Received 9 March 2023
Revised 21 August 2023
14 November 2023
Accepted 5 January 2024

Independent directors' status and R&D: a study based on Chinese cultural background

Shangkun Liang and Rong Fu
School of Accountancy, Central University of Finance and Economics, Beijing, China, and
Yanfeng Jiang
School of Economics and Management, Beijing University of Agriculture, Beijing, China

Abstract

Purpose – Independent directors are important corporate decision participants and makers. Based on the Chinese cultural background, this paper interprets the listing order of independent directors as independent directors' status, exploring their influence on the corporate research and development (R&D) behavior.

Design/methodology/approach – This paper studies A-share listed firms in China from 2008 to 2018 as the sample. The main method is ordinary least square (OLS) regression. We also use other methods to deal with endogenous problems, such as the firm fixed effect method, change model method, two-stage instrumental variable method, and Heckman two-stage method.

Findings – (1) Higher independent directors' status attribute to more effective exertion of supervision and consultation function, and positively enhance the corporate R&D investment. The increase of the independent director' status by one standard deviation will increase the R&D investment by 4.6%. (2) The above effect is more influential in firms with stronger traditional culture atmosphere, higher information opacity and higher performance volatility. (3) High-status independent directors promote R&D investment by improving the scientificity of R&D evaluation and reducing information asymmetry. (4) The enhancing effect of independent director' status on R&D investment is positively associated with the firm's patent output and market value.

Originality/value – This paper contributes to understanding the relationship between the independent directors' status and their duty execution from an embedded cultural background perspective. The findings of the study enlighten the improvement of corporate governance efficiency and the healthy development of the capital market.

Keywords Cultural background, Independent directors' status, R&D investment, R&D evaluation, Information asymmetry

Paper type Research paper

1. Introduction

The independent director system was originally established to restrain internal controlling shareholders, regulate the behavior of managers and safeguard the rights and interests of minority shareholders. The introduction of independent directors in a company can help

JEL Classification — G34, M14, Z13

The authors thank the reviewers and editors for their professional feedback and revision guidance.

Funding: This research was supported by the National Natural Science Foundation of China [72272164, 71872196] and National Office for Philosophy and Social Sciences [21&ZD145, 19ZDA098].

China Accounting and Finance Review
Vol. 26 No. 1, 2024
pp. 102-133
Emerald Publishing Limited
e-ISSN: 2307-3055
p-ISSN: 1029-807X
DOI 10.1108/CAFR-03-2023-0023

mitigate conflicts of interest between shareholders and agents and enhance monitoring efficiency. At the same time, as outside experts independent of the management, independent directors can bring strategic advice and resource support in a non-associated manner (Zhao & Zhou, 2013). The soul of the independent director system and the core of its effective performance is independence (Tan, 2003). The difficulty of directly observing and measuring the independence of independent directors has not only caused a lag in the corresponding academic research, but also brought into question the effectiveness of the entire independent director system. The recent financial fraud lawsuit against Kangmei Pharmaceutical Co. has once again sparked discussions in both academic and practical circles about the independence of independent directors. Five independent directors of Kangmei Pharmaceutical Co. are jointly and severally liable for hundreds of millions of dollars in civil damages for failing to timely identify the false entries in the annual reports involved in the case. Following the verdict of the case, a number of independent directors of listed companies submitted their resignations. This phenomenon has led to public concern that independent directors are merely "rubber stamps". Are independent directors serving in companies obedient to major shareholders and management, and not conducive to protecting the interests of investors and promoting corporate governance modernization? Currently, domestic scholars have attempted to explore the consequences of independent director independence in terms of the proportion and size of independent directors (Cong, 2004), diversity background (Adams & Ferreira, 2008), and board voting behavior (Ye, Zhu, Lu, & Zhang, 2011). But the independence portrayed in these studies is mainly based on formal institutional regulations or ex post performance results. Does the long-standing Chinese institutional background also shape certain characteristics and behaviors of independent directors, thus providing an opportunity to portray the independence of independent directors?

This paper explores the implementation of independent directors' supervisory and advisory functions in the Chinese capital market, based on a phenomenon that has received less attention in existing studies, namely the ranking of independent directors in the team of directors, supervisors and executives disclosed in annual reports. Throughout the ages, the importance of rankings is self-evident. Hierarchy is a fundamental element that emerges spontaneously in social life, giving order and coordination within socially dynamic collectives (Blader & Chen, 2012). Western sociological theory states that hierarchical structures imply a hierarchical order, which in turn reflects the power and status of individuals in the group (Jetten, Hornsey, & Adarves-Yorno, 2006). From the ancient ritual traditions as indicated by the idiom of "位尊权重" in the Xinhua Dictionary to the hierarchical concepts of "君为臣纲、父为子纲、夫为妻纲" in the literature of feudal society [1]. The vast and profound traditional Chinese cultural background has laid an important place for hierarchical ranking. This concept was subsequently inherited by Confucianism, and is reflected in one of the two basic principles advocated by Confucianism, namely "尊尊". It means that everyone should remain in his or her own position and should not overstep the hierarchy. Those in a superior position are superior to those in an inferior position, and that the latter should respect and obey the hierarchical gap (Du, Yin, & Lai, 2017, Du, Wei, & Lai, 2017) [2]. Fact-based observation reveals that Chinese listed companies assign different rankings to their independent directors in their annual reports [3]. Does the above cultural context mean that the independent directors' rankings also contain certain implications that affect the performance of their supervision and consultation functions? What impact does it have on the specific R&D decisions of the company and the value of the company? Exploring these questions has rich theoretical and practical implications for improving the system of independent directors in China and promoting the healthy development of the capital market.

Based on the above considerations, from the perspective of the order of presentation of independent directors in annual reports, this paper examines the impact of independent directors' status on companies' R&D decisions using a sample of Chinese A-share listed

companies from 2008 to 2020. The empirical results show that the elevation of the independent directors' status can stimulate companies to increase their R&D investment. Specifically, with each increase of one standard deviation in the independent director's position, R&D investment rises by 4.6%. Channel tests indicate that high-status independent directors primarily promote R&D investment by improving the scientificity of R&D evaluation and reducing information asymmetry. Heterogeneity tests show that the aforementioned promotion effect is stronger in companies with strong traditional cultural atmosphere, low information transparency, and high performance volatility. Economic consequence tests reveal that the enhancing effect of independent directors' status on R&D investment is positively associated with the firm's patent output and market value. These findings confirm the positive impact of independent directors' status on the effectiveness of their performance in the Chinese background.

The research in this paper has two possible implications.

First, it enriches the research related to the factors influencing corporate innovation from the perspective of independent director independence. Most of the studies have explored the drivers of corporate innovative behavior have been conducted from financial and governance factors such as financing constraints (Brown, Martinsson, & Petersen, 2012), economic policies (Gu, Chen, & Pan, 2018) and information quality (Zhong, 2018). The exploration of independent directors' independence has mostly started from the proportion of independent directors or their personal characteristics (Cong, 2004). Unlike previous studies, this paper examines the impact of ranking as an implicit rule on the effectiveness of independent directors' supervision and consultation from the perspective of an important non-financial factor, which is a useful addition to existing research on corporate innovation.

Second, it advances research on the consequences of independent directors' performance in the Chinese institutional background. This paper examines independent directors' status as determined by the order in which they are listed in a corporate's annual report, and finds that in the context of the Chinese distinctive cultural system that promotes "seniority", ranking is given far-reaching and significant significance and has an important impact on corporate decision-making. This finding has important practical value for optimizing the hierarchy of directors, supervisors and executives, evaluating and enhancing the effectiveness of independent directors' performance, and provides insights into the factors influencing the effectiveness of independent directors' performance in different cultural contexts.

Thirdly, the study extends the exploration of independent director characteristics. The ranking of independent directors is the average ranking of independent directors in the annual report, reflecting the relative position of independent directors in the executive group. At the same time, the higher the ranking of independent directors, the higher their independence, and correspondingly, they may be more respected and talented. This is fundamentally different from the proportion of independent directors that has received much attention in previous literature. The proportion of independent directors is the ratio of the number of independent directors to the total number of board members, reflecting the relative size of independent directors. Research on the proportion of independent directors assumes that independent directors have independence and homogeneity. However, within the same proportion of independent directors, distinct independent director characteristics can influence their independence and role effectiveness (Adams & Ferreira, 2008; Masulis, Wang, & Xie, 2012). Grounded in China's informal institutional context, this study concentrates on the ranking of independent directors in corporate annual reports, revealing that a higher ranking of independent directors in the disclosed executive team indicates elevated status and independence, enhancing their functional contribution. This finding challenges the assumption of homogeneity among independent directors, facilitates an explanation of the causes behind the ineffectiveness of independent director roles from the perspective of

executive power allocation, and enriches the exploration of independent director characteristics.

2. Literature review and hypothesis development

2.1 Literature review

2.1.1 The function of independent directors. Existing research on independent directors argues that independent directors primarily perform supervision and consultation functions in corporate governance. Studies advocating a supervision function argue that the supervision of corporate management by independent directors helps to balance the allocation of power and achieve efficient collaboration, thereby protecting the legitimate interests of minority shareholders (Fama & Jensen, 1983; Beasley, 1996). Studies advocating a consultation function argue that independent directors use their financial background (Adams & Ferreira, 2008), political background (Du, Zeng, & Du, 2014), academic background (Quan & Li, 2017), and overseas background (Masulis *et al.*, 2012) to provide professional information and practical advice to ensure that corporate strategies are scientific. In addition, some studies advocate that independent directors have a decision-making function. They argue that independent directors' objective and impartial participation in board decisions can make the decision-making checks and balances mechanism work to a greater extent (Xie, Su, & Wang, 2016).

2.1.2 The proportion of independent directors and corporate R&D behavior. Technological innovation, which drives economic growth and social progress, is an important way for firms to develop and accumulate knowledge and technology. R&D activities help companies acquire, absorb and apply cutting-edge technological resources. They promote technological upgrading, create an insulation mechanism against imitation by competitors, and drive economic growth and social progress (Hu, Li, & Guo, 2015). Such stock-based resources and capabilities are seen as key determinants of a firm's ability to maintain an edge in a highly competitive market and to reap long-term profits. However, R&D activities may also be restricted by self-interested or risk-averse motivated management due to their negative characteristics, such as long payback period and high relative risk (Richardson, 2006).

The relationship between independent directors and R&D behavior has been explored to some extent by academics. Earlier studies have explored the impact of independent director independence on corporate innovation by starting with the easily observable characteristic of the proportion of independent directors. Pearce and Zahra (1991) find that the proportion of independent directors is significantly and positively correlated with corporate R&D investment, but Xiao's (2016) study shows no correlation between the two, He and Chen (2009) even conclude a negative correlation. In this regard, some studies have argued that the lack of independence is the key reason why the current system of independent directors in China has failed to play a substantial role in corporate governance (Ye *et al.*, 2011), while others have fundamentally questioned whether independent directors are "rubber stamp" and "vase director" (Hermalin & Weisbach, 1991).

2.1.3 The characteristics of independent directors and corporate R&D behavior. As independence is difficult to observe directly, domestic and foreign scholars have gone on to study independent directors from the perspective of their differentiated personal characteristics. Li, Wang, and Zhang (2019) found that the enhancement of technically independent directors on a firm's innovation activities was mainly reflected in the ratio of R&D expenditure to sales, invention patent applications and grants, and utility model/design patent applications and grants. Qin and Zhang (2019) show that the loss of political affiliation of independent directors has a significant positive impact on a firm's innovation output. Cao, Wu, Wang, Fang, and Cui (2023) find that the resignation of independent directors with academic backgrounds leads to a sharp decline in corporate R&D investment. From these studies, it can be seen that the existing studies on independent directors and R&D investment

focus on their explicit characteristics and lack the examination of their implicit status characteristics. Nguyen and Nielsen (2010) suggest that the root cause of independent directors' relegation to a "vase" may be the overriding power of senior management over independent directors, making it difficult for independent directors to play a real role even if they are actively motivated to supervise and consult. Therefore, studying the independent directors' status based on the mechanism of informal hierarchy of power in the team of directors, supervisors and executives is more likely to effectively explain their effectiveness in performing their duties.

