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Social norms in managerial decision-making: Psychological and/or neural perspectives

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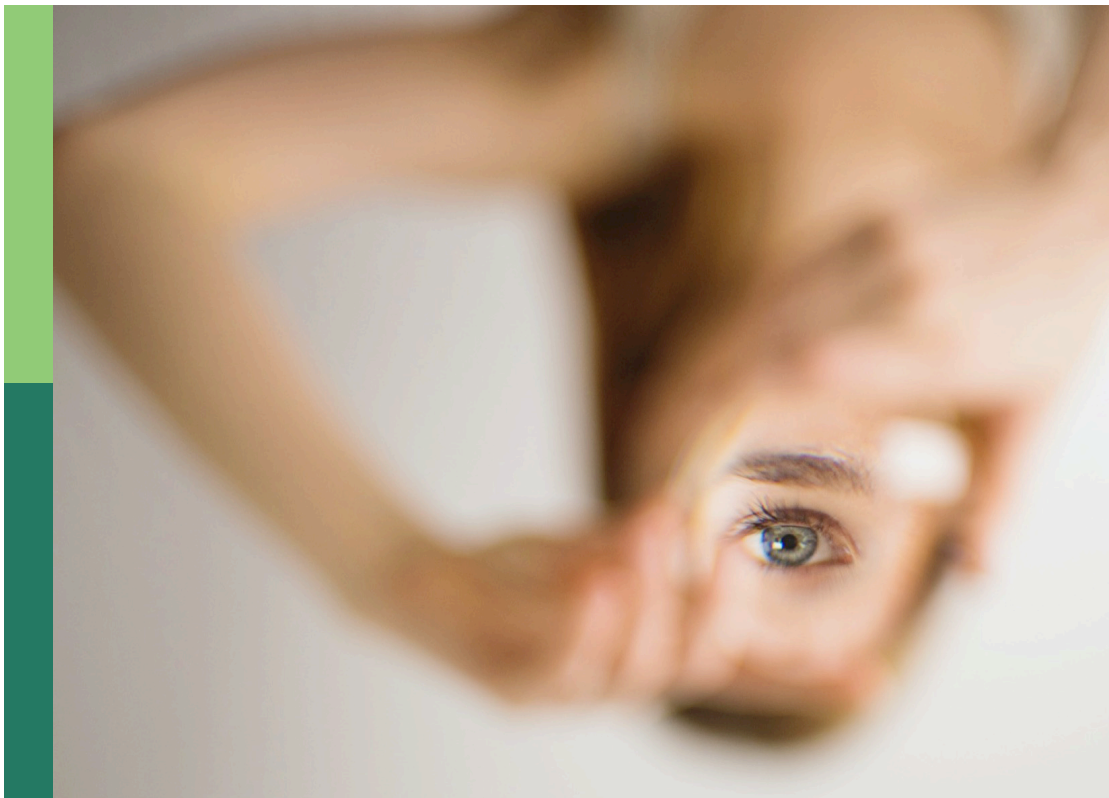

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Social norms in managerial decision-making: Psychological and/or neural perspectives

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Editorial: Social norms in managerial decision-making: Psychological and/or neural perspectives

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Editorial on the Research Topic
Social norms in managerial decision-making: Psychological and/or neural perspectives

Introduction

Social norms, the concept that originates from the field of sociology (Opp, 1982; Elster, 1989), represent what people ought to do or actually do in a specific situation (Cialdini et al., 1990; Bonan et al., 2020; Yin et al., 2021). As Fehr and Fischbacher (2004, p. 63) stated that "the ability to develop and enforce social norms is probably one of the distinguishing characteristics of the human species," social norms can greatly influence individual and organizational decision-making processes.

The impact of social norms has long been a core topic in the fields of behavioral economics, psychology, sociology, and decision neuroscience. There is also increasing attention from studies of managerial decision-making in recent years. For instance, several reviews and Editorial articles have emphasized the usefulness of social norm theory in empirical business ethics research (Blay et al., 2018) and corporate governance (Stathopoulos and Talaulicar, 2022). However, the discussion on management issues is insufficient. We still know little about how social norms affect specific managerial decision-makings, the management systems and forces that constrain or enhance social norms, the cognitive and emotional mechanisms in the process, as well as the relevant neural evidence. To address this important while underexplored research area, we have proposed this Research Topic and finally accepted 13 manuscripts. These manuscripts have investigated the roles of social norms in managerial decisions such as donation

and pro-social activities (five articles), corporate social responsibility (CSR) and pro-environmental behaviors (four articles), and corporate innovation (four articles). The main ideas and contributions of these articles are outlined below.

Social norms in donation decisions and pro-social activities

Several papers have examined the roles of social norms in donation decisions. Prior studies have shown that donors who are informed of information about other people' previous donation tend to comply with social norms by mimicking these people's donation decisions (Smith et al., 2015; Drouvelis and Marx, 2021). Peng et al. investigated how individual donation behavior was affected by previous information and found that donors imitated not only the amount of donated money but also the choice of anonymity and the positive sentiment expressed by others.

Similarly, the article from Li et al. explored the influences of social capital and social recommendation on charity crowdfunding performance. Using 4,780 project data from the charity crowdfunding of Sina MicroBlog, the authors found that both external social capital and internal capital significantly improved the fundraising performance of crowdfunding projects. Moreover, projects with more social recommendations were more likely to obtain financial support.

As a study focusing on the impact factors of corporate philanthropic donations, Chen H. et al. used data from the 12th Chinese Privately Owned Enterprise (POEs) Survey and found that an entrepreneur's military experience had a positive influence on corporate philanthropic donations. Further, the entrepreneur with military experience still donated even if their firms suffered from financial constraints. The findings by Chen H. et al. suggest that entrepreneurs with military experience may be more likely to value social norms for altruism.

Additionally, two articles investigated the roles of social norms in pro-social activities. Using an experimental design of the sequential public goods game, Fu et al. showed that the level of a leader's investment in public goods could significantly affect the cooperation behavior of team members. The results of Wang et al. demonstrated an inverted *U*-shaped relationship between top management team (TMT) compensation gap and corporate performance, and this relationship was weakened when TMT members owned a higher level of fairness preference.

Social norms in CSR and pro-environmental behaviors

There are several papers investigating the roles of social norms in CSR. Wang and Cao investigated executives' decision-making on CSR activities between their predecessor firms and the successor firms by tracking their movements across Chinese listed firms, which indicated that their value for social norms for CSR maintained consistently in a certain period. Moreover, two other articles by Khan et al. and Qu et al. examined the influence of tournament incentives on CEOs and corporate network position on CSR, respectively, which showed that the above two factors demonstrated positive effects on CSR Performance.

Additionally, Wan and Deng presented an experimental study of the effect of group identity on pro-environmental behaviors. They found that group identity primed by housing ownership did not affect individual environmental behavior, while social norms primed by publicity and education showed significant positive effects on the development of individual and group pro-environmental behavior.

Social norms in corporate innovation

Four articles introduced the influences of social norms on corporate innovation activities. Two articles suggested that enterprise managers might treat typical innovation activities of market stakeholders (e.g., upstream enterprises, downstream enterprises, and competitors) as social norms, and then conducted similar innovation activities for their own enterprises. For instance, Chen S. et al. presented an empirical study of the influences of external innovations from upstream enterprises, downstream enterprises, and competitors on the exports of private enterprises. They found that the external innovations by market shareholders could significantly promote private enterprises' innovations, which further enhanced their export performance. Similarly, Liu et al. also found the existence of peer effect in the innovation activities of listed enterprises.

Additionally, Zhang and Ma investigated the relationship between faultlines of board directors and innovation activities of Chinese companies. The results showed that social-related faultlines demonstrated a negative effect on corporate innovation while cognitive-related faultlines showed a positive effect. The authors suggested that social-related faultlines might lead to the out-group discrimination effect among sub-groups of the board, and thus harmed corporate innovation performance.

Finally, Shao et al. introduced an empirical study which investigated the roles of celebrity CEOs in firms' innovation investment activities. The authors suggested that the norms for preserving celebrity status would motivate celebrity CEOs to develop a higher level of innovation investments. The results also showed that the effect of celebrity CEOs on innovation investment was positively moderated by analyst coverage. These findings were consistent with the ideas that social norms would show a higher influence when subjects were under observation by social members (Schram and Charness, 2015).

Conclusions

This Research Topic highlights the roles of social norms in managerial decision-making. The collected articles demonstrate that social norms can influence a wide scope of business activities, ranging from donation, CSR, pro-environmental behaviors to corporate innovation. We suggest that future lines of research can further explore how social norms interact with country- and firm-level institutional characteristics to influence business activities in different countries.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Positive Sentiment and the Donation Amount: Social Norms in Crowdfunding Donations During the COVID-19 Pandemic

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Public welfare fundraising has been used to collect donations for medical supplies and has played an important role in the fight against the COVID-19 pandemic. This paper studies online crowdfunding donations from the Alumni Association of Wuhan University to North American alumni; donation data are used to investigate how individuals' donation behavior is affected by the previous donation amount and information provided by the fundraising platform. First, our results show that one's donation amount is positively affected by the previous donation amount. Second, the donor's positive sentiment in the message that he or she leaves, as measured by either natural language processing or a manual rating, can affect the subsequent anonymity and messages but not the subsequent donation amount. Third, anonymous donations are much smaller than non-anonymous donations.

Keywords: crowdfunding, social norms, sentiment analysis, COVID-19, donation

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INTRODUCTION

Online public welfare fundraising, in which donors are purely donating and asking for nothing in return, is gradually replacing on-site fundraising because of its advantages of faster dissemination, its ability to reach a larger audience, and its greater pertinence. In 2020, 12.9% of total fundraising came from online giving worldwide, and the growing trend of online donations was clear[1]. Online crowdfunding is an important fundraising tool launched on an online platform within a certain period of time to obtain small donations from a group of people who mostly do not know each other (Mollick, 2014).

In economics, people are often assumed to be self-interested, but in reality, human is not entirely driven by material interests. Exploring donors' motivations and identifying the determinants that affect donation behaviors are essential and practical for fundraisers to increase the donation amount. Bagheri et al. (2019) explore the motivations of donors to fund projects on charity crowdfunding platforms and suggest a set of intrinsic individual motivations, including shared problems, values, thoughts, and beliefs, helping a minority, technical knowledge, and the capacity of the project to learn from and help to realize ideas and create value, that lead to donations on charity crowdfunding platforms. Lee and Chang (2008) point out the intrinsic determinants of charity behaviors, including psychographic, and attitudinal factors, such as general perceptions of charities, a sense of social responsibility, familiarity with a charity, and empathy.

[1]Charitable Giving Report 2021 from www.blackbaud.com.

Many studies have been conducted to explore what kinds of information and the extent to which the information can mediate individuals' intrinsic determinants and further nudge individuals' donation behaviors. With the development of the internet and the changes in charity crowdfunding channels, online charity platforms offer opportunities for fundraisers to provide potential donors with information that could influence their behaviors. It is of great theoretical and practical significance for researchers, fundraisers, and charity platforms to address whether several common types of information and the basic design of many online charity platforms positively impact individuals' donation behaviors.

This paper uses data from online crowdfunding donations by Wuhan University alumni during the COVID-19 pandemic to study the factors affecting crowdfunding donations. The Wuhan University Alumni Association launched the "Donate Masks for North American Alumni" donation campaign in March 2020 to purchase epidemic prevention materials to assist alumni overseas.[2] The crowdfunding campaign used the WeChat public platform to openly collect donations and opinions from a large number of alumni.

The length of the single donation sequence in this study is close to 1,500, and half of the donors left a message, which allows us to use linguistic sentiment analysis[3] for the sequence. To analyze the impact factors in the process of online crowdfunding donations, this paper includes historical donation amounts and the lengths and sentiments of messages in econometric models. In addition, we study how historical donation information affects the anonymous selection of subsequent donors, which is another topic not considered in the previous empirical literature. Our research demonstrates the role of the message, atmosphere, donation amounts (descriptive social norm), and anonymity behaviors of previous donors in subsequent donors' behaviors.

In a disaster that affects a wide range of areas and a large number of people, people can share experience messages online and quickly allocate social resources through online crowdfunding donations, which is especially important and effective. The features of this kind of donation can provide insights for research focusing on individuals' donation behaviors in charitable crowdfunding projects launched to fight against disasters such as the COVID-19 pandemic. The donation data also allow us to focus on how information affects individuals' donation behavior, controlling all donors with the same social identity and similar educational background.

This paper confirms the impact of descriptive social norms on crowdfunding donations. As some of the earliest researchers on leaving messages in donations, we do not find evidence that leaving messages and donors' sentiments can affect the subsequent donations amounts. These results are very similar regardless of whether we use natural language processing or a manual rating. However, Saleh et al. (2021) found that crowdfunding donations related to the COVID-19 pandemic have significantly longer descriptive messages, more social media sharing, and a higher total donation and last longer than other donations. Our paper points out the possibility that emotional messages that are left may promote enthusiasm for participation (the total number of participants) in donations but does not increase the average donation amount.

This paper is organized as follows. We first outline the literature review and hypothesis development, second describe the data and method, third present the results, and finally offer the discussion and conclusion.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Influence of Social Information on Donation Behavior

Online donation platform practitioners often apply information intervention to encourage visitors to donate more. Much research focuses on what kind of information can nudge individuals' donation behaviors, among which the information and donation behaviors are usually related to individuals' donation amount.

However, the conclusions regarding the positive or negative impacts of information on donation behaviors are not consistent. Many prior studies show that information about the previous donation amounts increases individuals' donation amounts (Shang et al., 2007; Martin and Randal, 2008; Shang and Croson, 2009; Smith et al., 2015; Goeschl et al., 2018; Vesely and Klöckner, 2018; van Teunenbroek and Bekkers, 2020; Drouvelis and Marx, 2021; Li et al., 2021; van Teunenbroek et al., 2021). There are also several studies drawing different conclusions and showing a negative effect (Croson and Shang, 2008, 2013; Meyer and Yang, 2016; Kubo et al., 2018); or no effect (Murphy et al., 2015) of several types of social information on donation amounts under certain situations.

Some studies explore the mechanism of the impact of social information on donation behaviors. Smith et al. (2015), Sasaki (2018), and van Teunenbroek and Bekkers (2020) suggest that social information influences donation or contribution behavior *via* social norms, which are a standard or reference for what is appropriate, and then triggers subsequent decision makers' conformity behaviors. Different from their conclusion, van Teunenbroek et al. (2021) find no evidence that social information affects giving behavior or mood *via* perceived social norms.

Descriptive social norms are an essential category of social norms and have attracted much attention in the literature. Using field experiments, Agerström et al. (2016) and Bartke et al. (2017) find that providing people with descriptive norms (e.g., "this is

[2]Wuhan University is the largest and most influential university in Wuhan. Overseas alumni of Wuhan University donated a large number of medical supplies in the early stage of the COVID-19 epidemic. At the end of March, the epidemic had been effectively controlled in Wuhan, but the epidemic in North America was widespread. The Chinese alumni launched this online event to raise funds to purchase medical supplies (e.g., medical masks) for North American alumni.

[3]Sentiment analysis is the use of natural language processing, text analysis, computational linguistics, and biometrics to systematically identify, extract, quantify, and study affective states and subjective information. Sentiment analysis is widely applied to the voice of the customer materials such as reviews and survey responses, online and social media, and healthcare materials for applications that range from marketing to customer service to clinical medicine (https://en.wikipedia.org/wiki/Sentiment_analysis).

what most people do," or "2/3 of the population in Germany make charitable donations each year") substantially increased charitable giving. Goette and Tripodi (2020) find that donors in the experiment expect others to donate more, and in turn, they donate more themselves. This phenomenon is described as the social information effect (Shang and Croson, 2009; van Teunenbroek and Bekkers, 2020). The empirical literature finds that online donations can produce descriptive social norms of the donation amount (Smith et al., 2015; Sasaki, 2018). In the crowdfunding donations examined in this paper, the donation page displays only the last five donation amounts, which is convenient for investigating the impact of descriptive social norms.

Since online crowdfunding is a sequential donation process, historical donation information can affect the behavior of future donors (Potters et al., 2005; Gaechter et al., 2010). Meer (2017) also finds that matching grants to donation amounts from a third party, as well as amount competitions among donation projects, could increase the contributions. Based on previous studies, van Teunenbroek et al. (2020) report that descriptive social norms will motivate people's donation behavior through awareness of the need for help as well as perceived descriptive social norms of the donation amount, but at the same time, the donation will become less attractive when the impact of the individual donation, which is also reflected in descriptive social norms, is considered low. Online crowdfunding typically allows people to leave messages; however, no linguistic analysis of donors' messages has been conducted in the previous literature.

On the internet, one can more easily display all kinds of information to affect other people's decisions. In an online crowdfunding donation, donors can choose whether to provide personal information and/or leave a message, and future donors can see the information left by the previous donors and their donation amount. A fixed environment for donating and expressing opinions on the website can help us observe the channels that influence donations.

We have reasons to believe that messages and the atmosphere in the donation may also impact behavior. This inference is based on the following three facts. First, studies show that people must be aware of there being a need for help before they feel motivated to give (Levitt and Kornhaber, 1977; Bekkers and Wiepking, 2011); the longer the message, especially the sentiment shown in the message, the greater the potential donors' perception of need. Second, positive sentiment has a stimulating effect. Many positive messages reflect that a donation is attractive and can be regarded as a signal of the high quality of the donation project, which may motivate people to donate (Quinn and Dutton, 2005). Third, positive sentiment has a strengthening effect. Psychological research has shown that people tend to repeat actions that make them feel positive (Collins, 1993). Therefore, historical messages conveying positive sentiment are likely to inspire subsequent donors to leave messages with positive sentiment. However, there is no literature linking positive sentiment to people's donation behavior because the existing research has not introduced an index for language sentiment tendentiousness.

Our work contributes to the literature on the impacts of social information on donation behavior. The first reason it does so is that previous studies do not draw a consistent conclusion on whether social information has a positive or negative impact on donation behavior, especially the donation amount. In addition, when exploring what kind of information can nudge individuals' donation behaviors, prior studies consider only the information and behavior related to the donation amount, and they pay less attention to the donation message, even though the message holds great significance for fundraisers, donors, and recipients when funds are raised for people facing a disaster.

Anonymity, Social Norms, and Donation Behavior

Decision observability or unobservability is an essential contextual factor in donation projects. Many field experiments have noted that when donations are non-anonymous, people donate more money than when donating anonymously (Soetevent, 2005; Alpizar et al., 2008; Vesely and Klöckner, 2018). In these field experiments, people were randomly assigned to a charitable donation in either the non-anonymity (also called behavior observability) or anonymity condition.

In this paper, however, donors themselves could choose to be non-anonymous or anonymous on an online sequential donation platform, which means that they had the option to hide their name and avatar or not. Past studies based on these similar anonymous behaviors point out that the most common reason driving people to donate anonymously was to avoid judgments from the public (Peacey and Sanders, 2013; Raihani, 2014; Imada, 2020; Raihani and Power, 2021).

Firmansyah and Pratama (2021) compare donors' anonymity and donation amount on GoFundMe and Kitabisa, donation-based crowdfunding platforms in the United States and Indonesia, respectively, and they find that anonymous and self-identified donors donate a similar amount of money on GoFundMe, while anonymous donors donate significantly less money than self-identified donors on Kitabisa. They attribute the differences in donation and anonymity behaviors between the two donation-based crowdfunding platforms to cultural and religious influences. Individuals in the United States, which is an individualistic country, are more likely to embrace differences. In contrast, individuals in Indonesia are expected to conform to social norms because they come from a collectivistic country.

