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Board authority culture, cultural diversity and corporate innovation

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ABSTRACT

Culture is the core factor of corporate innovation, and board culture is the core embodiment of cultural factors in corporate governance. Board culture will have an important impact on corporate innovation, So what kind of board culture can Chinese boards build to better contribute to corporate innovation? Based on this core issue, this paper empirically explores the relationship between board authority culture, board cultural diversity and corporate innovation from the unique perspective of board culture. The results show that board authority culture is negatively related to corporate innovation; board cultural diversity can negatively regulate the relationship between board authority culture and corporate innovation, that is, the construction of diverse board culture of the Chinese board is more conducive to corporate innovation. The main reason why board authority culture inhibits corporate innovation is that board authority culture has obedience effect and inhibits corporate innovation through the path of increasing agency costs and weakening management risk preferences. Further research finds that the negative moderating effect of board culture diversity on the relationship between board authority culture and corporate innovation is more effective when the chairman has the highest authority directorship and has reputation authority but not political resource authority and organisation authority.

KEYWORDS

Board authority culture;
board cultural diversity;
corporate innovation;
obedience effect

1. Introduction

Corporate innovation is an important driving force for economic growth and an important force for a country to achieve sustainable development. Culture is the core factor of corporate innovation and the main driving force to promote corporate innovation (Cravens et al., 2002). The research on the topic of ‘culture and corporate innovation’ is a hot and difficult topic in the current academic research. The existing research have examined the influence of religious culture (Barro & McCleary, 2003; Ruan et al., 2014), trust culture (Karlan et al., 2009; Lin et al., 2017), dialect culture (Pan et al., 2017), and

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Confucian culture (Xu & Li, 2019) on corporate innovation from the perspective of culture-related concepts, and believe that these cultures can promote corporate innovation; National culture (Zhang et al., 2015) and gambling culture (Zhao et al., 2018) inhibit corporate innovation; The impact of national culture on corporate innovation is uncertain (Bezrukova et al., 2009; Hofstede, 1980). Board culture is the core embodiment of cultural factors in corporate governance, but there are few studies on the relationship between board culture and corporate innovation. A few literatures have explored the influence of the board culture of cronyism on managers' excess compensation (Zheng et al., 2012), but ignored the authority culture formed by the hidden order differences within the board. The board authority culture is the difference in the authority of directors within the board caused by the difference in the ability and influence among directors (Zhang et al., 2015), which reflects the 'authoritarianism' in Chinese traditional Confucian culture within the board. Gree Electric Appliances has built a board culture with Chairman Dong Mingzhu as the authority, which adheres to independent innovation and promotes the high-quality development of the corporate. However, Liu Gang, the former chairman of Yunnan State-owned Capital Operation Co., LTD., built the board authoritative culture of 'one word', which reduced the collective decision-making of the board to a mere formality, and inhibited the level of corporate innovation. So, whether the board authoritative culture has a promoting effect or a inhibiting effect on corporate innovation, the previous studies have not given a clear answer.

In addition to the board authority culture, the board is also impacted by foreign cultures and presents the characteristics of cultural diversity. With the implementation and continuous advancement of the 'Go Global' strategy and the 'the Belt and Road' strategy of Chinese enterprises, more and more foreign talents have poured into China's board to serve as directors. According to statistics, China's A-share listed companies have introduced 2,421 foreign directors (excluding the data of foreign Chinese directors) from 2007 to 2016, which has increased of 1.66 times from 128 in 2007 to 340 in 2016.¹ There have been studies on the impact of diversity of board nationalities on corporate innovation, but no consistent results have been obtained. Some believe that there is a positive correlation between the two (Du et al., 2017), while others believe that there is a negative correlation (Tuggle et al., 2010). And this triggered a realistic thinking on whether the Chinese board should introduce foreign directors. The reason is that these studies only focus on the background characteristics of board members' nationality, but ignore the cultural factors behind nationality. It only focuses on the surface issue of 'whether to introduce foreign directors', ignoring the deep topic of 'how to effectively introduce foreign directors'. Frijns et al. (2016) extended cultural diversity to the field of the board for the first time, proposed the concept of 'board cultural diversity', and empirically studied the impact of board cultural diversity on corporate performance under the background of various nationalities and cultures. This type of board cultural diversity is mainly to examine the nationality background of directors. Directors with different nationalities represent different national cultures. If there are directors with multiple nationality backgrounds in the boardroom, the board culture presents the characteristics of diversity. Then, how does the board cultural diversity brought by foreign directors affect the

¹The author collected the data of foreign directors of A-share listed companies in China from 2007 to 2016 by hand and made statistics and calculations.

relationship between the existing board authority culture and corporate innovation in China? What kind of board culture should be build by the board in China to facilitate corporate innovation? Is it to strengthen the existing board authority culture or build the board cultural diversity? The discussion of these problems has very important theoretical and practical significance.

To answer the above practical questions, theoretical research needs to start from a unique perspective. From the dual perspectives of the board authority culture and the board cultural diversity, this paper focuses on the theme of 'What kind of board culture can better help corporate innovation' and explores the relationship among the board authority culture, the board cultural diversity and corporate innovation based on the sample of Chinese A-share listed companies. Although the board authority culture in this study belongs to the sub-culture of Chinese traditional Confucian culture, it is different from the previous literature concerning Confucian culture and corporate innovation in the following aspects: First, the variable measurement is different. In the past, the Confucian culture is measured by the distribution of Confucian academies recorded in historical books as the proxy variable of Confucian culture (Xu & Li, 2019). However, this paper focuses on the authoritarianism of Confucian culture, and adopts a realistic indicator measurement method, which is measured by the Gini coefficient of the sum of the characteristics of the internal board authority culture; Second, the focus of cultural content is also different. Confucian culture is a traditional Chinese culture, which focuses on the national level of culture, while the board authority culture focuses on the organisational level of culture, focusing on the authoritative culture presented in the decision-making organisation of the board; Third, this paper not only focuses on the impact of local board culture on corporate innovation, but also examines the influence of foreign culture shock on the relationship between the two.

The main contributions of this paper are as follows: First, it enriches and expands the relevant research in the field of corporate innovation. The existing literature on the theme of 'culture and corporate innovation' mostly studies corporate innovation from the perspective of national culture. In contrast, this paper extends culture to the field of organisational culture and examines the influence of board authority culture on corporate innovation. This not only enriches the literature in the field of 'culture and corporate innovation', but also enriches the research literature in the field of board governance; Second, it provides a new perspective for the board culture to affect corporate behaviour, breaking through the inherent limitations of previous literature from the single perspective of the board culture. From the dual perspective of board culture, this paper not only focuses on the Chinese board authority culture, but also on the board cultural diversity brought about by foreign directors. The research will have a more comprehensively and in-deep understanding of the relationship between board culture and corporate innovation from the dual perspective; Thirdly, it expands the research scope of board culture and enriches the research results in the field of board culture. The existing studies focus on the impact of the diversity of board nationalities on corporate innovation, but ignore the cultural factors behind the nationality of directors. This paper for the first time measures the board cultural diversity in China based on the data of foreign directors on the board of Chinese listed companies and the national cultural data of Hofstede et al. (2010) in six cultural dimensions. Combined with the original board authority culture in China, this paper tries to solve the problem of 'what kind of board culture can better promote

corporate innovation' and extends the research on the board cultural diversity to the field of Chinese capital market. Its research results will help enrich the research on the field of board culture; The fourth is to provide empirical evidence on the construction of board culture for countries with economies in transition. The board governance of countries in transition economies is still not perfect, which will not only be affected by the original board culture, but also be impacted by foreign cultures. How to coordinate the contradictions between the local board culture and foreign board culture, and construct a board culture suitable for the development of the countries in transition economies is extremely urgent. The conclusions of this paper can provide empirical support for the resolution of their contradictions and the construction of an effective board culture.

2. Literature review and hypotheses development

2.1. Board culture in China

A board culture of good corporate governance should consist of three elements: engagement with the aim of contributing to the community, commitment based on emotional attachment, and encouragement to respond to conflict in a constructive manner. The opposite factors will produce a bad board culture, have a negative impact on corporate governance, and frustrate the organisation's ability to achieve its goals (Chilliak, 2014). Early studies on board culture mainly focused on the board culture of 'cronyism'. Brick et al. (2006) and Zheng et al. (2012) demonstrated the impact of the board culture of cronyism on executive overcompensation, found that the board culture of cronyism would increase the level of executive overcompensation. With the deepening of relevant studies, researchers have found that due to the differences in social capital, resources and reputation and other factors among directors, the authority of directors within the board will differ, thus forming the board authority culture (Zhang et al., 2015). The traditional Chinese culture is represented by the Confucian culture. Its values follow the Confucian culture of 'benevolence, justice, courtesy, wisdom and trust', and advocate the principles of 'respect' and 'affinity', of which the principle of 'respect' emphasises the superiority and inferiority of both parties, while the principle of 'affinity' highlights the proximity of relationships (Hwang, 2001). This culture emphasises the order of hierarchy and authority of the venerable (Du et al., 2017). Generally speaking, scholars have begun to realise the importance of the board authority culture and have tried to analyse it from the perspective of Chinese cultural background. However, these studies are still confined to a single level of board culture and lack consideration of the board cultural diversity.

Chinese board members include not only Chinese directors, but also foreign directors. The introduction of these foreign directors not only brings advanced governance experience to the Chinese board, but also brings cultures from different home countries of the directors. These foreign cultures will influence the culture that exists in the Chinese board itself, carrying out to form board cultural diversity. Frijns et al. (2016) introduced the four cultural dimensions of Hofstede into the field of board culture based on their content, and empirically explored the impact of board cultural diversity on corporate performance using data from the UK capital market. Cao et al. (2016) used the proportion of ethnic minority board members on the board of directors to measure superficial board ethnic cultural diversity and explored its impact on corporate innovation, and the results of the

study showed that directors with more ethnic minority members had higher levels of corporate innovation output, especially when the company had more ethnic minority inventor board members, which helped to create internal synergies and enhance corporate innovation. Huijismans (2017) examined the impact of board ethnic cultural diversity and board nationality diversity on corporate social performance (CSP), but there is no evidence that board-level ethnic cultural diversity has a significant impact on social performance. It can be seen that current studies on board cultural diversity are still relatively scarce, and some of them still remain in the measurement of the four cultural dimensions of Hofstede, and there is a lack of measurement and related studies on board cultural diversity based on the six cultural dimensions of the latest Hofstede, and no studies have been conducted to introduce it to the field of Chinese board culture.

2.2. Hypotheses development

2.2.1. Board authority culture and corporate innovation

Traditional Chinese culture is represented by Confucianism, which emphasises hierarchical order and authoritarianism. The 'hierarchical order' in Confucianism requires people to 'restrain themselves and return to the rites for benevolence', and advocates that everything must be in accordance with the rites and laws, requiring that things that are not in accordance with the rites should not be seen or done, and words that are not in accordance with the rites should not be heard or said. New ideas, new theories and new behaviours are considered 'unkind' (Analects of Confucius – Yan Yuan). In Confucian culture, 'authoritarianism' requires people to 'fear the Mandate of Heaven, fear people of high moral standing, and fear the words of the sages' (Analects of Confucius – Ji Shi). It is clear that Confucian culture is a hierarchical and 'top-oriented' authority culture. Specifically in the area of the board, the board is a meeting-type decision-making body from the perspective of the board formal system, and the rules of decision-making within the board are that all directors are equal, each director has one vote, and there is no legal hierarchy within the board. However, in fact, all directors within the board are not completely free from hierarchical differences. Due to the differences in knowledge, experience, resources, and reputation of individual directors, it is easy for directors with extensive experience, broad network resources, and deep knowledge to gain respect, more voice and authority within the board, while, on the contrary, those directors who perform less well in terms of knowledge, experience and resources will have less voice and a lower status. This hidden hierarchy, which is spontaneously created by the ability and influence of individual members within the board team, actually reflects a culture of authority (He & Huang, 2011). It can be seen that board authority culture is the difference in authoritative status among directors due to differences in resources, reputation, and experience within the board, with the higher positions having higher authority and the lower positions having lower authority. Then, what kind of influence does the board authority culture have on corporate innovation? The answer is provided by the authority subordination characteristics presented in the board authority culture.

The influence of the board authority culture on corporate innovation is mainly reflected in the three stages: the strategic decision-making in advance, the implementation of innovation activities in the process and the feedback of innovation information after the event.

In the prior stage, it is reflected in the decision-making of the board on corporate innovation strategy (Zhou & Li, 2012). The board authority culture emphasises the obedience of authority, that is, the inferior should obey the superior. In fact, there is generally a relatively clear implicit hierarchy within the board, such as who will speak first, when they will speak, and which directors will speak directly to each other or first. Although there is no explicit formal board system, it will form a potential hierarchy when making decisions within the board. It is usually the honourable person in the boardroom who speaks first, the directors who are similar status to the honourable person have the first conversation with him/her, and other directors express their own views, while the directors who are inferior often speaks last. It is more often the case that the inferior director 'endorses' the superior director's viewpoint with a little elaboration on the basis of the superior director's viewpoint, which evolves into the inferior's 'authority dependence' on the superior.

