture and innovation cannot be ignored, since the association between corporate culture and innovation may reflect causalities other than those hypothesized by us (Hartnell, Ou and Kinicki, 2011). Therefore, our results might be subject to two types of endogeneity concerns: omitted variables and reverse causality. The omitted variables may bias our coefficient estimates if the unobservable firm characteristics are correlated with both creation culture and innovation output. Further, our observed relation between creation culture and innovation may be spurious if the unobservable firm characteristics affect culture and innovation jointly. The reverse causality is another endogeneity concern which could result in biased and inconsistent ordinary least squares (OLS) regression estimates. We observe that a more creative culture leads to higher innovation output and efficiency, but some of this observed relation could be attributed to the possibility that the level of expected innovation predicts a firm's creative culture. Although it is difficult to alleviate endogeneity concerns completely, we use a set of robustness tests to mitigate the potential bias.

The omitted variable problem could arise from both time-varying and time-invariant unobservables. Our earlier test – including a comprehensive set of additional controls for CEO and board characteristics – to a large extent mitigates the effect of time-varying omitted

[15] *Gender* is a dummy equal to one if the CEO is female, and zero otherwise. *Age* is the natural logarithm of CEO actual age. *Education* dummy equals one when the CEO has a Master's degree or above, and zero otherwise. *Tenure* is the CEO's contract period in natural logarithm. *Political Connection* is a dummy equal to one if the CEO is connected to the central government, and zero otherwise. *Board Size* is measured as the total number of board members. *Board Independence* is measured as the percentage of independent directors on the board. *Duality* is a dummy equal to one if the CEO is also the chairman of the board, and zero otherwise.

[16] In addition, to alleviate concerns that other CVF culture dimensions (compete, control, collaborate) may impact innovation or weaken the effect of creation culture, we control for these culture dimensions in our baseline regression model. We find a consistent and statistically significant impact of creation culture on innovation even after controlling for the other CVF culture dimensions. Results are not reported but available from the authors upon request. Overall, the presence of competing CVF culture dimensions does not attenuate the observed relation between creation culture and innovation.

Table 3. Creation culture and innovation

Dependent variable	(1) *Ln(Inven+1)*	(2) *Ln(Inven+ Utility+1)*	(3) *Innovation Efficiency*	(4) *Ln(Citations+1)*
Creation Culture	0.843***	1.428***	0.100***	0.617***
	(5.188)	(7.362)	(6.330)	(3.730)
Firm Size	0.217***	0.211***	−0.006***	0.225***
	(19.754)	(16.037)	(−6.601)	(20.868)
Firm Age	−0.092***	−0.172***	−0.010***	−0.110***
	(−3.030)	(−4.790)	(−3.608)	(−3.595)
Leverage	0.159***	0.249***	−0.001	0.127**
	(2.751)	(3.623)	(−0.089)	(2.221)
ROA	0.794***	0.775***	0.031**	1.009***
	(5.099)	(4.324)	(2.156)	(6.223)
Book to Market	−0.113***	−0.115***	−0.001	−0.091***
	(−7.326)	(−6.282)	(−0.923)	(−5.855)
SOE	−0.099	−0.166	−0.009	−0.222***
	(−1.083)	(−1.593)	(−1.078)	(−3.351)
Constant	−1.947***	−1.796***	0.020	−1.497***
	(−14.534)	(−11.350)	(1.628)	(−11.372)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES
N	17,295	17,295	17,295	17,295
Adj-R^2	0.268	0.315	0.114	0.140