2.1.4 The function of independent directors' status. Existing literature has found that individuals with higher hierarchical rankings tend to express and implement their opinions more freely, whereas those with lower rankings tend to be more compliant (Ridgeway & Johnson, 1990; Gould, 2002; Jetten *et al.*, 2006). The distinctive cultural background of "seniority" in China highlights the significant role of seating arrangement in corporate governance (Jiang, Yao, & Chen, 2018; Zhu, Ye, Tucker, & Chan, 2016). Gao and Ma (2002) believe that independent directors with high visibility have higher independence and are more conducive to their supervisory and advisory functions. Zhu *et al.* (2016) argue that the listing sequence of directors in China's annual reports reflects the internal power distribution within the board, revealing that higher-ranking independent directors exert a stronger influence on corporate decisions, resulting in higher company value. Jiang *et al.* (2018) found, based on the unique institutional background in China, that financial directors in a higher position can reduce the risk of stock price collapse. The higher the ranking of independent directors in the team of directors, supervisors and executives in the annual report disclosure, the higher their status, and the correspondingly more respected and talented they may be, which in turn affects the performance of their supervision and consultation functions. Based on this reflection, this paper attempts to explore the impact of independent directors' status on corporate innovation decisions and its mechanisms.

2.2 Hypothesis development

Independence is central to the effective functioning of independent directors in governance, but the independence of independent directors in domestic enterprises is far from what is expected by the system. According to Cong (2004), the reasons for this are, on the one hand, the low proportion of independent directors to the total number of board members, who are subordinate to the chairman and directors in most companies. On the other hand, the limited incentive effect of ex-ante fixed annual salary on independent directors. Tan (2003) argues that if it is difficult to enhance the independence of independent directors by increasing their proportion, more power could be considered for independent directors. Unlike the formal hierarchical structure where individual authority and responsibilities are clearly defined, the basic feature of the board of directors is individual equality and one person one vote. Apart from the chairman of the board, there is no formal hierarchical relationship between board members in the formal sense. However, Xie, Zhang, Wu, and Dong (2017) pointed out that an elite board without a leader can hardly ensure its governance effectiveness. A clearly sequenced and distinguished difference in the status of directors is more helpful in improving the effectiveness of board governance. Related studies have also found that informal hierarchies formed spontaneously by board members based on their individual abilities and influence help to enhance director trust and overcome ineffective conflicts (Johnson, 2004), and have a positive contribution to corporate performance (He & Huang, 2011).

Zhu *et al.* (2016) argue that independent directors who are disclosed high in a company's annual report have more power and correspondingly greater independence. Jiang *et al.* (2018) also show that the top-ranked CFOs in the executive sequence have greater power to check the CEO. The high profile and experience of high-status independent directors make them

more concerned about maintaining reputational capital than avoiding loss of wealth and seats, and they have a greater incentive to use their expertise, an information advantage and social capital to perform their duties independently. This influence also affects decisions such as the corporate R&D investment.

Through a review and analysis of Resource-Based View, Upper Echelons Theory, and agency theory, we think that high-status independent directors can promote corporate R&D investment. This analysis unfolds from two perspectives:

Firstly, the discussion is from the perspective of enhancing the scientific nature of R&D evaluation. According to Resource-Based View (Grant, 1991), specialized skills and unique information serve as the driving forces behind sustained innovation within a company. High-status independent directors typically possess solid professional knowledge and skills. Moreover, the traditional cultural concept of "those of higher status speak first, those of lower status speak later" provides a safeguard for the consultation function of independent directors. Additionally, high-status independent directors act as a "gatekeeper" for the company's interactions with the external world, offering the ability to provide necessary information resources for corporate R&D. Therefore, on one hand, high-status independent directors can leverage their domain expertise to compensate for any gaps in managerial proficiency, thus enhancing the corporate R&D capabilities. On the other hand, owing to their understanding of market demands and the influence stemming from their high status, high-status independent directors are more likely to raise questions and offer reasonable queries (Hillman & Dalziel, 2003). In this way, high-level independent directors can assist the management in evaluating complex and uncertain R&D projects based on market demand, thereby promoting the company's R&D investment.

Secondly, the discussion is from the perspective of reducing information asymmetry. According to Upper Echelons Theory, the psychological characteristics of executives influence a company's development planning and strategic decision-making. R&D activities are characterized by long investment payback periods, relatively high risks, and information asymmetry. Therefore, R&D investment may create significant pressure on short-term financial performance and may cause resistance from risk-averse management. In the context of agency theory, when a company exhibits high levels of information asymmetry, management tends to prefer low-risk, short-term investment projects to decorate reported performance, which can hinder R&D efforts (Stein, 1988). High-status independent directors have high social attention and influence, and are more willing to consider the long-term development and value of the company. They have the motivation to suppress management's short-term behavior of reducing R&D investment. Moreover, High-status independent directors can reduce information acquisition costs and have high independence to inquire and obtain true accounting information due to their high status. This feature helps high-status independent directors suppress management's behavior of adjusting accounting profits by reducing R&D expenses, thereby promoting the company's research and development investment.

Based on the above analysis, we propose the following research hypothesis.

H1. High-status independent directors are helpful to enhance the corporate R&D investment.

3. Research design

3.1 Model construction and variable definitions

We designed regression model (1) to test the relationship between independent directors' status and R&D investment.

$$R\&D = \beta_0 + \beta_1 Status + \Sigma Control + \Sigma Industry + \Sigma Year + \Sigma Region + \varepsilon \quad (1)$$

Referring to Huang and Chen (2011), Liang, Yan, and Xu (2020) and Jiang, Xu, and Ban (2022), *R&D* is defined as the ratio of R&D investment to total assets. We use the ratio of R&D investment to main operation revenue for robustness testing.

Status is independent directors' status, referring to the measurement of CFOs' status defined by Jiang *et al.* (2018).

$$Status = 1 - Rank / Total \quad (2)$$

Rank is defined as the ranking of independent directors in the "Directors, Supervisors, Executives and Staff" section of the company's annual report. *Total* is defined as the total number of directors, supervisors and executives. The first person to be disclosed in the annual report has the smallest *Rank* as 1, and the last person disclosed with the largest *Rank* as the total number of directors, supervisors and executives of the company. Therefore, the earlier one independent director is disclosed, the larger *Status*, and the higher status one will get. *Status* is the annual average of all independent directors' status in each company. For examples of independent directors' status measurement, please see Appendix for Table A1 and Table A2.

Referring to Huang and Chen (2011) and Zhu *et al.* (2016), we included control variables in our regression. They are the concurrently general manager and chairman of the board Duality (*Duality*), leverage (*Lev*), return on assets (*ROA*), growth ability (*Growth*), Cash holding (*Cash*), firm size (*Size*), the percentage of shares held by the top shareholder (*Firsthold*), management shareholding ratio (*Manhold*), company listing years (*Listage*), board size (*Boardsize*), independent director ratio (*IndR*), book-to-market ratio (*Bm*) and nature of ownership (*SOE*). Table 1 reports the definitions and explanations of the main variables for baseline regression, robustness tests, and further analysis. To avoid the influence of extreme values, we winsorize all continuous variables at the 1% level.

3.2 Data sources and sample selection

We take the A-share listed companies of China from 2008 to 2020 as the research sample. We use the following process to refine the sample. (1) Eliminate ST and *ST observations. (2) Exclude the observations of financial industries. (3) Eliminate the missing or abnormal observations [4]. Our final sample included 18709 firm-year observations. The data used for the study were obtained from the CSMAR. The ranking of directors, supervisors and executives has been manually compared and adjusted according to the order of disclosure in the company's annual report. The statistical analysis was performed using Stata 14.0.

4. Empirical results and analysis

4.1 Descriptive statistics and correlation analysis

Table 2 Panel A reports the descriptive statistics of the main variables. The minimum value of *R&D* is 0, the maximum value is 0.108, the median value is 0.018 and the mean value is 0.021, which is consistent with Huang and Chen (2011). Compared with Chang, Fu, Low, and Zhang (2015), the R&D investment of Chinese companies still lags behind that of developed countries. The minimum value of *Status* is 0.088 and the maximum value is 0.800, which is consistent with Jiang *et al.* (2018). This means that independent directors are not listed in the same order in the annual report, with both at the beginning and the end. The descriptive statistics of other variables are within reasonable limits. Table 2 Panel B presents the descriptive statistics of *Status* across different industries. The results show that there is variation in *Status* among various industries, as indicated by the mean values. Industries

Name	Symbol	Definition
R&D investment	*R&D*	R&D investment/total assets
Independent directors' status	*Status*	1 - Annual report disclosure sequence of independent directors/total number of directors, supervisors and executives
Concurrently general manager and chairman of the board	*Duality*	A dummy variable that equals 1 if the general manager and the chairman of the board are the same person, and 0 otherwise
Leverage	*Lev*	Total debt/total assets
Return on assets	*ROA*	Profit/total assets
Growth ability	*Growth*	The ratio of the difference between the operating income at the year end and that at the beginning of the year to the operating income at the beginning of the year
Cash holding	*Cash*	Cash and cash equivalents/total assets
Firm size	*Size*	Log (total assets)
Percentage of shares held by the top shareholder	*Firsthold*	The shareholding ratio of the largest shareholder
Management shareholding ratio	*Manhold*	The shareholding ratio of the management
Company listing years	*Listage*	Log (Total number of company's listing years)
Board size	*Boardsize*	Log (total number of board members)
Independent director ratio	*IndR*	The ratio of the total number of independent directors to the total number of board members
Book-to-market ratio	*Bm*	Book value/Market value
Nature of ownership	*SOE*	A dummy variable that equals 1 if the company is state-owned, and 0 otherwise
Instrumental variables	*Status_prov*	Mean Independent Director Position within the Same Year and Province
Inverse mills ratio	*IMR*	Inverse Mills Ratio Calculated from Model (3) Regression
Independent directors' status 2	*Status2*	Mean Residual Obtained from Regression Using Model (4)
Promulgation of document no. 18	*DID*	Interaction Term of Group Identifier (*Treat*) and Event Period (*Post*). When the independent director position is elevated after the issuance of Document No. 18 in 2013, Treat takes the value of 1, otherwise 0; when the sample is before the year 2013, Post takes the value of 0, otherwise 1
R&D synchronicity 1	*HerdRD1*	Absolute Deviation of Company's R&D Investment Level from the Average R&D Investment Level of Industry Leaders in the Previous Year
R&D synchronicity 2	*HerdRD2*	Absolute Deviation of Company's R&D Investment Level from the Median R&D Investment Level within the Industry in the Previous Year
Earnings management 1	*AbsDA1*	Absolute Value of Discretionary Accruals Calculated using the Jones Model
Earnings management 2	*AbsDA2*	Absolute Value of Discretionary Accruals Calculated using the Lu Jianqiao Model
Proportion of board members with overseas background	*Overseas1*	Number of Board Members with Overseas Background/ Total Board Members
Proportion of independent directors with overseas background	*Overseas2*	Number of Board Members with Overseas Background/ Total Independent Directors
Chairman's overseas background dummy variable	*Overseas3*	Chairman with Overseas Background takes the value of 1; otherwise, it takes the value of 0
Regional cultural atmosphere intensity dummy variable	*Area*	Company's Registered Location in a High "Power Distance" Area takes the value of 1; otherwise, it takes the value of 0
Opacity of information 1	*Lowtrans1*	Standard Deviation of Operating Profit for the Past Three Years/Standard Deviation of Operating Cash Flow for the Past Three Years
Opacity of information 2	*Lowtrans2*	Mean Analyst Forecast Accuracy for the Company

Source(s): Table by authors

Table 1. Definition of the main variables in the study

Variable	No.	Mean	SD	Min	p25	p50	p75	Max
Panel A: descriptive statistics of key variables								
R&D	18709	0.021	0.019	0.008	0.018	0.029	0.000	0.108
Status	18709	0.526	0.108	0.467	0.533	0.600	0.088	0.800
Duality	18709	0.297	0.457	0.000	0.000	1.000	0.000	1.000
Lev	18709	0.401	0.196	0.244	0.392	0.545	0.052	0.928
ROA	18709	0.043	0.064	0.016	0.041	0.073	−0.412	0.224
Growth	18709	0.223	0.519	−0.003	0.127	0.304	−0.679	5.618
Cash	18709	0.162	0.123	0.075	0.127	0.212	0.010	0.615
Size	18709	22.090	1.239	21.196	21.907	22.771	19.566	27.664
Firsthold	18709	0.341	0.144	0.229	0.322	0.434	0.082	0.750
Manhold	18709	0.165	0.207	0.000	0.038	0.322	0.000	0.678
Listage	18709	1.831	0.922	1.099	1.946	2.639	0.000	3.296
Boardsize	18709	2.296	0.364	2.079	2.197	2.485	1.609	3.434
IndR	18709	0.330	0.096	0.333	0.333	0.400	0.115	0.571
Bm	18709	0.525	0.256	0.321	0.492	0.701	0.090	1.257
SOE	18709	0.288	0.453	0.000	0.000	1.000	0.000	1.000