Yeung and Tung (1996) and Ma (2007) found that Chinese tend to adopt non-confrontational conflict management strategies and are afraid to express opposing views to their superiors based on 'face' concerns. In contrast, innovation requires decentralised organisational structure to provide autonomy as an internal motivation, promote flexibility, trigger communication and constructive debate, and stimulate creativity (Rogers, 1983; Sauermann & Cohen, 2010); At the same time, innovation requires greater power sharing, equality, and social mobility to promote open communication, knowledge sharing and flexibility, which will contribute to innovation (Hofstede, 1980; Kumar, 2014). However, the board authority culture requires that the inferior should obey the superior, not hurt the 'face' of the superior, and not put forward views that are contrary to the superior. The result is often that it is difficult to carry out independent communication and debate within the board, and it is difficult to carry out the constructive debate on innovation effectively. It is easy to miss good opportunities in making innovation strategic decisions. Therefore, the board authority culture is not conducive to the improvement of corporate innovation level in the prior stage of innovation decision-making. On the other hand, innovation is a high-risk activity with a high failure rate. It requires not only strong leaders to promote, but also subordinates to actively obey the requirements of superiors to implement innovative projects. The decision-making strategy of the board for corporate innovation will be more reflective of 'authoritative' directors, especially if there are technical experts in the board members, which will enhance the scientific nature of innovation decision-making strategy, and thus promote the improvement of corporate innovation performance. From this perspective, the board authority culture will be conducive to the improvement of corporate innovation.

In the middle stage of corporate innovation, management is the executor of corporate innovation decisions. Because corporate innovation is a long-term, complex, high-investment, long-period, and slow-impact activity, management usually prefers to invest funds, energy, resources, etc. into projects with quick-impact and short-period for personal interests, that is, there is short-sighted behaviour of the management. However, the board authority culture pursues the 'supremacy' authoritarianism, emphasising the obedience of subordinates to superiors. The apparent obedience may weaken the supervision of the board on the short-sighted behaviour of the management, thus inhibiting the effective development of corporate innovation activities. On the other hand, from the perspective of management's self-interest, authoritative superiors may enhance their reputation by applying for and granting patents, which will further enhance corporate innovation.

In the post-event stage of corporate innovation, how effective the implementation of innovation activities needs to be timely feedback of the information to the superior department. However, the board authority culture emphasises the obedience of the subordinates to the superior, which easily leads to the lag of the feedback of the subordinates on the execution of innovation activities. Firstly, the subordinates are afraid to report the information about the poor execution of corporate innovation activities to the superior in time, and they are worried that the superior will blame them for the unfavourable execution of the subordinates; Secondly, the subordinates are more accustomed to accepting the orders from their superiors and obeying the instructions from their superiors. The feedback from the subordinates may be influenced by the board authority culture and not valued by the authoritative directors within the board. After the information fed back about innovation implementation activities is not valued for many times, the subordinates will be negligent to give timely feedback on the corresponding information at a later stage, resulting in the asymmetry of the feedback information on the execution effect of corporate innovation activities. On the other hand, because the superior has the right to evaluate and even appoint the personnel of the subordinates, the subordinates usually obey the decision-making instructions given by the superior in order to obtain the possibility of promotion in the future. If the authoritative superior is interested in corporate innovation, the subordinates will actively meet and implement the superior's innovation decisions, actively carry out various innovation activities, and provide timely feedback to the authoritative superior on the implementation effect of innovation activities, thus better promoting the improvement of corporate innovation level.

Based on the above analysis, this study proposes the following competitive hypotheses:

Hypothesis H1a: There is a negative correlation between board authority culture and corporate innovation.

Hypothesis H1b: There is a positive correlation between board authority culture and corporate innovation.

2.2.2. Board authority culture, cultural diversity, and corporate innovation

The success of corporate innovation largely depends on human capital and its intrinsic values and preferences, which are basically constituted of culture (Chen et al., 2017). This is because corporate innovation requires dynamic interaction between people with different knowledge, skills, beliefs, views, and problem-solving, and cultural diversity contributes to such interactive behaviour (Niebuhr, 2010). The continuous introduction of foreign directors can not only promote the transfer of knowledge and break the limitations of domestic directors by using their cognition, skills and experience developed from their home countries (Fujita & Weber, 2004), but also bring diverse cultures to the board, creating an external shock to the original culture within the board, and thus affecting the relationship between the board authority culture and corporate innovation.

The power distance view is mainly the power distance cultural perspective of Hofstede's (1980) cultural theory, which emphasises the use of power distance to

investigate the power allocation and operation in the boardroom. Specifically, in the field of board culture, the power distance culture in the board cultural diversity reflects the inequality of power distribution within institutions and organisations (Hofstede, 1980, 2001). The lower power distance reflects greater power sharing and equality, promotes open communication, knowledge sharing and flexibility, and contributes to innovation (Boone et al., 2019; Hofstede, 1980). On the contrary, high-power distance will inhibit creativity and innovation because hierarchical structure with strict control and rigid mechanism will inhibit confrontation and limit information sharing and knowledge spillover (Kumar, 2014). The Chinese board authority culture emphasises the observance of 'order of superiority and inferiority' within the board, which reflects the high-power distance culture. It is not conducive to equal communication among board members, nor to stimulate the creativity and innovation of internal members. Board cultural diversity emphasises the diversity of the cultures in the countries where the board members come from, including those from countries close to China with high power distance and those from countries with low power distance.

If foreign directors from countries with low power distance culture are introduced, the existing single culture within the board will be impacted, and the board authority culture will be culturally integrated with the diversity of culture brought by foreign directors. First of all, the interaction between local and foreign directors creates cultural diffusion, local directors no longer only accept local culture, but begin to tend to learn and accept foreign culture that is considered useful and relevant to their goals (Arieti, 1976; Ashraf & Galor, 2007; Simonton, 1997), thus forming new innovative ideas, methods and contents, etc.; Secondly, because of the different cultures within the board, the board members may have different perceptions and interpretations of the real situation, which helps to break the authoritative culture of high power distance within the Chinese board, encourages all members within the board to express their views freely and equally, which can easily stimulate the creativity and innovative thinking of members, and improve the innovation level of the company (Dahlin et al., 2005; Milliken & Martins, 1996); Finally, the culture of countries with low power distance emphasises equality and communication among members. Introducing foreign directors from countries with low power distance can bring about board culture different from that of Chinese board, presenting the characteristics of cultural diversity. Such board cultural diversity can break the authoritative obedience effect brought by the board authority culture and advocate equal and effective communication between subordinates and superiors, which can subordinate departments to give timely and effective feedback on innovation implementation, and the board of directors can fully discuss, absorb and make corresponding adjustment on innovation strategy decision after obtaining such innovation feedback, so as to promote the effective development of corporate innovation activities and improve the level of corporate innovation. In addition, foreign directors have higher uncertainty and tolerance towards corporate innovation activities, which can not only bring a diverse culture to the Chinese board, but also introduce advanced corporate governance experience in the foreign directors' home countries, effectively play the supervisory role of the board and inhibit the short-sighted behaviour of management (Giannetti et al., 2015). In other words, the board cultural diversity can make up for the defects of the board authority culture in its supervision function, so as to supervise the management more effectively, devote more resources into the corporate innovation activities, and supervise the self-interest behaviour of the management in the implementation of innovation activities, thus improving the level of corporate innovation.

The group fracture view is opposed to the power distance view, which is primarily based on the group fracture zone theory.

Based on one or more similar attributes of group members, the group fault zone is a set of virtual dividing lines that divide a group into relatively homogeneous subgroups (Lau & Murnighan, 1998; Thatcher et al., 2003). The theory emphasises that subgroup members view will regard members of the group as 'we' and out-of-group members as 'they', and this social classification process will lead to in-group support and out-group discrimination. The presence of strong fault lines will can exacerbate in-group conflict (Bezrukova et al., 2009; Li & Hambrick, 2005) and negatively affect in-group trust (Harrison & Klein, 2007), information sharing, and knowledge exchange (Lau & Murnighan, 1998). At the same time, the existence of the fault zone will also cause internal conflicts, reduce meeting time and discussion on key issues, which is not conducive to communication and information sharing. There are foreign and local directors in board cultural diversity. Foreign directors may be difficult to integrate into the 'circle' of local directors due to their differences in nationality, skin, cognition, etc, and there is a fracture zone between them, with board members recognising their 'circle' more than the board as a whole (Kaczmarek et al., 2012). This hinders the free information exchange and knowledge sharing between foreign and local directors (Lim et al., 2013). It is not only difficult to break the original board authority culture, but also easy to form cultural conflicts within the board. It can be seen that the existence of board fracture zones will intensify the conflicts between subgroups, weaken organisational communication and teamwork (Bezrukova et al., 2009; Dyck & Starke, 1999). It is difficult to have full communication and free debate among board members, which hinders the creativity and innovative thinking of board members, and can inhibit the improvement of corporate innovation level.

Based on the above analysis, this study proposes the following competitive hypotheses:

Hypothesis H2a: Under certain other conditions, board cultural diversity has a negative moderating effect on the relationship between board authority culture and corporate innovation.

Hypothesis H2b: Under certain other conditions, board cultural diversity has a positive moderating effect on the relationship between board authority culture and corporate innovation.

3. Sample and research design

3.1. Sample and data

The data of all A-share listed companies in China from 2007 to 2016 is taken as the sample of this study, the main reason for choosing 2007 as the starting year is that since 2007, the CSRC has required listed companies to disclose corporate R&D data in detail. In the process of sample screening, the following aspects of data processing are done: First, the sample of listed companies in the financial and insurance industry are deleted; Second, the sample of ST and *ST listed companies are removed; Third, the financial

data that could not be made up by manual collation and the corporate governance data are eliminated; Fourth, all continuous variable data in the sample are tail-shrunk according to the upper and lower 1% quantiles of the variable. Since all independent variables, regulatory variables and control variables are treated by lagging for one period, the actual sample time window is 2008–2016, and a total of 15,881 valid sample data are obtained, involving 2,504 Chinese A-share listed companies.

The data of foreign directors are mainly obtained by manually reading the annual reports of listed companies by hand, and double-checked by Wencai, Sina Finance, Baidu and the official websites of listed companies. In order to avoid duplicate names among directors, the nationality information of directors is searched according to the method of company code and directors' names to determine the nationality of directors; Considering that Chinese with foreign nationality status are more influenced by Chinese traditional culture, this part of Chinese samples are classified as Chinese samples. Finally, the sample data of 2,421 foreign directors from 29 different countries and regions are obtained. In addition to the data of foreign directors, Hofstede's official website is also used to obtain the latest data on the six cultural dimensions measurement of board cultural diversity. In addition, the annual report of the listed company and other materials are scanned by hand to find whether the directors are from the controlling shareholder unit or family members. The data of institutional investors' shareholding are obtained from the WIND database, and data on other variables are mainly obtained from the CSMAR database.

3.2. Research design

3.2.1. Measure of corporate innovation

Referring to Chen et al. (2015) and Yuan and Wen (2018), the corporate innovation variable (Patent) is quantified using the corporate innovation output indicator, i.e. the natural logarithm of the total number of invention, utility and design patents granted to the firm in the year plus one. In addition to the total innovation output of the firm, the robustness test also examines both the type of innovation and the speed of innovation of the firm, where the type of innovation includes invention patent innovation (IPatent), utility model patent innovation (UPatent) and design patent innovation (DPatent), which are each measured using the natural logarithm of the total number of such patents granted in the year plus one; the speed of innovation The speed of innovation is measured by setting the number of patents granted to companies after filing in years 1–4 (Grant1st, Grant2nd, Grant3rd and Grant4th) and using the natural logarithm of the total number of patents granted in each year plus one.

3.2.2. Measure of board authority culture

Directors' competence and influence are key factors that contribute to the development of the board authority culture. The greater the competence and influence, the easier it is for board members to gain the respect of others and thus dominate (Magee & Galinsky, 2008). Board authority culture is formed in two main ways: one is based on the social relationships behind the individual. This includes the representation of the majority shareholder status behind the organisation (organisation authority) and the possession of powerful social network resources (Resource authority); the other way is based on individual-level contribution. This includes members' expertise in a particular field formed

by their own abilities and qualities (Expert authority) and the reputation they have accumulated (Reputation authority) (Liu et al., 2015). Referring to Finkelstein (1992), He and Huang (2011) and Wu et al. (2018), the board authority culture is divided into four components: expert authority, organisation authority, resource authority and reputation authority.

Since this paper examines the influence of board authority culture on corporate innovation, expert authority here refers mainly to expert authority in technical fields. Referring to Hu and Ji (2017), a director is judged to have technical expert authority if he or she has one of the following four aspects and takes the value of 1, otherwise it is 0: (1) The director has study experience in engineering and other technically strong majors; (2) The director has work experience in R&D, key technical positions, etc.; (3) The director has a senior technical title, such as senior engineer, professor engineer, etc.; (4) Directors have experience in invention patents or patent awards.

Referring to Wu et al. (2018), if the director comes from the controlling shareholder unit or is a family member, it indicates that the director is given a certain implicit authority by the organisation, and even if this part of the director does not hold the position of chairman, other board members will have some respect and obedience to the identity of this part of the director, so we take the value of 1 for the director who comes from the controlling shareholder unit or is a family member, and 0 otherwise. Resource authority is mainly to examine whether the director has political affiliation background, if so then the value is 1, otherwise it is 0. Reputation authority is mainly to examine the director's part-time positions in other companies, the more part-time positions the stronger the reputation of the director.

Referring to He and Huang (2011), the Gini coefficient of the total number of sources of board authority is used to measure the board authority culture. The Gini coefficient is calculated by the following formula:

$$QW = \frac{2\text{cov}(y, r_y)}{N\bar{y}}$$

Where: QW represents board authority culture. y represents the total sum of the above four sources of director authority; r_y represents the ranking number of the total number of authoritative sources within the board of company in that year, which takes the value of 0 if there is no value, and the more the total number is, the greater the value will be, and if the number of authority sources of director is the same, the ranking number also takes the same value; $\text{cov}(y, r_y)$ represents the covariance of y and r_y ; N represents the size of the company's board of directors; and \bar{y} represents the mean of y . The larger the value of Gini, the greater the hierarchy of board authority and the higher the board authority culture.