This table presents the baseline OLS estimation results. The dependent variables are: *Ln(Inven+1)*, as the natural logarithm of the number of invention patent applications plus one in column (1); *Ln(Inven+Utility+1)*, as the natural logarithm of the number of invention and utility patent applications plus one in column (2); *Innovation Efficiency*, as the number of invention patents scaled by firm's cumulative R&D investment from year t−2 to year t in column (3); and *Ln(Citations+1)*, as the natural logarithm of the number of invention patent citations plus one in column (4). The full sample comprises 17,295 firm-year observations with 2,583 unique firms between 2008 and 2017. All variables are defined in Table A.1. All models include year, industry and province fixed effects. Robust standard errors are clustered at the firm level. t-Values are in parentheses.
*, ** and *** represent significance levels at 10%, 5% and 1%, respectively.

variables, which might be correlated with both creation culture and innovation. To mitigate omitted variable concerns caused by time-invariant firm characteristics, we substitute year, industry and province fixed effects in our main regression (Table 3) with *Industry* × *Province* and *Province* × *Year* fixed effects following Cumming *et al*. (2019) and Fiordelisi *et al*. (2019). These fixed effects control for specific industries located in specific provinces and province-level policies, which might simultaneously affect creation culture and innovation variables over time. We further augment this analysis following Fiordelisi *et al*. (2019) and Oster (2019) to examine the potential bias induced by omitted variables and add two estimators (δ and β^{omitted}) in our regressions. The estimator δ captures the importance of omitted variables in relation to control variables and β^{omitted} represents the effect of creation culture on innovation under the assumption that omitted variables and control variables are equally important.[17] Table A.3 (in the online supporting information) reports the results, including *Industry* × *Province* and *Province* × *Year* fixed effects and the adjustment for the effect of unobservables on our creation culture variable. Overall, the results are consistent with our baseline findings and robust to addition of the above fixed effects and adjustment for the potential omitted variables. The estimator δ shows large values which are greater than the 1 cutoff suggested by Oster (2019) across all models. Moreover, the values of β^{omitted} are very close to the coefficients of *Creation Culture* in all models, suggesting that the potential omitted variables cause a very small effect on our main regression coefficients.[18]

[17]Assuming $\delta = 1$.
[18]We also use *Year* × *Industry* and *Industry* × *Province* fixed effects and the unreported results are consistent.

Table 4. Creation culture and innovation with additional controls

Dependent variable	(1) *Ln(Inven+1)*	(2) *Ln(Inven+Utility+1)*	(3) *Innovation Efficiency*	(4(*Ln(Citations+1)*
Creation Culture	0.834***	1.409***	0.097***	0.616***
	(5.144)	(7.282)	(6.162)	(3.733)
Firm Size	0.218***	0.217***	−0.005***	0.223***
	(19.437)	(16.171)	(−5.760)	(20.461)
Firm Age	−0.066**	−0.130***	−0.008***	−0.090***
	(−2.174)	(−3.589)	(−2.856)	(−2.898)
Leverage	0.185***	0.286***	0.001	0.152***
	(3.201)	(4.170)	(0.234)	(2.650)
ROA	0.767***	0.727***	0.026*	0.992***
	(4.925)	(4.062)	(1.791)	(6.124)
Book to Market	−0.113***	−0.117***	−0.001	−0.091***
	(−7.267)	(−6.387)	(−1.088)	(−5.783)
SOE	−0.159*	−0.245**	−0.016*	−0.277***
	(−1.725)	(−2.333)	(−1.751)	(−4.129)
CEO Gender	−0.165***	−0.183***	0.000	−0.119***
	(−5.044)	(−4.632)	(0.091)	(−3.781)
CEO Age	−0.048*	−0.041	−0.003	−0.029
	(−1.913)	(−1.446)	(−1.393)	(−1.340)
CEO Education	0.148***	0.232***	0.008***	0.127***
	(6.542)	(8.444)	(3.599)	(5.996)
CEO Tenure	0.019**	0.009	0.001	0.023***
	(2.305)	(0.866)	(1.025)	(2.814)
CEO Political	0.046	−0.092	−0.006	0.135**
	(0.868)	(−1.475)	(−1.345)	(2.406)
Board Size	0.022	0.016	−0.001	0.000
	(0.838)	(0.544)	(−0.219)	(0.005)
Independent Director	−0.048	−0.045	−0.003	0.100
	(−0.586)	(−0.496)	(−0.319)	(1.577)
Duality	0.066***	0.091***	0.011***	0.020
	(3.235)	(3.820)	(5.264)	(1.009)
Constant	−1.989***	−1.946***	0.019	−1.573***
	(−11.772)	(−9.847)	(1.248)	(−10.089)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES
N	17,295	17,295	17,295	17,295
Adj-R^2	0.272	0.319	0.116	0.142