Industry name	No.	Mean	SD	Min	p25	p50	p75	Max
Panel B: descriptive statistics of independent director status (status) by industry								
Agriculture, forestry, animal husbandry, and fishery	212	0.543	0.106	0.467	0.557	0.615	0.214	0.800
Mining industry	347	0.565	0.097	0.529	0.575	0.619	0.088	0.783
Food and beverage manufacturing	714	0.532	0.110	0.467	0.533	0.600	0.094	0.792
Textiles, clothing, leather, and fur manufacturing	490	0.500	0.103	0.429	0.500	0.571	0.212	0.800
Wood and furniture manufacturing	111	0.500	0.125	0.429	0.500	0.600	0.088	0.789
Papermaking, printing manufacturing	338	0.526	0.104	0.467	0.538	0.600	0.088	0.778
Petroleum, chemical, plastic, and rubber manufacturing	2017	0.516	0.107	0.462	0.529	0.583	0.088	0.800
Electronics manufacturing	2334	0.526	0.107	0.467	0.533	0.600	0.088	0.800
Metal, non-metal manufacturing	1545	0.525	0.106	0.467	0.533	0.591	0.088	0.800
Machinery, equipment, instrument manufacturing	4438	0.521	0.110	0.462	0.529	0.588	0.088	0.800
Pharmaceutical and biological products manufacturing	1460	0.524	0.103	0.467	0.529	0.591	0.088	0.800
Other manufacturing	458	0.532	0.106	0.462	0.538	0.600	0.088	0.800
Electricity, heat, gas, and water production and supply	306	0.557	0.090	0.500	0.563	0.618	0.282	0.800
Construction industry	483	0.576	0.114	0.500	0.577	0.648	0.214	0.800
Wholesale and retail trade	413	0.537	0.117	0.472	0.550	0.600	0.088	0.789
Transportation, warehousing, and postal services	236	0.536	0.107	0.467	0.532	0.600	0.278	0.800
Accommodation and catering services	21	0.527	0.040	0.500	0.528	0.556	0.425	0.600
Information technology industry	1633	0.525	0.109	0.467	0.533	0.600	0.088	0.800
Real estate industry	171	0.543	0.098	0.500	0.556	0.600	0.273	0.800
Rental and business services	196	0.501	0.102	0.438	0.500	0.559	0.167	0.800
Scientific research and technical services	209	0.538	0.102	0.500	0.556	0.596	0.214	0.800
Water conservation, environmental protection, and public facility management	216	0.535	0.091	0.500	0.529	0.600	0.329	0.800
Health and social work	68	0.515	0.105	0.462	0.527	0.600	0.214	0.700
Culture, sports, and entertainment	204	0.533	0.098	0.467	0.538	0.600	0.267	0.800
Comprehensive	89	0.572	0.102	0.525	0.571	0.632	0.261	0.789

Table 2.
Descriptive statistics

Source(s): Table by authors

with higher *Status* include Construction, Comprehensive Services, and Mining, with mean values of 0.576, 0.572, and 0.562. Industries with lower *Status* include Textile, Clothing, Fur Manufacturing, Wood and Furniture Manufacturing, and Leasing and Business Services, with mean values of 0.500, 0.500, and 0.501. By the way, the variance inflation factors (VIF) of the main variables in the model regressions are all below 3, so the multicollinearity problem does not seriously affect the empirical results.

4.2 Research hypothesis test

Table 3 reports the regression results of our hypothesis. To improve the robustness of the results, Model (1) controls for the industry fixed effect (*Industry*), year fixed effect (*Year*) and region fixed effect (*Region*). All tables report the *T*-values adjusted for firm-level clustering and robust standard errors in parentheses. The explained variable in Column (1) of Table 3 is current R&D investment (*R&D*). The results show that the regression

DepVar =	(1) *R&D*	(2) $R\&D_{t+1}$	(3) $R\&D_{t+2}$	(4) $R\&D_{t+3}$
Status	*0.009***	*0.009***	*0.010***	*0.009***
	(3.82)	*(3.49)*	*(3.18)*	*(2.68)*
Duality	0.001	0.000	0.000	0.001
	(1.04)	(0.83)	(0.53)	(0.81)
Lev	0.003*	0.003	0.002	0.001
	(1.90)	(1.53)	(0.85)	(0.41)
ROA	0.021***	0.026***	0.027***	0.030***
	(6.00)	(6.13)	(4.85)	(4.50)
Growth	−0.000	0.000	−0.000	−0.000
	(−0.60)	(0.67)	(−0.19)	(−0.83)
Cash	0.011***	0.013***	0.013***	0.012***
	(4.28)	(4.82)	(4.64)	(4.03)
Size	−0.000	−0.000	−0.001	−0.001
	(−0.98)	(−1.01)	(−1.24)	(−1.41)
Firsthold	−0.006***	−0.006***	−0.005**	−0.005*
	(−3.05)	(−2.83)	(−2.28)	(−1.88)
Manhold	0.001	0.001	0.000	0.000
	(0.86)	(0.55)	(0.17)	(0.23)
Listage	−0.001	−0.000	0.000	0.000
	(−1.64)	(−0.80)	(0.51)	(0.93)
Boardsize	0.002	0.002	0.002	0.002
	(0.90)	(1.09)	(0.96)	(0.75)
IndR	−0.004	−0.002	0.000	0.001
	(−0.81)	(−0.29)	(0.01)	(0.21)
Bm	−0.016***	−0.013***	−0.011***	−0.009***
	(−10.33)	(−7.46)	(−5.63)	(−4.44)
SOE	0.001*	0.001	0.001	0.001
	(1.79)	(1.55)	(1.21)	(1.28)
Constant	0.031***	0.026***	0.029***	0.031***
	(4.16)	(3.22)	(3.26)	(3.11)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	18,709	15,440	12,742	10,276
Adj-R^2	0.281	0.272	0.257	0.248

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

Table 3. Independent directors' status and corporate R&D investment

coefficients of *ROA* and *Cash* are positive and significant. Companies with high levels of profitability and high cash holdings are more resilient to risk and are in a stronger position to support R&D projects that are relatively slow to return capital. The findings are consistent with Liu and Xue (2015). The regression coefficient of *Firsthold* is negative and significant. Large shareholders with high shareholdings are more likely to encroach on the interests of minority shareholders, so there is less incentive for companies to innovate. The results are consistent with Liang *et al.* (2020). On this basis, the regression coefficient of *Status* is 0.009 and significant at the 1% level. Its economic significance is 0.046 [5]. The increase in the independent director's status by one standard deviation will increase the R&D investment by 4.6% relative to the mean. This result indicates that the higher the independent directors' status, the greater the corporate R&D investment, supporting the research hypothesis. However, does the independent directors' status have a short-term or long-term impact on the corporate R&D investment? We have explored further Columns (2), (3), and (4) of Table 3. The explained variables are future R&D investment in the following first, second and third periods respectively, those are $R\&D_{t+1}$, $R\&D_{t+2}$ *and* $R\&D_{t+3}$. The regression coefficients of *Status* in Columns (2), (3), and (4) are 0.009, 0.010 and 0.009, respectively, all of which are significant at the 1% level. Overall, these results suggest that independent directors' status positively enhances corporate R&D investment and this effect has a certain long-term effect.

4.3 Robustness test

4.3.1 The firm fixed effect method. The regression of the firm fixed effects model helps to alleviate the problem of missing variables in the model that does not change over time. Therefore, we use this method for the robustness test. The regression result is shown in Column (1) of Table 4. The coefficient of *Status* is positive and significant at the 10% level.

4.3.2 The change model method. To mitigate the effect that a company's fixed annual report format may have on the disclosure order of independent directors, we use a change model for the robustness test. The regression result is shown in Column (2) of Table 4. The coefficient of $\Delta Status$ is positive and significant at the 5% level [6].

4.3.3 Two-stage instrumental variables method. The rankings of independent directors in the same year and region tend to converge, but their impact on the R&D investment of individual companies is small. Therefore, referring to Gao, Ng, and Wang (2011) and Zhu *et al.* (2016), we select the mean of independent director status in the same year and province (*Status_prov*) as the instrumental variable. The two-stage instrumental variable method is used for endogeneity treatment to alleviate the endogeneity issues of missing variables and causal inversion in the study. The regression result is shown in Column (3) of Table 4. The coefficient of *Status* is positive and significant at the 1% level.

4.3.4 Heckman two-stage method. The aforementioned study indicates that the higher the independent directors' status, the greater the corporate R&D investment. However, the relationship between independent directors' status and the corporate R&D investment may be plagued by endogeneity problems of the self-selection effect. For example, companies with high market value may be more willing to prioritize the disclosure of independent directors. In addition, the personal characteristics of independent directors may also have an impact on their status. Therefore, we use the Heckman two-stage method for the robustness test. Referring to Zhu *et al.* (2016), we construct Model (3) as the first stage model. The explained variable in the first stage of the model is *Highstatus*, which equals 1 when independent directors' status exceeds the industry annual median, and 0 otherwise. The explanatory variables are the independent directors' personal characteristic variables (*Characteristic*) and the firm-level control variables (*Control*). The *Control* is the same as before. The *Characteristic* are as follows. *Gender,* female equals 1, male equals 0. *Age* is the natural logarithm of the age

Table 4.
Robustness test

DepVar =	(1) *R&D*	(2) *ΔR&D*	(3) *R&D*	(4) *R&D*	(5) *R&D*	(6) *R&D2*	(7) *R&D*	(8) *R&D*	(9) *R&D*	(10) *R&D*	(11) *R&D*
Status	*0.002**		*0.017****	*0.008****	*0.009****	*0.014****		*0.009****	*0.009****	*0.014****	
	(1.91)		*(5.13)*	*(5.69)*	*(3.85)*	*(2.61)*		*(3.82)*	*(3.75)*	*(3.97)*	
ΔStatus		*0.002***									
		(2.01)									
Status2							*0.005***				
							(2.32)				
DID											*0.001**
											(1.90)
Duality	0.000	0.000	0.001**	0.001**	0.001	0.004***	0.001	0.001	0.000	0.001*	−0.000
	(1.00)	(0.36)	(2.32)	(2.34)	(1.45)	(3.13)	(0.92)	(1.04)	(0.32)	(1.69)	(−0.11)
Lev	−0.001	−0.002*	0.003***	0.004***	0.004**	−0.042***	0.003*	0.003*	0.003	0.005**	−0.004
	(−1.30)	(−1.90)	(3.44)	(3.16)	(2.08)	(−9.81)	(1.94)	(1.89)	(1.56)	(2.28)	(−1.49)
ROA	0.006***	0.006***	0.022***	0.016***	0.015***	−0.098***	0.020***	0.021***	0.021***	0.023***	0.007
	(3.84)	(3.48)	(9.70)	(5.75)	(3.71)	(−8.93)	(5.37)	(6.00)	(5.44)	(3.85)	(1.22)
Growth	−0.000	0.000	−0.000	−0.001*	−0.000	−0.001	−0.000	−0.000	−0.000	−0.000	0.000
	(−0.42)	(1.47)	(−0.59)	(−1.84)	(−1.26)	(−1.43)	(−0.79)	(−0.59)	(−0.85)	(−0.04)	(1.03)
Cash	−0.004***	−0.005***	0.011***	0.009***	0.011***	0.039***	0.010***	0.011***	0.011***	0.017***	−0.005**
	(−4.28)	(−5.39)	(9.38)	(6.64)	(4.05)	(5.69)	(3.75)	(4.28)	(4.26)	(5.52)	(−2.21)
Size	−0.003***	−0.005***	−0.000***	−0.001	0.000	0.003***	−0.000	−0.000	−0.000	−0.000	−0.005***
	(−11.29)	(−15.78)	(−2.79)	(−1.50)	(0.13)	(3.85)	(−0.77)	(−0.98)	(−0.77)	(−0.67)	(−4.73)
Firsthold	−0.001	−0.002	−0.006***	−0.008***	−0.006***	−0.027***	−0.007***	−0.006***	−0.005**	−0.010***	−0.000
	(−0.81)	(−1.42)	(−6.33)	(−6.08)	(−3.11)	(−5.34)	(−3.32)	(−3.05)	(−2.50)	(−3.66)	(−0.02)
Manhold	0.006***	0.004***	0.002**	0.000	0.001	0.009**	0.000	0.001	0.001	0.001	0.001
	(5.22)	(3.08)	(2.19)	(0.39)	(0.78)	(2.01)	(0.18)	(0.86)	(0.64)	(0.77)	(0.33)
Listage	−0.002***	−0.000	−0.001***	−0.001***	−0.001**	−0.002***	−0.001	−0.001	−0.001*	−0.001*	0.001
	(−5.40)	(−0.52)	(−3.37)	(−2.82)	(−2.02)	(−2.67)	(−1.23)	(−1.63)	(−1.87)	(−1.76)	(0.90)
Boardsize	0.002**	0.003***	0.002***	0.002	0.001	−0.002	0.002	0.002	0.002	0.001	0.001
	(2.57)	(3.76)	(2.69)	(0.68)	(0.78)	(−0.40)	(1.08)	(0.90)	(0.89)	(0.38)	(0.80)
IndR	−0.002	0.001	−0.006**	−0.005	−0.005	0.004	−0.001	−0.004	−0.006	−0.002	−0.004
	(−0.83)	(0.52)	(−2.00)	(−0.83)	(−0.80)	(0.24)	(−0.15)	(−0.81)	(−1.13)	(−0.29)	(−0.80)
Bm	−0.007***	−0.003***	−0.016***	−0.019***	−0.018***	−0.036***	−0.018***	−0.016***	−0.016***	−0.018***	−0.002
	(−10.65)	(−5.49)	(−21.17)	(−18.78)	(−11.13)	(−10.41)	(−10.80)	(−10.33)	(−9.39)	(−7.89)	(−1.35)