China is a country dominated by collectivism, and people have been educated to be united since childhood. Under such a social background, we expect our anonymity and donation amount results to be similar to those of Indonesia in Firmansyah and Pratama (2021). We propose the hypothesis that a considerable number of people will choose to be anonymous and that individuals who choose to be anonymous will donate less than non-anonymous individuals.

Online Crowdfunding Donations (Especially for the COVID-19 Pandemic)

Donation-based online crowdfunding has become an increasingly popular tool because of its time and cost efficiency

in obtaining financial support for people facing unexpected events such as natural disasters and pandemics (Sura et al., 2017; Radu and McManus, 2019; Saleh et al., 2021). The emotion and sentiment involved play an essential role in appealing to potential donors to contribute (Korolov et al., 2016; Rhue and Robert, 2018), especially on online charity platforms.

Many social context-related factors impact donors' psychological states and behaviors (Ferguson et al., 2015; Braun, 2017). Li et al. (2021) suggest that participants' social anxiety decreased along with the abatement of the pandemic and that social anxiety completely mediated the relationship between pandemic abatement and the decrease in the contagion of positive donation behaviors. By comparing COVID-19-related campaigns and non-COVID-19-related campaigns, Saleh et al. (2021) suggest that COVID-19-related campaigns raised more money, had a longer narrative description, and were more likely to be shared on Facebook than other campaigns in the study period.

The donation in this paper has characteristics that are similar to those in the literature: a long duration, many participants, messages that are left, and a high total donation. We observed a considerable amount of sharing in the Wuhan University Alumni WeChat group, but we do not have social media sharing data.

Hypothesis Development

Based on the literature, we construct the following three hypotheses:

Hypothesis 1 (Message and Sentiment Effect) *In sequential (crowdfunding) online donation, the length and the positive sentiments expressed in the previous messages can affect those of subsequent donors.*

Previous studies show that the text or video of the project descriptions or charity advertising applied by fundraisers can evoke individual emotions and influence the decision-making of potential donors (Chen et al., 2021; Wymer and Gross, 2021). Based on this idea, we believe that donor messages can also affect donor behavior by arousing the emotions of subsequent donors. Different from previous studies, our paper focuses on the information and emotional transmission between donors instead of focusing on the information and emotion communication among fundraisers and potential donors, as done by previous studies.

In the empirical section, we try to determine whether previous messages and their sentiments affect subsequent messages and sentiments.

Hypothesis 2 (Descriptive Social Norms) *In sequential (crowdfunding) online donations, the previous donation amounts can affect the donation amounts of subsequent donors.*

Social norms also include how much others donate. Individuals tend to imitate and follow the observed donation amounts of other donors. As a result, donors may adjust their donations according to the amounts given by previous donors.

Hypothesis 3 (The Anonymity Effect) *In sequential (crowdfunding) online donation, previous anonymity can increase the possibility of anonymous subsequent donors. Moreover, anonymous donations are smaller than non-anonymous donations.*

The donor's intention to remain anonymous is also affected by how many previous donors chose to remain anonymous. Economists note that donors are influenced by the estimated impact of their donation (Duncan, 2004). When people choose to be anonymous, their individual impact, or the social norms' impact, is weaker than if they were not anonymous; thus, their willingness to donate will be lower (Firmansyah and Pratama, 2021).

DATA AND METHOD

Introduction of the Donation Platform and Sample Selection

The fundraising page displays the total amount of funds raised, the total number of donors, and detailed donation information about the last five donors, including their names,[4] WeChat avatars, donation amounts, and messages left. Donors can choose to remain anonymous, and if they do so, their WeChat avatar will be replaced by a picture showing a pink heart. Additionally, their nicknames will be uniformly displayed as "caring people," while the display of their donation amount and message will not be affected by their anonymity decision.

As shown in **Figure 1A**, a person who enters this page can click the red button in the middle of the page, "I want to donate," to make a donation. Once a donor clicks "I want to donate," the donation website switches to the second page shown in **Figure 1B**. After entering the donation amount, filling in his or her private information (including his or her name, email, and phone number), leaving a message (or not), and deciding whether to be anonymous, the name, donation amount, anonymity and message will be updated on the donation page in real time, as shown in **Figure 1A.**[5]

The donation platform requires real-name authentication; thus, the private information of donors must be submitted. The message is optional for donors, and the donation platform does not set a default message. If a donor does not leave a message, nothing will be displayed in the corresponding place in **Figure 1A**.

This online fundraising process is a sequential donation; the information of donors has a cascade effect. That is, historical donation information plays a role in the current donation decision, and current donation information affects the behavior of future donors. Specifically, as shown in **Figure 2**, the information from the previous set of donors includes the previous donation amounts, messages, and positive sentiment

[4]On the donation platform, donors' self-reported names are displayed to the public if they do not choose to be anonymous. Based on the data, we find all the non-anonymous donors showed their real names instead of nicknames.

[5]Because the page contains a brief introduction to the donation, the length of the actual donation page is so long that one cannot see the anonymous option when one first chooses the donation amount. This is one of the reasons why we believe that the donation amount will affect anonymity.

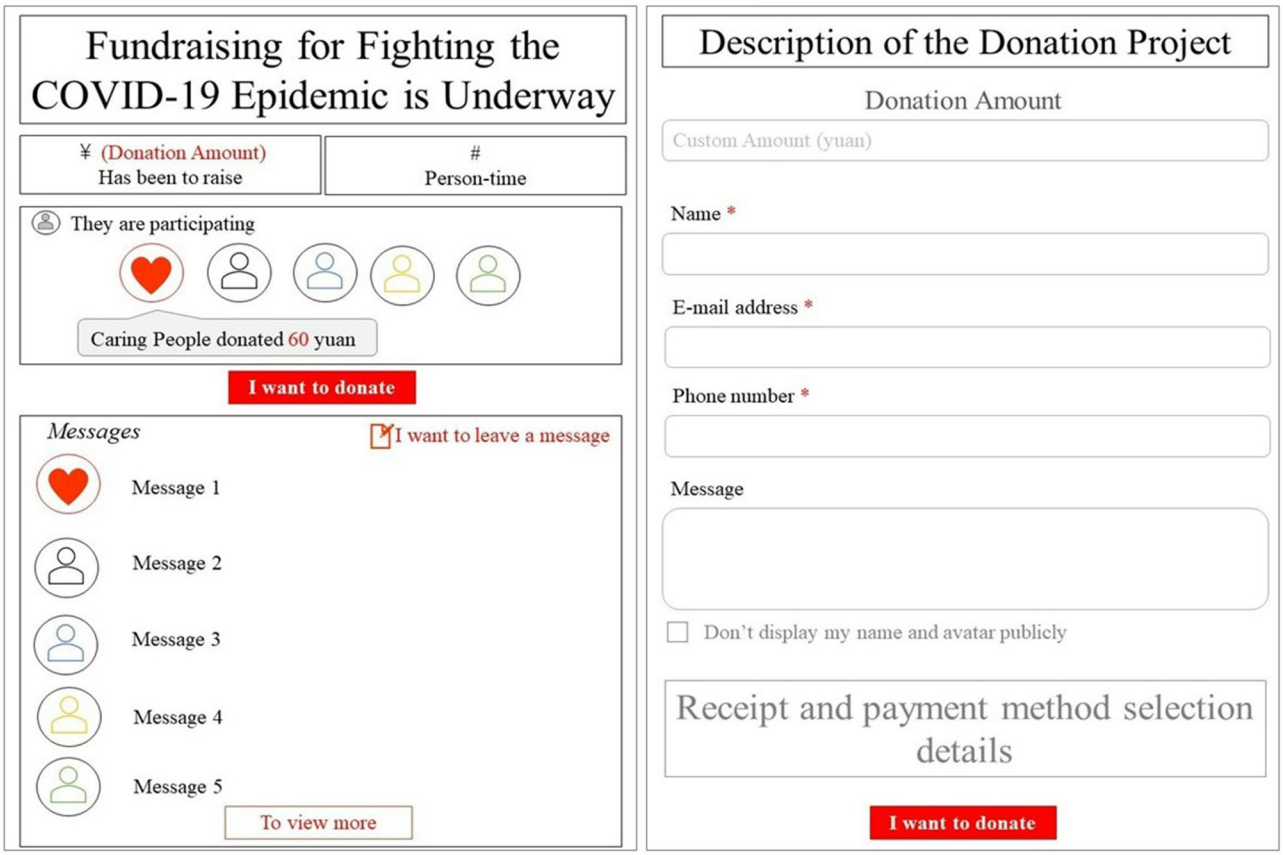

FIGURE 1 | The crowdfunding donation, **(A)** Page 1, **(B)** Page 2. This figure contains the core content of the actual fundraising pages.

reflected in their messages. Assume a donor at time T can see the information set and donation amounts in the last five donors $T-5$ to $T-1$. After observing the information of the latest five donors, a donor at time T can choose how much to donate, whether to remain anonymous, and what message (if any) to leave.

To avoid the impact of a significant change in the epidemic over a long period of time, we used donation data from the week following the project launch date (from 25 March 2020 to 1 April 2020). This project was launched on the evening of 24 March 2020 and was shared with alumni starting on 25 March 2020. There were several test records created by programmers at the beginning; thus, we exclude the records created on 24 March 2020. Although the donation website was open until early May 2020, the number of donations after April 1 was very sparse and <10. Finally, a total of 1,481 valid samples were obtained, and the total donation amount was 453,249.9 RMB (∼65,000 USD).

We collected all available information, including donors' names, donation amounts, messages, and whether the donors chose to remain anonymous. Donors used the messages to express appreciation for the crowdfunding donation, to express optimism about the prospects of fighting the epidemic, or to note deep feelings between the donor and the recipient. There were 718 donors who left messages, accounting for 48% of the total donors. There were some identical messages and a total of 580 different messages.

The donations for these 1,481 samples range from 1 to 15,520 RMB (∼2,300 USD), and the average donation amount is ∼306 RMB (∼42 USD). We use dummy variables to indicate whether a donor chose to remain anonymous: the variable *Anonymous* is equal to 0 for a donor who is not anonymous, and *Anonymity* is equal to 1 for anonymous donors. A total of 475 donors chose to remain anonymous, while 1,006 donors decided to leave their names.

Message and Sentiment Score

For the non-empty messages, after deleting meaningless characters, we found that each message had an average of 6 characters, indicating that most of the donors' messages were short texts. The overall sentiment of the messages was

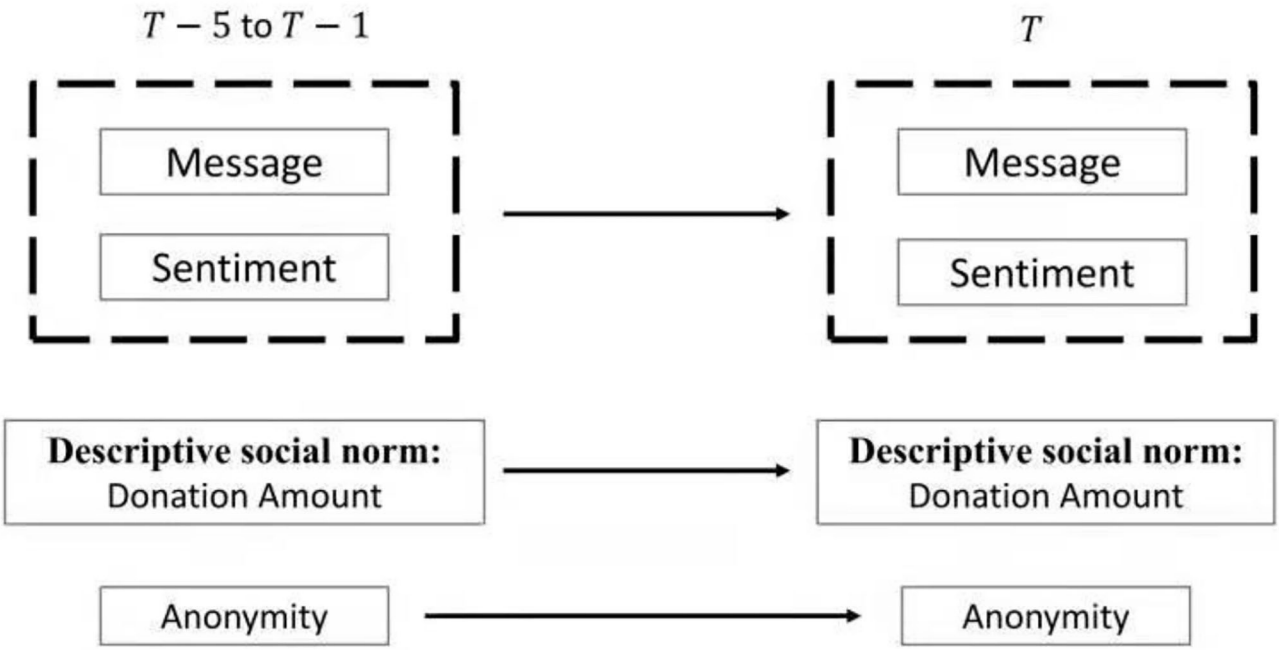

FIGURE 2 | Effect of norms on donations and positive sentiment.

TABLE 1 | Message examples in the donation.

Message example	NLP sentiment	MR sentiment
Example 1: I am a healed patient of COVID-19. I received many kind people's encouragement and help during the most difficult times. Now it's time to do my part. I hope everyone will unite as one and win this battle against the epidemic. When the spring flowers bloom, we will meet again ~	>0.999	6.556
Example 2: The alumni of WHU around the world are one family	0.810	4.167
Example 3: Spend together	0.708	2.875

relatively positive. To determine the positivity[6] of each message, we first used the snowNLP package in Python. In **Table 1**, NLP Sentiment denotes the sentiment score determined by the snowNLP package. Chinese differs from English in that there is no interval between words. Therefore, this package first breaks down each message into words and then evaluates them based on the package's specific wordbook and assigns a total sentiment score to the message. This score is a continuous value between 0 and 1: a higher score means the message is more positive. Finally, we set the length of the message and sentiment score to 0 for observations of donations with no message. If we count only donors who left a message, the average sentiment score of the messages is 0.774. **Table 1** shows examples of messages and their sentiment scores.

In addition to adopting snowNLP to conduct sentiment analysis, we recruited 51 graduate student subjects (average age = 23.58, 17 males and 34 females) from Wuhan University to rate the donation messages. Every subject was required to rate 116 messages (1/5 of the total) randomly selected from the 580 total unique messages. The subjects were informed of the brief description of the donation projects, and they were informed of the following: "This questionnaire contains 116 questions. Each question stem is a message left by a previous donor when donating. Please rate the emotional strength of each message, with 1 point being the weakest and 7 points being the strongest."[7]

Finally, we use the average score rated by human subjects as the manual rating (MR) sentiment of each message. Counting only the 580 unique messages, we obtain an average MR sentiment score of 4.289.

The Spearman test results show a significant positive correlation between the NLP and MR sentiment scores (number

[6]The value output of snowNLP ranges from 0 to 1, with 0 representing negative sentiment and 1 representing positive sentiment. Based on previous studies, snowNLP is often used to analyze messages or texts that express individuals' subjective experience of something or their feelings, such as tourists' experience of attractions (Zhang et al., 2022) and potential borrowers' feelings toward a peer-to-peer (P2P) lending platform (Huang et al., 2021). Therefore, it is feasible to adopt snowNLP to conduct text analysis. Furthermore, to verify the significance of the snowNLP sentiment scores, we recruited subjects to manually score the messages of donors (details are displayed as follows).

[7]We do not directly use the word "positive" in the questionnaire because we believe that all messages in this donation are not negative. The translation of the questionnaire is in the **Appendix**.

TABLE 2 | Summary statistics.

Statistic	N	Mean	St. Dev.	Min	Pctl (25)	Pctl (75)	Max
Donation amount	1,481	306.043	569.907	1	100	400	15,520
Anonymity	1,481	0.321	0.467	0	0	1	1
Message length	1,481	6.032	11.434	0	0	9	100
NLP Sentiment	1,481	0.376	0.434	0	0	0.901	1.000
MR sentiment	1,481	2.473	1.676	1	1	4.111	7

of observations = 580; Spearman's rho = 0.2409; p-value = 0.0000). The MR sentiment scores of the 718 non-empty messages are based on the 580 unique messages rated. Additionally, we set the MR sentiment score to 1 for observations of donations with no message. The descriptive statistics of the MR sentiment scores of 1,481 observations are shown in **Table 2**.

We report summary statistics for the main variables in **Table 2**.

RESULTS

Main Results

To study how the behavior of donors is affected by historical donation information, we construct a regression model using ordinary least squares estimation to explore how historical donation amounts, message length, message sentiment[8] and anonymity affect subsequent donor behavior.

The front page of the crowdfunding platform displays real-time information about the latest five donors. When new donors view the page, they can see the amounts of money donated by the five previous donors before, the content of their messages, and their choice of whether to remain anonymous. If desired, the donors can obtain all the information about the previous donors by scrolling through the pages on their phones. However, due to the limitation of mobile phone interface size, a single page contains information about only five donors at a time, so considerable time and energy are required to obtain more donation information. Therefore, we believe that only the information of the last five donors directly impacts donor behavior; the impact of information from earlier donors is small.

Thus, dynamic regression is conducted according to the following regression equation:

$$Y_i = \alpha + \beta_1 log(DonAmt5_i) + \beta_2 MessLen5_i + \beta_3 Anonymity5_i + \beta_4 Sentiment5_i$$

In this regression, the independent variable $log(DonAmt5_i)$ is the logarithm of the total donation amounts of the latest five donors before the ith donor. The reason we use the logarithm value is that donation amounts have a very wide range of values (minimum value, 1 Yuan; maximum value, 15,520 Yuan). $MessLen5_i$ is the total message length of these five donors. We sum the dummy variable values of whether the latest five donors are anonymous to obtain the variable $Anonymity5_i$. In the same way, the total sentiment scores of the five people who left messages before the ith donor are calculated as $Sentiment5_i$. The VIF (variance inflation factor) values of $log(DonAmt5)$, $MessLen5$, $Anonymity5$, and $Sentiment5$ are 1.037, 1.701, 1.016, and 1.675, respectively, which represent a low level of multicollinearity.

[8]Unless otherwise specified, the sentiment scores mentioned in this paper refer to the NLP sentiment scores rated by snowNLP.

TABLE 3 | The regression results of donation behavior.

	Dependent variable			
	MessLen	Sentiment	log(DonAmt)	Anonymity
	OLS	*OLS*	*OLS*	*Logit*
	(1)	(2)	(3)	(4)
log(DonAmt5)	0.828	−0.016	0.123***	0.048
	(0.560)	(0.018)	(0.048)	(0.089)
MessLen5	0.004	0.0003	−0.001	−0.003
	(0.018)	(0.001)	(0.001)	(0.003)
Anonymity5	0.017	0.010	−0.040	0.140***
	(0.283)	(0.010)	(0.026)	(0.050)
Sentiment5	0.703**	0.032**	−0.022	0.098
	(0.351)	(0.013)	(0.032)	(0.066)
Intercept	−1.334	0.408***	4.258***	−1.428**
	(4.049)	(0.133)	(0.344)	(0.654)
Observations	1,481	1,481	1,481	1,481
R_2	0.008	0.010	0.007	
F Statistic	2.972**	3.609***	2.736**	
Log Likelihood				−923.925

****, **, and * denote statistical significance at the 0.01, 0.05, and 0.1 level. The coefficient values represent unstandardized regression coefficients. Robust standard errors are in parentheses.*

Our study aims to determine how an individual's donating behavior is influenced by other people's donation information, specifically how the information of the last five donors affects the subsequent donor's decision to donate. Y is the dependent variable of interest, and we consider four dependent variables: the ith donor's message length, anonymity, message sentiment score, and donation amount.