3.2.3. Measure of board cultural diversity

Referring to Frijns et al. (2016), the following three steps are followed to quantify the board cultural diversity variable. First, referring to Hofstede (2001) and Hofstede et al. (2010), we assign each director with the national culture scores of the six Hofstede's culture dimensions including power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, long- versus short-term orientation, and indulgence versus self-restraint. Next, based on the scores of each cultural dimension published by Hofstede on its official website in 103 countries and regions around the world, each director in the

sample is assigned a value for each cultural dimension according to his or her nationality background, and the cultural distance of each board member's nationality background on each cultural dimension is calculated as shown in model (1):

$$DT_{ij} = \sqrt{\sum_{k=1}^6 [(I_{ki} - I_{kj})^2 / V_k]} \quad \forall \quad i \neq j, \quad (1)$$

where DT_{ij} is the cultural distance between each two directors (i, j), I_{ki} is the culture score on dimension k for a director i , I_{kj} is the cultural score on dimension k for a director j , and V_k is the in-sample variance of the score for the specific cultural dimension.

Finally, we capture the firm-level board cultural diversity with the average of cultural distances in all pairs of board directors, calculated as shown in model (2):

$$CD_{nt} = \frac{\sum_{i,j} DT_{ij,nt}}{m(m-1)/2} \quad \forall \quad i < j, \quad (2)$$

where CD_{nt} indicates the board cultural diversity of firm n in year t , and m is the number of board members. To normalise for the board size, board cultural diversity is scaled by the number of pairs of board members.

3.2.4. Control variables

Referring to Schonlau and Singh (2009) and Larcker et al. (2011), the median calculated board network centrality is used as the main research indicator. The specific process of data processing is as follows: In the first step, directors are tagged using the information of directors' part-time positions in the CSMAR database; In the second step, using the large social network data analysis software PAJEK, three centrality measures (three standard indicators of degree centrality, intermediation centrality and proximity centrality) are calculated for each tagged director each year; In the third step, on a company basis, the median values of the three network centrality measures are calculated for the board of that company each year; In the fourth step, in order to eliminate the differences in different centrality measures, the three network centres of all companies are divided into 10 groups by year and assigned values 1–10 as the ranking indicator, and then the three ranking indicators are averaged to obtain a comprehensive network centrality indicator of the company as a board capital variable (DSZB).

Referring to Frijns et al. (2016) and Kang et al. (2018), a number of board characteristics variables are controlled for, including dual membership (Dual), proportion of independent directors (Indep), board size (Bsize), director age (Age), director tenure (Tenure), director gender (Gender), the number of board meetings (Meeting), and average director remuneration (B_comp); in addition, a number of firm characteristics variables are controlled for, including firm size (Size),

sales growth (Grow), financial leverage (Lev), and firm performance (ROA). Referring to Makri et al. (2006), Aghion et al. (2013), Du et al. (2017), management equity incentive (Equity), institutional investor ownership (JG), nature of ownership (State), cross-shareholding (Cross), and R&D investment (R&D) variables are controlled for, in addition to industry and year. The industry classification is based on the industry classification

standard issued by the Securities and Futures Commission in 2012, with the first two characters of the industry code for manufacturing and the first character for each of the remaining industries, making a total of 22 industries. The specific variable definitions are shown in [Appendix](#).

3.3. Regression model of the baseline analysis

In order to test the relationship between the board authority culture, the board cultural diversity and corporate innovation, since the corporate innovation variables are quantified by the patent authority, considering the lag of patent authority, all independent variables, regulatory variables, and control variables are treated by lagging for one period, and the dependent variables are taken as the current values. Specific model construction is shown in model (3) and model (4):

$$\begin{aligned} Patent_{i,t} = & a_0 + a_1QW_{i,t-1} + a_2Dual_{i,t-1} + a_3Indep_{i,t-1} + a_4BSize_{i,t-1} + a_5Age_{i,t-1} + a_6Tenure_{i,t-1} \\ & + a_7Gender_{i,t-1} + a_8DSZB_{i,t-1} + a_9Meeting_{i,t-1} + a_{10}B_Comp_{i,t-1} + a_{11}Size_{i,t-1} \\ & + a_{12}ROA_{i,t-1} + a_{13}Lev_{i,t-1} + a_{14}Grow_{i,t-1} + a_{15}JG_{i,t-1} + a_{16}Equity_{i,t-1} + a_{17}Cross_{i,t-1} \\ & + a_{18}State_{i,t-1} + a_{19}R\&D_{i,t-1} + \sum Ind + \sum Year + \varepsilon \end{aligned} \quad (3)$$

$$\begin{aligned} Patent_{i,t} = & a_0 + a_1QW_{i,t-1} + a_2CD_{i,t-1} + a_3QW_{i,t-1} \times CD_{i,t-1} + a_4Dual_{i,t-1} + a_5Indep_{i,t-1} + a_6BSize_{i,t-1} \\ & + a_7Age_{i,t-1} + a_8Tenure_{i,t-1} + a_9Gender_{i,t-1} + a_{10}DSZB_{i,t-1} + a_{11}Meeting_{i,t-1} \\ & + a_{12}B_Comp_{i,t-1} + a_{13}Size_{i,t-1} + a_{14}ROA_{i,t-1} + a_{15}Lev_{i,t-1} + a_{16}Grow_{i,t-1} + a_{17}JG_{i,t-1} \\ & + a_{18}Equity_{i,t-1} + a_{19}Cross_{i,t-1} + a_{20}State_{i,t-1} + a_{21}R\&D_{i,t-1} + \sum Ind + \sum Year + \varepsilon \end{aligned} \quad (4)$$

Model (3) is to test the influence of the board authority culture on corporate innovation, so as to verify hypothesis H1; Model (4) is to test the impact of cultural diversity on the relationship between the board authority culture and corporate innovation, so as to verify hypothesis H2.

4. Empirical results

4.1. Descriptive statistics

[Table 1](#) shows the results of descriptive statistics for the main variables under the full sample. According to the contents of [Table 1](#), the mean value of corporate innovation (Patent) is 1.213, the median value is 0.693, the minimum value is 0 and the maximum value is 4.997, indicating that there is a wide variation in the number of patents granted to listed companies in China and the overall number of granted patents is still low. Board authority culture variable (QW) has a mean value of 0.531 and a median value of 0.526, indicating that board culture of listed companies in China is dominated by authority culture. The mean value of board cultural diversity variable (CD) is 0.023, with 0 below the 3/4th percentile, indicating that the board of Chinese listed companies is dominated by Chinese board members, while the proportion of foreign directors on the board is still relatively low and the overall level of board cultural diversity is low. Descriptive statistics for other control variables are also presented in [Table 1](#) below.

Table 1. Descriptive statistics.

Variable	N	Mean	25%	Median	75%	Std	Min	Max
Patent	14285	1.213	0	0.693	2.303	1.462	0	4.997
QW	14285	0.531	0.418	0.526	0.636	0.155	0.200	0.926
CD	14285	0.023	0	0	0	0.117	0	0.905
Dual	14285	0.216	0	0	0	0.412	0	1
Indep	14285	0.369	0.333	0.333	0.400	0.052	0.294	0.571
Age	14285	3.907	3.861	3.908	3.955	0.070	3.730	4.071
Tenure	14285	2.914	1.650	2.790	4.040	1.555	0.150	7.030
Gender	14285	0.132	0.050	0.111	0.200	0.112	0	0.714
Bsize	14285	2.168	2.079	2.197	2.197	0.198	1.609	2.708
DSZB	14285	4.271	3.667	4	5	1.138	1	10
Meeting	14285	2.296	2.079	2.303	2.485	0.332	0.693	4.043
B_Comp	14285	13.75	13.420	14.020	14.560	2.046	0	17.390
Size	14285	21.890	20.990	21.730	22.600	1.269	18.910	26.890
Lev	14285	0.453	0.286	0.456	0.619	0.213	0.050	0.998
ROA	14285	0.043	0.014	0.039	0.070	0.058	-0.221	0.250
Grow	14285	0.212	-0.027	0.116	0.284	0.598	-0.673	4.792
JG	14285	0.061	0.007	0.033	0.080	0.084	0	0.458
Equity	14285	0.034	0	0	0	0.123	0	0.705
Cross	14285	0.018	0	0	0	0.131	0	1
State	14285	0.467	0	0	1	0.499	0	1
R&D	14285	0.011	0	0.001	0.015	0.020	0	0.110

4.2. Variable correlation

Table 2 presents a table of the correlation coefficients between the main variables. Based on the contents of Table 2, it can be seen that there is a significant negative correlation between the board authority culture variable (QW) and the corporate innovation variable (Patent) at the 1% level, indicating a negative correlation between the two without considering the control variables. The board cultural diversity variable (CD) is significantly and positively correlated with the corporate innovation variable (Patent) at the 1% level. The variables Dual, Indep, Size, ROA, JG, Age, Tenure, Equity and R&D are all significantly and positively correlated at the 1% level with the variables Patent. This indicates that the adoption of a two-tier board structure, the higher the proportion of independent directors, the larger the company, the better the company's performance, the higher the proportion of shares held by institutional investors, the older the average age of directors, the longer the average tenure of directors, the higher the degree of management equity incentives, and the higher the R&D investment, the greater the number of patents granted to the company. The relationships of the correlation coefficients of other variables are detailed in Table 2.

In addition, this paper also tested the VIF values of all independent variables, regulating variables, control variables and dependent variables. The test results showed that the VIF values of all tested variables are less than 2.5, indicating that there is no multicollinearity problem between these variables.

4.3. Results of the baseline analysis

Table 3 presents the results of the relationship between board authority culture, board cultural diversity and corporate innovation. Column (1) in Table 3 shows that there is a significant negative correlation between the board authority culture (QW) and the corporate innovation (Patent) at the 1% level, indicating that the higher the level of board authority culture, the lower the level of corporate innovation output, i.e. board

Table 2. Pearson correlation matrix.

	Patent	QW	CD	Dual	Indep	Age	Tenure	Gender	Bsize	DSZB	Meeting
Patent	1										
QW	-0.078***	1									
CD	0.092***	0.012	1								
Dual	0.081***	0.078***	0.011	1							
Indep	0.016***	-0.013*	-0.013*	0.098***	1						
Age	0.057***	0.112**	0.112**	-0.106***	0.045***	1					
Gender	0.068***	-0.004	0.013	0.059***	0.024***	0.281**	1				
Bsize	-0.066***	0.146**	-0.005	0.109***	0.024***	-0.103**	0.065**	1			
DSZB	0.011	-0.142***	0.029**	-0.180***	-0.446**	0.135***	-0.064***	-0.114***	1		
Meeting	0.008	-0.099**	0.017*	-0.048**	0.020**	0.146***	0.102**	-0.046***	0.065***	1	
B_Comp	-0.045***	0.036***	-0.036***	0	0.046***	-0.089***	-0.066**	-0.025***	-0.032***	0.035***	1
Size	0.091***	0.046**	0.029**	0.069***	-0.062***	0.023***	0.092**	0.030***	0.096***	0.051***	0.065***
Lev	-0.108***	-0.167***	0.011	-0.164***	0.034***	0.337***	0.129***	-0.140***	0.260***	0.194***	0.186***
ROA	0.135***	-0.046**	-0.056***	-0.165***	-0.025***	0.060***	-0.079**	-0.087***	0.158***	0.065***	0.176***
Grow	-0.038***	0.031***	-0.018**	-0.00100	0.014*	-0.005	-0.023***	0.019*	0.008	0.026***	-0.030***
Equity	0.060***	-0.038***	-0.029**	-0.029***	-0.050***	-0.085***	-0.101***	0.002	-0.025***	0.004	0.089***
Cross	0.104***	0.021***	-0.011	0.075***	0.019**	-0.028***	0.114***	-0.029***	0.086***	0.038***	0.021***
State	-0.105***	-0.034***	0.018**	-0.049***	-0.00100	0.067***	-0.014*	0.045***	-0.047***	0.029***	0.155***
R&D	0.341**	-0.195***	-0.076**	-0.279***	-0.077***	0.235***	-0.118***	-0.184**	0.081***	0.049***	0.030***
		-0.065***	0.046**	0.107***	0.048***	0.048***	0.184***	-0.004	-0.039***	0.016*	-0.060***
B_Comp	1										
Size	0.147***	1									
Lev	-0.040***	0.435***	1								
ROA	0.133***	0.020**	-0.363***	1							
Grow	-0.005	0.059***	0.059***	0.197***	1						
JG	0.052***	0.142***	0.026**	0.141***	0.022***	1					
Equity	0.081***	0.028***	-0.066**	0.127***	0.025***	0.038***	1				
Cross	0.036***	0.137***	0.044**	-0.003	-0.019**	0.052***	-0.023**	1			
State	-0.121***	0.325***	0.300**	-0.121***	-0.042***	0.130***	-0.203***	0.091***	1		
R&D	0.078***	0.038**	-0.115**	0.022***	-0.028***	-0.028**	0.048***	0.024***	-0.159**	1	

Note: ***, **, * and **** represent the 10%, 5% and 1% levels of significance, respectively.

Table 3. Board authority culture, cultural diversity, and corporate innovation.