(*continued*)

Table 4.

DepVar =	(1) *R&D*	(2) *ΔR&D*	(3) *R&D*	(4) *R&D*	(5) *R&D*	(6) *R&D2*	(7) *R&D*	(8) *R&D*	(9) *R&D*	(10) *R&D*	(11) *R&D*
SOE	0.003**	0.001	0.001***	0.001	0.001	0.001	0.002**	0.001*	0.001	0.002	−0.001
	(2.47)	(1.07)	(3.12)	(1.12)	(1.35)	(0.38)	(2.02)	(1.78)	(1.50)	(1.52)	(−0.16)
IMR				−0.001							
				(−0.37)							
Constant	0.076***	−0.001	0.011**	0.029***	0.026***	−0.004	0.023***	0.031***	0.031***	0.031***	0.132***
	(14.49)	(−0.80)	(2.02)	(4.02)	(3.12)	(−0.22)	(2.75)	(4.17)	(3.89)	(2.93)	(5.70)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm											Yes
N	18,709	15,440	18,709	12,693	18,133	18,709	14,673	18,705	14,100	11,883	4,159
Adj-R^2	0.012	0.178	0.280	0.292	0.299	0.274	0.278	0.281	0.280	0.170	0.040

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively

Source(s): Table by authors

of the independent director. *Compensation* is the natural logarithm of the annual salary of the independent director. *Tenure* is the natural logarithm of the number of years of service of the independent director. *Majorback* equals 1 when the independent director's major is accounting, economics, finance, or management, 0 otherwise. *Dutyback* equals 1 when the independent director's previous positions are management, marketing, or finance, 0 otherwise.

$$Highstatus = \beta_0 + \Sigma Characteristic + \Sigma Control + \Sigma Industry + \Sigma Year + \varepsilon \quad (3)$$

Model (3) controls for the industry-fixed effect and year-fixed effect in the regression. The inverse mills ratio (IMR) calculated from the regression is later included in Model (1) and regresses again. The regression result is shown in Column (4) of Table 4. Controlling for IMR, the coefficient of *Status* is positive and significant at the 1% level.

4.3.5 Eliminate the observations of undisclosed R&D investment. Whether listed companies voluntarily disclose R&D investment may have endogenous problems. For example, companies with better operating results may be more willing to disclose the progress of their R&D projects. Therefore, we exclude the observations of undisclosed R&D investment for the robustness test. The regression result is shown in Column (5) of Table 4. The coefficient of *Status* is positive and significant at the 1% level.

4.3.6 Remeasure explained variable. Referring to Tang, He, and Xu (2015), in order to mitigate the impact of explained variable measurement bias on the results, *R&D2* is defined as the ratio of R&D investment to main operation revenue. The regression result is shown in Column (6) of Table 4. Replacing the explained variable, the coefficient of *Status* is positive and significant at the 1% level.

4.3.7 Remeasure explanatory variable. To alleviate the problem that high-caliber independent directors tend to work for high-caliber companies and that companies prefer to list such independent directors higher in their annual reports, Model (4) is constructed to re-measure independent directors' status by referring to Zhu *et al.* (2016). The residual of the regression of Model (4), which is the portion that cannot be explained by individual characteristics of *Rank2*, is used as the measure of independent directors' status. *Status2* is the annual average of all independent directors' status in each company. Model (4) is as follows:

$$Rank2 = \beta_0 + \Sigma Character + \Sigma Industry + \Sigma Year + \varepsilon \quad (4)$$

where *Character* is the characteristic of independent directors [7]. *Rank2* is the reverse ranking in the company's annual report divided by the total number of directors, supervisors and executives, which is the ranking that has been normalized to the interval [0,1]. The first disclosed person with the largest *Rank2* is the total number of directors and supervisors divided by the total number of directors and supervisors, which equals to 1. The last disclosed person with the smallest *Rank2* is 1 divided by the total number of directors and supervisors. The regression result is shown in Column (7) of Table 4. Replacing the explained variable, the coefficient of *Status2* is positive and significant at the 5% level.

4.3.8 Excluding samples of abnormal disclosures. In order to exclude the cases where the company's annual report is suspected to be disclosed according to the ascending order of the board members' surnames, and the cases where the disclosure of independent directors is suspected to be symbolically high but restricts the performance of their functions [8], we try to eliminate the above sample and retest. The regression results are shown in Columns (8) and (9) of Table 4. The coefficients of *Status* are positive and significant at the 1% level.

4.3.9 Only samples from the manufacturing and information technology industries. To address the issue of a broad sample, this paper refers to Liang *et al.* (2020) and selects only two industries with generally high R&D investment for the robustness test, namely

manufacturing and information technology industries. The regression result is shown in Column (10) of Table 4. The coefficient of *Status* is positive and significant at the 1% level.

4.3.10 Impact of document no. 18. In 2013, the Central Organization Department drafted the "Opinions on Further Regulating Party and Government Leading Cadres' Concurrent Positions (Appointments) in Enterprises" (Document No. 18), which required government officials to resign from any enterprise that could potentially involve or create conflicts of interest. This sparked a wave of resignations among politically affiliated independent directors in listed companies (Tang & Lin, 2016; Xin, Deng, & Teng, 2016), and also led to changes in the composition of independent directors within listed companies. For instance, Qin and Zhang (2019) found that this policy increased the proportion of independent directors holding senior engineer titles. Following the resignation of politically affiliated independent directors, any government subsidies or industry entry support related to political affiliations might also disappear. In response to the survival and development needs, companies may then hire more independent directors with rich professional skills or social capital, attaching greater importance to the role of independent directors. Consequently, this could lead to an effective enhancement of the status of independent directors.

Therefore, within the sample period of 2011–2024 [9], focusing on listed companies with political affiliations prior to the promulgation of Document No. 18 [10], we use the promulgation of Document No. 18 as an exogenous shock to examine further the impact of independent director status on corporate R&D behavior. The *DID* is a dummy variable related to the promulgation of Document No. 18, which is equal to the intersection term of the *Treat* and *Post*. The *Treat* is a grouping identifier. When the independent director status of the company is elevated after the promulgation of Document No. 18, the company's *Treat* is assigned a value of 1, otherwise the *Treat* value is 0. The *Post* is the post-event indicator. If the company is in a period prior to 2013, the *Post* is assigned a value of 0. On the contrary, if the company is in the period of 2013 and later, the *Post* is assigned a value of 1. Concerning the political affiliation, a company is considered to have political affiliations if at least one executive in the company has held leadership positions in government agencies, public security systems, academic research institutions, etc.

Replacing the independent director status (*Status*) in Model (1) with the promulgation of Document No. 18 (*DID*), the test results are presented in Column (11) of Table 4. The coefficient of *DID* is positive and significant at the 10% level, providing support for the conclusion that independent director status promotes corporate R&D investment.

4.3.11 Other robustness tests. (1) Referring to Hu *et al.* (2015), we use the mean value of the ratio of R&D investment to main business revenue of listed companies in the previous three years to measure the corporate R&D investment. (2) Considering that the regression results may be affected by the personal characteristics of independent directors, we add personal characteristics controlling for six aspects of independent directors' gender, age, remuneration, tenure, professional background and duty background to the regression model. (3) Excluding samples that appear to disclose annual reports in ascending and descending order of board members' last names' strokes. The results of these three robustness tests also remained stable.

5. Further exploration

5.1 Channel analysis

Based on the theoretical analysis presented earlier, it can be inferred that independent director status influences corporate R&D behavior through two main channels. Firstly, it enhances the scientific assessment of R&D projects. High-status independent directors, leveraging their domain expertise, can compensate for managerial knowledge gaps and improve the scientificity of R&D project evaluation. Secondly, it reduces information

asymmetry. High-status independent directors can effectively query and obtain accurate accounting information, which helps to suppress management's earnings management behavior by reducing R&D expenses. Therefore, we attempt to explore the channels through which the status of independent directors affects R&D investment from two aspects: enhancing the scientificity of R&D evaluation, and reducing information asymmetry. When conducting channel tests, referring to Wen and Ye (2014), we build upon Model (1) to establish the following Models (5) and (6):

$$Channel = \beta_0 + \beta_1 Status + \Sigma Control + \Sigma Industry + \Sigma Year + \Sigma Region + \varepsilon \quad (5)$$

$$R\&D = \gamma_0 + \gamma_1 Status + \gamma_2 Channel + \Sigma Industry + \Sigma Year + \Sigma Region + \varepsilon \quad (6)$$

In Models (5) and (6), *Channel* is a mediation variable and can be replaced with specific indicators based on different channels. Other variables remain consistent with the previous Model (1). The procedure for channel tests is as follows: Firstly, if the coefficient of *Status* in Model (5) is significant, regression is performed on Model (6). Secondly, if both the coefficients of *Status* and *Channel* in Model (6) are significant, this suggests the existence of partial mediation effects. If only the coefficients of *Channel* in Model (6) are significant, this indicates a complete mediation effect.

5.1.1 Channel test for scientific assessment of R&D. In the context of governmental intervention and insufficient private information, Chinese companies might blindly follow the choices of the majority in the market for R&D decisions (Zhang, Hu, & Yang, 2019). These decisions, based on managerial irrational judgments, reflect knowledge gaps within the management and most of them have lower scientific validity. This study posits that high-status independent directors, leveraging their domain expertise and deep understanding of R&D, can compensate for the management's knowledge gaps, thereby enhancing the scientific assessment of R&D projects and contributing to the improvement of corporate R&D capabilities. Regarding the scientific assessment of R&D, we examine the R&D synchronicity. *HerdRD* is the R&D synchronicity. we follow the existing literature on the measurement of investment herding behavior in securities markets and managers (Christie & Huang, 1995; Stickel, 1990; Ye & Li, 2012) and adopts the following two methods to measure *HerdRD*: firstly, R&D Synchronicity 1 (*HerdRD1*), which measures the absolute deviation between a company's R&D investment level and the average R&D investment level of industry leaders from the previous year. Industry leaders were among the top 10% of companies in the industry with the largest asset size in the previous year. The average R&D investment level is a weighted average weighted by asset size. Secondly, R&D Synchronicity 2 (*HerdRD2*), which measures the absolute deviation between a company's R&D investment level and the median R&D investment level within the industry from the previous year. The larger the values of *HerdRD1* and *HerdRD2*, the lighter the company's conformity to industry leaders' R&D investment, indicating lower R&D synchronicity and stronger scientific assessment of R&D projects.