The regression results are shown in **Table 3**. Column (1) shows the relationship between the length of the ith donor's message and the donation information of the five donors before him or her. The sentiment scores of the latest five donors have a significant positive impact on the length of the donor's message (p-value = 0.046). For every one-point increase in the total sentiment score of these five donors, the subsequent donor leaves a message with ∼0.7 more characters.

Furthermore, the results in column (2) show that the sentiment scores of the last five donors not only influence the message length of the subsequent donor but also have a significant positive impact on the sentiment score of his or her message (p-value = 0.016). In other words, when a donor opens the fundraising platform, he or she can see the messages of the previous five donors. If the donor sees messages with more positive sentiment, the donor is more likely to leave a message with positive sentiment. Thus, as we infer in the

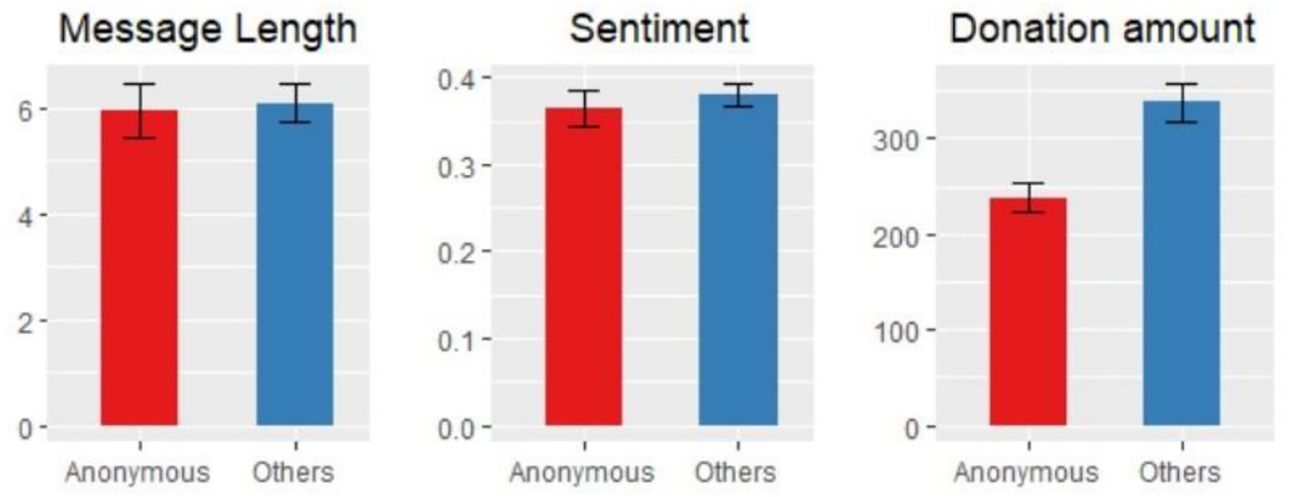

FIGURE 3 | Donation behavior of anonymous and non-anonymous donors (histograms represent arithmetic means; error bars represent standard errors).

previous section, positive sentiment is contagious, and positive sentiment's reinforcement effect is confirmed here. In other words, Hypothesis 1 is partially verified.

Column (3) shows the impact of historical donation information on the subsequent donation amount. The donation amounts of the last five people have a significant positive impact on the donation amount of a subsequent donor (p-value = 0.010). This result confirms Hypothesis 2: donors adjust their donation amount based on the donation amounts of others, which reflects their compliance with this descriptive social norm and is consistent with a series of studies drawing the conclusion that information about the donation amounts of previous donors increase individuals' donation amounts.

However, the messages of previous donors and choices of anonymity did not have a significant direct impact on the amount of money donated by subsequent donors, as shown in column (3). While we did not find evidence that more positive recent messages can inspire people to donate more, we believe that the messages of donors are influenced by the messages of other donors.

The results in column (4) confirm Hypothesis 3 from one perspective. These results show how the donation information of the latest five donors affects the choice of anonymity of the subsequent donor. The length of the previous donors' messages, sentiment scores, and donation amount had no significant effect on the subsequent donor's choice of anonymity, but whether the previous donors chose to remain anonymous significantly affected the subsequent donor's decision (p-value = 0.005). The coefficient of *Anonymity*5, β_3, is positive; that is, when a donor observes that more previous donors chose to remain anonymous, the donor is more likely to choose to remain anonymous, and vice versa. This result suggests that people tend to imitate the actions of people before them. This is another form of conforming to social norms.

Next, we separately assessed the donation behaviors of anonymous and non-anonymous donors, and the results are shown in **Figure 3**.

We compared the behaviors of anonymous and non-anonymous donors. Forty-Seven and Forty-Nine percentage of anonymous and non-anonymous donors left messages, respectively. In the left panel of **Figure 3**, the red bar shows that the average length of messages from anonymous donors is 5.95, and the blue bar shows that the average length of messages from anonymous donors is 6.08. No significant difference was observed between the two lengths (p-value = 0.42; all tests reported within the text are Wilcoxon rank-sum tests). The middle panel of **Figure 3** shows a similar result for the sentiments of anonymous and non-anonymous messages: no statistically significant difference is observed (p-value = 0.56). That is, anonymous and non-anonymous donors do not write messages with different content.

In the right panel of **Figure 3**, the left bar shows the average donation of anonymous donors, and the right bar shows the average donation of non-anonymous donors. A significant difference was found (p-value < 0.01): the average anonymous donation was 237.95 Yuan, and the average non-anonymous donation was 338.19 Yuan. This result supports Hypothesis 3: anonymous donations are smaller than non-anonymous donations. Our results regarding anonymous behaviors are consistent with those of many studies (Soetevent, 2005; Alpizar et al., 2008; Vesely and Klöckner, 2018; Firmansyah and Pratama, 2021). One possible explanation is that people attach great importance to evaluations from others and hope to be positively viewed as responsible people, especially in China, a country with a collectivistic culture. Thus, donors who do not have the ability or willingness to donate more than the socially accepted amounts in their mind will tend to remain anonymous.

TABLE 4 | The regression results of donation behavior (MR sentiment scores).

	Dependent variable			
	MessLen	Sentiment	log(DonAmt)	Anonymity
	OLS	*OLS*	*OLS*	*Logit*
	(1)	(2)	(3)	(4)
log(DonAmt5)	0.788	0.035	0.122**	0.042
	(0.560)	(0.072)	(0.048)	(0.089)
MessLen5	0.008	−0.002	−0.001	−0.003
	(0.019)	(0.002)	(0.001)	(0.003)
Anonymity5	0.019	0.041	−0.040	0.139***
	(0.284)	(0.038)	(0.026)	(0.050)
Sentiment5	0.131	0.052***	0.001	0.024
	(0.099)	(0.014)	(0.009)	(0.018)
Intercept	−1.466	1.576***	4.282***	−1.501**
	(4.008)	(0.532)	(0.346)	(0.664)
Observations	1,481	1,481	1,481	1,481
R_2	0.004	0.011	0.004	
F Statistic	2.455**	5.196***	2.640**	
Log Likelihood				−924.075

***, **, and * denote statistical significance at the 0.01, 0.05, and 0.1 level. The coefficient values represent unstandardized regression coefficients. Robust standard errors are in parentheses.

TABLE 5 | The regression results of donation behavior (time trend controlled).

	Dependent variable			
	MessLen	Sentiment	log(DonAmt)	Anonymity
	OLS	*OLS*	*OLS*	*Logit*
	(1)	(2)	(3)	(4)
log(DonAmt5)	1.098*	−0.011	0.110**	0.078
	(0.581)	(0.019)	(0.048)	(0.090)
MessLen5	−0.003	0.0001	−0.001	−0.003
	(0.018)	(0.001)	(0.001)	(0.003)
NoMess5	1.567	0.019	0.169	0.328
	(1.624)	(0.052)	(0.155)	(0.290)
Anonymity5	−0.050	0.009	−0.036	0.133***
	(0.283)	(0.010)	(0.026)	(0.049)
Sentiment5	0.832**	0.034**	0.035	0.125*
	(0.355)	(0.014)	(0.034)	(0.068)
Intercept	−3.436	0.359**	4.579***	−1.545**
	(4.523)	(0.143)	(0.367)	(0.712)
Control for the time trend	Yes	Yes	Yes	Yes
Observations	1,481	1,481	1,481	1,481
R_2	0.016	0.012	0.011	
F Statistic	3.943***	2.900***	2.823***	
Log Likelihood				−921.566

***, **, and * denote statistical significance at the 0.01, 0.05, and 0.1 level. The coefficient values represent unstandardized regression coefficients. Robust standard errors are in parentheses.

Robustness Check: Using the MR Sentiment Score

This section uses the MR sentiment score as the sentiment variable instead of the NLP sentiment score used in **Table 3** to conduct regressions in **Table 3**. The results, shown in **Table 4**, are similar to those shown in **Table 3**.

The results of Column (1) in **Table 3** show that the sentiment scores of the last five donors have a significant positive impact on the length of the donor's message. In contrast, this positive effect disappears in **Table 4** when using the MR sentiment score to replace the NLP sentiment score. All the results of Columns (2), (3), and (4) in **Table 4** confirm the robustness of those in **Table 3**.

Robustness Check: Time Trend Controlled

This section shows regressions that control for the time trend, and similar results are shown in **Table 5**.

Except for the NoMess5 dummy variable and controlling for the time trend, the dependent and independent variables of **Table 5** are the same as those in **Table 3**. **Table 5** shows results that are similar to those shown in **Table 3**. Furthermore, NoMess5 means that there is no message left by the previous five donors, and it has no significant impact on the dependent variables.

When historical messages contain more positive sentiment, subsequent donors are more likely to be affected by the positive sentiment and to leave longer and more positive texts, thus forming a virtuous cycle with a trend of spreading positive sentiment.

Figure 4 shows comparisons between the first and second halves of the donation sequence. The message length of the first half is 5.02, which is significantly less than that of the second half, 7.05 (p-value < 0.01). The sentiment score had the same significant trend, from 0.34 in the first half to 0.41 in the second half (p-value < 0.01). However, anonymity did not have a significant trend (p-value $= 0.11$), and the number of donations had an opposite significant downward trend from the first half (325.00) to the second half (287.11) (p-value < 0.01).

Placebo Test: Using the Information of the 100 Previous Donors

This section shows the results of the placebo test. Instead of the main regression using the information of the past five periods, the regression uses the information of the placebo test as the independent variable and finds no results that are significant at the 5% level.

In **Table 6**, the independent variable $log(DonAmt_{m100})$ is the logarithm of the average donation of the last 100 donors before the current donor. $MessLen_{m100}$ is the average message length of these 100 donors. We average the dummy variable values of whether the latest 100 donors are anonymous to obtain the variable $Anonymity_{m100}$. In the same way, the average sentiment scores of the 100 people who left messages before the current donor are calculated as $Sentiment_{m100}$. The dependent variables are the same as in **Table 3**. The VIFs (variance inflation factors) of $log(DonAmt_{m100})$, $MessLen_{m100}$, $Anonymity_{m100}$ and

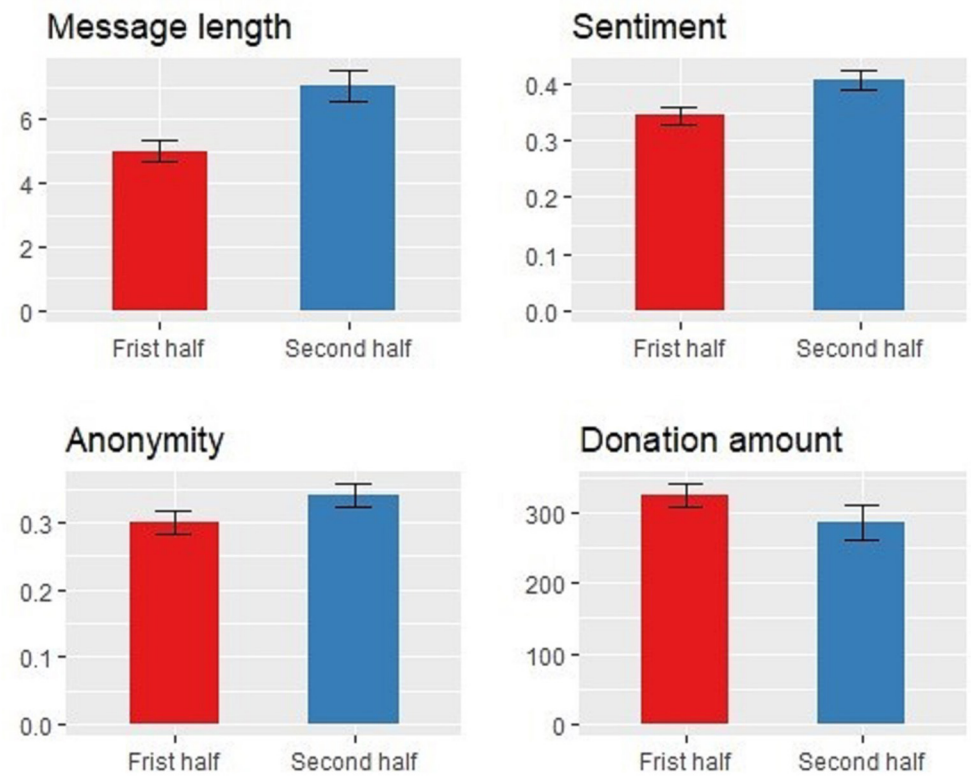

FIGURE 4 | Trends in the donation sequence (histograms represent arithmetic means; error bars represent standard errors).

TABLE 6 | The placebo regression results of donation behavior.

	Dependent variable			
	MessLen	**Sentiment**	**log(DonAmt)**	**Anonymity**
	OLS	***OLS***	***OLS***	***Logit***
	(1)	**(2)**	**(3)**	**(4)**
$log(DonAmt_{m100})$	0.252	−0.009	0.192	0.271
	(1.790)	(0.067)	(0.168)	(0.352)
$MessLen_{m100}$	0.266	0.009	0.036	0.012
	(0.463)	(0.017)	(0.040)	(0.081)
$Anonymity_{m100}$	1.940	0.136	0.695	0.557
	(6.158)	(0.261)	(0.665)	(1.333)
$Sentiment_{m100}$	11.795	0.339	1.753*	3.733*
	(10.966)	(0.388)	(0.959)	(1.974)
Intercept	4.204	0.294	7.260***	3.442
	(11.599)	(0.437)	(1.076)	(2.283)
Observations	1,381	1,381	1,381	1,381
R_2	0.003	0.005	0.020	
F Statistic	0.925	1.630	7.135***	
Log Likelihood				–862.418

****, **, and * denote statistical significance at the 0.01, 0.05, and 0.1 level. The coefficient values represent unstandardized regression coefficients. Robust standard errors are in parentheses.*

$Sentiment_{m100}$ are 1.362, 3.050, 1.580, and 3.967, respectively, which represent a low level of multicollinearity.

DISCUSSION AND CONCLUSION

Our findings extend the results of previous studies. The social norm effect reveals that donors tend to mimic other people's donations after observing how much they donate. This paper conducts a broader study on compliance with social norms and finds that donors' imitation of others is not limited to the amount of money donated but also includes their choice of anonymity and the positive sentiment expressed in their messages. This research has the following highlights:

First, the online donation scenario considered in this paper has much stronger environmental control than on-site donations. In an on-site donation, the information received by each donor may vary greatly. In this online fundraising platform, donors donated through mobile phones, and all donors saw the same page, the same introduction and the same donation environment. In other words, the information structure observed by each donor was consistent. Additionally, the donors had similar donation reasons and similar educational backgrounds because the donation campaign was initiated by the alumni association

and donations were given to alumni. Last, the anonymity of online donations is more secure than that of offline donations.

Second, this paper uses natural language processing and manual scoring to evaluate the positive sentiment degree of donors' messages and finds that positive sentiment in messages is infectious, leading to the spread of positive sentiment. Chen et al. (2021) suggest that emotional elements are also worth considering in a charitable setting, and previous studies have ignored exploring the connotative emotional cues inside the texts or pictures presented by online charity projects. Based on this idea, we try to examine the effects of previous donors' messages on subsequent donors' behaviors. Although our results provide no evidence that the sentiment of the message significantly impacts donation amounts, this paper provides several references for researchers to explore the effects of the message on donation behaviors, including donation participation rates, donation amounts, and other behaviors.

Third, the findings in this paper provide ideas for the design of a fundraising platform. To improve the effectiveness of fundraising projects, we suggest that historical donation amounts be disclosed. In particular, several pieces of information with the highest donation amount can be displayed on the top of the donation page to motivate subsequent donors. The choice to remain anonymous could be an option, but platform developers should consider whether to show anonymous donations to others.

One concern regarding the conclusion of this paper is the particularity of donations from the WHU Alumni Association. However, online donations generally occur in groups with specific relationships, and we will conduct further research on other types of group donations in the future. As another concern, this paper assumes that the appearance of online donors is completely random. This assumption cannot be verified in the empirical data, which may cause problems of endogeneity. Additionally, this paper does not indicate whether the positive sentiment in messages can attract more potential donors. If it can, we then can explain why COVID-19-related donations are shared more on social media, have a higher total amount, and last longer than others. In the future, lab and field experiments with structures similar to crowdfunding donation can be used for further research.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

YL collected and cleaned all the data, and undertook the sentimental analysis. YP conducted the analysis and wrote the paper. LW contributed the ideas and was in charge of the submission and the revision of the paper. All authors contributed to the article and approved the submitted version.

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APPENDIX: THE INTRODUCTION TO MANUAL RATING

Questionnaire task: Please rate the donation message of a previous donation project.

[**Donation Project Introduction**] In 2020, with the spread of COVID-19, the Wuhan University Beijing Alumni Association, under the call of the Wuhan University Alumni Association, responded to North American alumni's appeal for material help and raised funds for overseas alumni to purchase masks, protective suits and other protective resources.

A vast number of alumni and caring people enthusiastically supported this project and lent a helping hand (Note: The donation project was launched on March 25, 2020, when the domestic pandemic was basically under control and the overseas pandemic began to break out).

This questionnaire contains 116 questions; each question stem is a message left by a previous donor when donating. Please rate the emotional strength of each message, with 1 point being the weakest and 7 points being the strongest (To protect the donors' privacy, we replace the personal information in the message with [XXX]).

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Does Whipping Tournament Incentives Spur CSR Performance? An Empirical Evidence From Chinese Sub-national Institutional Contingencies

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The current study investigates whether tournament incentives motivate chief executive officer(s) (CEOs) to be socially responsible. Furthermore, it explores the role of sub-national institutional contingencies [i.e., state-owned enterprises (SOE) vs. non-SOEs, foreign-owned entities (FOE) vs. non-FOEs, cross-listed vs. non-cross-listed, developed region] in CEO tournament incentives and the corporate social responsibility performance (CSRP) relationship. Data were collected from all A-shared companies listed in the stock exchanges of China from 2014 to 2019. The study uses the baseline methodology of ordinary least squares (OLS) and cluster OLS regression. Moreover, firm-fixed effects regression, two-stage least squares regression, and propensity score matching deal with the endogeneity problem and check the robustness of the results. The results provide reliable evidence that tournament incentives motivate CEOs to be more socially responsible. On the other hand, sub-national institutional contingencies positively affect the association between CEO tournament incentives and CSRP. The findings have important implications for companies and regulators who wish to enhance CSP by providing incentives to top managers.