Variable	(1)	(2)	(3)	(4)
	Full sample Patent i, t	Full sample Patent i, t	Full sample Patent i, t	Foreign directors' sample ² Patent i, t
$QW_{i,t-1}$	-0.146** (-2.049)		-0.211*** (-2.941)	0.872* (1.674)
$CD_{i,t-1}$		0.334*** (3.161)	-0.950*** (-2.626)	-0.848 (-1.465)
$QW_{i,t-1} \times CD_{i,t-1}$			2.417*** (3.591)	2.181** (2.051)
$Dual_{i,t-1}$	0.092*** (3.496)	0.093*** (3.507)	0.094*** (3.576)	0.269** (2.411)
$Indep_{i,t-1}$	-0.100 (-0.431)	-0.094 (-0.406)	-0.082 (-0.353)	-2.361** (-2.136)
$Age_{i,t-1}$	-0.428** (-2.567)	-0.479*** (-2.869)	-0.517*** (-3.097)	-0.777 (-0.988)
$Tenure_{i,t-1}$	0.023** (2.305)	0.024** (2.405)	0.024** (2.409)	0.090** (2.139)
$Gender_{i,t-1}$	-0.370*** (-4.045)	-0.388*** (-4.251)	-0.378*** (-4.137)	-0.564 (-1.340)
$DSZB_{i,t-1}$	0.087 (1.304)	0.086 (1.301)	0.080 (1.206)	0.356 (1.072)
$Meeting_{i,t-1}$	0.007 (0.723)	0.008 (0.831)	0.007 (0.725)	-0.015 (-0.295)
$B_Comp_{i,t-1}$	-0.124*** (-3.684)	-0.122*** (-3.655)	-0.121*** (-3.619)	-0.125 (-0.902)
$Bsize_{i,t-1}$	0.022*** (3.890)	0.021*** (3.769)	0.022*** (3.895)	0.007 (0.284)
$Size_{i,t-1}$	0.208*** (16.833)	0.208*** (16.935)	0.207*** (16.769)	0.255*** (4.309)
$Lev_{i,t-1}$	-0.339*** (-5.529)	-0.337*** (-5.493)	-0.331*** (-5.401)	-0.684* (-1.943)
$Roa_{i,t-1}$	2.270*** (11.230)	2.270*** (11.235)	2.279*** (11.277)	3.454*** (3.722)
$Grow_{i,t-1}$	-0.094*** (-6.282)	-0.094*** (-6.290)	-0.094*** (-6.268)	-0.046 (-0.615)
$JG_{i,t-1}$	0.336** (2.526)	0.353*** (2.652)	0.354*** (2.661)	-0.536 (-0.905)
$Equity_{i,t-1}$	0.789*** (8.685)	0.801*** (8.804)	0.799*** (8.792)	0.441 (1.228)
$Cross_{i,t-1}$	-0.002 (-0.024)	-0.005 (-0.057)	-0.011 (-0.135)	-0.732*** (-2.678)
$State_{i,t-1}$	-0.069*** (-2.845)	-0.054** (-2.256)	-0.062*** (-2.582)	0.411*** (3.213)
$R\&D_{i,t-1}$	12.150*** (16.869)	12.216*** (16.972)	12.146*** (16.881)	6.108** (2.104)
$Cons$	-2.344*** (-3.542)	-2.249*** (-3.418)	-1.948*** (-2.938)	-2.871 (-0.915)
$Year$	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	14285	14285	14285	852
$Adj-R^2$	0.346	0.347	0.348	0.352

Note: **, *** and **** represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

authority culture has a suppressive effect on the level of corporate innovation output, supporting the research hypothesis H1a. In column (2) There is a significant positive

²The foreign directors' sample here refers specifically to the sample of companies with foreign directors on their boards of directors, excluding those with only Chinese directors, as there is board cultural diversity on the boards of companies with foreign directors, while the sample of all Chinese boards only has a board authority culture, so the results of the empirical tests for the sample with foreign directors are presented separately here, as in the table below.

correlation between the board cultural diversity (CD) and the corporate innovation (Patent) at the 1% level, indicating that board cultural diversity has a facilitating effect on the level of corporate innovation output. Columns (3) and (4) show the effect of the interaction between board authority culture and board cultural diversity on corporate innovation for the full sample and the foreign director sample respectively. The coefficients of the interaction terms for $QW_{t-1} * CD_{t-1}$ are 2.417 and 2.181 respectively, which are significantly positively correlated at the 1% and 5% levels respectively, indicating that board cultural diversity has a negative moderating effect on the relationship between board authority culture and corporate innovation, and that board cultural diversity inhibits the negative correlation between them both, supporting hypothesis H2a.

4.4. Endogeneity tests

4.4.1. Endogeneity tests using instrumental variable (IV) two-stage regression approach

The above test found a significant negative correlation between board authority culture and corporate innovation, with board authority culture inhibiting corporate innovation output. However, the relationship between board authority culture and corporate innovation may be influenced by third-party factors, causing them to rise and fall together, thus creating an endogeneity problem. To address this issue, this paper uses the IV-2SLS model to re-estimate the relationship between board authority culture and corporate innovation.

Kung & Ma (2014) found that Qing rulers established military garrisons in provinces with serious local rebellions to deter local rebellions; in places where they are established, rulers are often more motivated to build new Confucian temples to promote Confucianism. In these places, the rulers are usually more motivated to build new Confucian temples, to promote Confucianism, to enhance the loyalty of the people to the dynasty, and to strengthen the authority of Confucian culture. We refer to Rao et al. (2022), who use whether or not a province had established a 'Mancheng' ($MC_{i,t-1}$) as an instrumental variable with a lag of one period, with provinces that had established a Mancheng taking a value of 1 and 0 otherwise.³ The instrumental variable ($MC_{i,t-1}$) is closely related to Confucian culture, but not directly to corporate innovation. Since board authority culture is a subculture of Confucian culture, the instrumental variable ($MC_{i,t-1}$) is related to board authority culture, but not to current corporate innovation. In order to test the reliability of the instrumental variables, the first step is to verify whether OLS regression or IV-2SLS regression should be used; the Hausman test showed that there is an endogeneity problem between board authority culture and corporate innovation, and IV-2SLS regression should be used; then, the weak instrumental variable test is adopted, and the test result showed that the F statistic is 9.84, $p = 0.0017$, rejecting the original hypothesis of 'weak instrumental variables' is rejected. Therefore, the choice of instrumental variables in this paper is valid and there is no problem of weak instrumental variables.

³The data for 'Mancheng' comes from the article 'Qing Dynasty Mancheng Kao' (Ma Xiedi: 'Qing Dynasty Mancheng Kao', Manchu Studies, 1990, no. 1).

Table 4 presents the results of the IV-2SLS test of the relationship between board authority culture and corporate innovation. From the results of the first stage test, it can be seen that whether or not provinces set up ‘full cities’ ($MC_{i,t-1}$) in the first stage with a lag of one period is significantly negatively correlated to board authority culture (QW_{t-1}) with a lag of one period at the 1% level, indicating that the instrumental variables are effectively selected; the board authority culture on corporate innovation at the 1% level, indicating that board authority culture still has a significant negative correlation on corporate innovation, further supporting hypothesis H1a; furthermore, the interaction term between board authority culture and cultural diversity in the second stage is significantly positively correlated to corporate innovation at the 10% level, indicating that board cultural diversity has a negative moderating effect on the relationship between board authority culture and corporate innovation. The interaction term between board authority culture and cultural diversity in the second stage has a negative moderating effect on corporate innovation, further supporting hypothesis H2a. The above results suggest that the above findings remain robust after controlling for endogeneity problems.

4.4.2. Endogeneity tests using residual value as a proxy variable

Considering that board authority culture may be determined by board characteristics, it may lead to endogeneity problems due to missing variables in the selection of board characteristics variables. Referring to Jiang et al. (2018), we used board characteristics variables to estimate their residual values, with the following model:

$$QW_{i,t-1} = a_0 + a_1Dual_{i,t-1} + a_2Indep_{i,t-1} + a_3BSize_{i,t-1} + a_4Age_{i,t-1} + a_5Tenure_{i,t-1} + a_6Gender_{i,t-1} + a_7DSZB_{i,t-1} + a_8Meeting_{i,t-1} + a_9B_Comp_{i,t-1} + \sum Ind + \sum Year + \varepsilon \quad (5)$$

The residual value Residual_{*i,t-1*} estimated from model (6) is then put back into model (7) and model (8) as follows:

$$Patent_{i,t} = a_0 + a_1Residual_{i,t-1} + a_2Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (6)$$

$$Patent_{i,t} = a_0 + a_1Residual_{i,t-1} + a_2CD_{i,t-1} + a_3CD_{i,t-1} \times Residual_{i,t-1} + a_4Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (7)$$

where Patent_{*i,t-1*} is the current period’s corporate innovation output variable, Residual_{*i,t-1*} is the estimated residual, CD_{*i,t-1*} is the lagged one-period board cultural diversity variable, Control_{*i,t-1*} is a control variable other than board characteristics, Year and Ind are year and industry control variables respectively, and the variable descriptions are detailed in Appendix.

The regression results are presented in Table 5. column (1) reports the results of the test of model (6). The results show that dual tenure, director tenure, director gender and director remuneration are significantly and positively correlated to board authority culture, while the proportion of independent directors, director age and board size are negatively related to board authority culture. Column (2) reports the results of the test of model (7). The results show a significant negative correlation between Residual_{*i,t-1*}, the residual value estimated from the board characteristics variable, and corporate innovation, further supporting hypothesis H1a. Columns (3) and (4) report the results of testing

Table 4. Endogeneity tests using instrumental variable (IV) two-stage regression approach.

Variable	Stage 1 QW _{i,t-1}	Stage 2 Patent _{i,t}	
MC _{i,t-1}	-0.009*** (-3.140)		
QW _{i,t-1}		-2.457*** (-2.965)	-1.172*** (-3.482)
CD _{i,t-1}			-1.710* (-1.743)
QW _{i,t-1} × CD _{i,t-1}			1.975* (1.879)
Dual _{i,t-1}	0.004 (1.060)	0.172* (1.883)	0.173** (2.206)
Indep _{i,t-1}	0.025 (0.870)	0.593 (0.808)	0.546 (0.875)
Age _{i,t-1}	-0.219*** (-9.360)	-5.339*** (-3.122)	-4.795*** (-3.711)
Tenure _{i,t-1}	-0.002 (-1.370)	-0.017 (-0.479)	-0.005 (-0.186)
Gender _{i,t-1}	0.110*** (8.650)	2.119** (2.376)	1.608*** (2.579)
Bsize _{i,t-1}	-0.035*** (-4.170)	-0.633** (-1.973)	-0.514** (-2.077)
DSZB _{i,t-1}	-0.009*** (-6.740)	-0.190*** (-2.650)	-0.153*** (-2.946)
Meeting _{i,t-1}	0.007 (1.540)	0.041 (0.356)	0.021 (0.212)
B_Comp _{i,t-1}	0.004*** (6.530)	0.114*** (3.134)	0.097*** (3.616)
Size _{i,t-1}	-0.011*** (-7.380)	-0.030 (-0.343)	0.009 (0.131)
Lev _{i,t-1}	0.020** (2.260)	0.101 (0.405)	0.087 (0.412)
Roa _{i,t-1}	-0.127*** (-4.460)	-0.422 (-0.358)	0.338 (0.400)
Grow _{i,t-1}	0.006** (2.230)	0.069 (0.840)	0.040 (0.601)
JG _{i,t-1}	0.017 (1.050)	0.686* (1.724)	0.657* (1.933)
Equity _{i,t-1}	-0.015 (1.390)	0.439 (1.555)	0.536** (2.287)
Cross _{i,t-1}	-0.004 (-0.410)	-0.114 (-0.505)	-0.158 (-0.835)
State _{i,t-1}	-0.040*** (-12.060)	-0.919*** (-3.024)	-0.772*** (-3.496)
R&D _{i,t-1}	-0.369 (-4.770)	4.331 (1.224)	5.617** (2.052)
Cons	1.659*** (18.340)	0.172* (1.883)	0.173** (2.206)
Year	Yes	Yes	Yes
Ind	Yes	Yes	Yes
N	14258	14258	14258
Adj-R ²	0.117	0.326	0.326

Note: **, *** and **** represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

Table 5. Endogeneity tests using residual value as a proxy variable.