The results of the channel test based on enhancing the scientific assessment of R&D are presented in Table 5. In this table, the channel indicators in columns (1) and (2) represent *HerdRD1*. Column (1) displays the results of Model (5), where the coefficient of *Status* is positive and significant at the 1% level. Column (2) shows the results of Model (6), with both the coefficients of *Status* and *HerdRD1* being positive and significant at the 1% level. The channel indicators in columns (3) and (4) represent *HerdRD2*. Column (3) presents the results of Model (5), where the coefficient of *Status* is positive and significant at the 5% level. Column (4) displays the results of Model (6), with both the coefficients of *Status* and *HerdRD2* being positive and significant at the 1% level. These results indicate that when the channel variable is *HerdRD*, partial mediation effects exist. This suggests that independent director status can improve R&D investment levels by reducing R&D synchronicity, supporting the channel analysis based on enhancing the scientific assessment of R&D.

DepVar =	(1) *HerdRD1*	(2) *R&D*	(3) *HerdRD2*	(4) *R&D*
Status	*0.006***	*0.003***	*0.004***	*0.005***
	(2.92)	*(3.00)*	*(2.19)*	*(3.10)*
HerdRD1		*0.990***		
		(140.15)		
HerdRD2				*0.843***
				(39.62)
Duality	0.000	0.000	0.000	0.000
	(0.69)	(1.06)	(0.71)	(0.33)
Lev	0.005***	−0.002**	0.003***	0.000
	(4.08)	(−2.39)	(2.70)	(0.20)
ROA	0.010***	0.011***	−0.001	0.021***
	(3.34)	(6.11)	(−0.53)	(7.30)
Growth	−0.000	0.000	0.000	−0.000
	(−1.46)	(0.96)	(0.17)	(−0.94)
Cash	0.008***	0.003***	0.005***	0.007***
	(3.85)	(2.66)	(2.79)	(3.71)
Size	0.000	−0.000**	0.000*	−0.001**
	(0.76)	(−2.13)	(1.92)	(−2.04)
Firsthold	−0.004**	−0.002**	−0.003*	−0.004**
	(−2.26)	(−2.53)	(−1.84)	(−2.45)
Manhold	−0.000	0.002**	−0.001	0.003***
	(−0.30)	(2.38)	(−1.01)	(2.76)
Listage	−0.000	−0.001***	0.000	−0.001*
	(−0.33)	(−2.71)	(0.46)	(−1.86)
Boardsize	0.001	−0.000	0.001	0.001
	(1.05)	(−0.02)	(1.09)	(0.72)
IndR	−0.002	−0.003	0.001	−0.003
	(−0.35)	(−1.12)	(0.33)	(−0.70)
Bm	−0.014***	−0.002***	−0.011***	−0.008***
	(−11.47)	(−2.98)	(−9.21)	(−6.94)
SOE	0.001	0.001	0.001	0.001
	(1.40)	(1.39)	(1.07)	(1.50)
Constant	−0.001	0.012***	−0.006	0.016**
	(−0.10)	(2.84)	(−1.04)	(2.49)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	18,017	18,017	15,440	15,440
Adj-R^2	0.211	0.760	0.165	0.540

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

Table 5. Independent director status, R&D synchronicity, and corporate R&D investment

5.1.2 Channel test for information asymmetry. When a company experiences high levels of information asymmetry, the management, driven by self-interest motives, might adjust accounting profits to manipulate the company's performance levels using its internal information advantage. Given the long payback period and relatively high risks associated with R&D activities, management may tend to reduce R&D expenditure in pursuit of short-term performance gains. In this context, this study posits that high-status independent directors, motivated by the company's long-term development, are inclined to mitigate management's short-termism. Furthermore, their ability to inquire and access accurate accounting information reduces their dependence on management, thereby contributing to an increase in R&D levels. Concerning information asymmetry, referring to Cao, Lu, and Li (2015)

and Hutton, Marcus, and Tehranian (2009), the study employs Earnings Management (*AbsDA*) as a measure. Two specific methods are employed:

Firstly, *AbsDA1* is calculated by employing the adjusted Jones model (Dechow, Sloan, & Sweeney, 1995). When calculating *AbsDA1*, the following model (7) is first used for regression by year and industry, and then the estimated regression coefficients from model (7) are substituted into the model (8) to calculate the absolute value of the operational accrued profit.

$$TA_{i,t}/A_{i,t-1} = a_0(1/A_{i,t-1}) + a_1(\Delta REV_{i,t}/A_{i,t-1}) + a_2(PPE_{i,t}/A_{i,t-1}) + \varepsilon_{i,t} \quad (7)$$

$$DA_{i,t} = TA_{i,t}\Big/A_{i,t-1} - \left(\widehat{a}_0(1/A_{i,t-1}) + \widehat{a}_1((\Delta REV_{i,t} - \Delta REC_{i,t})\Big/A_{i,t-1}\right) + \widehat{a}_2(PPE_{i,t}/A_{i,t-1})\Big) \quad (8)$$

Secondly, *AbsDA2* is calculated using the Lu Jianqiao Model (Lu, 1999). When calculating AbsDA2, the following model (9) is first used for regression by year and industry, and then the estimated regression coefficients from model (9) are substituted into the model (10) to calculate the absolute value of the operational accrued profit.

$$TA_{i,t}/A_{i,t-1} = a_0(1/A_{i,t-1}) + a_1(\Delta REV_{i,t}/A_{i,t-1}) + a_2(PPE_{i,t}/A_{i,t-1}) + a_3(IA_{i,t}/A_{i,t-1}) + \varepsilon_{i,t} \quad (9)$$

$$DA_{i,t} = \mathrm{TA}_{i,t}\Big/A_{i,t-1} - \left(\widehat{a}_0(1/A_{i,t-1}) + \widehat{a}_1((\Delta REV_{i,t} - \Delta REC_{i,t})\Big/A_{i,t-1}\right) + \widehat{a}_2(PPE_{i,t}/A_{i,t-1}) + \widehat{a}_3(IA_{i,t}/A_{i,t-1})\Big) \quad (10)$$

In the Models (7)-(10), *TA* represents Total Accruals, calculated as (Yearly Increase in Current Assets - Yearly Increase in Current Liabilities - Yearly Increase in Cash - Yearly Increase in Short-term Borrowings + Yearly Increase in Non-current Assets Due Within One Year - Yearly Depreciation and Amortization). *A* stands for Total Assets; *REV* stands for Yearly Increase in Operating Revenues; *REC* stands for Yearly Increase in Accounts Receivable; *PPE* denotes the Original Value of Fixed Assets; *IA* encompasses Intangible Assets and Other Long-term Assets. Higher values of *AbsDA1* and *AbsDA2* indicate a higher level of earnings management, implying a more severe information asymmetry issue in the company.

The results of the channel analysis based on information asymmetry are presented in Table 6. In this table, the channel indicators in columns (1) and (2) represent *AbsDA1*. In column (1), the examination outcome of Model (5) shows that the coefficient of *Status* is negative and significant at the 5% level. In column (2), the examination outcome of Model (6) reveals that the coefficient of *Status* is positive and significant at the 1% level, while the coefficient of *AbsDA1* is negative and significant at the 5% level. The channel indicators in columns (3) and (4) represent *AbsDA2*. In column (3), the examination outcome of Model (5) shows that the coefficient of *Status* is negative and significant at the 10% level. In column (4), the examination outcome of Model (6) indicates that the coefficient of *Status* is positive and significant at the 1% level, while the coefficient of *AbsDA2* is negative and significant at the 5% level. These results suggest that when the channel variable is *AbsDA*, partial mediation effects are established. In other words, independent director status can improve R&D investment levels by reducing earnings management, thereby supporting the channel analysis based on information asymmetry.

5.2 Different constraints analysis

The theoretical analysis and empirical results presented indicate that high-status independent directors, leveraging their advantages in consultation and supervision, can

DepVar =	(1) *AbsDA1*	(2) *R&D*	(3) *AbsDA2*	(4) *R&D*
Status	*−0.013***	*0.009****	*−0.011**	*0.009****
	(−2.03)	*(3.75)*	*(−1.81)*	*(3.76)*
AbsDA1		*−0.003***		
		(−2.19)		
AbsDA2				*−0.003***
				(−2.01)
Duality	−0.001	0.001	−0.000	0.001
	(−0.36)	(0.95)	(−0.18)	(0.94)
Lev	0.034***	0.003*	0.035***	0.003*
	(5.78)	(1.80)	(5.90)	(1.85)
ROA	−0.214***	0.021***	−0.211***	0.021***
	(−10.60)	(5.72)	(−10.51)	(5.71)
Growth	0.035***	−0.000	0.033***	−0.000
	(7.31)	(−0.17)	(7.71)	(−0.22)
Cash	−0.004	0.011***	−0.005	0.011***
	(−0.67)	(4.41)	(−0.82)	(4.57)
Size	0.004***	−0.000	0.004***	−0.000
	(3.43)	(−0.86)	(3.44)	(−0.93)
Firsthold	−0.004	−0.006***	−0.002	−0.006***
	(−0.70)	(−3.15)	(−0.50)	(−3.08)
Manhold	0.004	0.001	0.002	0.001
	(0.90)	(0.75)	(0.48)	(0.70)
Listage	0.002	−0.001*	0.001	−0.001*
	(1.29)	(−1.76)	(1.03)	(−1.65)
Boardsize	−0.017***	0.002	−0.016***	0.002
	(−3.45)	(0.98)	(−3.28)	(1.04)
IndR	−0.005	−0.004	−0.008	−0.004
	(−0.26)	(−0.67)	(−0.46)	(−0.64)
Bm	−0.060***	−0.016***	−0.059***	−0.016***
	(−11.11)	(−10.34)	(−11.37)	(−10.37)
SOE	−0.004**	0.001*	−0.005**	0.001*
	(−1.98)	(1.79)	(−2.14)	(1.74)
Constant	0.053*	0.019**	0.051*	0.020**
	(1.88)	(2.49)	(1.82)	(2.51)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	18,490	18,490	18,464	18,464
Adj-R^2	0.090	0.281	0.093	0.282

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively

Source(s): Table by authors

Table 6. Independent director status, information asymmetry, and corporate R&D investment

effectively reduce R&D synchronization and information asymmetry, ultimately promoting R&D investment. However, does this effect vary under different constraint conditions? First, from the perspective of traditional cultural differences, the strength of traditional hierarchical concepts can influence the representation of status through ranking, thereby affecting the power and functionality of independent directors ranked higher. Secondly, from the perspective of information environment differences, the quality of the information environment can impact management's compliance with shareholders' intentions, thereby influencing the scope of effectiveness for high-status independent directors. Lastly, from the perspective of operating environment differences, the stability of the operating environment is closely related to the accuracy of R&D assessment and management's willingness for R&D,

thereby affecting the scope of effectiveness for high-status independent directors. Consequently, we attempt to further validate the impact of independent director status on a corporate R&D behavior and deepen the understanding of its mechanisms, by exploring three aspects: traditional cultural differences, information environment differences, and operating environment differences.

5.2.1 Traditional cultural differences. In the preceding sections, independent directors' ranking is used to signify the magnitude of their status. The influence of independent director status on a corporate R&D behavior is contingent on the degree of emphasis placed on these rankings. The underlying assumption for this logic to hold is that rankings hold significant importance. In traditional cultures, the notion that order determines inferiority affirms ranking as an indication of status. Companies with a strong traditional culture tend to have a hierarchical organizational structure with a single line of chain and a definite superior-subordinate relationship (Li, Ling, & Liu, 2012). This atmosphere will reinforce the value that executives place on status and power. At this point, independent directors ranking higher will possess greater authority and independence, consequently amplifying the impact of independent director status. Conversely, if the atmosphere of hierarchical differences is weaker, then the impact of independent directors' status will be less even if the disclosure order is higher. We therefore infer that independent directors' status plays a more important role in R&D decisions when companies with strong traditional cultural atmosphere.