This table presents the OLS estimation results including additional control variables. The dependent variables are: *Ln(Inven+1)*, as the natural logarithm of the number of invention patent applications plus one in column (1); *Ln(Inven+Utility+1)*, as the natural logarithm of the number of invention and utility patent applications plus one in column (2); *Innovation Efficiency*, as the number of invention patents scaled by firm's cumulative R&D investment from year t−2 to year t in column (3); and *Ln(Citations+1)*, as the natural logarithm of the number of invention patent citations plus one in column (4). The full sample comprises 17,295 firm-level observations with 2,583 unique firms between 2008 and 2017. All variables are defined in Table A.1. All models include year, industry and province fixed effects. Robust standard errors are clustered at the firm level. t-Values are in parentheses.
*, ** and *** represent significance levels at 10%, 5% and 1%, respectively.

In order to address reverse causality, we employ instrumental variable analysis using a two-stage least-squares (2SLS) approach. It is important, however, to note that finding suitable instruments for culture – and specifically corporate culture – is practically very difficult (Nash and Patel, 2019). Nonetheless, we rely on the extant literature to formulate our instrument for the creation culture (Cumming *et al*., 2019; Mazouz and Zhao, 2019). Following this literature, we use the industry-year

Moreover, our unreported results remain qualitatively the same after including firm fixed effects, as well as including lagged values (2 and 3) of the creation culture.

average of the creation culture as our main instrumental variable in 2SLS regressions.[19] We believe that our instrument is valid because the industry culture may strongly influence the culture of any given firm in the industry. Firms operating in an industry with a creative culture are more likely to regard the industry culture as a useful economic attribute and try to build a creative culture. In contrast, it is unlikely that these industry-level instrumental variables directly predict firm-level innovation that cannot be explained by the firm-level culture. Furthermore, an industry-level variable is less likely to be affected by an individual firm's policy, and satisfies both exclusion and relevance conditions. Our approach is consistent with Jiang *et al*. (2017) and Li *et al*. (2019), who use the industry average for instrumenting disclosure tone and integrity culture. Table 5 reports results for the instrumental variable regressions. First-stage results are presented in column (1), with *Creation Culture* as dependent variable. Consistent with our expectation, the industry average is positively and significantly (1% level) associated with creation culture, suggesting the validity of the instrumental variable. The Kleibergen–Paap rk Wald F statistic in our 2SLS regression is sufficiently higher than the critical value (16.38) for the weak instrument test on 2SLS size (Stock and Yogo, 2005), suggesting that our instrumental variable is not weak. Columns (2)–(5) (Table 5) present results of the second stage using predicted creation culture and all four innovation proxies as the dependent variable. The coefficients of *Creation Culture* are positive and significant for all innovation variables except innovation efficiency. Our results from the instrumental variable analysis are generally consistent with our main results in Table 3.

Alternative measures of creation culture

It is possible that our findings are sensitive to how we measure creation culture. We employ three approaches to minimize the potential measurement issues with our creation culture measure. First, we scale creation words by the total number of words in firms' annual reports, following Fiordelisi and Ricci (2014). Different to our main measure, this measure shows the relative importance of creation words in the whole annual report. The relevant results presented in Table A.4 (in the online supporting information) show that our key findings persist.