Keywords: corporate social performance, CEO tournament incentives, sub-national institutional contingencies, tournament theory, foreign ownership, development

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INTRODUCTION

Earlier researchers have extensively considered the various corporate social responsibility (CSR) perspectives and their effects on the economy (Jo and Harjoto, 2011). Later, corporate finance literature focused on the financial and accounting determinants of a CSR performance (CSRP) such as government, the external stakeholders' significance (David et al., 2007), society (Matten and Moon, 2008), institutional pressure (Matten and Moon, 2008; Bondy et al., 2012), etc. Others contributed to advancing the relevant strand of literature by investigating internal factors, including the chief executive officer's (CEO's) political ideology, the ethical commitment of the top management team (Muller and Kolk, 2010), CEO overconfidence (McCarthy et al., 2017), the

CEO's power (Jiraporn and Chintrakarn, 2013; Li et al., 2016), gender diversity in the boardroom (McGuinness et al., 2017), executive compensation (Jian and Lee, 2015), and the firm's financial condition. Last but not least, the top management role cannot be overlooked in determining the firm's ethical and social orientation because of the concentration of decision-making power (Waldman et al., 2006).

Currently, researchers have started explaining the 'competition' as another important determinant of CSR (Zhao et al., 2021). The idea of competition has its roots in the economic theory, namely in tournament theory, which describes variances in managerial performance compensation (Lazear and Rosen, 1981; O'Reilly et al., 1988). The theory of the tournaments applies to a contest in which managers are eligible for bonuses and other benefits. The pay gap between CEO and other executives leads to good competition among managers, leading to better business results. The executives are motivated by substantial incentives for the winner of tournaments. This gap between the winner of the competition and the person in second place can be an operational incentive mechanism as the executives are evaluated on relative instead of absolute performance. Therefore, we expect that increasing the incentives/gap among executives and CEOs can make them more socially responsible for proving as deserving of that prize. According to tournament theory, Lazear and Rosen (1981) propose that pay disparity can be explained as prizes paid to contestants in the labor market according to their rank order.

Institutional contingencies are diverse characteristics of institutions within the same economy. He and Fang (2016) named these institutional discrepancies as sub-national institutional contingencies. This study has researched the most vital aspect of contingencies in the sub-national context for Chinese firms. We established an empirical endeavor for different patterns, such as listed companies' patterns (non-cross-listed and cross-listed), ownership patterns (non-state and state ownership), and regional patterns (less-developed and developed regions).

This research revolves around the intersection of three concepts: CSRP, tournament incentives, and subnational institutions. The study aims to explore the relationship between CSRP and tournament incentives and CSRP and subnational institutions. Moreover, the study projects the moderating role of subnational institutions in bridging CSRP and tournament incentives. The purpose and finding of the study add valuation contribution in CSR literature and tournament theory. The study aims to acquire insight into the mechanism through which the CSRP is motivated by the incentive scheme. This study has been built upon the notion that incentives motivate executives to take actions that can have financial and social implications. Incentivized CEOs face a loss if they demonstrate undesirable CSRP, as the market reacts strongly to it, resulting in a decrease in market value (McGuire et al., 2019). Conversely, robust CSRP is considered the only insurance choice whose unknown advantages are visible in performance deficiencies (Cassimon et al., 2016). Incentive plans can encourage managers to be socially responsible, mitigating agency conflicts (Cai et al., 2011). Executives are more willing to take higher risks to win a tournament, resulting in more effective operating, financial, and social policies (Goel and Thakor, 2008).

When we consider the case in the context of China, it takes on further significance. China is an important emerging economy with a high degree of economic growth, providing more ownership structure diversity (Khan et al., 2017) in many sub-national areas (Chan et al., 2010). In contrast, some fresh studies have found that the Chinese economy has already emerged, so it no longer possesses the emerging economy title. For example, Bruton et al. (2021) and Zhang et al. (2021) have convincingly argued that China has emerged as an aspirant economy. How tournament incentives affect the CSRP in a freshly emerged economy could be an interesting story to tell. Nevertheless, China has many firms listed across regions such as Hong Kong, London, and New York (He and Fang, 2016; Khan et al., 2021). This institutional variation enables us to investigate its impact on CSRP.

Even though China's economy is still heavily regulated by the government, the country's central planning system has been gradually replaced by more market-oriented policies. Promotion within the CCP/Government hierarchy with lifelong benefits, such as job security, housing subsidies, pensions, and medical treatment, is important for executives working in government-controlled companies. As a result, we expect that tournament cash incentives in Chinese companies will be weaker than in Western companies. As a first step in making tournament cash incentives weaker, there is a strong non-cash incentive (political promotion). Another factor that makes tournament prizes less appealing is that CEO pay in publicly traded companies controlled by the government is typically capped at multiples (between 3 and 15 times) of the average worker's wage (Firth et al., 2006). Culturally, China has a high level of collectivism, which includes a greater emphasis on equality (Hofstede, 2001). As a socialist country, China focuses on promoting social harmony. A "reasonable," but not excessive, pay disparity between managerial levels is therefore expected by the general public.

Second, we extend the literature beyond developed countries by providing the first empirical study from China's largest developing country to the best of the authors' knowledge. China's institutional factors are unique (Guariglia and Yang, 2016; Ali et al., 2019). Scholars have recommended that the most promising corporate governance focuses on understanding the institutional factors in which governance occurs (Davis, 2005). We extend the existing literature on the relationship between government ownership and CSRP (Fan et al., 2007; Li et al., 2016; Khan et al., 2019) by exploring for the first time whether the effect of CEO tournament incentives on CSRP varies between state-owned enterprises (SOE) and non-SOEs (NSOEs). We find that the positive effect of CEO tournament incentives on CSRP is more pronounced in SOEs than in NSOEs. These results suggest that SOEs can benefit in the context of CSRP from providing high tournament incentives to their CEOs.

Previously available researchers have demonstrated that executives with high CSRP tend to receive larger pay packages; it makes the CEOs involved in corporate social responsibility (CSR) (Krüger, 2015). However, these studies do not provide a comprehensive picture since they only recognize the CEO's

overall compensation rather than CEO tournament incentives, i.e., the pay differential between executives and CEOs. The present study contributes to the existing literature on the internal drivers of CSRP by investigating CEOs' tournament incentives as determinants of CSRP for the first time. The study fills another gap. Compared with the existing literature, present research adds following other significant contributions. First, this research contributes to the literature on CSRP in-house drivers by examining CEOs' tournament incentives as determinants of CSRP for the first time. Second, this study explores whether diverse sub-national institutes have a different connection with a company's CSRP. This work proposes that sub-national institutes are active in compelling and smoothing premeditated selections. Our findings suggest that managers are driven by bonuses and prizes (in line with tournament theory) in the Chinese market. Growth-inducing salary rewards allow executives to compete with one another, allowing the company to flourish financially and socially. Further, this study's outcomes reveal sub-national institutional contingencies [i.e., firms in less-developed vs. more-developed regions, non-cross-listed vs. cross-listed companies, non-foreign-owned entities (FOEs) vs. FOEs, non-SOEs vs. SOEs] positively affect CSRP. The fallouts of this research divulge that CSRP in firms in more-develop areas, cross-listed companies, FOEs, and SOEs are higher than their counterparts.

Section Theoretical Discussions and Relevant Work will discuss the theoretical foundation and associated literature in detail. Data and Research methodology details are in section Data and Methodology, followed by discussions of results and conclusions, respectively, in sections Results and Conclusions and Policy Implementations.

THEORETICAL DISCUSSIONS AND RELEVANT WORK

Role of Top Executives in Taking CSR

Top management is responsible for key decision-making. A firm's corporate social responsibility performance indicates the orientation and priorities of the company's executives. In this context, the agency theory also supported the role of top management for corporate environmental and social performance disclosure practices (Jensen and Meckling, 1976; Cordeiro et al., 2013). According to another theory, known as Upper-Echelon theory, managers (particularly CEOs) play a critical role in the selection and implementation of strategic decisions that ultimately affect the performance or growth of a company (Hambrick and Mason, 1984; Hambrick, 2007); this includes decisions related to corporate social responsibility (CSR) initiatives. According to this perspective, these characteristics (e.g., age, functional tracks, career experiences, and education) of top executives are important determinants of the strategic decisions made by firms in relation to social practices. Several studies have found that the characteristics of top management (CEOs in particular) can encourage greater executives' commitment to compliance with institutional regulations, which can have a positive impact on environmental sustainability and performance (Ntim and Soobaroyen, 2013; Zahid and Simga-Mugan, 2019; Grofčíková, 2020; Lu et al., 2020; Malkawi and Khayrullina, 2021).

Tournament Theory

The pay gap between the CEO and the next level is typically quite large (Gomez-Mejia, 1994), and managerial marginal product arguments (O'Reilly et al., 1988) do not provide a convincing explanation for this phenomenon. According to tournament theory, which states that workers in the labor market compete for rewards based on their position in the competition, Lazear and Rosen (1981) propose that this discrepancy can be explained. They argue that the competition for CEO positions could be likened to a tournament, where the prizes are fixed in advance and participants put forth an effort to increase their chances of winning a prize that isn't based on one's absolute performance but rather on one's performance relative to other competitors (Conyon et al., 2001). It is argued by Rosen (1986) that large top prizes are theoretically required for tournament survivors to be motivated so that they do not rest on their past achievements when they enter the final contest. When monitoring costs are high, contests make sense to determine compensation packages. According to tournament theory, executive pay should have a convex relationship with the organizational level. The prize (gap) and the number of participants should also have a positive relationship. Finally, the company's performance should be positively correlated with executive wage dispersion (O'Reilly et al., 1988).

CEO Tournament Incentives and CSRP

It is still unclear how tournament rewards impact firm CSRP. Some studies have approached this problem in a roundabout way, but the precise relationship remains unknown. We begin by describing the literature on the association between tournament rewards and firm performance, keeping in mind that CSR is directly linked to firm performance (Ali et al., 2019). Second, we discuss the literature stream that advocates that compensation (the main player in tournament theory) is directly linked with CSP. Last, we discuss the scarce literature which links tournament incentives with CSRP directly or indirectly.

Some evidence suggests that CSR reward helps to affect CSRP (Hong et al., 2016). Based on tournament theory, the CEO's payout seems to be better than what you might expect (Vo and Canil, 2019). The CEO typically gets higher pay because of their additional duties that stem from its overall success (O'Reilly et al., 1988). Hannan et al. (2008) claimed that CEOs compete for performance when prizes are awarded according to ability. Rivalry breeds executive pay inequality in an organization (Gnyawali et al., 2008). CEOs focus on CSR activities due to innate enjoyment of incentives, which is directly linked to the success of the company, as well as extrinsic motivations; hence the organizations' goals and values are related (Petrenko et al., 2016). CEOs may be compensated for their CSR-related nonfinancial benefits, such as satisfying shareholders, increasing the company's image and promoting respect, and the cause of social responsibility. Where executives believe their image can be advanced by working on corporate social responsibility, they're

inclined to spend their time and money on CSR to achieve it (Barnea and Rubin, 2010).

Chief executive officer (CEO) remuneration, especially incentives, may directly affect decisions concerning CSR deeds. Monitoring mechanisms by the board of directors can help CEOs' incentives align with shareholders' concerns, which according to the job match theory, is a good match between the CEO and firm reflected by better firm performance. The prevailing view is that businesses try to incentivize CSR activities because CSR is an essential component of their long-term, lasting sustainability and viability. Competitive compensation for executives can cause internal conflict and lead to less involvement in corporate social responsibility, making resolution difficult (Cai et al., 2011). Also, CEOs' compensation appears to be reduced in companies that attract a lot of media coverage. They are thusly bombarded with shareholder demands, potentially resulting in less greed. According to Mr. Potts, CEOs who have high ethical and social responsibility earn lower pay than those who do not as a result. There can incite violent out burgeoning conduct in senior management, including excessive risk-taking and risk-taking for personal gain (Becker and Huselid, 1992). An important consideration when planning a tournament is that it rewards people based on their output; as a result, it provides an effective motivation to improve, increasing overall production (Connelly et al., 2014). Similarly, research has found that salary inequality serves as valid evidence of corporate success (Lazear and Rosen, 1981; Hu et al., 2013; Elkins, 2018; Elsayed and Elbardan, 2018). One notable problem with this literature is that it does not account for corporate social responsibility with tournament theory.

The literature on tournaments and CSR growth is still incented. Nothing on this subject has been concluded, although some scholars have tried to investigate it. CEO personality and CSR motivations are intertwined (Petrenko et al., 2016). Over-investing in "corporate social responsibility" for social media acceptance and appreciation (Galaskiewicz, 1997; Barnea and Rubin, 2010). Due to the interests of CEOs directing their money toward the organization's clients, staff, and vendors, these stakeholders are more likely to help the firm's day-to-to-day activities. CEOs are compensated because their companies have higher ROI (Jian and Lee, 2015; Ali et al., 2019). The prize money will make the scheme work better and have more value (Kini and Williams, 2012). The importance of a formal system of corporate governance for compensation of CSR influences CSR (Hong et al., 2016). We have yet to establish a definitive connection between tournament pay and playing well. Tournament rewards have been unable to define precisely the influence of CSSR participation. Furthermore, no research on this question has been conducted in China.

Therefore, tournament theory encourages productivity. Competitors perform better if the compensation is provided with regard to the tournament view to winning in mind (Hannan et al., 2008). Tournament theory points out a pay disparity between executives, leading to increased hostility among colleagues, strengthening competition, leading to better company results as those executives invest in C-E. In agreement with conventional wisdom, we believe that CEO tournament rewards will inspire them to spend more on corporate social responsibility because the prestige of the company and their goods will be enhanced, the credibility of the CEO will be strengthened, and trust will be restored among stakeholders. The studies have overwhelmingly shown that managers do their best work when motivated by bonuses, such as rewards and prize money.

Conventional wisdom states that companies should reward CEOs for sustainable growth with CSR. Since prize money is given based on contrast, we believe that CEOs and executives will enhance the gap between them instead of reducing it. Often, CEOs tend to work for the firm's financial success as well as CSR. Since these CEOs will receive tournament rewards, it follows that there is a positive relationship between CSRP and tournament performance.

H_1: CEOs' tournament incentive is positively associated with CSRP.

Role of Sub-national Institutional Contingencies in CEO Tournament Incentives and CSP Nexus

CEO Tournament Incentives and CSRP in SOEs vs. Non-SOEs

China's SOEs have two main goals: managing products or services markets. Second, the state restricts SOEs from engaging in CSR to gain political support. As a result, SOE executives are interested in the government's priorities and strategies in order to gain rewards like tournaments or promotional incentives (Xu et al., 2015). Due to political ties and government constraints, CEOs of SOEs are more likely to improve the organization's image by CSR (Marquis and Qian, 2014) than CEOs from non-SOEs (Zheng and Zhang, 2016).

Furthermore, SOE executives are often selected and promoted through political maneuvering. As a result, SOE executives and board members are encouraged to make decisions in the government's best interests, prioritizing social goals over financial benefits (Firth et al., 2007). Public criticism of executive pay and CEO success also increases for SOEs (Hu et al., 2013). Government agencies track CEO results since the state offers sufficient financial support to SOEs (Musacchio et al., 2015). This motivates executives to participate in politically approved CSR (Campbell, 2007). The Chinese government also provides incentives to SOE executives (Hung et al., 2012) in exchange for the company's participation in CSR (Li et al., 2016).

H_2: CEO tournament incentives' incremental impact on CSRP is more keenly recognized in SOEs than non-SOEs firms.

CEO Tournament Incentives and CSRP in FOEs vs. Non-FOEs

Prior literature revealed that foreign ownership raises (Firth et al., 2007). Thus, FOEs have higher pay-performance sensitivity. The literature indicates that foreign ownership affects firms' outcomes such as strategic investment (David et al., 2006), performance (Yoshikawa et al., 2010), wage (Yoshikawa et al., 2005), redundancies, and adoption of global governance codes (Yoshikawa et al., 2010).

Firms' CSR performance increases with the degree of internalization in China (Cheung et al., 2015). There is underlying evidence that global counterparties, particularly from developed markets, possessed more ingrained and enduring attitudes concerning CSR. Executives' decision-making can be steered in a specific direction through a compensation structure (Bebchuk et al., 2002). Traditionally, the goal was to encourage executives to maximize profits by aligning their interests with shareholders (Kini and Williams, 2012). Nevertheless, if firms' goals are to encourage executives to further environmental and social objectives, their incentives may be used to align with CSR. Foreign owners pressurize corporations to pay for performance systems to incentivize CEOs (Firth et al., 2007). We contend that executive compensation incentivizes top executives to make financial, social, and strategic decisions and that FOEs influence these actions. Given the discussions above, we expect the following result.

H_3: CEO tournament incentives' incremental impact on CSRP is more keenly accepted in FOEs than non-FOEs firms.

CEO Tournament Incentives and CSRP in Cross-Listed vs. Non-cross-Listed Firms

Cross-listing condenses barriers and offers access to the capital market and group of investors. Cross-listed companies achieve higher market performance than their counterpart (Doidge et al., 2004), higher-earning announcements and abnormal returns (Del Bosco and Misani, 2016), external financing (Reese Jr and Weisbach, 2002) more excellent analyst coverage (Lang et al., 2003) low information asymmetry, squat cost of capital (Hail and Leuz, 2009). Moreover, cross-listed firms also gain extraordinary transaction volumes in domestic markets (Smith and Sofianos, 1997). Furthermore, internationalization provides opportunities for leveraging and learning to understand from diverse institutional settings (i.e., foreign and domestic markets). In China, firms cross-listed in HKSE also cross-listed on the London Stock Exchange or New York Stock Exchange (He and Fang, 2016).

Diverse business environments and governance systems (Matten and Moon, 2008) imply that companies will encounter best practices, local needs, and social priorities besides cross-listing expectations that differ from domestic markets (Del Bosco and Misani, 2016). When investigating the United Kingdom (UK) and Canadian organizations listed in the United States (US) markets, Southam and Sapp (2010) witness that cross-listing is associated with an increase in executives' pay. Cross-listed organizations pay greater rewards for their executives than domestic organizations. Chinese companies choose to cross-list on the stock market of Hong Kong, where executives enjoy a significant pay gap due to western-designed institutional lucidity and greater inequality tolerance because they are more concerned about shareholder value than social equity. Consequently, Chinese cross-listed firms incorporate more incentives in their pay design (Berrone and Gomez-Mejia, 2009). Furthermore, increase sends to increase after cross-listing (Boubakri et al., 2016). Consequently, cross-listing encourages firm executives to boost CSRP by improving governance through adhering to foreign regulations and norms, increasing the reputation of a company to enhance its plea to stakeholders and investors, overcome foreignness liability, enhance competitiveness (Jo and Harjoto, 2011), and mitigate litigation risk and regulatory burden (Boubakri et al., 2016). These benefits suggest higher CSRP in cross-listed firms.

H_4: CEO tournament incentives' incremental impact on CSRP is more keenly accepted in cross-listed firms than non-cross-listed ones.

CEO Tournament Incentives and CSRP in More-Developed Region vs. Less-Developed Region Firms

The unique Chinese institutional context encompasses differences in governance mechanisms according to the firm's regional location (more-developed or less-developed region). The market development level in Chinese regions differs significantly from each other. The factor and commodity markets are highly developed, and the legal framework and market intermediaries are similar to those in developed economies (Shi et al., 2012). Contrastingly, organizations in less-developed regions are less strict at law enforcement, have poor local government effectiveness, more intervention, and more exploitation (Chan et al., 2010). The literature indicates that firms' internal monitoring quality is affected by regions. In executives' compensation, pay-performance and turnover-performance sensitivity are weak due to low external monitoring in an organization in under-developing regions (Conyon and He, 2014).