To test this inference, this paper introduces the overseas experience of company executives for analysis. The perception of rank differential order may be weaker when company executives are educated overseas or have overseas work experience. The more executives of this type are in the company's management team, the lower the traditional cultural atmosphere of the team may be and the less effective the independent directors' status may be. Referring to Wen and Song (2017), the impact of overseas experience is measured in three ways. *Overseas1* is the proportion of the number of board members with overseas background to the total number of board members. *Overseas2* is the proportion of the number of independent directors with overseas background to the total number of independent directors. *Overseas3* is a dummy variable for the chairman's overseas background. At the same time, we take into account the regional cultural differences caused by the geographical factors in China. Referring to Zhao, Li, and Sun (2015), based on the median "power distance" in the nine cultural practices dimensions of GLOBE, we define *Area* as a dummy variable for the intensity of regional cultural atmosphere. When the company is registered in a high "power distance" area, *Area* equals to 1, and 0 otherwise. The regression results are shown in Table 7. Columns (1)-(4) correspond to the three measures of the influence of overseas experience and the intensity of the cultural atmosphere in the region. The coefficient of the interaction *Status*×*Overseas1* in Column (1) is negative and significant at the 5% level. The coefficient of the interaction *Status*×*Overseas2* in Column (2) is negative and significant at the 5% level. The coefficient of the interaction *Status*×*Overseas3* in Column (3) is negative and significant at the 10% level. The coefficient of the interaction *Status*×*Area* in Column (4) is positive and significant at the 10% level. These results suggest that the effect of high-status independent directors on corporate R&D investment is more significant in companies with a strong traditional culture.

5.2.2 Information environments differences. Based on the channel analysis of information asymmetry, it is posited that high-status independent directors can constrain managerial behavior by seeking and obtaining accurate accounting information. However, the effectiveness of this channel may vary across different company information environments. When the corporate information environment is transparent, stakeholders have access to sufficient truthful information and management's self-interest is better curbed (Zhong, 2018). The role of independent directors in supervision and consultation may not be

DepVar =	(1) *R&D*	(2) *R&D*	(3) *R&D*	(4) *R&D*
Status	0.013***	0.013***	0.010***	0.005
	(4.75)	(4.83)	(4.15)	(1.64)
Status×Overseas1	*−0.028***			
	(−2.36)			
Overseas1	0.016***			
	(2.63)			
Status×Overseas2		*−0.028***		
		(−2.36)		
Overseas2		0.017***		
		(2.64)		
Status×Overseas3			*−0.015**	
			(−1.91)	
Overseas3			0.009**	
			(2.15)	
Status×Area				*0.008**
				(1.83)
Area				−0.006**
				(−2.58)
Duality	0.001	0.001	0.001	0.001
	(1.03)	(1.02)	(1.04)	(1.02)
Lev	0.003*	0.003*	0.003*	0.003*
	(1.83)	(1.85)	(1.90)	(1.88)
ROA	0.021***	0.021***	0.021***	0.021***
	(5.97)	(5.97)	(6.03)	(5.95)
Growth	−0.000	−0.000	−0.000	−0.000
	(−0.59)	(−0.57)	(−0.63)	(−0.54)
Cash	0.010***	0.011***	0.011***	0.011***
	(4.18)	(4.20)	(4.25)	(4.31)
Size	−0.000	−0.000	−0.000	−0.000
	(−1.06)	(−1.09)	(−1.01)	(−0.95)
Firsthold	−0.006***	−0.006***	−0.006***	−0.006***
	(−3.04)	(−3.01)	(−3.09)	(−3.03)
Manhold	0.001	0.001	0.001	0.001
	(0.90)	(0.87)	(0.86)	(0.87)
Listage	−0.001	−0.001	−0.001	−0.001
	(−1.63)	(−1.59)	(−1.63)	(−1.64)
Boardsize	0.002	0.002	0.002	0.001
	(0.90)	(0.93)	(0.91)	(0.88)
IndR	−0.004	−0.004	−0.004	−0.004
	(−0.81)	(−0.78)	(−0.78)	(−0.83)
Bm	−0.016***	−0.016***	−0.016***	−0.016***
	(−10.29)	(−10.30)	(−10.32)	(−10.33)
SOE	0.002*	0.002*	0.002*	0.001*
	(1.90)	(1.83)	(1.84)	(1.78)
Constant	0.018**	0.019**	0.020**	0.033***
	(2.36)	(2.41)	(2.54)	(4.41)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	18,709	18,709	18,709	18,709
Adj-R^2	0.282	0.282	0.282	0.282

Table 7.
Traditional cultural differences

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

obvious. Conversely, when the information environment is opaque, information asymmetry makes agents more likely to act against the wishes of their principals, and internal governance problems are more severe. At this point, the functions of high-status independent directors in curbing management's opportunistic behavior and safeguarding the long-term value of the company are stronger. The paper therefore concludes that independent directors' status plays a more important role in R&D decisions when the information environment of the company is opaque.

To test this inference, this paper introduces information opacity for analysis. Referring to Lang, Lins, and Maffett (2012), *Lowtrans1* is a discretionary surplus smoothing index. This index is specifically the quotient of the standard deviation of operating profit over the past three years and the standard deviation of cash flow from operating activities, which portrays the extent to accruals the firm uses for profit smoothing. The larger the *Lowtrans1*, the higher the company's surplus smoothing and the lower the information opacity. In addition, referring to Thomas (2002) and Cao, Sun, and Yuan (2019), *Lowtrans2* is the analyst forecast bias [11]. Specifically, the natural logarithm of the absolute value of the difference between the analysts' forecasted EPS and the firm's actual EPS for that year was used as the single forecast accuracy. The mean of all analyst forecast accuracies is the degree of analyst forecast bias for that firm. The larger the *Lowtrans2*, the greater the degree of analyst forecast bias and the higher the information opacity. The regression results are shown in Table 8. Columns (1) and (2) correspond to the two measures of information opacity respectively. The coefficient of the interaction *Status*×*Lowtrans1* in Column (1) is positive and significant at the 5% level. The coefficient of the interaction *Status*×*Lowtrans2* in Column (2) is positive and significant at the 5% level. These results suggest that the enhancing effect of high-status independent directors on a corporate R&D investment is more significant in companies with low information transparency.

5.2.3 Operating environment differences. Channel analysis based on the scientific evaluation of R&D suggests that high-status independent directors can assist the management in evaluating and making decisions about R&D projects through their specialized knowledge and skills. The stability of the operating environment is closely related to management's willingness for R&D and the accuracy of R&D assessments. Therefore, the influence of independent directorship may vary across different company operating environments. In companies with significant fluctuations in the operating environment, innovation, characterized by long payback periods and high uncertainty, may lead management to have stronger motivation for reducing R&D investment to meet performance targets (Wang, Liu, & Zhang, 2023). In such cases, high-status independent directors have a greater role to play. On the contrary, in companies with stable operating environments, the motivation for management to reduce R&D investment to maintain stable performance is weaker (Narayanan, 1985). Moreover, a stable operating environment enhances the accuracy of R&D evaluations, thereby diminishing the significance of independent directors' roles. Therefore, the paper infers that independent directors' status plays a more important role in R&D investment decisions when the company's operating environment is highly volatile.

To test this inference, we introduce operating volatility for analysis. Referring to Liu and Li (2019), *Highvol1* and *Highvol2* are measured by the rate of change of two financial performance indicators, ROA and ROE, respectively. The regression results are shown in Table 9. Columns (1)-(2) correspond to the two measures of operating volatility, respectively. The coefficient of the interaction *Status*×*Highvol1* in Column (1) is positive and significant at the 5% level. The coefficient of the interaction *Status* × *Highvol2* in Column (2) is positive and significant at the 5% level. These results suggest that the enhancing effect of high-status independent directors on a corporate R&D investment is more significant in companies with high operational volatility.

DepVar =	(1) *R&D*	(2) *R&D*
Status	0.008***	0.013***
	(3.15)	(4.23)
Status×Lowtrans1	*0.001***	
	(2.30)	
Lowtrans1	−0.001***	
	(−2.58)	
Status×Lowtrans2		*0.003***
		(2.24)
Lowtrans2		−0.001
		(−1.47)
Duality	0.001	0.001
	(1.04)	(1.04)
Lev	0.003*	0.003**
	(1.89)	(1.97)
ROA	0.021***	0.023***
	(6.01)	(6.34)
Growth	−0.000	−0.000
	(−0.55)	(−0.19)
Cash	0.011***	0.011***
	(4.27)	(4.24)
Size	−0.000	−0.000
	(−0.97)	(−1.17)
Firsthold	−0.006***	−0.006***
	(−3.06)	(−3.05)
Manhold	0.001	0.001
	(0.86)	(0.70)
Listage	−0.001	−0.001
	(−1.64)	(−1.43)
Boardsize	0.002	0.002
	(0.90)	(0.94)
IndR	−0.004	−0.004
	(−0.81)	(−0.84)
Bm	−0.016***	−0.016***
	(−10.36)	(−10.31)
SOE	0.001*	0.002*
	(1.79)	(1.89)
Constant	0.021***	0.020**
	(2.71)	(2.53)
Industry	Yes	Yes
Year	Yes	Yes
N	18,709	18,709
Adj-R^2	0.281	0.282

Table 8. Information environment differences

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

5.3 Economic consequences

5.3.1 Innovation patent output. The impact of independent directors' status on company innovation decisions is examined above mainly through R&D investment. However, does this impact have further economic consequences? Scherer (1965) points out that patents could be a better measure of R&D output, and he was the first to use innovation patents as a measure of R&D output. The output of patents means that the company's R&D projects have moved

DepVar =	(1) *R&D*	(2) *R&D*
Status	0.009***	0.009***
	(3.82)	(3.82)
Status×Highvol1	*0.006***	
	(2.30)	
Highvol1	−0.004***	
	(−2.84)	
Status×Highvol2		*0.002***
		(2.30)
Highvol2		−0.001***
		(−2.65)
Duality	0.001	0.001
	(1.04)	(1.04)
Lev	0.003*	0.003*
	(1.90)	(1.91)
ROA	0.022***	0.022***
	(6.04)	(6.02)
Growth	−0.000	−0.000
	(−0.59)	(−0.59)
Cash	0.011***	0.011***
	(4.28)	(4.28)
Size	−0.000	−0.000
	(−0.98)	(−0.99)
Firsthold	−0.006***	−0.006***
	(−3.05)	(−3.05)
Manhold	0.001	0.001
	(0.86)	(0.86)
Listage	−0.001	−0.001
	(−1.64)	(−1.64)
Boardsize	0.001	0.002
	(0.89)	(0.91)
IndR	−0.004	−0.004
	(−0.82)	(−0.81)
Bm	−0.016***	−0.016***
	(−10.32)	(−10.33)
SOE	0.001*	0.001*
	(1.78)	(1.79)
Constant	0.020***	0.020***
	(2.62)	(2.62)
Industry	Yes	Yes
Year	Yes	Yes
N	18,709	18,709
Adj-R^2	0.281	0.281

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

Table 9. Operating environment differences

from the R&D stage to the production stage. At this time, the uncertainty of R&D activities has been significantly reduced. To a large extent, this can be recognized as a positive economic consequence that is beneficial to the company. High-status independent directors with rich experience and vision can objectively evaluate the corporate R&D investment to ensure the long-term stability and effectiveness of R&D, thereby enhancing the output of company innovation. To test this inference, firstly, referring to Gu *et al.* (2018), *Patent1* is

measured by the natural logarithm of the number of patents applied plus one. Secondly, referring to Yan, Liang, and Yuan (2019), *Patent2* is measured by the natural logarithm of the number of patents granted plus one. Considering the lag effect of patent acquisition, the number of patents applied and granted uses the future period value. The regression results are shown in Columns (1) and (2) of Table 10. The coefficients of *Status* are positive and significant at the 5% and 1% levels, respectively. These results suggest that high-status independent directors contribute to the company's innovation patent output.

5.3.2 Company market value. The ultimate goal of company innovation is to increase market value. So, can the impact of the aforementioned independent directors' status on innovation input ultimately have an effect on company value? To test this inference, referring to Zhu *et al.* (2016), firstly, *TQ1* is measured by the ratio of company market value to total assets. Secondly, excluding net intangible assets and net goodwill from total assets, and then calculating *TQ2*. The regression results are shown in Columns (3) and (4) of Table 10.