Second, it might be argued that not all words in our creation bag equally characterize a creation culture.[20] In order to mitigate the noise and measurement problems in our *Creation Culture* variable, we use a reduced bag of words consisting of the most relevant words. We reconstruct our *Creation Culture* variable using only words such as idea*, innovate*, learn*, new*, start* and vision*. The relevant results reported in Table A.5 (in the online supporting information) show a consistent and significant effect of creation culture across all measures of innovation.

Finally, we use a more robust CVF bag of words measure for cultural dimensions following Andreou *et al*. (2020). The authors develop this new bag of words based on the keywords used within the Organizational Culture Assessment Instrument (OCAI), a survey developed by Cameron and Quinn (2011) to measure firms' culture through the responses of firms' employees.[21] The OCAI-based bag of words captures diverse dimensions considered important by the firms in measuring their internal culture. Andreou *et al*. (2020) demonstrate that the OCAI-based approach provides a relatively better and more robust measure of corporate culture using content, external, dimensionality and predictive validity tests. We reconstruct CVF culture dimensions using the OCAI-based bag of words and recalculate our creation culture measure using Eq. (1). The results of our baseline regressions using the OCAI-based creation culture are presented in Table A.6 (in the online supporting information) and show our key findings to be unchanged.[22]

[19]We also use the industry median as an instrument for creation culture in our 2SLS regression and find that the results remain unchanged. Moreover, use of province average as an instrument yields qualitatively similar results. The unreported results are available from the authors upon request.

[20]Word stems such as dream*, envis*, freedom*, risk*, thought*, etc. might not be considered relevant to a creative culture.

[21]Cameron and Quinn (2011) base OCAI along six dimensions: dominant characteristics, organizational leadership, management of employees, organization glue, strategic emphases and criteria of success.

[22]We also test the robustness of our results using an OCAI-based measure in two ways: (1) using other culture dimensions as controls in the baseline regression model and (2) scaling the OCAI creation bag of words by the

Table 5. Instrumental variable regressions

	First stage	Second stage			
Model	(1)	(2)	(3)	(4)	(5)
Dependent variable	*Creation Culture*	*Ln(Inven+1)*	*Ln(Inven+ Utility+1)*	*Innovation Efficiency*	*Ln(Citations+1)*
Industry Average	0.999***				
	(34.923)				
Creation Culture		0.764**	1.247***	0.030	0.666***
		(2.337)	(3.054)	(0.900)	(3.250)
Firm Size	−0.001**	0.217***	0.211***	−0.006***	0.225***
	(−2.127)	(19.774)	(16.042)	(−6.683)	(20.908)
Firm Age	−0.018***	−0.093***	−0.176***	−0.011***	−0.109***
	(−14.428)	(−3.042)	(−4.809)	(−4.013)	(−3.562)
Leverage	−0.029***	0.157***	0.244***	−0.002	0.129**
	(−11.705)	(2.690)	(3.508)	(−0.417)	(2.242)
ROA	−0.008	0.793***	0.774***	0.031**	1.009***
	(−1.167)	(5.102)	(4.323)	(2.123)	(6.238)
Book to Market	0.000	−0.113***	−0.115***	−0.001	−0.091***
	(0.743)	(−7.336)	(−6.285)	(−0.899)	(−5.869)
SOE	−0.004	−0.100	−0.170	−0.011	−0.221***
	(−1.613)	(−1.102)	(−1.630)	(−1.240)	(−3.331)
Constant	0.072***	−1.930***	−1.757***	0.035***	−1.507***
	(11.057)	(−13.163)	(−10.025)	(2.598)	(−11.070)
					YES
Year Effect	YES	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES	YES
N	17,295	17,295	17,295	17,295	17,295
Adj-R^2	0.633	0.268	0.315	0.113	0.140
Kleibergen–Paap rk Wald F statistic	1208.936***				
Critical value − 10% maximal IV size	16.38				