In China, local governments are free to make policies to develop market intermediaries, factor markets, and product markets. Thus, strategic choices vary in a regional environment (Chan et al., 2010). Market reforms have caused significant progress, but huge gaps still exist among less-developed and developed regions (Fan et al., 2003). In China, different regions of the country have a difference in institutional mechanisms and market development (Fan et al., 2007). Developed regions are associated with a more formal structure, better protection of investors' interests, stronger governance mechanisms, and improved civil rights protection (Cordeiro et al., 2013).

Moreover, some scholars have established that a firm's internal monitoring and control also differ in the context of regional contingencies. For instance, Conyon and He (2011) studied executive compensation and corporate governance links in Ch. They found that the CEO pay-performance link is more keenly felt in more-developed regions than in less-developed regions. Another study reported a weaker CEO compensation-performance nexus in the framework of less developed areas (Firth et al., 2007).

Recently, due to rising environmental issues, such as air contamination, water disposal, and greenhouse gas emissions, both the public and government have grown demand for accountability and sustainability progress (Zheng et al., 2014). Therefore, in more-developed regions, executives chasing tournament incentives are more likely to affect CSP than expected in less-developed areas for two reasons. One may

increase legality among stakeholders and the society, while the other may be to gain subsidies and incentives associated with going green. Therefore, to develop an indulgence of whether the impact of CEO tournament incentives on CSP prevails in the same way in both developed and less-developed regions, we categorize our sample firms into more-developed regions and less-developed regions. Taken together, we make the following predictions:

H_5: *CEO tournament incentives' incremental impact on CSRP is more keenly accepted in the more-developed region.*

DATA AND METHODOLOGY

Data Description

The current study employs the China Stock Market and Accounting Research (CSMAR) for data collection. CSP data was gained from Ranking (RKS), which delivers sovereign standing for listed corporations in China (Wu et al., 2016). From 2014 to 2019, the first sample includes A and H share corporations listed on the Hong Kong, Shanghai, and Shenzhen stock exchanges. For reliable results, missing values were not included, and the final sample involved 11,991 observations. To avoid extreme values, we winsorize continuous variables at the 1st and 99 percentiles. We first calculated other executives' CEO and average compensation and merged this data set with CSR rating data. Then, we merged the data of all control variables used in multiple analyses and deleted 3,838 firm-year observations with missing data needed for the firm-level control variables and 9,276 firm-year observations with a missing value for the CEO-level control variables. The final tournament incentive-CSP sample is 12,881 firm-year observations. To test the hypothesis with sub-national institutional contingencies, we merge the data with sub-national institutional contingencies (i.e., state vs. non-State organizations, foreign-owned vs. non-foreign-owned, cross-listed companies vs. non-cross-listed companies, more-developed region companies vs. less-developed region's company's) data. This procedure leads to a final sample of 11,991 firm-year observations for the study.

Variable Measurements

Dependent Variable

Corporate Social Responsibility Performance (CSRP): Consistent with previous literature, we use RKS's social ratings based on the GRI 3 reformed to the Chinese perspective (Lau et al., 2016; McGuinness et al., 2017). RKS determines social ratings for three principal areas of reporting, such as Macrocosm (Overall), Content, and Technique. CSR reports encompass three main dimensions (overall evaluation, content evaluation, and technical evaluation) further subdivided into 70 sub-dimensions of CSR activities. The overall dimension, which is further subdivided into 14 sub-dimensions, assesses social responsibility policy, stakeholder engagement, and knowledge comparability among the other dimensions.

Independent Variables

Chief executive officer (CEO) tournament incentive: following prior studies (Chen et al., 2011; Kini and Williams, 2012; Hu et al., 2013; Vo and Canil, 2019), the primary variable of interest is CEOs' tournament incentive. We measure Tournament_Incentives as the difference in compensation between CEOs and other executives. First, we calculate the average executive pay by dividing the total compensation paid to the executives by the total number of executives. Second, we calculate the CEO pay gap by dividing the total CEO compensation by the average compensation paid to executives. Finally, we used two measures to quantify the tournament reward to ensure robust results: CEO_PayGap, measured as the logarithm of CEOs' total pay minus the average compensation of executives, and CEO_PayGapRatio, measured as the ratio of CEO pay to executives' compensation (Chan et al., 2010; Hu et al., 2013; He and Fang, 2016). The following equations present the measurement:

$$\boldsymbol{CEO\_PayGap = Log\left(CEOPay - Ave.ExecutivePay\right)} \quad (1)$$

$$\boldsymbol{CEO\_PayGapRatio = \left(\frac{CEO\ Pay}{Ave.ExecutivePay}\right)} \quad (2)$$

Moderating Variables (Sub-national Institutional Contingencies)

State-owned enterprises (SOEs vs. non-SOEs): In line with previous literature (Conyon and He, 2014; He and Fang, 2016), the SOE is set for 1 if the government or state is the owner 0 otherwise.

Foreign ownership (FOEs vs. non-FOEs): Following McGuinness et al. (2017), FOE is 1 for foreign-owned enterprises and 0 otherwise.

Cross-listing (cross-listed vs. non-cross-listed firms): We defined cross-listed firms (Cross_Listed), the cross-listed firm is coded as 1 if the firm is listed in Hong Kong stock exchange, and 0 otherwise, as measured in prior studies (He and Fang, 2016).

Regional development (more-developed-region vs. less-developed-region): In line with previous studies (Cordeiro et al., 2013; He and Fang, 2016), we defined the developed region (D_Region) as the dummy variable which equals to 1 if a firm's head office is listed in the more developed region of China, and 0 otherwise (for further details of variables see the Table A1 in **Supplementary Material**).

Empirical Models

To test our entire hypothesis following models are estimated. The first is to test the effect of CEO tournament incentives on CSRP (Equations 3 and 4). Second, we test how SNIC moderates CEO tournament incentives and the CSRP nexus (Equations 5–8). Following previous studies (Barnea and Rubin, 2010; McGuinness et al., 2017; Fernández-Gago et al., 2018; Ali et al., 2019), we use ordinary least squares (OLS) and cluster OLS regression to test equations. The following are the equations of the study:

$$\begin{aligned} \mathrm{CSRP}_{\mathrm{it}} = {} & \alpha + \beta_1 \mathrm{CEO\_PayGap}_{\mathrm{it}} + \beta_2 B\_Size_{\mathrm{it}} \\ & + \beta_3 \mathrm{B\_Ind}_{\mathrm{it}} + \beta_4 \mathrm{B\_Share}_{\mathrm{it}} + \beta_5 \mathrm{B\_FemaleP}_{\mathrm{it}} \\ & + \beta_6 \mathrm{CEO\_Duality}_{\mathrm{it}} + \beta_7 \mathrm{CEO\_Tenure}_{\mathrm{it}} \\ & + \beta_8 \mathrm{CEO\_Degree}_{\mathrm{it}} + \beta_9 \mathrm{SOE}_{\mathrm{it}} + \beta_{10} \mathrm{FOE}_{\mathrm{it}} \\ & + \beta_{11} \mathrm{F\_Size}_{\mathrm{it}} + \beta_{12} \mathrm{F\_Age}_{\mathrm{it}} + \beta_{13} \mathrm{F\_GrowOpp}_{\mathrm{it}} \end{aligned}$$

$$+\beta_{14}\text{TobinQ}_{it} + \beta_{15}F\_Growth_{\text{it}} + \beta_{16}\text{F\_Leverage}_{\text{it}} + \beta_{17}\text{Cross\_Listed}_{\text{it}} + \beta_{18}\text{D\_Region}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Year\_Dummies}_{\text{it}}\varepsilon_{\text{it}} \quad (3)$$

$$\text{CSRP}_{\text{it}} = \alpha + \beta_1\text{CEO\_PayGapRatio}_{\text{it}} + \beta_2 B\_Size_{\text{it}} + \beta_3\text{B\_Ind}_{\text{it}} + \beta_4\text{B\_Share}_{\text{it}} + \beta_5\text{B\_FemaleP}_{\text{it}} + \beta_6\text{CEO\_Duality}_{\text{it}} + \beta_7\text{CEO\_Tenure}_{\text{it}} + \beta_8\text{CEO\_Degree}_{\text{it}} + \beta_9\text{SOE}_{\text{it}} + \beta_{10}\text{FOE}_{\text{it}} + \beta_{11}\text{F\_Size}_{\text{it}} + \beta_{12}\text{F\_Age}_{\text{it}} + \beta_{13}\text{F\_GrowOpp}_{\text{it}} + \beta_{14}\text{TobinQ}_{\text{it}} + \beta_{15}F\_Growth_{\text{it}} + \beta_{16}\text{F\_Leverage}_{\text{it}} + \beta_{17}\text{Cross\_Listed}_{\text{it}} + \beta_{18}\text{D\_Region}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Year\_Dummies}_{\text{it}}\varepsilon_{\text{it}} \quad (4)$$

$$\text{CSRP}_{\text{it}} = \alpha + \beta_1\text{CEO\_PayGap}_{it} + \beta_2\text{SOE}_{\text{it}} + \beta_3\text{CEO\_PayGap}_{it} \times \text{SOE}_{\text{it}} + \beta_4 B\_Size_{\text{it}} + \beta_5\text{B\_Ind}_{\text{it}} + \beta_6\text{B\_Share}_{\text{it}} + \beta_7\text{B\_FemaleP}_{\text{it}} + \beta_8\text{CEO\_Duality}_{\text{it}} + \beta_9\text{CEO\_Tenure}_{\text{it}} + \beta_{10}\text{CEO\_Degree}_{\text{it}} + \beta_{11}\text{FOE}_{\text{it}} + \beta_{12}\text{F\_Size}_{\text{it}} + \beta_{13}\text{F\_Age}_{\text{it}} + \beta_{14}\text{F\_GrowOpp}_{\text{it}} + \beta_{15}\text{TobinQ}_{\text{it}} + \beta_{16}\text{F\_Growth}_{\text{it}} + \beta_{17}\text{F\_Leverage}_{\text{it}} + \beta_{18}\text{Cross\_Listed}_{\text{it}} + \beta_{19}\text{D\_Region}_{\text{it}} + \sum_{i=1}^{n}\beta_{\text{n}}\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_{\text{n}}\text{Year\_Dummies}_{it}\varepsilon_{\text{it}} \quad (5)$$

$$\text{CSRP}_{\text{it}} = \alpha + \beta_1\text{CEO\_PayGap}_{\text{it}} + \beta_2\text{FOE}_{\text{it}} + \beta_3\text{CEO\_PayGap}_{\text{it}} \times \text{FOE}_{\text{it}} + \beta_4 B\_Size_{\text{it}} + \beta_5\text{B\_Ind}_{\text{it}} + \beta_6\text{B\_Share}_{\text{it}} + \beta_7\text{B\_FemaleP}_{\text{it}} + \beta_8\text{CEO\_Duality}_{\text{it}} + \beta_9\text{CEO\_Tenure}_{\text{it}} + \beta_{10}\text{CEO\_Degree}_{\text{it}} + \beta_{11}\text{SOE}_{\text{it}} + \beta_{12}\text{F\_Size}_{\text{it}} + \beta_{13}\text{F\_Age}_{\text{it}} + \beta_{14}\text{F\_GrowOpp}_{\text{it}} + \beta_{15}\text{TobinQ}_{\text{it}} + \beta_{16}\text{F\_Growth}_{\text{it}} + \beta_{17}\text{F\_Leverage}_{\text{it}} + \beta_{18}\text{Cross\_Listed}_{\text{it}} + \beta_{19}\text{D\_Region}_{\text{it}} + \sum_{i=1}^{n}\beta_{\text{n}}\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_{\text{n}}\text{Year\_Dummies}_{\text{it}}\varepsilon_{\text{it}} \quad (6)$$

$$\text{CSRP}_{\text{it}} = \alpha + \beta_1\text{CEO\_PayGap}_{\text{it}} + \beta_2\text{Cross\_Listed}_{\text{it}} + \beta_3\text{CEO\_PayGap}_{\text{it}} \times \text{Cross\_Listed}_{\text{it}} + \beta_4\text{B\_Size}_{\text{it}} + \beta_5\text{B\_Ind}_{it} + \beta_6\text{B\_Share}_{\text{it}} + \beta_7\text{B\_FemaleP}_{\text{it}} + \beta_8\text{CEO\_Duality}_{\text{it}} + \beta_9\text{CEO\_Tenure}_{\text{it}} + \beta_{10}\text{CEO\_Degree}_{\text{it}} + \beta_{11}\text{SOE}_{\text{it}} + \beta_{12}\text{FOE}_{\text{it}} + \beta_{13}\text{F\_Size}_{\text{it}} + \beta_{14}\text{F\_Age}_{\text{it}} + \beta_{15}\text{F\_GrowOpp}_{\text{it}} + \beta_{16}\text{TobinQ}_{\text{it}} + \beta_{17}\text{F\_Growth}_{\text{it}} + \beta_{18}\text{F\_Leverage}_{\text{it}} + \beta_{19}\text{D\_Region}_{\text{it}} + \sum_{i=1}^{\text{n}}\beta_{\text{n}}\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Year\_Dummies}_{\text{it}}\varepsilon_{\text{it}} \quad (7)$$

$$\text{CSRP}_{\text{it}} = \alpha + \beta_1\text{CEO\_PayGap}_{\text{it}} + \beta_2\text{D\_Region}_{\text{it}} + \beta_3\text{CEO\_PayGap}_{\text{it}} \times \text{D\_Region}_{\text{it}} + \beta_4 B\_Size_{\text{it}} + \beta_5\text{B\_Ind}_{\text{it}} + \beta_6\text{B\_Share}_{\text{it}} + \beta_7\text{B\_FemaleP}_{\text{it}} + \beta_8\text{CEO\_Duality}_{\text{it}} + \beta_9\text{CEO\_Tenure}_{\text{it}} + \beta_{10}\text{CEO\_Degree}_{\text{it}} + \beta_{11}\text{SOE}_{\text{it}} + \beta_{12}\text{FOE}_{\text{it}} + \beta_{13}\text{F\_Size}_{it} + \beta_{14}\text{F\_Age}_{it} + \beta_{15}\text{F\_GrowOpp}_{\text{it}} + \beta_{16}\text{TobinQ}_{\text{it}} + \beta_{17}\text{F\_Growth}_{\text{it}} + \beta_{18}\text{F\_Leverage}_{\text{it}} + \beta_{19}\text{Cross\_Listed}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Industry\_Dummies}_{\text{it}} + \sum_{i=1}^{n}\beta_n\text{Year\_Dummies}_{\text{it}}\varepsilon_{\text{it}} \quad (8)$$

where the subscript i indicates the firms and t indicate the years throughout the analysis. We include the year and two-digital code industry dummies to avoid any common trend in CSRP. CSRP refers to corporate social responsibility performance (i.e., CSR_Rating) defined as weighted average rating score apportioned by Rankins (RKS) ranging from 0 to 100; CEO_Pay Gap refers to the pay gap between executives and CEO, which defined total compensation of a CEO minus average compensation of all other executives; CEO_Pay Gap Ratio refers to the ratio between CEO and executives' compensation (defined as ratio between CEO and executives' average compensation); CEO_Pay Gap × SOE refers to interaction effect of SOE in CEO Tournament incentives and CSP; CEO_Pay Gap × FOE refers to interaction effect of FOE in CEO Tournament incentives and CSP; CEO_Pay Gap × Cross_Listed refers to interaction effect of Cross_Listed in CEO Tournament incentives and CSP; CEO_Pay Gap × D_Region refers to interaction effect of D_Region in CEO Tournament incentives and CSP; B_Size refers to board size (defined as total number board directors); B_Ind refers as board

independence (defined as the proportion of outside directors on the board); B_Share refers as board share (defined as the proportion of shares held by board directors); B_FemaleP refers to portion of female directors (defined percentage of female board directors); CEO_Duality refers to CEO duality (well-defined as if the CEO has a dual role as Chairperson then dummy variable equals 1, and 0 otherwise); CEO_Tenure refers as CEO tenure (as the total number of years since the CEO joined as CEO in a firm); CEO_Degree refers to CEO degree education (equals 1 if the CEO has at least a bachelor degree, and 0 otherwise); SOE refers to state-owned enterprises (defined as a dummy variable, which equals 1 if the local or central government is the dominant owner, and 0 otherwise); FOE refers to foreign owned enterprises (defined as a dummy variable that equals 1 if the foreign investors owned shares in a firm, and 0 otherwise); F_Size, F_Age, F_GrowOpp, TobinQ, F_Growth, F_Leverage, Cross_Listed, D_Region indicates corporation size, company age, organization development chances, Tobin's Q ratio, company growth, organization leverage, cross-listed companies and advance region corporations, respectively. Total sales are used as the corporation size in log form. Age is the number of years listed. The book-to-market ratio is the organization's development chance. The variation in company assets is used as company growth. Debt to asset ratios is used as organizational leverage. Finally, cross-listed companies and advanced region corporations are dummy variables of this study; Industry_Dummies refer to industry effect on CSRP; Year_Dummies refers to year dummies to control the year effect on CSRP.

RESULTS

Descriptive Statistics and Correlation Analysis

Table A2 in **Supplementary Material** shows an increasing trend in CSRP in the sample period, which shows that Chinese companies are showing more intentions toward CSRP along with financial performance. The CEO's average compensation trend in China is also increasing. The proportion of independent directors increases gradually over the period, which shows an improvement in corporate governance in China. Similarly, board room gender diversity also increases another prediction of strong corporate governance in China. This decrease in SOEs shows that Chinese listed firms transition toward the Anglo-Saxon model. Other essential variables, such as CEO duality and CEO tenure, show an increasing trend. Firm age is increasing with the time that Chinese listed firms are performing well to continue their business for a more extended period. Most of the Chinese firms are located in the more developed region of China, and the number of companies is growing in the developed area.

Chief executive officer (CEO) pay gap has a mean of RMB 407,000, indicating that CEOs earn an average of RMB 407,000 more per year than other executives. Another metric of tournament incentive (CEO PayGapRatio) has a mean of 2.59 and a *SD* of 1.2, indicating that CEOs are paid 2.59 times as much as other executives. According to CSR Rating, the average compound CSR rating for Chinese companies is 27.61%, with a maximum score of 89.29 in China. The average board size in China is 10.26, with an average of 38% independent directors, which meets the CSRS requirement that independent directors make up one-third of all listed companies' board members. The average SOE is 46%, and the trend in China is decreasing as a result of the reform program (Khan et al., 2019). On average, CEO tenure is 3.44% in China, with a 2.93% *SD*. The board's average proportion of shares apprehended is 10%, with a *SD* of 0.18.

In China, 24% of CEOs have a double role as CEO and chairman, with a *SD* of 42%. The mean value of the CEO degree is 93%, with a *SD* of 25%. The average FOEs in China are just 5%, with a 23% *SD*. The mean firm size is 21.98 and 1.25 *SD*, and the maximum organization size is 28. The average age is 9.1 years, with a *SD* of 6.22. The maximum age of the firm is 28 years in China. The mean firm growth opportunity was 0.98, and 0.99 *SD* and the average market performance of the listed Chinese company is 2.76, with a *SD* of 0.08. The average firm growth in a sample period is 0.83, with a minimum of −12.81 and a maximum growth of 64.7%. The mean value of firm financial leverage is 0.45, with a 0.36 *SD*. Table A3 in **Supplementary Material** shows that 6% of the studied companies are cross-listed on different stock markets, especially in Hong Kong and 64%of firms have their head office in the more developed region of China.