DepVar =	(1) *Patent1*	(2) *Patent2*	(3) *TQ1*	(4) *TQ2*
Status	*0.357***	*0.387****	*0.291****	*0.353****
	(2.58)	*(3.11)*	*(2.79)*	*(2.96)*
Duality	0.040	−0.017	0.036	0.056*
	(1.18)	(−0.61)	(1.36)	(1.84)
Lev	0.090	−0.143	−0.214**	−0.456***
	(0.90)	(−1.48)	(−2.35)	(−4.35)
ROA	0.262	−0.022	2.904***	2.986***
	(1.19)	(−0.12)	(11.81)	(10.99)
Growth	0.008	−0.016	−0.018	0.042**
	(0.49)	(−1.05)	(−1.26)	(2.51)
Cash	0.252*	−0.107	0.936***	0.725***
	(1.88)	(−0.92)	(7.66)	(5.38)
Size	0.130***	0.119***	−0.355***	−0.374***
	(4.81)	(5.27)	(−22.05)	(−20.87)
Firsthold	−0.242*	−0.000	0.201**	0.120
	(−1.81)	(−0.00)	(2.11)	(1.13)
Manhold	−0.146	−0.107	−0.650***	−0.690***
	(−1.53)	(−1.18)	(−8.46)	(−7.68)
Listage	−0.054**	−0.070***	0.145***	0.163***
	(−2.20)	(−3.14)	(7.38)	(7.42)
Boardsize	−0.088	0.126	0.047	0.057
	(−0.81)	(1.29)	(0.60)	(0.64)
IndR	−0.746*	0.498	0.790***	0.924***
	(−1.76)	(1.16)	(2.83)	(2.93)
Bm	−0.182**	0.020		
	(−1.99)	(0.25)		
SOE	0.198***	0.195***	−0.142***	−0.233***
	(3.55)	(3.82)	(−3.58)	(−5.29)
Constant	−1.773***	−2.860***	9.303***	9.917***
	(−2.83)	(−5.36)	(23.35)	(22.80)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	18,709	18,709	18,709	18,709
Adj-R²	0.083	0.081	0.303	0.305

Table 10. Economic consequences

Note(s): *T*-statistics in parentheses are based on standard errors adjusted for firm-level clustering; *, ** and *** indicate significance at the 10, 5, and 1% levels, respectively
Source(s): Table by authors

The coefficients of *Status* are positive and are significant at the 1% level [12]. These results suggest that high-status independent directors contribute to the company market value. The above results show that high-status independent directors promote the company's innovation investment, enhance the company's patent output, and ultimately increase the company's market value.

6. Conclusions

The system of independent directors has received widespread academic attention and is widely regarded as an important mechanism for imposing external constraints on a company. Chinese society has been influenced by the deep-rooted concept of "seniority", and there is an obvious idea of rank status differences. This study is based on the institutional background of culture with Chinese characteristics, and starts from the implicit status of independent directors' rankings. Taking Chinese A-share listed companies from 2008 to 2020 as the research sample, we explore the objective manifestations, moderating effects, mechanism and economic consequences of independent directors' status influencing corporate R&D decisions through theoretical deduction and empirical testing. This study finds that independent directors' status has a significant positive effect on corporate R&D investment, and this finding remains stable after several robustness tests. Channel analysis reveals that high-status independent directors facilitate increased R&D investment by enhancing the scientific evaluation of R&D and reducing information asymmetry. Heterogeneity tests demonstrate that the aforementioned facilitation is stronger in companies with strong traditional cultural atmosphere, low information transparency, and high performance volatility. Economic consequence analysis indicates that the promotion of R&D investment by independent directors further enhances the company's patent output and increases its market value.

These findings have the following possible suggestions and insights.

Firstly, attach importance to the informal hierarchy of the board and optimize company financial behavior. The informal hierarchy of the board has important research value in the Chinese context. Although the board structure is homogeneous among domestic listed companies, objective differences in the internal and external environments of different companies make it difficult to meet the standards of the board mandate with homogenized formal institutional arrangements. He and Huang (2011) first explore the impact of informal hierarchy on company financial performance, from the perspective of informal relationships within the board. This study focuses on the status of independent directors, an important member of the board, and verifies their positive impact on company R&D behavior. This finding enriches the research on the internal functioning mechanism of the board. At the same time, it reveals that companies should take into account the influence of the informal board hierarchy on the distribution of power in the process of annual report disclosure. For independent directors, who are particularly concerned about social reputation and industry image, companies need to fully respect their right to express their opinions, listen to and absorb their opinions, and show a cherished and responsible attitude. The company should avoid the negative economic consequences of laches, discouragement and even frequent departures due to the low importance of independent directors. Then, it will optimize R&D investment and other financial behaviors, and ultimately achieve the fundamental goal of maximizing company value.

Secondly, the company should coordinate internal environment and governance mechanisms to promote company R&D innovation. The original purpose of the independent director system was to curb opportunistic behaviors such as abuse of power by major shareholders and executives and reckless appropriation of large sums of money, and to protect the interests of medium–small investors. However, management selects daily

business management actions depending on changes in the company's internal information environment, and this is a problem that is difficult for companies to identify and avoid in a timely manner. When the performance of the supervision and consultation functions of independent directors affects the interests of management, the process of implementing these functions is often difficult and ineffective. This could result in independent directors whose independence is seriously compromised becoming vases in the company, just like the public debate about independent directors in the recent Kangmei Pharmaceutical Co. incident. The findings of this paper confirm the effectiveness of the independent directorship. Not only do we find a significant effect of independent directors with status advantages in enhancing corporate R&D investment, but also that corporate information transparency and performance volatility have significant moderating effects on the relationship between independent director status and corporate R&D behavior. This reveals that companies should fully consider the interaction between their internal environment and regulatory governance forces in the corporate governance process. According to their respective information environment and business environment, companies should differentially deploy their governance forces so that their own characteristics and governance mechanisms can complement each other as much as possible to achieve the ultimate goal of long-term healthy development of the company.

Thirdly, inherit traditional culture by adopting their good points and avoiding their shortcomings, and rationally allocate power to enhance the science of decision-making. The traditional Chinese cultural atmosphere has been a subtle influence on the company culture. The existence of an informal hierarchy of the board coordinates the order of business strategy within the company, and the hierarchical gap mapping the level of power of board members also shapes the submissive behavior of lower-level people toward higher-level people. In order to ensure the smoothness of informal communication among board members, companies need to explore and bring into play the advantages of traditional culture, and make reasonable use of traditional concepts to ensure the effectiveness of governance mechanisms such as independent directors, so as to achieve the inheritance and development of the Chinese tradition. However, Du, Yin *et al.* (2017) and Du, Wei *et al.* (2017) find that the Confucian culture's concept of "seniority" has weakened the motivation of independent directors to give advice. This reveals that companies should pay close attention to and suppress the possible disadvantages of traditional culture, and inherit traditional culture according to their own characteristics and adopt their good points and avoid their shortcomings. Companies need to focus on the internal coordination and balance of the board of directors as a team as a whole. In order to avoid the power advantage of major shareholders and management from weakening the supervision and consultation functions of independent directors and negatively impacting the science and effectiveness of company decision-making.

Notes

1. 位尊权重: High position means weighty power. 君为臣纲、父为子纲、夫为妻纲: It reflects a special moral relationship between ruler and subject, father and son, and husband and wife in feudal society. It requires that subject, son, and wife must be absolutely subservient to the ruler, father, and husband. At the same time, it also requires the ruler, father and husband to set an example for their subject, son, and wife.
2. Zhu *et al.* (2016) point out that two internationally renowned scholars who have served as independent directors in a number of Chinese listed companies were interviewed and pointed out that the order of disclosure of corporate annual reports is usually also the order of signatures and the order of seating at board meetings, suggesting the level of importance and esteem in which executives are held.
3. Examples of the order of disclosure of directors, supervisors and executives in the annual reports of two companies are given in the Appendix.

4. For example, companies with an asset-liability ratio greater than 1, that is insolvency.
5. 0.046 = 0.009*0.108/0.021.
6. In the change model, all control variables, including dummy variables, are first-order differential values.
7. Independent director characteristics include age, gender, annual salary, educational background, financial background, professional background, tenure of office, whether they serve part-time and the total number of directors, supervisors and executives.
8. We argue that companies that symbolically disclose their independent directors at a high level tend to disclose their independent directors at a certain position in the annual report consecutively. When the independent directors change, the new independent directors will fill the higher disclosure position of the former independent directors rather than spreading the disclosure according to their status. Therefore, this paper tries to eliminate the sample of independent directors whose status has not changed from the previous year, that is the suspected symbolic disclosures.
9. The promulgation date of Document No. 18 was in 2013, and a two-year period before and after that date was selected, covering the years 2011 to 2014. Using a two-year window was primarily aimed at mitigating potential noise effects that might arise from long sample period. The choice of using one year or three years as the baseline for the sample period, will not change the research findings.
10. The reason for using listed companies with political affiliations prior to the promulgation of Document No. 18 as the research sample is mainly because Document No. 18 primarily targeted companies with executives having governmental backgrounds. The changes in independent directors within these companies can be defined as being influenced by the promulgation of Document No. 18.
11. Thomas (2002) found that analysts' forecast bias decreased when companies disclosed more information.
12. To avoid multicollinearity between *TQ* and *Bm*, we didn't control the *Bm* in the regression.

References

Adams, R. B., & Ferreira, D. (2008). Do directors perform for pay. *Journal of Accounting and Economics*, *46*(1), 154–171. doi: 10.1016/j.jacceco.2008.06.002.

Beasley, M. S. (1996). An empirical analysis of the relation between the board of director composition and financial statement fraud. *The Accounting Review*, *71*(4), 443–465.

Blader, S., & Chen, Y. (2012). Differentiating the effects of status and power: A justice perspective. *Journal of Personality and Social Psychology*, *102*(5), 994–1014. doi: 10.1037/a0026651.

Brown, J. R., Martinsson, G., & Petersen, B. C. (2012). Do financing constraints matter for R&D?. *European Economic Review*, *56*(8), 1512–1529. doi: 10.1016/j.euroecorev.2012.07.007.

Cao, F., Lu, B., & Li, Z. (2015). Can institutional investor reduce stock price crash risk?. *Accounting Research*, 11, 55–61, (in Chinese).

Cao, F., Sun, J., & Yuan, R. (2019). Board directors with foreign experience and stock price crash risk: Evidence from China. *Journal of Business Finance & Accounting*, *46*(9-10), 1144–1170. doi: 10.1111/jbfa.12400.

Cao, S., Wu, J., Wang, C., Fang, Z., & Cui, X. (2023). Academic independent director abnormal resignations and R&D investment: Evidence from China. *Emerging Markets Finance and Trade*, *59*(1), 238–264. doi: 10.1080/1540496x.2022.2089016.

Chang, X., Fu, K., Low, A., & Zhang, W. (2015). Non-executive employee stock options and corporate innovation. *Journal of Financial Economics*, *115*(1), 168–188. doi: 10.1016/j.jfineco.2014.09.002.

Christie, W. G., & Huang, R. D. (1995). Following the pied piper: Do individual returns herd around the market. *Financial Analysts Journal*, *51*(4), 31–37. doi: 10.2469/faj.v51.n4.1918.

Cong, C. (2004). An empirical study on board setting and corporate business performance of listed companies in China. *Journal of Management World*, 11, 142–143, (in Chinese).

Dechow, P. M., Sloan, R. G., & Sweeney, A. P. (1995). Detecting earnings management. *Accounting Review*, *70*(2), 193–225.

Du, X., Zeng, Q., & Du, Y. (2014). Do politically connected independent directors help Chinese listed private firms enter high-barrier industries?. *China Accounting and Finance Review*, *16*(4), 116–146. doi: 10.7603/s40570-014-0022-2.

Du, X., Yin, J., & Lai, S. (2017). Seniority, CEO tenure, and independent directors' dissenting behaviors. *China Industrial Economics*, 12, 151–169, (in Chinese).

Du, X., Wei, J., & Lai, S. (2017). Do foreign directors mitigate earnings management? Evidence from China. *International Journal of Accounting*, *52*(2), 142–177. doi: 10.1016/j.intacc.2017.04.002.

Fama, E. F., & Jensen, M. C. (1983). Separation of ownership and control. *Journal of Law and Economics*, *26*(2), 301–325. doi: 10.1086/467037.

Gao, M., & Ma, S. (2002). Empirical analysis of the relationship between independent director system and company performance - also on the institutional environment for effective exercise of independent directors in China. *Nankai Economic Studies*, 2, 64–68, (in Chinese).

Gao, W., Ng, L., & Wang, Q. (2011). Does corporate headquarters location matter for firm capital structure?. *Financial Management*, *40*(1), 113–138. doi: 10.1111/j.1755-053x.2010.01136.x.