Variable	(1) Full sample QW _{i,t-1}	(2) Full sample Patent _{i,t}	(3) Full sample Patent _{i,t}	(4) Foreign directors' sample Patent _{i,t}
Dual _{i,t-1}	0.012*** (3.744)			
Indep _{i,t-1}	-0.006 (-0.210)			
Age _{i,t-1}	-0.307*** (-15.484)			
Tenure _{i,t-1}	-0.001 (-0.957)			
Gender _{i,t-1}	0.132*** (11.444)			
Bsize _{i,t-1}	-0.067*** (-8.986)			
DSZB _{i,t-1}	-0.011*** (-7.445)			
Meeting _{i,t-1}	0.004 (1.067)			
B_Comp _{i,t-1}	0.004*** (6.067)			
Residual _{i,t-1}		-0.146** (-2.218)	-0.225*** (-3.391)	0.303 (0.591)
CD _{i,t-1}			0.242** (2.570)	0.180 (1.166)
Residual _{i,t-1} × CD _{i,t-1}			2.713*** (4.626)	2.949*** (3.096)
Size _{i,t-1}		0.217*** (19.923)	0.216*** (19.773)	0.284*** (5.351)
Lev _{i,t-1}		-0.374*** (-6.581)	-0.367*** (-6.488)	-1.015*** (-3.141)
Roa _{i,t-1}		2.313*** (12.283)	2.315*** (12.295)	3.372*** (3.727)
Grow _{i,t-1}		-0.104*** (-7.475)	-0.103*** (-7.418)	-0.076 (-1.122)
JG _{i,t-1}		0.369*** (2.881)	0.382*** (2.982)	-0.897 (-1.592)
Equity _{i,t-1}		0.769*** (8.851)	0.778*** (8.931)	0.381 (1.136)
Cross _{i,t-1}		0.022 (0.264)	0.009 (0.112)	-0.848*** (-3.370)
State _{i,t-1}		-0.084*** (-3.808)	-0.080*** (-3.663)	0.377*** (3.263)
R&D _{i,t-1}		12.748*** (18.559)	12.710*** (18.511)	5.702** (2.016)
Cons	1.878*** (23.866)	-4.082*** (-18.116)	-4.046*** (-17.976)	-5.825*** (-5.473)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	14285	14285	14285	852
Adj-R ²	0.099	0.339	0.341	0.337

Note: "*, ** and ***" represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

model (8) under the full sample and the foreign director sample respectively. The results show that the interaction term between board cultural diversity and Residual_{i,t-1} has a significant positive effect on corporate innovation output, indicating that there is still a negative moderating effect of board cultural diversity on the relationship between board authority culture and corporate innovation after controlling for endogeneity issues, further supporting hypothesis H2a.

4.4.3. Endogeneity tests considering the effect of missing variables in directors' management style

Considering that directors with different management styles have their own considerations when serving in office, for those directors with an overconfident management style, their investment decisions on the firm are not negative, but rather lead to more corporate risk-taking and increased investment in corporate innovation (Yu et al., 2013). To address the possible endogeneity problem caused by the omission of the director management style variable, we refer to Jiang et al. (2009) and used whether the number of directors' shareholdings increased (Confident, with a value of 1 if the number of directors' shareholdings increased and 0 otherwise) to measure director overconfidence management style, and took the one-period lagged value as an additional control variable to bring into model (3) and model (4). The regressions are re-run and Table 6 shows the results of the empirical tests after controlling for the director overconfidence management style variable. The results in Table 6 show that the above findings remain consistent after controlling for the director management style variable.

4.4.4. Endogeneity tests using firm fixed effects model

Although the above further controls the variable factors of director characteristics, there may still be potential missing variables that cause endogenous problems. In order to solve this endogenous problem, we adopt the firm fixed effect model to deal with it. Table 7 is the specific empirical test results. The results show that, except for some variables, the significance of these variables has decreased, which is consistent with the above research conclusions, indicating that the above research conclusions are reliable.

4.5. Robustness tests

4.5.1. Alternative measurements of board authority culture

Referring to Wu et al. (2018), when measuring board authority culture, expert authority is removed and only the Gini coefficient is measured on the basis of total organisation authority, resource authority and reputation authority to measure the board authority culture variable. The re-measured board authority culture variables are then re-substituted into models (3) and (4) for a further regression. Our findings (untabulated) show that board authority culture has a negative effect on corporate innovation, board cultural diversity has a positive effect on corporate innovation, and negatively moderates the relationship between board authority culture and corporate innovation, indicating that the above findings still hold after replacing the measure of board authority culture variable.

4.5.2. Consider the effects of the type and rate of corporate innovation

The previous paper examined the relationship between board authority culture, board cultural diversity and corporate innovation, considering the impact on the total number of patents granted to firms, but did not address the issue of the type of patents granted and the rate at which patents are granted each year. To explore their impact on the type of innovation and the speed of innovation, this paper constructs innovation type variables (IPatent, UPatent, DPatent) and innovation speed variables (Grant1st, Grant2nd, Grant3rd and Grant4th) from the first to the fourth year, as detailed in the definitions of the variables shown in Appendix.

Table 6. Endogeneity tests considering the effect of missing variable in directors' management style.

Variable	(1)	(2)	(3)	(4)
	Full sample Patent _{i,t}	Full sample Patent _{i,t}	Full sample Patent _{i,t}	Foreign directors' sample Patent _{i,t}
$QW_{i,t-1}$	-0.146** (-2.059)		-0.212*** (-2.955)	0.897* (1.722)
$CD_{i,t-1}$		0.343*** (3.241)	-0.942*** (-2.603)	-0.810 (-1.386)
$QW_{i,t-1} \times CD_{i,t-1}$			2.420*** (3.587)	2.112** (1.975)
Dual _{i,t-1}	0.090*** (3.395)	0.090*** (3.404)	0.092*** (3.473)	0.275** (2.453)
Indep _{i,t-1}	-0.095 (-0.411)	-0.089 (-0.384)	-0.077 (-0.331)	-2.322** (-2.099)
Age _{i,t-1}	-0.426** (-2.556)	-0.480*** (-2.870)	-0.517*** (-3.098)	-0.852 (-1.070)
Tenure _{i,t-1}	0.024** (2.374)	0.025** (2.478)	0.025** (2.482)	0.091** (2.175)
Gender _{i,t-1}	-0.372*** (-4.066)	-0.390*** (-4.273)	-0.380*** (-4.158)	-0.570 (-1.360)
$DSZB_{i,t-1}$	0.082 (1.234)	0.081 (1.228)	0.075 (1.132)	0.350 (1.055)
$Meeting_{i,t-1}$	0.007 (0.753)	0.008 (0.862)	0.007 (0.755)	-0.016 (-0.303)
B_Comp _{i,t-1}	-0.128*** (-3.827)	-0.127*** (-3.801)	-0.126*** (-3.765)	-0.118 (-0.850)
Bsize _{i,t-1}	0.021*** (3.768)	0.020*** (3.642)	0.021*** (3.769)	0.009 (0.335)
Size _{i,t-1}	0.206*** (16.699)	0.207*** (16.796)	0.205*** (16.630)	0.258*** (4.355)
Lev _{i,t-1}	-0.329*** (-5.350)	-0.325*** (-5.306)	-0.320*** (-5.213)	-0.695** (-1.978)
Roa _{i,t-1}	2.224*** (11.007)	2.223*** (11.003)	2.231*** (11.043)	3.444*** (3.698)
Grow _{i,t-1}	-0.096*** (-6.405)	-0.096*** (-6.416)	-0.095*** (-6.394)	-0.042 (-0.559)
JG _{i,t-1}	0.334** (2.515)	0.352*** (2.645)	0.353*** (2.654)	-0.513 (-0.865)
Equity _{i,t-1}	0.757*** (8.309)	0.769*** (8.422)	0.767*** (8.409)	0.484 (1.332)
Cross _{i,t-1}	0.001 (0.013)	-0.002 (-0.020)	-0.008 (-0.098)	-0.735*** (-2.671)
State _{i,t-1}	-0.059** (-2.435)	-0.044* (-1.826)	-0.052** (-2.153)	0.408*** (3.177)
$R\&D_{i,t-1}$	12.104*** (16.806)	12.170*** (16.908)	12.099*** (16.816)	6.164** (2.125)
Confident _{i,t-1}	0.077*** (3.408)	0.080*** (3.506)	0.080*** (3.519)	-0.091 (-0.870)
Cons	-2.327*** (-3.515)	-2.224*** (-3.379)	-1.921*** (-2.897)	-2.629 (-0.831)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	14285	14285	14285	852
Adj. R ²	0.347	0.347	0.348	0.352

Note: **, *** and **** represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

Our findings (untabulated) show that board authority culture has a significant negative influence on invention patent innovation, utility model patent innovation and design patent innovation, which supports hypothesis H1a. Our findings (untabulated) show that

Table 7. Endogeneity tests using firm fixed effects model.

Variable	(1)	(2)	(3)	(4)
	Full sample Patent _{i,t}	Full sample Patent _{i,t}	Full sample Patent _{i,t}	Foreign directors' sample Patent _{i,t}
<i>QW</i> _{<i>i,t-1</i>}	-0.180*** (-2.851)		-0.023 (-0.358)	0.724 (1.369)
<i>CD</i> _{<i>i,t-1</i>}		0.384** (1.961)	-0.279 (-0.825)	-0.331 (-0.557)
<i>QW</i> _{<i>i,t-1</i>} × <i>CD</i> _{<i>i,t-1</i>}			0.891* (1.641)	1.916* (1.779)
<i>Dual</i> _{<i>i,t-1</i>}	0.022 (0.825)	0.045 (1.353)	0.012 (0.471)	0.293** (2.542)
<i>Indep</i> _{<i>i,t-1</i>}	0.281 (1.244)	0.157 (0.615)	0.149 (0.670)	-3.065*** (-2.958)
<i>Age</i> _{<i>i,t-1</i>}	-0.197 (-0.972)	-0.301 (-1.249)	-0.468** (-2.290)	-0.256 (-0.315)
<i>Tenure</i> _{<i>i,t-1</i>}	0.001 (0.214)	0.006 (0.679)	0.006 (0.815)	0.154*** (3.255)
<i>Gender</i> _{<i>i,t-1</i>}	-0.288*** (-2.598)	-0.448*** (-3.623)	-0.319*** (-2.882)	-1.212*** (-2.719)
<i>DSZB</i> _{<i>i,t-1</i>}	0.245*** (3.205)	0.128 (1.517)	0.174** (2.284)	-0.506 (-1.603)
<i>Meeting</i> _{<i>i,t-1</i>}	-0.001 (-0.114)	0.004 (0.479)	0.006 (0.814)	-0.012 (-0.235)
<i>B_Comp</i> _{<i>i,t-1</i>}	-0.075*** (-2.755)	-0.064** (-2.232)	-0.018 (-0.651)	-0.256 (-1.541)
<i>Bsize</i> _{<i>i,t-1</i>}	0.016*** (3.632)	0.018*** (3.642)	0.015*** (3.358)	0.004 (0.186)
<i>Size</i> _{<i>i,t-1</i>}	-0.004 (-0.255)	0.071*** (3.504)	0.007 (0.342)	0.233*** (3.757)
<i>Lev</i> _{<i>i,t-1</i>}	0.012 (0.168)	-0.251*** (-2.988)	-0.050 (-0.674)	-0.710* (-1.861)
<i>Roa</i> _{<i>i,t-1</i>}	0.788*** (4.812)	0.700*** (3.479)	0.522*** (3.191)	2.840*** (2.696)
<i>Grow</i> _{<i>i,t-1</i>}	-0.021* (-1.843)	-0.036*** (-3.389)	-0.020* (-1.739)	-0.105 (-1.370)
<i>JG</i> _{<i>i,t-1</i>}	-0.096 (-0.646)	0.152 (0.755)	-0.064 (-0.436)	-0.441 (-0.689)
<i>Equity</i> _{<i>i,t-1</i>}	-0.055 (-0.811)	0.152* (1.743)	0.024 (0.357)	0.042 (0.112)
<i>Cross</i> _{<i>i,t-1</i>}	-0.001 (-0.024)	0.002 (0.171)	-0.011 (-0.135)	-0.789*** (-2.956)
<i>State</i> _{<i>i,t-1</i>}	0.095* (1.799)	-0.143*** (-3.393)	0.109** (2.080)	0.466*** (3.395)
<i>R&D</i> _{<i>i,t-1</i>}	3.742*** (8.360)	4.657*** (7.774)	1.726*** (3.697)	14.623*** (4.806)
<i>Cons</i>	1.413* (1.761)	0.406 (0.427)	2.055** (2.387)	-0.695 (-0.223)
<i>Year</i>	Yes	Yes	Yes	Yes
<i>Firm</i>	Yes	Yes	Yes	Yes
<i>N</i>	14285	14285	14285	852
<i>Adj-R²</i>	0.171	0.186	0.177	0.193

Note: ***, **, and * represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

board cultural diversity negatively moderates the relationship between board authority culture and innovation in the three types of companies, further supporting hypothesis H2a.

Our findings (untabulated) show that board authority culture does not have a significant effect on the corporate innovation variable in the first and second year, while it has a significant negative effect on the corporate innovation in both

the third and fourth year, possibly due to the time lag of patent grant approval. Mostly, this supports the hypothesis H1a. Our findings (untabulated) show that board cultural diversity has a significant negative moderating effect on the impact of board authority culture and the speed of corporate innovation, but the moderating effect tends to decrease year on year after the second year, further supporting hypothesis H2a.

4.5.3. *Alternative measurements of corporate innovation*

Two measures are selected to re-measure the innovation performance variable: first, considering that patent grant has a certain lag, patent applications are used to portray the innovation performance variable, and the natural logarithm of the total number of patent applications plus one is selected to re-measure the corporate innovation variable (Apply); second, the innovation efficiency variable (Eff) is selected to re-measure corporate innovation. Referring to Hirshleifer et al. (2013), the firm's innovation efficiency indicator is measured as follows:

$$Eff = \frac{Patent_{i,t+1}}{R \& D_{i,t} + 0.8 * R \& D_{i,t-1} + 0.6 * R \& D_{i,t-2} + 0.4 * R \& D_{i,t-3} + 0.2 * R \& D_{i,t-4}}$$

Where R&D is a firm's R&D expenditure, the natural logarithm of a firm's R&D investment is chosen to measure this indicator. The regression results are shown in Table 5 after replacing the innovation efficiency variables above with patent applications (Apply) and the re-measured innovation efficiency variable (Eff) and bringing them into the model to re-run the regression. Our findings (untabulated) remain consistent with the findings above and have not changed substantially, indicating the robustness of the study findings.