The average CSRP of the Chinese sub-national institutional contingencies is portrayed in Table A3 in **Supplementary Material**. The average CSRP of non-SOEs is 26.78, while the social performance regarding SOEs is 32.77. The *SD*s are 16.25 and 21.22, respectively. The results reveal that SOEs are inclined to contribute more to social deeds. Similarly, the CSR performance of firms with foreign owners is higher than that of firms with no foreign owners. The mean value of CSRP in FOEs is 35.65, with a *SD* of 21.4, while the mean value of non-FOEs is 28.85, with a *SD* of 18.53. The cross-listed in Hong Kong or other stock exchanges have a mean value of 33.38, and non-cross-listed firms have a 25.1 mean CSRP value. The average CSRP of cross-listed companies is 33.38, while for non-cross-listed companies, it is 25.1. The average CSRP in the developed region companies is 30.34, and the maximum is 90.25. The firm is located in the more-developed region frontrunner as equated with firms in the less-developed area.

The correlation between CEO tournament incentives and CSRP is consistent with our prediction, suggesting that CEO tournament incentives motivate CEOs to be more socially responsible. The correlation between Tobin Q and CSRP is 0.03, which specifies the confirmatory association between CSRP and CFP, consistent with our hypothesis. The correlation coefficient between the B_Female P and CEO_Pay Gap is also negative, which indicates that high B_Female P advances the detachment of the compensation committee and limits CEOs' undue compensation.

The correlation (Table A4 in **Supplementary Material**) between CSRP and SOEs is 0.16; the results predict the positive association between SOEs firms and CSRP, which is consistent with our conjecture in H2, suggesting that the firm's CSRP is

higher in SOEs firms. The correlation coefficient of foreign-owned firms 0.11 indicates a positive association between FOEs and CSRP, consistent with H3. A correlation coefficient is positively significant between cross-listed companies and CSRP. Likewise, the same relationship is predicted for D_Region and CSRP, which validates the H4 and H5 of the study. However, the correlation coefficient between sub-national institutional contingencies (i.e., firms in less-developed vs. more-developed regions, non-cross-listed vs. cross-listed companies, non-FOEs vs. FOEs, non-SOEs vs. SOEs) is positive and significant with CEO_Pay Gap, which is consistent with our prediction, suggesting that CEOs receive incentives for being socially responsible. We estimated the regression separately for each tournament incentive measure to alleviate multicollinearity.

CSRP and Tournament Incentives

The CEOs' tournament bonuses, according to H1, are positively related to CSRP. **Table 1** shows the results of two statistical models (OLS and Cluster OLS) for the relationship between CEO tournament incentives and CSP and the regression results of CEO tournament incentives and CSRP. Columns I and II contain the OLS regression results, while columns III and IV contain the cluster-OLS results. To account for cross-sectional dependency in the residuals, T-statistics in III and IV are considered on standard errors company clustered and shown in parentheses.

Chief executive officer (CEO) tournament incentives are linked to CSRP positively, which is consistent with H1. Our theory (that there is a substantial link between CEO tournament incentives and CEO pay) has been proved, as CEO Incentive coefficients (CEO-Incentives) are significant and have a *p*-value of 0.01. The results also support the tournament theory, which notes that if a CEO's compensation is different from that of other executives, antagonism between them will grow, resulting in increased firm output because the rewards motivate CEOs to spend more on CSR, which helps to raise the company's market profile. The findings align with Hu et al. (2013), who found a connection between CEO rewards and organizational success. Both versions featured year effects and two-digit industry codes.

Furthermore, *B_Share*, *B_Ind*, and *B_Size* remain important in board structure variables. The B_Size coefficient is important but negative, indicating that larger boards invest less in CSR (Garcia-Sanchez et al., 2014). This supports the theory that large boards may agonize over the lack of unity, agency dispute, and leisurely policymaking (Rao et al., 2012), and thus may be less interested in disclosing CSR-related details.

The coefficients of *B_Ind* and *B_Share*, on the other hand, remain positive and meaningful, indicating that companies with board independence and board members who own stock in their companies promote CSR investment. Previous research has shown that businesses with a high level of board independence are more likely to participate in CSR (Harjoto and Jo, 2011). However, in the models listed in **Table 5**, the coefficient of *CEO_Tenure* remains important and optimistic, implying that CEOs with longer tenure invest more in CSR. According to the career horizon theory, the CEO's passion for CSR investment grows as their service period increases (Chen et al., 2011). As a result, CEO tenure has a major impact on CSR efficiency. In all models listed in **Table 5**, the coefficient of *CEO_Degree* remains positive and important, implying that CEO education aids in improving a firm's CSP (Fernández-Gago et al., 2018).

In the models mentioned in **Table 1**, the coefficient of SOE remains large, implying that SOEs are more socially conscious

TABLE 1 | Effect of CEO tournament incentive on corporate social responsibility performance.

	OLS		Cluster-OLS	
	I	II	III	IV
CEO_PayGap	2.76*** (13.75)	–	2.76*** (9.07)	–
CEO_PayGapRatio	–	0.71*** (4.88)	–	0.70*** (3.36)
B_Size	−0.16** (−2.15)	−0.15** (−2.35)	−0.17* (−1.95)	−0.15* (−1.76)
B_Ind	2.28* (1.74)	3.24*** (2.79)	2.28* (1.69)	3.23** (2.08)
B_Share	3.52*** (2.94)	3.02*** (2.54)	3.51*** (2.16)	3.01** (2.01)
B_FemaleP	1.06 (0.70)	−0.45 (−0.30)	1.03 (0.44)	−0.45 (−0.19)
CEO_Duality	−0.91** (−2.15)	−0.57 (−1.39)	−0.91 (−1.53)	−0.57 (−1.01)
CEO_Tenure	0.34*** (5.10)	0.39*** (6.12)	0.34*** (3.99)	0.39*** (4.74)
CEO_Degree	0.86* (2.06)	1.18*** (3.23)	0.87* (1.96)	1.18* (2.00)
SOE	1.57*** (3.56)	1.23*** (2.80)	1.57** (2.03)	1.13* (1.76)
FOE	2.02*** (3.32)	2.50*** (4.18)	2.25*** (5.44)	2.24*** (3.19)
F_Size	108.60*** (32.56)	117.76*** (38.74)	108.59*** (17.51)	117.75*** (19.74)
F_Age	−0.04*** (−2.95)	−0.12*** (−3.71)	−0.11* (−1.90)	−0.12** (−2.07)
F_GrowOpp	−0.89*** (−3.93)	−1.12*** (−4.29)	−1.74*** (−2.98)	−1.12*** (−2.58)
TobinQ	0.38*** (7.57)	0.06*** (7.64)	0.38** (2.36)	0.05*** (3.70)
F_Growth	0.14 (1.11)	0.13 (1.21)	0.14 (1.41)	0.14 (1.56)
F_Leverage	2.01*** (−6.46)	−2.33*** (−7.92)	−2.12*** (−2.67)	−2.33*** (−2.52)
Cross_Listed	2.36*** (2.95)	3.14*** (3.94)	2.41** (2.24)	3.14*** (2.90)
D_Region	1.60*** (4.07)	1.98*** (5.22)	2.57*** (4.27)	2.86*** (4.63)
Constant	−345.24*** (−31.43)	−325.94*** (−32.41)	−332.61*** (−10.05)	−334.75*** (−10.07)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Adjusted-R^2	0.240	0.246	0.243	0.248

T-statistics are documented in parentheses.
****, **, * Significant at 1, 5, and 10%, respectively.*
See Table A1 in ***Supplementary Material*** *for the definition of variables and Equations (3), (4) for the models' details.*

TABLE 2 | CEO tournament incentive and corporate social responsibility performance (sub-sample SOEs vs. non-SOEs) and interaction effect.

	SOE		Non-SOE		Interaction effect	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
CEO_PayGap	3.73*** (10.71)	–	1.93*** (8.25)	–	1.19*** (7.30)	–
CEO_PayGapRatio	–	0.72*** (3.12)	–	0.64*** (3.63)	–	1.78*** (6.82)
CEO_PayGap × SOE	–	–	–	–	0.21*** (4.75)	–
CEO_PayGapRatio × SOE	–	–	–	–	–	0.53** (2.83)
B_Size	−0.19** (−2.05)	−0.15** (−2.01)	−0.10* (−1.06)	−0.13* (−1.71)	−0.07 (−0.74)	−0.04 (−0.37)
B_Ind	1.58 (0.39)	2.63 (0.68)	1.18 (0.45)	1.67 (0.58)	3.34 (1.09)	3.79 (1.24)
B_Share	−30.46** (−2.01)	−13.18 (−0.88)	4.63*** (3.97)	4.37*** (3.83)	6.31*** (4.64)	5.46*** (4.04)
B_FemaleP	−1.57 (−0.59)	−2.57 (−0.94)	1.59 (0.92)	1.64 (0.97)	−0.84 (−0.42)	−1.39 (−0.70)
CEO_Duality	0.73 (0.83)	1.06 (1.25)	−1.39*** (−3.11)	−1.14*** (−2.65)	−1.08* (−2.18)	−1.19* (−2.40)
CEO_Tenure	0.42*** (3.99)	0.59*** (5.85)	0.24*** (2.90)	0.26*** (3.27)	0.30*** (3.12)	0.29*** (3.46)
CEO_Degree	1.60** (2.67)	1.89*** (3.23)	1.16*** (4.13)	1.21*** (4.38)	1.31*** (4.82)	1.40*** (5.17)
F_Size	134.4*** (23.92)	153.2*** (29.05)	91.80*** (22.14)	99.65*** (26.33)	120.9*** (26.74)	118.4*** (26.71)
F_Age	−0.17*** (−2.94)	−0.20*** (−3.59)	0.10** (2.08)	0.09** (2.01)	−0.15*** (−3.42)	−0.12** (−2.90)
F_GrowOpp	−0.74*** (−2.83)	−1.11*** (−3.65)	−1.68*** (−4.19)	−2.09*** (−5.39)	−1.06*** (−3.18)	−1.22*** (−3.70)
TobinQ	−0.23 (−1.52)	−0.22 (−1.48)	0.11 (0.95)	0.23 (0.33)	0.79*** (7.24)	0.83*** (7.62)
F_Growth	1.40*** (7.26)	1.52*** (7.91)	0.21*** (4.38)	0.04*** (5.27)	0.12*** (3.96)	0.14** (2.86)
F_Leverage	−11.1*** (−11.07)	−12.6*** (−11.05)	−4.37*** (−6.77)	−4.23*** (−6.90)	−5.52*** (−7.97)	−5.78*** (−8.22)
Constant	−432.6*** (−23.12)	−456.2*** (−20.44)	−290.7*** (−17.99)	−304.8*** (−19.74)	−369.1*** (−28.29)	−363.1*** (−28.23)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.285	0.267	0.207	0.201	0.288	0.286
$Chi^2 = 17.24$, p-value = 0.0000					–	–

T-statistics are documented in parentheses.
****, **, * Significant at 1, 5, and 10%, respectively.*
See Table A1 in ***Supplementary Material*** *for the definition of variables and Equations (3)–(5) for the models' details.*

than other firms (e.g., Khan et al., 2019). At the 1% mark, the coefficient of FOEs remains significant, indicating that firms with foreign investors/owners support more investment in CSP; as a result, firm CSP increases more in FOEs (McGuinness et al., 2017).

Moreover, F_Size and Tobin Q remain positive and highly important among the firms' economic control variables in all models listed in **Table 1**. The F_Age coefficient is negative, indicating that younger companies prefer social activities more than older companies, which is t with our assumptions and previous research (Marquis and Qian, 2014). Similarly, the F_GrowthOpp coefficient remains negative and important, indicating that businesses with growth opportunities are more socially conscious than other firms, possibly to improve their corporate image. The Tobin Q and F_Size coefficients are important, indicating that larger and more profitable businesses spend more on CSR than smaller businesses (Fernández-Gago et al., 2018).

The coefficient of F_Leverage is negatively significant in all models reported in **Table 1**. This relationship is consistent with

the literature (Ali et al., 2019). The coefficient of Cross_Listed and D_Region is positively significant, suggesting cross-listed organizations and organizations traced in the more-developed canton tends to invest more in CSP because of more regulations and better corporate governance (Ali et al., 2019).

CEO Tournament Incentives and CSRP in SOEs vs. Non-SOEs

To test the study's H2 that predicts that CEO tournament incentives' incremental effect on CSRP is more keenly recognized in state-owned organizations than their counterparts. We estimate Equations (3)–(5) for subsamples of SOEs vs. non-SOEs and the interaction effect of SOEs, respectively. **Table 2** shows the effects of CEO Tournament incentives and CSRP in subsample SOEs vs. non-SOEs, using two different CEO Tournament incentive metrics (i.e., CEO Pay Gap and CEO Pay Gap Ratio). Model 1 in **Table 2** boosts the regression upshots for CSP on CEO_Pay Gap in SOEs subsample. The coefficient of CEO_Pay Gap is 3.73, with a *t*-value of 10.71 indicating the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample SOEs. Model 2 in **Table 2** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.72 and significant at a 1% level in SOEs subsample. The results are consistent with our conjecture.

Model 3 in **Table 2** reports regression fallouts of CSP on CEO_Pay Gap in a sub-sample of non-SOEs. The constant of CEO_Pay Gap is 1.93, with a *t*-value of 8.25, indicating the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample non-SOEs. Model 4 in **Table 2** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.64 and significant at level 0.01 in the sub-sample of the non-SOEs. These results are consistent with our conjecture. These results suggest that CEOs' tournament incentives in non-SOEs also lead to improved CSRP.

We applied a seemingly unrelated regression (SUR) method to compare the beta values. The chi2 coefficient is 17.24, with a *p*-value of 0 that confirms H2, which predicts that CEO tournament incentives incremental effect on CSP is highly accepted in SOEs than their counterparts.

Model 5 in **Table 2** presents the regression of CSRP on CEO tournament incentive (i.e., CEO_Pay Gap) and the interaction effect of SOEs; the coefficient of CEO_Pay Gap is 1.19, and CEO_Pay Gap × SOE is 0.21 with *t*-values 7.3 and 4.75, respectively. The outcomes are in line with our view that CEO tournament incentives' incremental effect on CSRP is highly accepted in state enterprises than their counterparts. Model 6 of **Table 2** states similar results with alternative CEO tournament incentive measurements (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 1.78, and the coefficient of interaction between CEO_Pay Gap Ratio × SOE is 0.53, both significant at the 1 and 5% levels, respectively. These results validate our findings and support H2.

CEO Tournament Incentives and CSRP in FOEs vs. Non-FOEs

To measure H3, FOEs are more accepting of the incremental impact of CEO tournament rewards on CSRP than their counterparts. We estimate Equations (5)–(7) for subsamples of FOEs vs. non-FOEs and the interaction effect of FOEs, respectively. The results of the interaction effect of FOEs are also reported in **Table 3**. Model 1 in **Table 3** reports the results for the regression of CSRP on CEO_Pay Gap in FOEs subsample. The coefficient of CEO_Pay Gap is 1.21 and significant at the 5% level indicating the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample FOEs. Model 2 in **Table 3** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.67 and significant at the 1% level in FOEs subsample. The results are consistent with our conjecture.

Model 3 in **Table 3** states the regression outcomes of CSRP on CEO_Pay Gap in the non-FOEs subsample. The coefficient of CEO_Pay Gap is 0.65, with a *t*-value of 2.91 indicating that the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample non-FOEs. Model 4 in **Table 3** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 1.24, significant at level 0.01 in the non-FOEs subsample. The results are consistent with our conjecture. These results suggest that CEOs' tournament incentives in non-FOEs also lead to improved CSP.

We applied a SUR method to compare the beta values model 1 and Model 3. The chi2 coefficient is 37.35, with a *p*-value of 0 confirming that CEO tournament incentives' incremental effect on CSP is more accepted in FOEs than their counterparts.

Model 5 in **Table 3** presents regression of CSRP on CEO tournament incentive (i.e., CEO_Pay Gap) and interaction effect of FOEs; the coefficient of CEO_Pay Gap is 1.65, and CEO_Pay Gap × FOE is 0.12, with *t*-values of 9.19 and 2.97, respectively. The outcomes align with our assumption that the incremental effect of tournament incentives on CSP is more recognized in foreign-owned companies than their counterparts. Model 6 of **Table 3** shows similar results with alternative CEO tournament incentive measurements (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.87, and the coefficient of interaction between CEO_Pay Gap Ratio × FOE is 1.64, both significant at the 5 and 1% levels, respectively. These results validate our findings and support H3.

CEO Tournament Incentives and CSRP in Cross-Listed vs. Non-cross-Listed Firms

Examining H4 of the study that predicts CEO tournament incentives' incremental effect on CSRP is more recognized in cross-listed companies than their counterparts. We calculate Equations (3), (4), and (7) for non-cross-listed and cross-listed firms and the interaction effect of cross-listed companies for subsamples of non-cross-listed and cross-listed companies, respectively. The results of the cross-listed interaction effect are also reported in **Table 4**. Model 1 in **Table 4** shows the regression

TABLE 3 | CEO tournament incentive and corporate social responsibility performance (sub-sample FOEs vs. non-FOEs) and interaction effect.

	FOE		Non-FOE		Interaction effect	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
CEO_PayGap	1.21** (2.91)	–	0.65*** (5.87)	–	1.65*** (9.19)	–
CEO_PayGapRatio	–	0.67*** (2.61)	–	1.24*** (2.35)	–	0.87** (2.15)
CEO_PayGap × FOE	–	–	–	–	0.12*** (2.97)	–
CEO_PayGapRatio × FOE	–	–	–	–	–	1.64*** (3.08)
B_Size	0.25 (1.13)	0.41** (1.97)	0.24*** (2.48)	0.36*** (2.75)	0.18* (1.91)	0.31*** (2.52)
B_Ind	−14.99** (−2.18)	−19.2*** (−2.84)	2.19 (1.00)	10.81*** (2.89)	−2.52 (−0.90)	8.00*** (2.23)
B_Share	9.99*** (2.72)	7.59** (2.17)	4.34*** (4.70)	2.46* (1.71)	4.56*** (5.06)	2.72* (1.95)
B_FemaleP	−5.49 (−1.18)	−0.69 (−0.41)	−0.39 (−0.28)	−0.07 (0.08)	−1.21 (−0.90)	−0.17 (−0.22)
CEO_Duality	−1.98 (−1.54)	−1.63 (−1.33)	−0.76** (−2.16)	−0.76* (−1.73)	−0.86*** (−2.64)	−0.82* (−192)
CEO_Tenure	0.34* (1.95)	0.41*** (2.87)	0.26 (4.95)	0.28*** (4.10)	0.28*** (5.55)	0.33*** (4.91)
CEO_Degree	−2.09** (−2.05)	−1.23 (−1.42)	0.74*** (2.65)	1.50*** (3.94)	0.96*** (5.20)	1.21*** (3.28)
F_Size	128.0*** (13.08)	141.2*** (15.50)	94.2*** (28.30)	7.93*** (35.08)	93.90*** (30.42)	8.08*** (38.23)
F_Age	0.18 (1.48)	0.13 (1.14)	−0.11*** (−3.17)	−0.08** (−2.07)	−0.13*** (−4.87)	−0.06 (−1.56)
F_GrowOpp	−2.05*** (−2.98)	−1.79*** (−3.34)	−1.66*** (−7.53)	−3.42*** (11.72)	−1.84*** (−8.89)	−3.54*** (−12.98)
TobinQ	0.71** (2.31)	0.58** (2.16)	0.58*** (7.59)	0.05*** (7.32)	0.67*** (9.00)	0.05*** (7.83)
F_Growth	−0.68** (−2.34)	−0.43 (−1.34)	−0.87*** (−3.80)	−0.49** (−2.11)	−0.89*** (−3.84)	−0.45* (−1.94)
F_Leverage	−14.5*** (−4.15)	−15.9*** (−5.45)	−3.29*** (−7.03)	−3.80*** (−6.81)	−4.03*** (−8.71)	−4.23*** (−7.57)
Constant	−156.3*** (−11.87)	−150.7*** (−13.84)	−112.9*** (−25.78)	−150.6*** (−26.88)	−119.9*** (−29.08)	−154.1*** (−29.29)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.308		0.302	0.301	0.306	0.291
$Chi^2 = 37.35$, p-value = 0.0000					–	–

T-statistics are documented in parentheses.
****, **, * Significant at 1, 5, and 10%, respectively.*
See Table A1 in ***Supplementary Material*** *for the definition of variables and Equations (5)–(7) for the models' details.*

upshots of CSP on CEO_Pay Gap in the cross-listed subsample. The coefficient of CEO_Pay Gap is 5.90 and significant at the 1% level, indicating the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample Cross-Listed. Model 2 in **Table 4** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 3.59 and significant at the 1% level in the Cross-Listed subsample. The results are consistent with our conjecture. Results show the upshots of CSRP on CEO_PayGap in the non-cross-listed subsample. The coefficient of CEO_Pay Gap is 1.44, with a *t*-value of 5.43 indicating that the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample non-cross-listed. Model 2 in **Table 4** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 1.06, significant at the 5% level in the non-cross-listed subsample. The results are consistent with our conjecture. These results suggest that CEOs' non-cross-listed tournament incentives also lead to improved CSP.