Gould, R. (2002). The origins of status hierarchies: A formal theory and empirical test. *American Journal of Sociology*, *107*(5), 1143–1178. doi: 10.1086/341744.

Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review*, *33*(3), 114–135. doi: 10.2307/41166664.

Gu, X., Chen, Y., & Pan, S. (2018). Economic policy uncertainty and innovation: Evidence from listed companies in China. *Economic Research Journal*, *53*(2), 109–123, (in Chinese).

He, Q., & Chen, S. (2009). An empirical study of board composition and R&D expenditure from Chinese listed firm. *Journal of Systems & Management*, *18*(6), 612–619, (in Chinese).

He, J., & Huang, Z. (2011). Board informal hierachy and firm financial performance: Exploring a tacit structure guiding boardroom interactions. *Academy of Management Journal*, *54*(6), 1119–1139. doi: 10.5465/amj.2009.0824.

Hermalin, B. E., & Weisbach, M. S. (1991). The effects of board composition and direct incentives on firm performance. *Financial Management*, *20*(4), 101–112. doi: 10.2307/3665716.

Hillman, A. J., & Dalziel, T. (2003). Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *The Academy of Management Review*, *28*(3), 383–396. doi: 10.5465/amr.2003.10196729.

Hu, Z., Li, J., & Guo, J. (2015). R&D investment and IPO price suppression: The moderating effect of venture capital. *Nankai Business Review*, *18*(6), 113–124, (in Chinese).

Huang, J., & Chen, X. (2011). Business group and R&D investment——an analysis from the perspective of knowledge spillover and internal capital market. *Economic Research Journal*, *46*(6), 80–92, (in Chinese).

Hutton, A. P., Marcus, A. J., & Tehranian, H. (2009). Opaque financial reports, R2, and crash risk. *Journal of Financial Economics*, *94*(1), 67–86. doi: 10.1016/j.jfineco.2008.10.003.

Jetten, J., Hornsey, M., & Adarves-Yorno, I. (2006). When group members admit to being conformist: The role of relative intragroup status in conformity self-reports. *Personality and Social Psychology Bulletin*, *32*(2), 162–173. doi: 10.1177/0146167205279904.

Jiang, Y., Xu, C., & Ban, X. (2022). The influence of network platform interaction on corporate total factor productivity: Evidence from China stock exchange investor interactive platforms. *China Accounting and Finance Review*, *24*(4), 445–463. doi: 10.1108/cafr-03-2022-0015.

Jiang, D., Yao, Z., & Chen, D. (2018). Status ranking of chief financial officer and stock price crash risk. *Journal of Management World*, *34*(3), 153–166, (in Chinese).

Johnson, P. (2004). Shared thinking and interaction in the family business boardroom. *Corporate Governance*, *4*(1), 39–51. doi: 10.1108/14720700410521952.

Lang, M., Lins, K., & Maffett, M. (2012). Transparency, liquidity and valuation: International evidence on when transparency matters most. *Journal of Accounting Research*, *50*(3), 729–774. doi: 10.1111/j.1475-679x.2012.00442.x.

Li, R., Ling, W., & Liu, S. (2012). Traditional values, superior-subordinate relationships and employee silent behavior: An empirical exploration in a local cultural context. *Journal of Management World*, 3, 127–140, (in Chinese).

Li, H., Wang, M., & Zhang, Q. (2019). Study on the executives with R&D backgrounds, career path and the growth of high-tech enterprises. *Journal of Management Science*, *32*(5), 23–36, (in Chinese).

Liang, S., Yan, Z., & Xu, C. (2020). Female executives and corporate innovation: Empirical evidence from Chinese listed companies. *Finance Research*, 3, 39–53, (in Chinese).

Liu, M., & Li, L. (2019). Strategic deviant, financial flexibility and operating performance fluctuation. *Journal of Shanxi University of Finance and Economics*, *41*(12), 80–92, (in Chinese).

Liu, X., & Xue, Y. (2015). CEO succession, the deviation of firm performance and R&D investment: A research on the perspective of orientation of strategic change. *Nankai Business Review*, *18*(3), 34–47, (in Chinese).

Lu, J. (1999). Empirical research on earnings management of China's loss-making listed companies. *Accounting Research*, 9, 25–35, (in Chinese).

Masulis, R., Wang, C., & Xie, F. (2012). Globalizing the boardroom-the effects of foreign directors on corporate governance and firm performance. *Journal of Accounting and Economics*, *53*(3), 527–554. doi: 10.1016/j.jacceco.2011.12.003.

Narayanan, M. (1985). Managerial incentives for short-term results. *The Journal of Finance*, *40*(5), 1469–1484. doi: 10.1111/j.1540-6261.1985.tb02395.x.

Nguyen, B. D., & Nielsen, K. M. (2010). The value of independent directors: Evidence from sudden deaths. *Journal of Financial Economics*, *98*(3), 550–567. doi: 10.1016/j.jfineco.2010.07.004.

Pearce, J. A., & Zahra, S. A. (1991). The relative power of CEOs and boards of directors: Associations with corporate performance. *Strategic Management Journal*, *12*(2), 135–153. doi: 10.1002/smj.4250120205.

Qin, X., & Zhang, X. (2019). De-politicization and innovation: Evidence from China. *Journal of Accounting & Public Policy*, *38*(4), 106668, N.PAG. doi: 10.1016/j.jaccpubpol.2019.05.005.

Quan, Y., & Li, S. (2017). Are academic independent directors punished more severely when they engage in violations?. *China Journal of Accounting Research*, *10*(1), 71–86. doi: 10.1016/j.cjar.2016.10.002.

Richardson, S. (2006). Over-investment of free cash flow. *Review of Accounting Studies*, *11*(2-3), 159–189. doi: 10.1007/s11142-006-9012-1.

Ridgeway, C., & Johnson, C. (1990). What is the relationship between socioemotional behavior and status in task groups?. *American Journal of Sociology*, *95*(5), 1189–1212. doi: 10.1086/229426.

Scherer, F. M. (1965). Firm size, market structure, opportunity, and the output of patented inventions. *American Economic Review*, *55*(5), 1097–1125.

Stein, J. C. (1988). Takeover threats and managerial Myopia. *Journal of Political Economy*, *96*(1), 61–80. doi: 10.1086/261524.

Stickel, S. E. (1990). Prediting individual analyst earnings forecasts. *Journal of Accounting*, *28*(2), 409–417. doi: 10.2307/2491158.

Tan, J. A. (2003). Study on independence of independent directors. *China Industrial Economics*, 10, 64–73, (in Chinese).

Tang, X., & Lin, Y. (2016). Characteristics of directors' place of origin, political relevance level, and company value: Evidences of directors' forced resignation based on 'No. 18 document'. *Economic Theory and Business Management*, 2, 28–45, (in Chinese).

Tang, S., He, K., & Xu, J. (2015). Proprietary costs and the disclosure of information about major customers: Evidence from Chinese listed firms. *China Accounting and Finance Review*, *17*(2), 99–128. doi: 10.7603/s40570-015-0006-x.

Thomas, S. (2002). Firm diversification and asymmetric information: Evidence from analysts' forecasts and earnings announcements. *Journal of Financial Economics*, *64*(3), 373–396. doi: 10.1016/s0304-405x(02)00129-0.

Wang, S., Liu, Y., & Zhang, Y. (2023). The impact of debt default risk on firm innovation effciency. *Journal of Nanjing University of Finance and Economics*, 3, 44–54, (in Chinese).

Wen, W., & Song, J. (2017). Executives' foreign experience and corporate social responsibility. *Journal of Management Science*, *30*(2), 119–131, (in Chinese).

Wen, Z., & Ye, B. (2014). Analyses of mediating effects: The development of methods and models. *Advances in Psychological Science*, *22*(5), 731–745. doi: 10.3724/sp.j.1042.2014.00731, (in Chinese).

Xiao, L. (2016). How corporate governance influences firm's R&D investment?——empirical evidence from strategic emerging industries in China. *Industrial Economics Research*, 1, 60–70, (in Chinese).

Xie, Z., Su, L., & Wang, J. (2016). The function orientation of independent direction. *Accounting Research*, 6, 46–54, (in Chinese).

Xie, Y., Zhang, Y., Wu, L., & Dong, F. (2017). The mechanism and empirical research of directors' status differences, behavior strength of decision-making and financial performance of private listed companies. *Chinese Journal of Management*, *14*(12), 1767–1776, (in Chinese).

Xin, Y., Deng, X., & Teng, F. (2016). Perceived institutional pressure and the resign of independent directors with official identity: An empirical study based on the document No. 18 of the organization department of the central committee of the CPC. *Journal of Finance and Economics*, *42*(8), 121–132, (in Chinese).

Yan, Z., Liang, S., & Yuan, C. (2019). Vertical interlock, institutional environment and corporate innovation. *Business and Management Journal*, *41*(10), 90–107, (in Chinese).

Ye, L., & Li, X. (2012). Managers' investment herd behavior, industrial policy and firm value: Based on the empirical test of China's A-share listed companies. *Journal of Jiangxi University of Finance and Economics*, 5, 24–32, (in Chinese).

Ye, K., Zhu, J., Lu, Z., & Zhang, R. (2011). The independence of independent directors: Evidence from board voting behavior. *Economic Research Journal*, *46*(1), 126–139, (in Chinese).

Zhang, F., Hu, K., & Yang, N. (2019). The herding behavior of firm R&D and its negative effect. *Studies in Science of Science*, *37*(3), 484–491, (in Chinese).

Zhao, Z., & Zhou, J. (2013). Independent directors with industrial expertise, audit complexity, and audit fee. *China Accounting and Finance Review*, *15*(1), 63–83.

Zhao, X., Li, H., & Sun, C. (2015). The regional cultural map in China: Is it 'the great unification' or 'the diversification'?. *Journal of Management World*, 2, 101–119, (in Chinese).

Zhong, R. (2018). Transparency and firm innovation. *Journal of Accounting and Economics*, *66*(1), 67–93. doi: 10.1016/j.jacceco.2018.02.001.

Zhu, J., Ye, K., Tucker, J. W., & Chan, K. C. (2016). Board hierarchy, independent directors, and firm value: Evidence from China. *Journal of Corporate Finance*, *41*, 262–279. doi: 10.1016/j.jcorpfin.2016.09.009.

Corresponding author
Shangkun Liang can be contacted at: liang_sk@126.com

Appendix

Code: 000008; Year: 2015

Name	Duty	*Rank*	*Status*	*Rank2*	Regression residual ε	*Status2*
Wang Zhiquan	Chairman of the Board	1		10/10		
Lai Weiqiang	Director、General Manager	2		9/10		
Bai Bin	Director	3		8/10		
Zhang Weihua	Independent Director	4	0.5 = [(1–4/10)+(1–5/10)+(1–6/10)]/3	7/10	0.1389149	0.0474365 = (0.1389149+0.044543 −0.0411503)/3
Zhu Zuqiang	Independent Director	5		6/10	0.044543	
Yi Tingbin	Independent Director	6		5/10	−0.0411503	
Zhong Yan	Vice General Manager	7		4/10		
Yang Jian	Chairman of Supervisors	8		3/10		
Li Yiming	Supervisor	9		2/10		
Gao Hui	Supervisor	10		1/10		

Source(s): Table by authors

Table A1. The first example of independent directors' status measurement

Code: 002048; Year: 2011

Name	Duty	*Rank*	*Status*	*Rank2*	Regression residual ε	*Status2*
Zhou Xiaofeng	Chairman of the Board	1		13/13		
Lin Fuqing	General Manager	2		12/13		
Lou Jiahao	Director	3		11/13		
Du Kunyong	Secretary of the Board	4		10/13		
Jin Liangkai	CFO	5		9/13		
Shao Hemin	Director	6		8/13		
Yu Shuli	Independent Director	7	0.2820513 = [(1–7/13)+(1–8/13)+(1–13/13)]/3	7/13	−0.0230956	−0.1857107 = (−0.0230956 −0.0821844 −0.451852)/3
Li Dansheng	Independent Director	8		6/13	−0.0821844	
Xu Bocang	Supervisor	9		5/13		
Shu Rongqi	Supervisor	10		4/13		
Yang Jun	Supervisor	11		3/13		
Du Fan	Vice General Manager	12		2/13		
Zhang Liren	Independent Director (New)	13		1/13	−0.451852	
Wang Jianxin	Independent Director (Departure)					

Source(s): Table by authors

Table A2. The second example of independent directors' status measurement