4.5.4. *Alternative measurements of board cultural diversity*

Two approaches are taken to re-measure board cultural diversity: first, Referring to Frijns et al. (2016), the board cultural diversity variable is re-measured using the four cultural dimensions of power distance culture, individualistic culture vs. collectivistic culture, uncertainty avoidance culture, and masculine temperament culture vs. feminine temperament culture (CD1); second, instead of categorising Chinese identified directors as Chinese, but to re-categorise them according to their acquired nationality and re-measure board cultural diversity using Hofstede's six dimensions of culture (CD2). The re-measured board cultural diversity variables are then brought into model (4) for regression. Our findings (untabulated) show that their findings remain consistent with those above, indicating that the paper's findings remain robust after replacing the board cultural diversity variable.

5. Obedience effect and channel tests

5.1. *The obedience effect of board authority culture*

Based on the logic of the previous analysis, the board authority culture is not conducive to corporate innovation because of the trust and obedience of the inferior to the authoritative directors. It can be deduced that board authority culture has

a disincentive effect on corporate innovation when the inferior has an obedience effect on board authority culture. To test whether the board authority culture really has an obedience effect, this paper explores the inner mechanism of the influence of board authority culture on corporate innovation from the perspective of obedience of inferior directors.

First, set the obedience (Obey) variable of directors, and make a natural ranking according to the order of the board of directors disclosed in the financial report referring to Zhu et al. (2016). Then, manually collect and sort out the data on whether the bottom 50% of the directors expressed their objections in the board meeting and whether the company is found to have violations in the next year. If the last 50% of the directors do not raise objections but are found to have violations in the next year, the value is 1; if they do not raise objections and are not found to have violations in the next year, the value is 0; if they raise objections, the value is -1. Finally, the following models (9) and (10) are constructed:

$$Obey_{i,t-1} = a_0 + a_1QW_{i,t-1} + a_2Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (8)$$

$$Patent_{i,t} = a_0 + a_1Obey_{i,t-1} + a_2QW_{i,t-1} + a_3Obey_{i,t-1} \times QW_{i,t-1} + a_4Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (9)$$

Table 8 presents the results of the empirical test of the obedience effect of board authority culture. Column 1 of Table 8 shows that the board authority culture (QW) has a significant positive effect on the director obedience (Obey), which initially indicates that the board authority culture has an obedience effect; column 2 shows the effect of both the board authority culture (QW) and the director obedience (Obey) on the corporate innovation variable when put into the model. The results show that both the board authority culture (QW) and the director obedience (Obey) are significantly negative, indicating that both the board authority culture and the director obedience variables have an inhibitory effect on corporate innovation; column 3 shows the results of the empirical test of model 9, where the interaction term ($QW_{i,t-1} \times Obey_{i,t-1}$) of the board authority culture variable (QW) and the director obedience variable (Obey) has a significantly negative effect on corporate innovation, indicating that Board authority culture inhibits the increase in the level of corporate innovation by exerting the director obedience effect, i.e. board authority culture has an obedience effect; Column 4 examines whether board cultural diversity helps to inhibit the obedience effect of board authority culture, and the results show that the interaction term of the board authority culture variable (QW), the director obedience variable (Obey) and the board cultural diversity variable (CD_i) ($QW_{i,t-1} \times Obey_{i,t-1} \times CD_{i,t-1}$) is significantly positive, indicating that board cultural diversity helps to suppress the obedience effect of board authority culture and can enhance corporate innovation. Overall, when the inferior director has the obedience effect on the superior director, i.e. when the board authority culture has the obedience effect, the board authority culture has a suppressive effect on corporate innovation, and the board cultural diversity helps to suppress this obedience effect.

Table 8. The obedience effect of board authority culture.

Variable	(1) Obey _{i,t-1}	(2) Patent _{i,t}	(3) Patent _{i,t}	(4) Patent _{i,t}
QW _{i,t-1}	0.034* (1.827)	-0.161** (-2.184)	-0.784*** (-5.961)	-0.288** (-2.383)
Obey _{i,t-1}		-0.058* (-1.774)	-0.011 (-0.297)	-0.059* (-1.797)
QW _{i,t-1} × Obey _{i,t-1}			-0.150*** (-3.976)	0.031 (0.901)
CD _{i,t-1}				-1.152** (-2.569)
QW _{i,t-1} × Obey _{i,t-1} × CD _{i,t-1}				2.168*** (3.138)
Dual _{i,t-1}	0.007 (0.958)	0.091*** (3.399)	0.131*** (4.350)	0.093*** (3.453)
Indep _{i,t-1}	0.016 (0.282)	-0.083 (-0.347)	-0.090 (-0.341)	-0.069 (-0.289)
Age _{i,t-1}	-0.001 (-0.016)	-0.460*** (-2.663)	0.082 (0.423)	-0.519*** (-2.998)
Tenure _{i,t-1}	0.019*** (10.342)	0.024** (2.386)	0.020* (1.727)	0.026** (2.530)
Gender _{i,t-1}	-0.005 (-0.189)	-0.417*** (-4.424)	-0.868*** (-8.318)	-0.415*** (-4.407)
Bsize _{i,t-1}	0.004 (0.223)	0.105 (1.527)	-0.007 (-0.096)	0.101 (1.481)
DSZB _{i,t-1}	0.000 (0.100)	0.007 (0.677)	-0.018* (-1.731)	0.007 (0.686)
Meeting _{i,t-1}	0.054*** (6.139)	-0.121*** (-3.470)	-0.286*** (-7.427)	-0.118*** (-3.374)
B_Comp _{i,t-1}	-0.001 (-1.067)	0.021*** (3.675)	0.014** (2.531)	0.022*** (3.798)
Size _{i,t-1}	-0.014*** (-5.077)	0.200*** (15.681)	0.161*** (11.522)	0.199*** (15.587)
Lev _{i,t-1}	0.086*** (4.880)	-0.305*** (-4.772)	-0.517*** (-7.649)	-0.300*** (-4.703)
Roa _{i,t-1}	-0.213*** (-3.615)	2.344*** (11.214)	1.842*** (8.069)	2.337*** (11.196)
Grow _{i,t-1}	0.013** (2.400)	-0.098*** (-6.459)	-0.121*** (-7.846)	-0.098*** (-6.432)
JG _{i,t-1}	-0.018 (-0.628)	0.259* (1.858)	0.738*** (4.774)	0.274** (1.969)
Equity _{i,t-1}	-0.015 (-0.623)	0.761*** (8.427)	0.789*** (7.583)	0.771*** (8.526)
Cross _{i,t-1}	-0.023 (-1.435)	0.041 (0.456)	-0.034 (-0.325)	0.032 (0.353)
State _{i,t-1}	-0.038*** (-5.699)	-0.075*** (-3.011)	-0.259*** (-9.406)	-0.071*** (-2.840)
R&D _{i,t-1}	-0.032 (-0.243)	12.122*** (16.541)	22.851*** (29.152)	12.100*** (16.525)
Cons	1.226*** (7.117)	-2.028*** (-2.944)	-1.600** (-2.080)	-1.727** (-2.495)
Year		Yes	Yes	Yes
Ind		Yes	Yes	Yes
N	13453	13453	13453	13453
Adj. R ²	0.021	0.345	0.175	0.346

Note: ***, ** and * represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

5.2. Channel tests

Based on the previous theoretical analysis, it can be seen that during the execution of innovation activities, the management may be more willing to invest capital, energy and resources in projects with quick results and short cycle time due to their own interests, and less willing or less willing to invest in innovation activities, and there is management short-sightedness, while the board authority culture weakens the board's supervision of management short-sightedness, which is not conducive to the company's innovation level. The board authority culture weakens the Board's oversight of management short-sightedness, which is not conducive to improving the level of corporate innovation. Agency costs and management risk appetite, which are influenced by management short-sightedness, are important factors affecting the level of corporate innovation. Therefore, this paper explores the mechanisms underlying the influence of board authority culture on corporate innovation from the perspectives of agency costs and management risk appetite.

Firstly, referring to Chen et al. (2005), the proportion of in-service consumption to operating revenue is selected as the variable measuring agency cost (Perk); referring to Gan and Liu (2022), the ratio of risky assets to total corporate assets is used to measure the management risk appetite variable (Risk), with a larger value indicating a higher degree of management risk appetite. Then, agency costs and management risk preference variables are treated with a one-period lag. Finally, we construct models (11) to (14) as follows:

$$Perk_{i,t-1} = a_0 + a_1QW_{i,t-1} + a_2Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (10)$$

$$Patent_{i,t} = a_0 + a_1Perk_{i,t-1} + a_2QW_{i,t-1} + a_3Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (11)$$

$$Risk_{i,t-1} = a_0 + a_1QW_{i,t-1} + a_2Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (12)$$

$$Patent_{i,t} = a_0 + a_1Risk_{i,t-1} + a_2QW_{i,t-1} + a_3Control_{i,t-1} + \sum Year + \sum Ind + \varepsilon \quad (13)$$

Table 9 presents the results of the mediating effect test for the effect of board authority culture on innovation performance. The results in column (1) of Table 9 show that the board authority culture variable (QW) has a significant positive effect on the agency cost variable (Perk), indicating that the board authority culture weakens the supervision of management and increases the agency cost of management; column (2) shows that both the board authority culture variable (QW) and the agency cost variable (Perk) have a significant negative effect on corporate innovation, indicating that (2) shows that both the board authority culture variable (QW) and the agency cost variable (Perk) have a significant negative effect on corporate innovation, indicating that agency cost has a partial mediating effect between board authority culture and corporate innovation. The results in column (3) show that the board authority culture variable (QW) has a significant negative effect on management risk preference (Risk), indicating that board authority culture weakens the degree of management risk preference; Column (4) shows that the board authority culture variable (QW) and management risk preference (Risk) have negative and positive effects on firm innovation, respectively, indicating that

Table 9. Channel tests.

Variable	(1) Perk _{i,t-1}	(2) Patent _{i,t}	(3) Risk _{i,t-1}	(4) Patent _{i,t}
QW _{i,t-1}	0.002** (2.548)	-0.167** (-2.241)	-0.022*** (-3.568)	-0.143** (-2.017)
Perk _{i,t-1}		-5.050*** (-6.526)		
Risk _{i,t-1}				0.588*** (6.064)
Dual _{i,t-1}	0.000 (1.053)	0.087*** (3.224)	0.006** (2.522)	0.091*** (3.466)
Indep _{i,t-1}	0.005** (2.359)	-0.091 (-0.381)	0.019 (1.023)	-0.121 (-0.522)
Age _{i,t-1}	-0.004** (-2.058)	-0.511*** (-2.949)	0.016 (1.126)	-0.440*** (-2.642)
Tenure _{i,t-1}	-0.000 (-0.006)	0.024** (2.329)	0.003*** (2.916)	0.021** (2.146)
Gender _{i,t-1}	0.001 (0.713)	-0.391*** (-4.144)	-0.026*** (-3.006)	-0.363*** (-3.965)
Bsize _{i,t-1}	0.002*** (3.514)	0.099 (1.436)	-0.027*** (-5.217)	0.096 (1.444)
DSZB _{i,t-1}	0.000** (2.293)	0.008 (0.808)	0.003*** (3.358)	0.005 (0.569)
Meeting _{i,t-1}	0.001*** (3.465)	-0.123*** (-3.562)	0.013*** (4.730)	-0.132*** (-3.935)
B_Comp _{i,t-1}	0.000** (2.219)	0.021*** (3.572)	-0.000 (-0.657)	0.022*** (3.961)
Size _{i,t-1}	-0.002*** (-18.590)	0.199*** (15.309)	-0.020*** (-21.082)	0.220*** (17.800)
Lev _{i,t-1}	-0.004*** (-5.022)	-0.376*** (-5.905)	0.059*** (10.037)	-0.372*** (-6.085)
Roa _{i,t-1}	-0.012*** (-4.137)	2.251*** (10.676)	0.102*** (5.257)	2.193*** (10.850)
Grow _{i,t-1}	-0.001** (-2.209)	-0.098*** (-6.312)	0.002 (1.295)	-0.095*** (-6.330)
JG _{i,t-1}	0.008*** (6.397)	0.331** (2.349)	0.085*** (6.700)	0.296*** (2.221)
Equity _{i,t-1}	-0.001 (-1.112)	0.787*** (8.593)	0.028*** (3.669)	0.773*** (8.580)
Cross _{i,t-1}	0.003*** (3.657)	-0.013 (-0.150)	0.012** (2.091)	-0.013 (-0.153)
State _{i,t-1}	-0.002*** (-6.393)	-0.070*** (-2.761)	-0.010*** (-4.602)	-0.066*** (-2.749)
R&D _{i,t-1}	-0.026*** (-5.534)	11.902*** (16.387)	0.752*** (15.275)	11.954*** (16.580)
Cons	0.056*** (8.171)	-1.758** (-2.537)	0.486*** (8.575)	-2.579*** (-3.892)
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	13418	13418	13143	13143
Adj. R ²	0.208	0.348	0.085	0.348
Sobel test		-0.016** (-2.44)		-0.016** (-2.01)

Note: **, ***, and **** represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

management risk preference has a partial mediating effect between board authority culture and firm innovation. The test results of the Sobel test are significant, further validating the mediating effects of agency costs and management risk preference. It indicates that board authority culture inhibits corporate innovation through the path of increasing agency costs and weakening management risk preferences.

6. Additional tests

To further examine the differential impact of heterogeneity in directorship and background, the paper then examines the relationship between board authority culture, board cultural diversity and corporate innovation in the context of differences in top authority directorship and differences in chairmanship authority types.