TABLE 4 | CEO tournament incentive and corporate social responsibility performance (sub-sample cross-listed vs. non-cross-listed) and interaction effect.

	Cross-listed		Non-cross-listed		Interaction effect	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
CEO_PayGap	5.90*** (3.90)	–	1.44*** (5.43)	–	1.57*** (5.94)	–
CEO_PayGapRatio	–	3.59*** (2.92)	–	1.06** (2.04)	–	0.97*** (2.90)
CEO_PayGap × Cross-Listed	–	–	–	–	0.37*** (4.65)	–
CEO_PayGapRatio × Cross-Listed	–	–	–	–	–	2.40*** (3.43)
B_Size	−0.34 (−0.43)	−0.03 (−0.02)	0.26* (1.77)	0.25* (1.91)	0.24* (1.65)	0.27** (2.17)
B_Ind	2.34 (1.20)	1.12 (1.21)	2.65 (0.84)	4.98* (1.95)	4.32 (1.03)	7.18** (2.00)
B_Share	−4.83*** (−3.63)	−3.56** (−2.39)	5.22*** (3.97)	4.53*** (3.49)	5.54*** (4.15)	4.79*** (3.64)
B_FemaleP	6.39 (1.17)	7.75* (1.66)	−0.19 (−0.09)	−0.85 (−0.44)	0.83 (0.42)	−0.18 (−0.23)
CEO_Duality	−7.13** (−2.07)	−1.69 (−0.62)	−1.22** (−2.45)	−0.89** (−2.08)	−1.42*** (−2.87)	−0.86** (−2.02)
CEO_Tenure	0.57* (1.65)	0.57** (2.01)	0.28*** (3.44)	0.30** (2.70)	0.29*** (3.73)	0.27*** (3.21)
CEO_Degree	0.14 (0.06)	1.27 (0.60)	1.59*** (5.75)	0.90** (2.41)	0.87** (2.09)	1.14*** (3.11)
F_Size	143.6*** (7.94)	177.2*** (9.90)	117.9*** (22.91)	127.9*** (26.62)	118.6*** (24.38)	130.7*** (28.94)
F_Age	−0.98** (−2.48)	−1.20** (−2.87)	−0.08** (−1.96)	0.11** (2.21)	−0.11** (−2.50)	−0.08** (−2.27)
F_GrowOpp	−7.28*** (−5.61)	−6.58*** (−5.58)	−2.53*** (−7.46)	−2.97*** (−10.46)	−1.38*** (−3.79)	−3.05*** (−12.92)
TobinQ	0.98*** (2.53)	0.49** (2.84)	0.83*** (6.92)	0.89*** (7.62)	0.70*** (6.28)	0.05*** (7.89)
F_Growth	−3.63* (−1.66)	−0.51 (−1.12)	−0.39 (−1.09)	−0.29 (−1.02)	0.02 (0.18)	−0.47** (−2.02)
F_Leverage	−2.58*** (−2.47)	−4.13*** (3.33)	−8.85*** (−10.12)	−8.04*** (−10.81)	−5.09*** (−7.39)	−4.34*** (−7.79)
Constant	−233.9*** (−7.35)	−216.6*** (−9.00)	−181.0*** (−27.16)	−153.0*** (−28.11)	−179.1*** (−27.99)	−152.9*** (−29.16)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.454	0.445	0.271	0.246	0.286	0.262
$Chi^2 = 25.14$, p-value = 0.0000					–	–

T-statistics are documented in parentheses.
****, **, * Significant at 1, 5, and 10%, respectively.*
See Table A1 in ***Supplementary Material*** *for the definition of variables and Equations (3), (4), and (7) for the models' details.*

Model 5 in **Table 4** presents the regression of CSP on CEO tournament incentive (i.e., CEO_Pay Gap) and interaction effect of cross-listed; the coefficient of CEO_Pay Gap is 1.57, and CEO_Pay Gap × Cross-Listed is 0.37 with *t*-values 5.94 and 4.65, respectively. The outcomes align with our assumptions that the CEO tournament incentives' incremental effect on CSP is more recognized on cross-listed companies than their counterparts. Model 5 of **Table 4** states similar results with alternative CEO tournament incentive measurements (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.97, and the coefficient of interaction between CEO_Pay Gap Ratio × is 3.43, both significant at the 1% level.

CEO Tournament Incentives and CSRP in More-Developed Region vs. Less-Developed Region Firms

To test H6 that predicts that CEO tournament incentives' incremental effect on CSRP is highly recognized in more-developed area companies than their counterparts. We estimate Equations (1), (2), and (4), respectively, for subsamples of developed-area and less-developed areas and the interaction effect of the developed region.

Table 5 reports the results of CEO Tournament incentives and CSRP in subsample more-D_Region vs. less-D_Region

with two alternative measures of CEO Tournament incentive (i.e., CEO_Pay Gap and CEO_Pay Gap Ratio). The results of the interaction effect of cross-listed are also reported in **Table 5**. Model 1 in **Table 5** shows the regression outcomes of CSP on CEO_Pay Gap in the D_Region subsample. The coefficient of CEO_Pay Gap is 1.56 and significant at the 1% level, representing the CEO Tournament incentives' incremental impact on CSP is positively significant in subsample D_Region. Model 2 in **Table 5** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.37 and significant at the 0.01 level. The outcomes are in line with our conjecture.

Model-3 in **Table 5** reports the outcomes of regression of CSP on CEO_Pay Gap in the less-D_Region subsample. The coefficient of CEO_PayGap is 1.29, with a *t*-value of 3.12, indicating the CEO Tournament incentives' incremental impact on CSPis positively significant in subsample less-D_Region. Model 4 in **Table 5** reports the same results with an alternative measure of CEO tournament incentive (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.23 significant at the 5% level in the less-D_Region subsample. The results are consistent with our conjecture. These results suggest that CEOs' tournament incentives in less-D_Region firms also lead to improved CSP.

We applied a SUR method to compare the beta values of Models 1 and 3. The chi2 coefficient is 27.22, with a *p*-value of 0 confirming H5 that predicts CEO tournament incentives' incremental effect on CSRP is highly recognized in more-developed region firms than in less-developed region firms.

Model 5 in **Table 5** presents the regression of CSRP on CEO tournament incentive (i.e., CEO_PayGap) and the interaction effect of D_Region; the coefficient of CEO_Pay Gap is 1.39, and CEO_PayGap × D_Region is 0.22 with *t*-values 4.51 and 5.63, respectively. The outcomes align with our assumption that CEO tournament incentives' incremental effect on CSRP is more recognized in companies from developed regions than their counterparts. Model 6 of **Table 5** shows similar results with alternative CEO tournament incentive measurements (i.e., CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 1.04, and the coefficient of interaction between CEO_Pay Gap Ratio × D_Region is 1.3, both significant at the 1% level. These results validate our findings and support H5.

Results and Discussions

Overall, the empirical results show that CEO tournament incentives motivate CEOs to be socially responsible since CEO tournament incentives are positively associated with CSP after controlling for CEO characteristics, ownership, company, and board alongside year and industry effect. Our findings confirm that CEO tournament incentives' incremental effect on CSP is highly accepted in SOEs than their counterparts. Since CEOs of SOEs may be under intense pressure from the government and other pressure groups, this result suggests that when they obtain substantial tournament rewards, they are more committed to CSRP.

The results state that CEO tournament incentives' incremental effect on CSP is highly accepted in state organizations than non-SOEs. SOE executives are likely to be under more public scrutiny as compared to non-SOE executives regarding their pay structures and CSP performance (Hu et al., 2013). Our findings demonstrate that CEO tournament incentives' incremental effect on CSP is highly recognized in FOEs than non-FOEs. Foreign owners pressurize corporations to pay for performance systems to incentivize CEOs (Firth et al., 2007). Therefore, organizations with foreign investments have higher sensitivities for the pay-performance nexus, and foreign investor ownership is associated with providing stronger pay-performance incentives to CEOs (Firth et al., 2007). The results are consistent with our conjecture. These results suggest that CEOs' non-cross-listed tournament incentives also lead to improved CSP.

The results are consistent with our conjecture and prior studies. Overall findings suggest that CEOs' non-cross-listed tournament incentives also lead to improved CSP. The Chinese cross-listed firms incorporate extra incentives in their pay design (Berrone and Gomez-Mejia, 2009). Besides, litigation risk tends to increase after cross-listing (Boubakri et al., 2016). Consequently, cross-listing encourages firm executives to boost CSP through improved governance by aligning with foreign regulations and norms, improving reputation to enhance a company's plea to stakeholders and investors, overcome foreignness liability, enhance competitiveness (Jo and Harjoto, 2011) and mitigate litigation risk and regulatory burden (Boubakri et al., 2016).

Finally, the outcomes are consistent with the literature regarding the development. Conyon and He (2011) studied executive compensation and corporate governance link in Chinese firms. They found that the CEO pay-performance link is more keenly accepted in more-developed regions than in less-developed regions. Another study reported a weaker pay-performance association from the perspective of less developed areas (Firth et al., 2007).

Endogeneity and Further Robustness Tests

We used the firm-fixed effect regression to control the influence of unidentified firm-level characteristics and address the omitted variable concern. Model 1 in Table A5 in **Supplementary Material** shows the results of the firm-fixed effects regression with CEO_Pay Gap. The CEO_ Pay Gap coefficient remains positive and significant at a 1% level, which suggests that with-in firm CEO tournament incentive is positively associated with CSP. Model 2 reports the firm-fixed effect regression outcomes for the impact of CEO tournament incentive on CSRP with an alternative measure of CEO tournament incentive (CEO_Pay Gap Ratio). The coefficient of CEO_Pay Gap Ratio is 0.47 ($p < 0.05$), which confirms the previous finding. The results of the firm-fixed effect regression are in line with the previous findings and support H1 that CEO Tournament incentive has a positive association with CSP. Overall, the results obtained from firm-fixed effect regression are consistent with H1 and suggest that the relationship between CEO tournament incentives and CSRP is unlikely to be driven by endogeneity due to omitted variable bias.

TABLE 5 | CEO tournament incentive and corporate social responsibility performance (sub-sample more-developed-region vs. less-developed-region) and interaction effect.

	More-D-region		Less-D-region		Interaction effect	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
CEO_PayGap	1.56*** (4.75)	–	1.29*** (3.12)	–	1.39*** (4.51)	–
CEO_PayGapRatio	–	0.37*** (2.98)	–	0.23** (2.27)	–	1.04*** (6.17)
CEO_PayGap × D_Region	–	–	–	–	0.22*** (5.63)	–
CEO_PayGapRatio × D_Region	–	–	–	–	–	1.30*** (3.91)
B_Size	0.07 (0.59)	0.15 (1.24)	0.79*** (5.01)	0.88*** (4.26)	0.27* (1.89)	0.27* (1.85)
B_Ind	1.07 (0.28)	2.44 (0.65)	4.16*** (2.67)	1.11** (2.87)	1.19 (0.38)	1.99 (0.65)
B_Share	4.14*** (2.66)	3.72** (2.39)	4.09** (2.26)	4.54** (2.46)	5.82*** (4.34)	5.30*** (4.03)
B_FemaleP	−1.69* (−1.73)	−3.62* (−1.67)	3.25** (2.44)	3.45** (2.60)	0.12 (0.06)	−0.102 (−0.05)
CEO_Duality	−1.19* (−1.97)	−0.90* (−1.74)	−0.77 (−1.36)	−0.94 (−1.21)	−1.46** (−2.97)	−1.44*** (−2.93)
CEO_Tenure	0.22* (2.04)	0.32*** (3.10)	0.42*** (3.90)	0.38*** (3.51)	0.28*** (3.62)	0.28*** (3.36)
CEO_Degree	1.99* (6.01)	2.15*** (6.59)	1.12** (2.28)	1.16** (2.41)	1.62*** (2.24)	0.94** (2.24)
F_Size	104.6*** (18.21)	116.0*** (21.32)	145.2*** (17.20)	155.7*** (19.77)	115.0*** (24.21)	133.3*** (29.56)
F_Age	0.18*** (2.88)	0.16** (2.68)	−0.18*** (−3.90)	−0.06 (−0.95)	0.16*** (3.17)	0.11** (2.20)
F_GrowOpp	−1.54*** (−3.34)	−1.71*** (−3.86)	−1.56*** (−2.67)	−2.08*** (−3.71)	−1.54*** (−4.31)	−1.65*** (−4.71)
TobinQ	0.72*** (5.21)	0.84*** (6.19)	1.01*** (5.17)	1.03*** (5.31)	0.82*** (7.08)	0.83*** (7.51)
F_Growth	−0.56** (−2.12)	−0.55** (−2.10)	−0.07 (−0.11)	−0.05 (−0.10)	−0.41 (−1.15)	−0.41 (−1.23)
F_Leverage	−4.98*** (−6.46)	−4.11*** (−5.41)	−6.88*** (−6.64)	−6.95*** (−6.73)	−5.40*** (−7.89)	−5.32*** (−7.72)
Constant	−148.6*** (−21.57)	−149.6*** (−21.41)	−182.5*** (−20.80)	−188.7*** (−21.18)	−178.9*** (−28.25)	−180.3*** (−28.48)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.330	0.266	0.302	0.290	0.289	0.287
$Chi^2 = 27.22$, p-value = 0.0000					–	–

T-statistics are documented in parentheses.

****, **, * Significant at 1, 5, and 10%, respectively.*

See Table A1 in ***Supplementary Material*** *for the definition of variables and Equations (3), (4), and (7) for the models' details.*

Previous studies have shown CEO_Pay Gap as an endogenous variable (Conyon and He, 2011). We used the accustomed endogeneity remedy to validate our findings, a two-stage least squares regression (2-SLS). We use two alternative instrumental variables (i.e., the industry average of CEO compensation and the local average pay of CEO) of CEO tournament incentives, which are likely to meet the criterion that it is correlated with the decision to pursue a CEO tournament incentive but is not correlated with CSP. The preference of 2SLS over OLS is based on endogeneity. Table A6 in **Supplementary Material** describes the 2SLS regression results regarding the nexus between the CEO and CSRP tournament incentives. The table reports the first and second stages of 2SLS with both instrumental variables (i.e., local average pay and industry average pay). The first stage of 2SLS reports that the instrumental variable is positively significant. The coefficient of CEO_Pay Gap in seconds is positively significant at the 1% level, which confirms our conjecture that CEO tournament incentives

motivate the CEO to be more socially responsible. The result of 2SLS validates the main regression results that state after controlling for a possible problem of endogeneity, the results are consistent.

Ordinary least squares (OLS) results may be deceptive due to self-selection preferences. In other words, the physiognomies of companies with low and high CSRP might diverge, and these characteristics may lead to differences in CSRP rather than increased tournament incentives. We follow Hung et al. (2012) to address this issue in critiquing the PSM method. We use the adjacent matching method PSM, which divides firms into a treatment group (i.e., a firm with a CEO tournament incentive) and a control group (firms without tournament incentives) having similar characteristics. We employ PSM using the probit model, where CEO tournaments (i.e., CEO_Pay Gap) are the dependent variable along with all explanatory variables. We created a dummy variable, CEO_Pay Gap, which equals 1 if the CEO_Pay Gap is higher than the sample's median, and 0 otherwise. We matched the companies grounded on entirely control variables of this study. The results of the PSM method are reported in Table A7a in **Supplementary Material**, and the second stage of PSM results are reported in Table A7b in **Supplementary Material**.

Table A7a in **Supplementary Material** reports the results of the first stage of the PSM model with two alternative measures of CEO tournament incentives (i.e., CEO_Pay Gap and CEO_Pay Gap Ratio). Table A7b in **Supplementary Material** reports the PSM results for stage two with two alternative measures of CEO tournament incentives (i.e., CEO_Pay Gap and CEO_Pay Gap Ratio). The ATT value is significant with a T-stat of 8.73 in the first model treated with CEO_Pay Gap. Similar results can be observed with an alternative measure of CEO tournament incentives. The ATT value in the model treated with CEO_Pay Gap Ratio is 2.52. The results are consistent with our conjecture that the CEO tournament incentive has a positive and significant relationship with CSP. The results of PSM are consistent with the initial results, which validate our findings.

CONCLUSIONS AND POLICY IMPLEMENTATIONS

The current research explores whether tournament rewards encourage CEOs to increase their investment in CSR activities. This study employs recent data from all A-share listed enterprises in the Chinese stock markets to investigate it. After controlling for factors such as ownership and board structure and economic variables regarding an organization, findings suggest that CEOs invest more in CSR projects when they receive comparatively better incentives. Our results are in line with tournament theory, which suggests that bonuses and prizes drive managers. Growth-inducing salary rewards allow executives to compete with one another, allowing the company to flourish financially and socially.

This study attempts to broaden insights into CSRP and the effect of sub-national institutional contingencies. The outcomes of this study reveal that sub-national institutional contingencies (i.e., firms in less-developed vs. more-developed regions, non-cross-listed vs. cross-listed companies, non-FOEs vs. FOEs, non-SOEs vs. SOEs) positively affect CSRP. The fallouts of this research divulge that CSP in firms in more-develop areas, cross-listed companies, FOEs, and SOEs are higher than their counterparts. The explanations for the upper CSRP in cross-listed companies or companies headquartered in more-developed regions, or FOES or SOEs, are shareholder protection, state pressure, proper security supervision, information asymmetry, CSR regulations, media coverage, and legal standards. The study results reveal that sub-national institutional contingencies affect the association between CEO tournament incentives and CSRP. Still, this relationship is more keenly felt in SOEs, FOEs, cross-listed firms, and firms in more-developed regions.