This table presents the 2SLS estimation results where the instrument variable is *Industry Average*, defined as the industry average of the creation-oriented culture. Column (1) presents first-stage regression results using *Creation Culture* as dependent variable. The dependent variables for second-stage regressions are: *Ln(Inven+1)*, as the natural logarithm of the number of invention patent applications plus one in column (2); *Ln(Inven+Utility+1)*, as the natural logarithm of the number of invention and utility patent applications plus one in column (3); *Innovation Efficiency*, as the number of invention patents scaled by firm's cumulative R&D investment from year t−2 to year t in column (4); and *Ln(Citations+1)*, as the natural logarithm of the number of invention patent citations plus one in column (5). The full sample comprises 17,295 firm-year observations with 2,583 unique firms between 2008 and 2017. The Kleibergen–Paap rk Wald F statistic is used in our regression. All variables are defined in Table A.1. All models include year, industry and province fixed effects. Robust standard errors are clustered at the firm level. t-Values are in parentheses.

*, ** and *** represent significance levels at 10%, 5% and 1%, respectively.

Overall, the results from tests using alternative measures of culture show that our key findings are not sensitive to the measurement of creation culture.

Alternative estimation method

Since our patent and citation variables are count-based, with many observations having zero patents and citations, we use Poisson and Tobit regression models following Jiang and Yuan (2018) and Mazouz and Zhao (2019). The results reported in Table A.7 (in the online supporting information) are qualitatively similar to the main results. The creation culture is significantly related to all innovation measures across both Poisson and Tobit models.

Further analysis

In this section, we use cross-sectional variation in firms' product market competition and managers' career concerns to further explore the effect of creation culture on innovation. Firms in a competitive product market strive to achieve and maintain a competitive advantage which is necessary for survival in the market. Investment in R&D and innovation is vital for firms to attain a sustainable competitive advantage. If a creation-oriented culture leads to higher innovation, we expect to have a stronger effect of creation culture in a highly competitive product market. In order to test this conjecture, we use the median value of the Herfindahl Hirschman Index (HHI) to split our sample into a high competitive product market (HHI below sample median) and a low competitive product market (HHI above sample median) following Chemmanur and Tian (2018) and Mazouz and Zhao (2019). Columns (1)–(4) of Table 6 report the results using high and low product market competition.[23] The results show that the magnitude of coefficient estimates on creation culture is much larger and highly significant for firms in a more competitive environment compared to firms in low market competition. The chi-square test values from columns (1)–(4) indicate that the difference in culture coefficients in low and high product market competition subsamples is statistically significant. These results suggest that creation culture exerts a more pronounced effect on innovation in firms operating in a highly competitive product market, and are consistent with our prediction.

A creation-oriented culture focuses on creating or generating new resources through innovation by fostering independent thinking, autonomy, flexibility and risk-taking (Hartnell, Ou and Kinicki, 2011). However, experimentation and creativity in new products and services is associated with failures and costs. Organizations that instil a creative culture provide a flexible structure with adaptability, where failure is accepted, tolerated and considered part of the cost of doing novel work (Hutchison-Krupat and Chao, 2014). Moreover, given the uncertainty and long-term nature of innovative projects, creative cultures shield managers from short-term performance evaluations by providing higher tolerance for failure. A strong creative culture is likely to reduce managers' career concerns, thereby facilitating innovation, and we expect that the effect of creation culture on innovation varies with the extent of managers' career concerns within a cross-section of firms. We follow Kim, Park and Song (2019) and use firm-level profitability growth as a proxy for managers' career concerns. Firms are split into high and low career concerns using the change in ROA growth rate during a given year compared to the previous year. Firms with a ROA growth that changes from top to bottom tertile are defined as firms with high career concern. Sample firms that do not belong to the high career concern subsample are defined as firms with low career concern. The results of our analysis using subsamples based on career concerns are reported in columns (5)–(8) of Table 6. While significant in both subsamples, the coefficient estimates of creation culture are much larger in high career concern firms compared to low career concern ones for both invention patents and citations. Moreover, the difference in culture coefficients between low and high career concern subsamples is statistically significant. Consistent with our expectations, creation culture has a larger effect on innovation in firms with high managerial career concerns.

total number of words in the annual report. The unreported results remain unchanged.