6.1. The effect of the highest authoritative director

To further test the relationship between board authority culture, board cultural diversity and corporate innovation under the difference in top authority directorship. Referring to Zhan et al. (2015), the highest-ranking director among board members is defined as the highest authoritative director, and the highest authoritative directorship is divided into five categories: chairman and managing director, chairman, managing director, independent director, and ordinary director, in order to examine the differences brought about by each category of authoritative directorship.

Table 10 reports the results of the empirical tests of the relationship between board authority culture, board cultural diversity and corporate innovation under the difference in supreme authority directorship. Columns (1) to (4) show the results of the empirical tests under the full sample. The interaction term between board authority culture and board cultural diversity ($QW_{t-1} * CD_{t-1}$) on corporate innovation has a significant positive relationship when the highest authoritative director is the chairman, a significant negative relationship when the highest authority directorship is independent, and a significant negative relationship when the highest directorship is chairman and managing director, ordinary director and The moderating effect is not significant when the highest-ranking director is the chairman and managing director, the ordinary director and the managing director. Columns (5) to (9) show the results of the empirical tests under the foreign director sample. The positive effect of the interaction term between board authority culture and board cultural diversity on corporate innovation is only significant when the highest authority director is the chairman of the board, has a significant negative relationship when the highest authority directorship is as an independent director, and is not significant when the highest authoritative status is as chairman and general manager, ordinary director, and general manager.

The possible reasons for the above test results are that the traditional Chinese culture follows a hierarchical cultural structure and the culture within the board is more influenced by the authority factor of the chairman. When a foreign culture enters, if the chairman has the highest authoritative status, he can well coordinate the conflicts between local and foreign directors, effectively absorb the beneficial elements of foreign board cultural diversity and realise the beneficial effects on corporate innovation The Chairman of the Board of Directors has the highest authority. If the chairman of the board and the general manager have the highest authoritative status, they have the dual support of the highest authority in both the formal and informal systems, and it is easy for the chairman of the board to have a 'one-man rule' within the board. According to Wu et al. (2017), the high personal authority of the chairman under the logic of the 'shareholder-centric' system tends to form his own 'circle' within the board of directors, and the board of directors outside the circle, due to the authority of the chairman, has a 'false



Table 10. The effect of the highest authoritative director.⁴

Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)			
	Full sample Chairman and General Manager		Full sample Chairman		Full sample General Manager		Full sample Independent Directors		Full sample Ordinary Directors		Foreign directors' sample Chairman and General Manager		Foreign directors' sample Chairman		Foreign directors' sample Independent Directors		Foreign directors' sample Ordinary Directors			
	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}	Patent _{i,t}		
QW _{i,t-1}	0.151 (0.498)	-0.314*** (-3.358)	-0.034 (-0.076)	-0.021 (-0.083)	-0.216 (-1.116)	-0.073 (-0.059)	0.162 (0.194)	7.542** (2.061)	2.380** (2.316)											
CD _{i,t-1}	-1.007 (-0.963)	-0.992** (-2.106)	0.731 (0.455)	5.201*** (3.757)	-1.355 (-1.467)	-0.847 (-0.635)	-1.494* (-1.827)	13.428*** (3.193)	-0.893 (-0.691)											
QW _{i,t-1} × CD _{i,t-1}	3.109	2.114**	0.324	-8.374***	3.364	4.267	2.606*	-25.790***	2.061											
Dual _{i,t-1}	(1.559) 0.167**	(2.339) -0.004	(0.104) 0.334	(-3.173) 0.033	(1.524) 0.100	(1.581) 0.287	(1.744) 0.046	(-3.277) 0.423	(0.887) 0.325											
Indep _{i,t-1}	(1.976) 2.185**	(-0.049) -0.899***	(1.448) -0.673	(0.395) 0.904	(1.435) 0.232	(0.949) 0.344	(0.129) -5.035***	(0.778) 6.650	(1.353) -3.583											
Age _{i,t-1}	(2.332) -1.144*	(-2.888) -0.239	(-0.522) 0.313	(1.208) -0.956	(0.332) (-1.181)	(0.121) -0.906	(-3.302) 0.192	(1.122) 4.681	(-1.490) 1.053											
Tenure _{i,t-1}	(-1.824) 0.023	(-1.073) 0.008	(0.293) 0.067	(-1.624) 0.041	(-1.181) 0.045*	(-0.473) 0.060	(0.156) 0.000	(0.916) -0.091	(0.572) 0.114											
Gender _{i,t-1}	(0.671) -0.874***	(0.575) -0.180	(1.198) -0.466	(1.172) -0.604**	(1.800) -0.299	(0.508) -1.341	(0.006) 0.559	(-0.372) 0.481	(1.289) -1.977**											
Bsize _{i,t-1}	(-2.598) 0.271	(-1.429) -0.029	(-0.806) 0.044	(-2.030) 0.375*	(-1.155) 0.107	(-1.076) -0.017	(0.789) 0.311	(0.231) 2.350	(-2.020) 0.295											
DSZB _{i,t-1}	(0.868) 0.038	(-0.317) -0.297	(0.108) 0.023	(1.867) -0.010	(0.557) 0.022	(-0.017) -0.104	(0.596) 0.018	(1.413) -0.105	(0.408) 0.020											
Meeting _{i,t-1}	(1.021) -0.108	(-0.297) -0.174***	(0.437) 0.355*	(-0.353) -0.104	(0.883) (-0.076)	(-0.776) 0.329	(0.248) -0.164	(-0.299) -0.891	(0.162) -0.351											
B_Comp _{i,t-1}	(-0.879) 0.098***	(-3.873) 0.019***	(1.823) 0.066	(-0.956) 0.045*	(-0.879) 0.008	(0.832) -0.205	(-0.734) -0.006	(-1.642) (-0.075)	(-1.194) 0.035											
Size _{i,t-1}	(3.411) 0.262***	(2.671) 0.187***	(1.595) 0.071	(1.932) 0.243***	(0.603) 0.214***	(-0.880) 0.910***	(-0.179) 0.161*	(-1.145) 0.736**	(0.837) 0.115											

(Continued)

⁴The test results for the highest authoritative directorship of the foreign director sample being the managing director are not presented here as the sample of foreign directors whose highest authoritative directorship is the managing director is small and is automatically excluded in the regression processing.

Table 10. (Continued).

Variable	(1) Full sample		(2) Full sample		(3) Full sample		(4) Full sample		(5) Full sample		(6) Foreign directors' sample		(7) Foreign directors' sample		(8) Foreign directors' sample		(9) Foreign directors' sample	
	Chairman and General Manager Patent _{i,t}	Patent _{i,t}	Chairman Patent _{i,t}	Patent _{i,t}	General Manager Patent _{i,t}	Patent _{i,t}	Independent Directors Patent _{i,t}	Patent _{i,t}	Ordinary Directors Patent _{i,t}	Patent _{i,t}	Chairman and General Manager Patent _{i,t}	Patent _{i,t}	Chairman Patent _{i,t}	Patent _{i,t}	Independent Directors Patent _{i,t}	Patent _{i,t}	Ordinary Directors Patent _{i,t}	Patent _{i,t}
Lev _{i,t-1}	(5.059)	(11.215)	(0.917)	(6.166)	(6.121)	(3.737)	(1.679)	(2.194)	(0.956)	(1.215)	(3.737)	(1.679)	(2.194)	(0.956)	(1.215)	(3.737)	(1.679)	(2.194)
	-0.437*	-0.432***	0.140	-0.494**	-0.268	-4.317***	-0.253	-4.317***	-0.091	-0.437*	-4.317***	-0.253	-4.317***	-0.091	-0.437*	-4.317***	-0.253	-4.317***
	(-1.818)	(-4.228)	(0.343)	(-2.358)	(-1.634)	(-3.412)	(-0.486)	(-2.358)	(-0.129)	(-1.818)	(-3.412)	(-0.486)	(-2.358)	(-0.129)	(-1.818)	(-3.412)	(-0.486)	(-2.358)
Roa _{i,t-1}	3.498***	1.764***	4.336***	2.041***	2.400***	1.082	3.195**	1.110	7.569***	3.498***	1.082	3.195**	1.110	7.569***	3.498***	1.082	3.195**	1.110
	(4.660)	(6.396)	(4.007)	(2.947)	(4.603)	(0.402)	(2.025)	(2.220)	(4.577)	(4.660)	(0.402)	(2.025)	(2.220)	(4.577)	(4.660)	(0.402)	(2.025)	(2.220)
	-0.139***	-0.083***	-0.165*	-0.040	-0.078**	-0.285	0.001	-0.021	-0.024	-0.139***	-0.040	0.001	-0.021	-0.024	-0.139***	-0.040	0.001	-0.021
	(-2.781)	(-4.434)	(-1.770)	(-0.826)	(-1.974)	(-0.918)	(0.008)	(-0.093)	(-0.146)	(-2.781)	(-0.826)	(0.008)	(-0.093)	(-0.146)	(-2.781)	(-0.826)	(0.008)	(-0.093)
JG _{i,t-1}	0.001	0.444**	0.470	-0.090	0.366	-0.717	-1.500*	5.810	-1.258	0.001	-0.717	-1.500*	5.810	-1.258	0.001	-0.717	-1.500*	5.810
	(0.003)	(2.532)	(0.579)	(-0.192)	(0.839)	(-0.364)	(-0.670)	(0.926)	(-0.670)	(0.003)	(-0.364)	(-0.670)	(0.926)	(-0.670)	(0.003)	(-0.364)	(-0.670)	(0.926)
Equity _{i,t-1}	0.504*	0.730***	2.064***	0.744***	1.071***	-1.507**	1.237**	2.327	-0.208	0.504*	-1.507**	1.237**	2.327	-0.208	0.504*	-1.507**	1.237**	2.327
	(1.915)	(5.691)	(3.858)	(2.797)	(4.508)	(-2.173)	(2.327)	(4.508)	(-0.257)	(1.915)	(-2.173)	(2.327)	(4.508)	(-0.257)	(1.915)	(-2.173)	(2.327)	(4.508)
	-0.749**	0.152	-1.630	-0.643*	0.085	-1.972**	0.022	0.085	-0.960	-0.749**	-1.972**	0.022	0.085	-0.960	-0.749**	-1.972**	0.022	0.085
	(-2.417)	(1.530)	(-1.099)	(-1.675)	(0.310)	(-2.088)	(0.071)	(0.310)	(-1.594)	(-2.417)	(-2.088)	(0.071)	(0.310)	(-1.594)	(-2.417)	(-2.088)	(0.071)	(0.310)
	-0.059	-0.065**	0.094	-0.090	-0.042	0.503	0.267	-0.042	0.625**	-0.059	0.503	0.267	-0.042	0.625**	-0.059	0.503	0.267	-0.042
	(-0.481)	(-2.037)	(0.610)	(-1.059)	(-0.603)	(1.044)	(1.396)	(-0.603)	(2.445)	(-0.481)	(1.044)	(1.396)	(-0.603)	(2.445)	(-0.481)	(1.044)	(1.396)	(-0.603)
R&D _{i,t-1}	10.602***	11.787***	15.048***	12.515***	12.056***	1.982	4.436	36.776***	8.345	10.602***	1.982	4.436	36.776***	8.345	10.602***	1.982	4.436	36.776***
	(4.787)	(11.001)	(3.294)	(5.826)	(7.368)	(0.388)	(0.836)	(3.587)	(1.623)	(4.787)	(0.388)	(0.836)	(3.587)	(1.623)	(4.787)	(0.388)	(0.836)	(3.587)
	-2.576	-2.016**	-4.458	-2.308	-1.855	-12.846	-3.116	-42.433*	-5.404	-2.576	-12.846	-3.116	-42.433*	-5.404	-2.576	-12.846	-3.116	-42.433*
	(-0.921)	(-2.338)	(-1.054)	(-0.967)	(-0.896)	(-1.485)	(-0.615)	(-1.879)	(-0.721)	(-0.921)	(-1.485)	(-0.615)	(-1.879)	(-0.721)	(-0.921)	(-1.485)	(-0.615)	(-1.879)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2047	7566	370	1301	3001	141	395	70	218	2047	141	395	70	218	2047	141	395	70
Adj-R ²	0.335	0.349	0.378	0.373	0.343	0.537	0.328	0.563	0.389	0.335	0.537	0.328	0.563	0.389	0.335	0.537	0.328	0.563

, *, and **** represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

consistency' in making board decisions. The board of directors outside of the circle, because of the authority of the chairman, is prone to 'false consistency' in group decision-making. Even with the introduction of a foreign board culture, it is difficult to shake the dual formal and informal authority of the chairman, and the negative effect of this culture of subordination is difficult to break. In addition, as independent directors are external directors, their influence in board decision-making is relatively weak, and even if they have the highest authority on the board, it is difficult to reconcile the contradictions between the various cultures within the board, making it difficult to achieve the integration of different board cultures and the expected positive impact on corporate innovation.

6.2. The effect of the type of chairman's authority

The above research has confirmed that the negative moderating effect of board cultural diversity on board authority culture and corporate innovation only holds when the highest authority director is the chairman of the board. Next, we examine the relationship between board authority culture, board cultural diversity and corporate innovation in the context of differences in the type of authority of the chairman. Referring to the above measures of board authority culture variables, we divide them into four groups according to the type of chairman authority, such as whether the chairman has reputation authority, expert authority, resource authority and organisation authority, in order to examine the differences brought about by each type of chairman authority.