[23]We use our baseline regression specification (Eq. (2)) augmented with additional controls for board and CEO characteristics. For brevity, we only report results using invention patents (*Inven*) and *Citations* as dependent variables. Unreported results are mainly consistent if we use other innovation proxies.

Table 6. Product market competition and managerial career concerns

	Ln(Inven+1)		*Citations*		*Ln(Inven+1)*		*Ln(Citations+1)*	
Dependent variable	Low competition	High competition	Low competition	High competition	Low career concern	High career concern	Low career concern	High career concern
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Creation Culture	0.586***	0.981***	0.024	1.099***	0.634***	1.132***	0.386***	1.184***
	(2.564)	(4.313)	(0.103)	(4.706)	(3.342)	(3.628)	(1.986)	(3.863)
Firm Controls	YES	YES	YES	YES	YES	YES	YES	YES
CEO Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Board Characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES	YES	YES	YES	YES
N	8,646	8,649	8,660	8,635	12,437	4,858	12,439	4,856
Adj-R^2	0.320	0.274	0.167	0.161	0.276	0.316	0.152	0.165
χ^2 test statistics	6.157***		5.644***		8.157***		7.215***	

This table presents estimation results for various subsamples. Columns (1) and (3) presents the results for the low competitive product market subsample, while columns (2) and (4) show the results for the high competitive product market subsample. Columns (5) and (7) present the results for the subsample of firms with low career concern, while columns (6) and (8) show the results for the subsample of firms with high career concern. The dependent variables are: *Ln(Inven+1)*, as the natural logarithm of the number of invention patent applications plus one and *Ln(Citations+1)*, as the natural logarithm of the number of invention patent citations plus one. All variables are defined in Table A.1. Firm controls and characteristics for CEO and board are included. All models include year, industry and province fixed effects. Robust standard errors are clustered at the firm level. t-Values are in parentheses.
*, ** and *** represent significance levels at 10%, 5% and 1%, respectively.

Conclusion

In this study, we investigate whether, and to what extent, corporate creation culture influences firm innovation in the Chinese market. We use textual analysis of annual reports following Fiordelisi and Ricci (2014) and Andreou *et al*. (2019) to quantify a creation culture. Using all listed firms on both the Shanghai and Shenzhen stock exchanges between 2008 and 2017, we find strong and consistent evidence that a creation culture positively affects innovation. Our results are robust to using alternative proxies of innovation and creation culture, as well as to the alternative model specifications including tests related to endogeneity issues. We also find that firms in more competitive markets and subject to higher managerial career concerns benefit most from the cultural effect.

We contribute to the growing stream of literature on corporate culture as well as the determinants of innovation. Recent studies have documented corporate culture as an important factor in determining firm-level economic outcomes such as risk-taking and CEO turnover (Fiordelisi and Ricci, 2014; Nguyen, Nguyen and Sila, 2019). We add to this stream of literature by showing that corporate culture is also an important factor for the innovative performance of firms. Corporate innovation is the key to firms' long-term competitiveness and sustainability, and finding factors that determine innovation is equally important for academic experts as well as practitioners. Our findings suggest that a creation culture is essential to spur innovation in firms, and these results have important practical implications for managers, boards, shareholders and policymakers alike.

Our study is not without limitations. First, although we have carried out a battery of robustness tests and provide evidence suggesting a causal interpretation, we cannot rule out that unobserved characteristics could bias our findings. Second, we rely on patent application data, and while patent-based proxies have several advantages over other innovation-related metrics such as R&D, they are imperfect measures of innovation and do not capture innovations that are not patented by the firms.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.
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Table A.6. OCAI-based creation culture measure and innovation
Table A.7. Poisson and Tobit regressions