Table 11 reports the results of testing the relationship between board authority culture, cultural diversity, and corporate innovation under the difference in chairman authority dimension. Panel A is the empirical test results under the full sample. The results of column (1) and column (2) show that the interaction term between board authority culture and board cultural diversity has a significant positive impact on corporate innovation in the group of chairmen with reputation authority relative to the group of chairmen without reputation authority. The results in columns (3) and (4) show that the interaction term between board authority culture and board cultural diversity has a significant positive effect on corporate innovation regardless of whether the chairman has expert authority or not, but the results of the Chow test do not find a significant difference between the two groups; The results in Column (5) and Column (6) show that the interaction term between board authority culture and board cultural diversity has a significant positive effect on corporate innovation, while no significant effect is found in the group where the chairman has resource authority and passes the subgroup difference test, indicating that the negative moderating effect of board cultural diversity on the relationship between board authority culture and corporate innovation is more likely to be exerted when the chairman does not have resource authority; the results in Column (7) and Column (8) show that the positive effect of the interaction term between board authority culture and board cultural diversity on corporate innovation is more significant when the chairman does not have organisation authority than when the chairman has organisation authority, and passes the group difference test, indicating that the negative moderating effect of board cultural diversity on the relationship between board authority culture and corporate innovation is more significant when the chairman does not have organisation authority. Panel B is a sample of expatriate Panel B is the results of the empirical test for the foreign director sample, and its findings remain consistent with those presented in Panel A.

Table 11. The effect of the type of chairman's authority.

Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	The chairman has reputation authority		The chairman non-reputation authority		The chairman expert authority		The chairman non-expert authority		The chairman resource authority		The chairman resource authority		The chairman has organization authority		The chairman non-organization authority	
	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}	Patent _{i,t}	Patent _{i,t-1}
Panel A: Results of the empirical test with the full sample.																
QW _{i,t-1}	-0.041	-0.454***	0.151	-0.277***	0.001	-0.301***	-0.277***	0.001	-0.301***	-0.177*	-0.301***	-0.177*	-0.277***	-0.177*	-0.277***	-0.177*
	(-0.439)	(-3.986)	(0.996)	(-3.435)	(0.009)	(-3.435)	(-3.435)	(0.009)	(-3.435)	(-1.832)	(-3.435)	(-1.832)	(-2.540)	(-1.832)	(-2.540)	(-1.832)
CD _{i,t-1}	-1.294***	0.739	-1.533**	-0.660	-0.153	-1.098***	-0.660	-0.153	-1.098***	-1.078***	-1.098***	-1.078***	-1.003	-1.078***	-1.003	-1.078***
	(-3.621)	(1.054)	(-2.386)	(-1.585)	(-0.197)	(-2.744)	(-1.585)	(-0.197)	(-2.744)	(-2.404)	(-2.744)	(-2.404)	(-1.553)	(-2.404)	(-1.553)	(-2.404)
QW _{i,t-1} × CD _{i,t-1}	2.998***	-0.346	3.597***	1.913**	0.629	2.831***	1.913**	0.629	2.831***	2.898	2.831***	2.898	1.989*	2.831***	1.989*	2.831***
	(4.606)	(-0.288)	(2.799)	(2.526)	(0.418)	(3.876)	(2.526)	(0.418)	(3.876)	(1.366)	(3.876)	(1.366)	(1.822)	(3.876)	(1.822)	(3.876)
Cons	-1.951**	-1.876	0.379	-2.364***	2.482**	-4.070***	-2.364***	2.482**	-4.070***	-2.106**	-4.070***	-2.106**	-1.962*	-4.070***	-1.962*	-4.070***
	(-2.395)	(-1.632)	(0.276)	(-3.172)	(2.136)	(-4.897)	(-3.172)	(2.136)	(-4.897)	(-2.442)	(-4.897)	(-2.442)	(-1.871)	(-4.897)	(-1.871)	(-4.897)
Control _{i,t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9681	4604	4768	9517	5001	9284	9517	5001	9284	8366	9284	8366	5918	8366	5918	8366
Adj. R ²	0.356	0.330	0.291	0.357	0.377	0.339	0.357	0.377	0.339	-0.731*	0.339	-0.731*	0.342	0.339	0.342	0.339
Chow test		0.244**		-0.288		-0.731*										1.026***
Panel B: Results of empirical tests under a sample of foreign directors.																
QW _{i,t-1}	0.008	2.009**	1.483	0.890	0.929	0.943	0.890	0.929	0.943	2.027***	0.943	2.027***	-0.867	2.027***	-0.867	2.027***
	(0.012)	(2.202)	(1.586)	(1.602)	(1.209)	(1.467)	(1.602)	(1.209)	(1.467)	(2.776)	(1.467)	(2.776)	(-1.057)	(2.776)	(-1.057)	(2.776)
CD _{i,t-1}	-2.027***	1.801	-0.193	-0.449	1.760	-1.367**	-0.449	1.760	-1.367**	-0.515	-1.367**	-0.515	-2.313**	-1.367**	-2.313**	-1.367**
	(-2.948)	(1.365)	(-0.197)	(-0.662)	(1.612)	(-1.977)	(-0.662)	(1.612)	(-1.977)	(-0.663)	(-1.977)	(-0.663)	(-2.311)	(-0.663)	(-2.311)	(-0.663)
QW _{i,t-1} × CD _{i,t-1}	4.094***	-1.524	2.091	1.082	-1.089	2.931**	1.082	-1.089	2.931**	1.303	2.931**	1.303	4.288**	2.931**	4.288**	2.931**
	(3.263)	(-0.692)	(1.086)	(0.893)	(-0.562)	(2.374)	(0.893)	(-0.562)	(2.374)	(0.893)	(2.374)	(0.893)	(2.407)	(2.374)	(2.407)	(2.374)
Cons	-6.206*	6.871	-3.981	-5.566	3.985	-7.786**	-5.566	3.985	-7.786**	-4.454	-7.786**	-4.454	4.126	-7.786**	4.126	-7.786**
	(-1.672)	(0.896)	(-0.586)	(-1.554)	(0.642)	(-1.993)	(-1.554)	(0.642)	(-1.993)	(-1.153)	(-1.993)	(-1.153)	(0.670)	(-1.153)	(0.670)	(-1.153)
Control _{i,t-1}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	635	217	304	548	270	582	548	270	582	539	582	539	313	539	313	539
Adj. R ²	0.368	0.451	0.420	0.448	0.553	-0.676*	0.448	0.553	-0.676*	0.372	-0.676*	0.372	0.374	0.372	0.374	0.372
Chow test		0.558**		-0.105												1.255**

, **, * and * represent the 10%, 5% and 1% levels of significance, respectively. All reported t-statistics are based on the robust standard errors clustering at firm level.

In summary, the effect of board cultural diversity on the relationship between board authority culture and corporate innovation is not significantly different in any of the groups of whether the chairman has expert authority, while it is significantly different in the groups of whether the chairman has reputation authority, resource authority and organisation authority. The possible reasons for this are, firstly, that when the chairman has reputation authority, he or she can obtain more resources for the company that can contribute to corporate innovation and promote the level of corporate innovation; secondly, when the chairman does not have resource authority, the company's board culture will be less influenced by politically connected factors, and there will be less interference with the positive effect of board cultural diversity, which helps to play a role in cultural diversity on the relationship between board authority culture. Third, when the chairman does not have organisation authority, it is easier to win the trust of other board members, and other board members can express their views more freely, which helps to bring into play the positive effect of board cultural diversity and negatively regulate the influence of board authoritative culture on corporate innovation.

7. Conclusion

Previous studies have not provided a clear answer to whether this type of board culture has a facilitating or inhibiting effect on corporate innovation, due to the differences in the ability and influence of individual directors within Chinese boards. In addition, with the implementation of the 'Go Global' strategy and the 'the Belt and Road' strategy of Chinese companies, more and more foreign talents have been coming into the Chinese board to take up directorships. What impact does the cultural diversity of foreign boards have on the original authoritative culture of Chinese boards, and what kind of board culture should Chinese boards build to help companies innovate?

Based on the above questions, this paper focuses on the theme of 'what kind of board culture is more conducive to corporate innovation', and explores the relationship between board authority culture, board cultural diversity and corporate innovation using the data of Chinese A-share listed companies from 2007 to 2016 as a sample. The findings show that the relationship between board authority culture and corporate innovation is negatively correlated; board cultural diversity can negatively regulate the relationship between board authority culture and corporate innovation. The obedience effect and mechanism tests find that the main reason why board authority culture inhibits corporate innovation is that board authority culture has an obedience effect and inhibits corporate innovation through the path of increasing agency costs and weakening management risk preferences; further research find that the negative moderating effect of board cultural diversity on the relationship between board authority culture and corporate innovation is only found in the highest It is further found that the negative moderating effect of board cultural diversity on the relationship between board authority culture and corporate innovation is only established under the condition that the highest authoritative directorship is that of the chairman, and it is more helpful when the chairman of the board has reputation authority but not political resource authority and organisation authority.

The findings of this paper have the following implications: firstly, the differences in individual directors' abilities and influence may create the board authority culture, and inhibit the level of corporate innovation through the resulting obedience effect. Secondly, the introduction of foreign cultures that can integrate with Chinese board cultures and the construction of a diverse board culture can negatively regulate the negative impact of the original board authority culture on corporate innovation, therefore, the Chinese boards should strengthen their internal cultural construction and build a diverse board culture, especially by focusing on introducing cultures that can be integrated with the Chinese board culture. Thirdly, the identity of the highest authority director and the arrangement of the position need to be re-understood. When the chairman of the board is the highest authoritative director, he can better coordinate the conflicts between different board members and effectively promote the integration of different board cultures, which in turn helps corporate innovation; however, when the chairman of the board and the general manager are the highest authoritative director, it is difficult to play the coordinating role of the chairman. It is recommended to reduce the internal power allocation arrangement of the integration of two positions, construct the true sense of 'board centralism', reduce the erosion and influence of 'shareholder centralism' on the board power; Fourthly, when selecting the chairman of the board, the company needs to comprehensively examine the personal background of the chairman, dialectically look at his politically affiliation resources and consider whether he has a high social reputation. It is recommended that companies with diverse board culture should focus on selecting talents with high social reputation but not political resource background as the chairman, because the chairman with such background can more effectively play the positive role of board culture on corporate innovation.

This paper also has some limitations. First, in reality, some listed companies may not be willing to apply for patents due to confidentiality, and their innovation ability is also strong. If these data can be reasonably distinguished and further tested, the reliability of the research conclusions will be enhanced; Second, the measurement of the board authority culture is the difficulty of this paper. At present, there is no authoritative and widely accepted measurement method. This paper uses the Gini coefficient of the sum of board reputation authority, expert authority, resource authority and organisation authority, which may not be precise enough. If more accurate methods can be taken to measure board authority culture, the reliability of the research conclusions of this paper will be increased; Third, Hofstede currently measures the board cultural diversity by scoring the cultures of various countries in various dimensions. However, Hofstede's own calculation of culture has certain limitations. For example, the use of the long-term oriented culture dimension has been questioned by later researchers. If more reliable cultures can be selected to measure the board cultural diversity in the later stage, it will enhance its research contributions in this field. The shortcomings of the above research will become the basis and consideration for further in-depth research in the future; Fourthly, this paper mainly measures the board cultural diversity by distinguishing foreign nationalities. There may be technological spillover in the process. For example, if the foreign advanced technological innovation culture is accepted, the possibility of technological spillover can be further distinguished by foreign nationalities in the future.

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Appendix

Variable definitions

Variable	Definitions
Patent	The natural logarithm of one plus the total number of patents authorised for invention, utility and design.
IPatent	Invention patent innovation, the natural logarithm of one plus the total number of patents authorised for invention.
UPatent	Utility patent innovation, the natural logarithm of one plus the total number of patents authorised for utility.
DPatent	Design patent innovation, the natural logarithm of one plus the total number of patents authorised for design.
Grant1st	The natural logarithm of one plus the total number of patent applications authorised for approval in the first year
Grant2nd	The natural logarithm of one plus the total number of patent applications authorised for approval in the second year
Grant3rd	The natural logarithm of one plus the total number of patent applications authorised for approval in the third year
Grant4th	The natural logarithm of one plus the total number of patent applications authorised for approval in the fourth year
ZZQW	organization authority, a dichotomous variable equals one if the director comes from the controlling shareholder unit or a family member, and zero otherwise.
ZJQW	Expert authority, a dichotomous variable equals one if the director is a technical expert authority, and zero otherwise.
ZYQW	Resource authority, a dichotomous variable equals one if the director has political affiliation background, and zero otherwise.
SYQW	Reputation authority, the sum of directors' part-time positions in other companies.
QW	Gini coefficient of the sum of the above four authorities
CD	Calculated according to model (1) and model (2)
Dual	A dichotomous variable equals one if the CEO serves also as the Chairperson of the board of directors, and zero otherwise.
Indep	The proportion of independent directors on board.
Bsize	The natural logarithm of the number of directors on board.
Age	The average age (in years) of all directors.
Tenure	The average tenure (in years) of all directors.
Gender	The proportion of female directors on board.
DSZB	See the above calculation steps for details
Meeting	The natural logarithm of the number of board meetings plus one.
B_Comp	The value of the total compensation of the company's directors divided by the total number of board members.
Size	The natural logarithm of total assets.
Grow	The rate of sales growth from year $t-1$ to year t .
Lev	Total debts divided by total assets.
JG	The number of shares held by institutional investors divided by the total shares issued.
ROA	Return on assets, which is calculated as net income divided by total assets.
Cross	Equals 1 if the company issues shares in A shares, B shares or H shares and 0 otherwise.
Equity	Management equity incentive, which is total equity compensation divided by total compensation.
State	A dichotomous variable which equals one if firm is a state-owned entity, and zero otherwise.
R&D	R&D expenditure divided by sales revenue.