Although this study has achieved the anticipated research goals and found some essential research conclusions, the research has a few limitations that offer new and interesting opportunities for future research. As China's market diverges from developed countries, there might be an issue of generalizability of the results, whereas our sample relies on listed companies in an emerging economy. Thus, the role of CEO tournament incentives in CSRP may not be suitable for unlisted firms or firms in developed markets. Consequently, future researchers are encouraged to test the hypotheses in other developing and developed countries to enhance and endorse the generalizability of the results. Second, although a series of tests were performed to tackle the endogeneity, we used only one proxy for CSRP. Future studies may use other variables for CSRP to establish a causal link. Fourth, in our analysis, the findings concentrate on China's institutional climate, an increasingly changing economy, and different from developed countries in numerous ways. Moreover, all sub-national institutional contingencies (i.e., firms in less-developed vs. more-developed regions, non-cross-listed vs. cross-listed companies, non-FOEs vs. FOEs, non-SOEs vs. SOEs) are derived from a single country. Future studies should consider how this is affected by other sub-national institutions (e.g., family businesses vs. non-family firms and semi-governmental firms). Moreover, future research is advised to extend this study in multinational settings and thereby enhance the generalizability of the findings.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: data is available on the CSMAR website. Requests to access these datasets should be directed to http://cndata1.csmar.com.

AUTHOR CONTRIBUTIONS

MK: conceptualization, methodology, formal analysis, review, and editing. SA: data curation, formal analysis, writing, review, and editing. RZ: investigation, writing, review, and editing. CH: resources and supervision. MN: review, editing, and conceptualization. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.841163/full#supplementary-material

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The Effects of Group Identity on Pro-environmental Behavioral Norms in China: Evidence From an Experiment

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This study experimentally evaluates the effects of group identity primed by property rights on pro-environmental behaviors (PEB) and social norms in an urban Chinese environment. The research in this paper expands the research perspective and method of domestic waste management and provides a theoretical basis for the establishment of a long-term mechanism of environmental treatment. We used two simple binary choice tasks that test the PEB and environmental types of individuals. This is one of the earliest tests for group identity and social norms in pro-environmental examinations in Chinese people. Our results reveal that (i) publicity and education have a significant positive effect on the development of individual and group pro-environmental behavioral norms; (ii) housing ownership has no differentiating effect on individual environmental behavior; and (iii) the development of social norms of pro-environmental behavior varies according to group conditions, which, in turn, determines individual environmental behavioral choices and types of environmental behavior. The results also suggest that PEB may be shaped and norms may be built by group conditions rather than group identity.

Keywords: pro-environmental behavioral, social norms, group identity, experimental economics, simulations

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INTRODUCTION

A new report shows that China released 27% of the global greenhouse gas emissions in 2020—larger than all developed countries combined.[1] The environmental behaviors of Chinese people significantly affect China and even the worldwide environment. Environmental governance is not only associated with the mode of firm production but is also closely related to residents' everyday lifestyles and environmental behaviors (Manisalidis et al., 2020). For example, residential life alone contributes 40% of total carbon emissions (Liu et al., 2011). Most previous studies have focused on the environmental protection behaviors of enterprises, but this paper focuses on the environmental behaviors of residents. The pro-environmental behaviors (PEB) of residents in different countries are different (Steg and Gifford, 2017), which is caused by many factors (national and ethnic cultural differences and the economic development level); hence, it is worthwhile to discuss this topic further (Mancha and Yoder, 2015; Morren and Grinstein, 2016).

Sharing attributes of public goods and eco-environmental resources have strong externalities in regard to their improvement, conservation, and maintenance. When a conflict arises between the

[1] Data source link: http://english.mee.gov.cn/accessed November 10, 2021.

environment and some small-scale individual economic interests, the externality of the individual resident's environmental behaviors is reflected by a difficulty in spontaneously establishing environmentally friendly behavior norms among rational residents. This inevitably leads to the tragedy of the commons. Therefore, external intervention is needed. Although individuals' everyday environmental behaviors have little to do with economic interests, intentional or unintentional non-PEB could combine to form an enormous total amount of carbon emissions, thereby increasing the damage to the environment.

After realizing the importance of individuals' environmental behaviors, it is imperative to explore the causes of the weak motivation behind these behaviors before developing and advancing environmental behavior strategies. Non-economic measures can be effective in incentivizing residents to practice PEBs (van den Bergh, 2008; Hage et al., 2009). Humans are one of the most social species in nature (Henrich and Muthukrishna, 2021), and Durkheim (1895) believed that the activities of these "social beings" are subject to the constraints of common social norms. In contrast to mandatory law provisions, social norms refer to a set of commonly observed rules gradually established in people's social practices and interactions; these rules are important manifestations of informal institutions (Cialdini et al., 1990). Group identity, which has been validated in other contexts, and its derivative group conditions may be a potential factor in influencing the cultivation of social norms (Lapinski and Rimal, 2005; Goldstein et al., 2008; Yin and Shi, 2021). Therefore, this paper innovatively introduces influencing factors such as group identity and group conditions into PEB research in China. Furthermore, the paper has practical significance for constructing a theoretical model.

Introducing domestic waste management rules and publicizing social norms on environmental protection are commonly used approaches to guiding individuals in establishing PEBs in practice, but their effectiveness for the residents' group environmental behavior norms still needs to be quantitatively validated.[2] For example, scholars influence publicity and education on PEB by using mediators such as attitudes (Mishal et al., 2017), values (Gilg et al., 2005), social atmosphere (Zhou et al., 2015), and awareness (Kirakozian, 2016). Meanwhile, other questions that need to be addressed also include the framing effect and group identity effect of the residents' environmental behaviors. Input-based public resource provision and exploitation-based public resource consumption, which are common pool problems, are two different behavioral frameworks. Are there any differences between sorting and non-increasing environmental behavior due to varied frameworks? Additionally, does the difference in residents' status primed by housing property ownership give rise to group identities of tenants or households and thus cause a difference in their environmental behaviors? To solve these problems, first, this study complements a laboratory experiment in which real community scenarios were simulated to inspire the social status identification of tenants and households. Second, we set group conditions and differentiated behavioral patterns to examine the residents' environmental behaviors. Third, the micro-experimental data were collected and used to anticipate the internal logic of the residents' environmental behaviors. Fourth, a computer simulation was conducted to explore the evolutionary path of the residents' environmental behaviors. Finally, the "black box" of macro social behaviors was approached. This research is of great realistic significance for designing effective environmental governance mechanisms, cultivating the residents' green lifestyle, and constructing a harmonious society.

This paper is organized as follows. Section "Literature Review" outlines the literature review. Section "Theoretical Hypotheses" proposes theoretical hypotheses. Section "Experimental Design and Procedures" describes the experimental design and procedures. Section "Results" presents the results. Section "Simulations" shows the simulation results. The last section offers the discussion and conclusion.

LITERATURE REVIEW

This research includes two main aims: one is to investigate the relationship between environmental behaviors and publicity education, group identity, and group conditions, and the other is to distinguish the differences between waste sorting and reducing PEBs. Thus, the literature review of this article relates to the PEBs' frameworks, publicity education, group conditions, and related research.

In this paragraph, we reviewed the social dilemma of PEB, comparing the different frameworks. Individual behaviors that benefit environmental protection are called PEBs. An individual's environmental behaviors are positively correlated with the living environment but negatively correlated with a personal consumption utility. Homburg and Stolberg (2006) differentiate the individual's PEBs into two categories: those maximizing positive effects (e.g., domestic waste sorting) and those minimizing negative effects (e.g., non-increasing the amount of waste). Practicing the PEBs of sorting and non-increasing domestic waste increases residents' life costs and reduces their consumption usage. Czajkowski et al. (2014, 2017) suggested that the positive and negative causal relationship between individuals' short-term interest conflict and environmental behaviors, as well as the low engagement of the individuals in PEBs and the social predicament of the public environment, is inevitable.

Here, we tried to return to the group identity research. Existing studies of group behaviors mainly adopt a paradigm that starts with realistic problems, draws conclusions from experimental data, and eventually achieves theoretical generalization. Group identity is a central concept in social psychology, sociology, anthology, and political science (McDermott, 2009). Group identity could be regarded as a factor that affects individual behavior, which is also a way to assess whether and to what

[2]In 2000, China piloted domestic waste sorting in eight cities, including Beijing, Shanghai, Guangzhou, and Shenzhen, by education and advocacy, putting assorted waste bins on the streets as well, with poor results. In 2017, the National Development and Reform Commission and Ministry of Housing and Urban-Rural Development issued a plan for garbage sorting, urging 46 cities to set up a basic system of laws and regulations on waste sorting by the end of 2020. (Source: http://www.gov.cn/zhengce/content/2017-03/30/content_5182124.htm).

extent people interact with in-group and out-group members (Chen and Li, 2009). The experimental research is highly effective in observing individual behaviors at a microscopic level and presents the interaction, aggregation, and trend toward a balance between group actions based on the characteristics of each group, making it an important instrument to decipher the "black box" for the emergence of macro social behaviors. Group identity originates from the individuals' recognition of their statuses. In their studies of China's social situations, Liu and Mao (2012) and Zhang and Yang (2017) pointed out that housing as the major component of urban household properties has already become an important indicator for wealth stratification, social differentiation, and interclass difference as a replacement for other traditional differentiation standards for social status. Through a laboratory experiment, Tajfel et al. (1971) validated that weak primary group identification will evoke biased group behaviors. Chen and Li (2009) and Saleem et al. (2018) found that, upon the completion of primary self-identification and weakness in-group identification, the increasing self-esteem, respect by others, empathy and value experience arising from out-group comparison, interaction, and other actions in line with group characteristics can further reinforce the sense of group identity, facilitate the stability and convergence of in-group behavioral patterns, and give rise to microscopic behavioral norms for both individuals and groups. Vazquez and Cortina (2018) defined the norms established by groups as "appropriate behavioral patterns," which eventually form social norms.

Additionally, Ockenfels and Werner (2014); Krupka and Croson (2016), Abrams et al. (2021), and Wright (2021) found that the structural differences among group conditions in sets are also an important factor causing the differences in the direction and extent of group identification. Chen and Li (2009) manipulated the group status using painting preferences, and the players faced 3 kinds of potential cases, which were called the group conditions, no-group condition, in-group condition, and out-group condition.[3] Based on existing research, Zhou et al. (2015) and Ke et al. (2018) examined the cooperation problem, finding that the more significant the in-group identity is, the higher the degree of division in the mixed group, which causes individuals to harm the interests of out-groups (even at the cost of their own interest), in addition to the repeated phenomenon of undermining the interests of the group and smaller cooperation inputs or larger consumption of non-co-operation. In combination with the social status differentiation model, the norm driver model, and the behavioral selection model, Akerlof and Kranton (2000) employed an economic game model to explain the behaviors of individuals themselves and others, as well as how identity and social norms drive the optimal solution to stable behaviors and the corresponding benefits. Li et al. (2019) revealed social status differentiation, a varied sense of responsibility, and group differentiation under a housing property. Based on a case study, Farrow et al. (2017) found significant effects of individuals' selection of input and consumption environmental behaviors on the development of social norms. Lin and Xu (2014) and Wang and Sun (2019) also carried out an empirical study to reconfirm the far-reaching effects of housing property and social differentiation on the construction of the community environment.

To date, the existing literature on environmental behavior governance has largely focused on how the government, market, and communities cultivate PEB norms through co-governance. From the perspective of governmental regulation, Halvorsen (2012) explored different categories of policy and regulatory measures, such as establishing sophisticated environmental protection institutions and improving legislative and incentive mechanisms. Based on empirical analysis, Peng (2010) and Xu and Ling (2019) found that publicity and education of PEBs can cognitively improve an environmental protection utility, reinforce environmental protection drivers, and positively guide the practice of PEBs but may lead to non-robust and varied outcomes. From the perspectives of market prices, quotas, and mixed regulation mechanisms, Guo et al. (2017) and Wei et al. (2018) adopted an experimental method to discuss the effect of marketization on carbon emissions control and the social efficiency of product manufacturers and firms dealing with urban domestic waste in the tertiary sector. However, Ostrom (2009) confirmed that, while governmental and market regulation could address the vulnerability of environmental problems, community organizations could also play an important role in environmental governance. Ostrom et al. (2012) argued that community organizations are, undoubtedly, an important approach to compensate for the drawbacks of the former two factors. Under the concept of autonomous organization and governance, non-governmental organizations use organizational behavioral rules to establish collective behavioral norms and informal institutions to increase the initiatives of organizational members. Brzustewicz et al. (2021) explored multiple incentive mechanisms, finding that environmental values, beliefs, and reputation scores are effective monitoring mechanisms for safeguarding collective behavioral norms. In contrast to the heterogeneity in the effects of external constraints on group norms, such as under reward, incentive institutions, and marketization mechanisms, Allcott (2011) and Bolsen et al. (2014) found that household water and energy consumption behaviors across different groups show significant differences.

In summary, individual environmental behaviors among urban residents have drawn intensive scholarly attention. However, there are still some problems that need further consideration: First, the importance of giving equal emphasis to individual environmental behaviors and further highlighting firm environmental responsibilities. Second, the practical significance of the group stratification indicator of a housing property for researching the difference in PEBs—as well as the crucial role of group theory in interpreting residents' environmental behaviors—has been underestimated. Third, the advantages of the experimental economic methodology in exploring microscopic behaviors have been overlooked. In this study, a low-cost laboratory experimental method was utilized, and participants were assigned the status of house tenants or purchasers to trace the dynamic vertical behavioral data and

[3]No-group condition: subjects had no group status information on their counterpart. In-group condition: subjects informed that their counterpart had the same group status as them. Out-group condition: subjects informed that their counterpart's group status was not like them.

substantially reflect the dynamic, diachronic changes in the interaction, aggregation, and a trend toward the balance of the micro-individual and the group environmental behaviors. As such, the study aims to validate the mechanism of how the environmental behavioral framework, publicity education, and group identity influence the cultivation of environmental behavioral norms—with a view of benefiting the establishment in terms of long-term environmental governance mechanisms and steady policy advancements.

THEORETICAL HYPOTHESES

Is There a Framing Effect of Environmental Behavior Selection Under Spontaneous Conditions?

Public environmental resources bear attributes of natural public goods, such as "non-excludability" and "non-rivalry." As individuals only obtain an insignificant fraction of resources in a large environment, residents tend to adopt a free rider-dominant strategy—such as non-PEB, promoting rational individual residents and groups to voluntarily put in public environmental resources, and exercise active abstinence measures. Since it is extremely difficult to fulfill common environmental welfare, the "tragedy of the commons" and "a prisoner's dilemma" can frequently occur. Additionally, when confronted with different frameworks of environmental behavior selection, such as homogeneous waste sorting and non-increasing, people can exhibit distinct favoritism in their behavioral decision-making. Therefore, Hypothesis 1 (H1) is proposed.

H1: It is very difficult to establish spontaneous PEB norms, and spontaneous environmental behaviors vary across different environmental behavior frameworks.
(a). It is difficult to expect people to spontaneously establish PEB norms.
(b). People's domestic waste sorting behavior is better than non-increasing behavior.

How Does Publicizing Pro-environmental Behaviors Norms Regulate the Effect of Environmental Behavior Frameworks?

Publicity education of PEB norms can strengthen awareness of environmental protection, improve people's environmental attitudes, and help them establish a correct sense of honor or disgrace toward environmental behaviors, as well as affect their willingness to engage in eco-environmental protection and endogenous behavioral drivers (Lu et al., 2020; Wang et al., 2020). By guiding residents' PEBs and cultivating individual environmental protection awareness at the cognitive and subjective levels, publicity aiming to produce PEB norms represents an important approach to fulfilling these conditions. However, further exploration is still needed to determine to what extent the publicity of PEB norms facilitates sorting and non-increasing and whether publicity education causes differentiation or convergence in environmental behavioral frameworks. Therefore, Hypothesis 2 (H2) is proposed.

H2: Publicity education of environmental social norms can effectively direct people's PEBs, and their effects vary across different behavioral frameworks.
a. Publicity education of environmental social norms can neither fundamentally change people's environmental behaviors nor help establish complete PEB social norms.
b. Environmental social norms may have different effects on sorting and non-increasing.

How do the Publicity Education of Social Pro-environmental Behaviors Norms and Group Identity Cause Interactive Effects on Environmental Behaviors Under Different Behavioral Frameworks?

Group identity theory interprets individual and group non-economic behaviors through group recognition, group status, and group comparison. Generally, individuals tend to classify others into the same or different groups based on their own characteristics and, at the same time, highlight status differences based on such identity characteristics (Eckel et al., 2010). Presently, housing assets are a major wealth component for the majority of residents, and tenant or purchaser identity is an important indicator of social stratification (Wu and Ge, 2019). The difference in tenant and purchaser identity may be reflected in the supply and acquisition behaviors of public goods. Therefore, Hypothesis 3 (H3) is proposed.

H3: After accepting environmental social norms, PEBs exhibit differences across tenant and purchaser identities.
a. Domestic waste sorting behavior varies across tenant and purchaser identities.
b. Non-increasing behavior varies across tenant and purchaser identities.

Do Individual Environmental Behaviors Vary Across Group Conditions?

Group theory mainly involves two aspects: in-group favoritism and out-group biases. On the one hand, in-group dominance is highlighted as in-group conditions actively provoke mutually beneficial preferences among members, thus prompting them to exhibit in-group favoritism-based PEB norms. On the other hand, derogation or even hostility is directed toward out-groups. People tend to impose harsher punishments against non-cooperative behaviors of out-group members. The deterrent of harsh punishments also further stimulates people to exhibit out-group bias-based PEB norms (Wang, 2019; Wang and Sun, 2019).

H4: After accepting the publicity of environmental social norms, group conditions may change people's environmental behaviors.
a. In-group conditions may change people's environmental behaviors.

b. Out-group conditions may change people's environmental behaviors.

EXPERIMENTAL DESIGN AND PROCEDURES

Experimental Design

The purpose of the experimental design of this study is to determine the influence of publicity education,[4] tenant-household social identities, and group conditions on the cultivation of norms under different environmental behavior frameworks. Individuals' activities of daily living are inseparable from those of municipal solid waste (MSW), such as trash or garbage (clothing, food scraps, and batteries) from homes, schools, hospitals, and businesses. The source reduction presented a friendly view of the environmental behaviors. Our experimental design is based on Offerman and Sonnemans's (1998) design. There are two types of source reduction behavioral decisions about MSW: one is sorting with a giving framework, and the other is reducing with a taking framework, both of which are completed in different situations. This experiment did some differences from the following aspects: (1) the number of the participants was increased, and the threshold for public goods was adjusted from 0.5 to 0.67. (2) The participants were asked to complete five 10-fold repetitions of decision interactions. We used a between-subject design, and the participants were always paired with another person from the same treatment. **Table 1** presents our experimental design. Overall, 96 subjects were recruited for the experiment, as shown in **Table 1**. All the participants were students at China Central Normal University, and they were randomly equally distributed among the four treatments.

This experiment mainly adopts two methods of publicity education to strengthen environmental social norms. One is to watch the eco-friendly video of MSW sorting and reducing pro-environmental behavior together. Two is to read the manual of Wuhan MSW management. After the automatic study, they were asked to complete self-testing to equip all the participants with consistent knowledge of pro-environmental behavior. In addition, for the group condition design, the participants should complete a slider competitive game together; they obtained corresponding scores through their own efforts, and the scores can be converted into benefits. Those who scored below the average are tenants, and the participants whose scores were above the average are the households. The classifications of social identities create two different group conditions: one is the in-group condition where all interaction participants were tenants or households; the other one is the out-group condition, where half of the participants are tenants, and the other half are households.

For the MSW sorting decisions, the participants' revenue contains three parts: the individual endowments (60 experiment tokens), the costs of the sorting choice (60 experiment tokens), and the final public revenue. The final public revenue depends on the number of participants who choose sorting, if and only if the numbers are no fewer than 4 (including self), the public revenue is 245 experiment tokens; otherwise, it is zero.

The individual MSW sorting revenue:

$$\text{Sorting revenue} = 60 - \text{sorting cost} + \text{final public revenue}.$$

For the MSW reducing decisions, the participants' revenue also contains the following elements: the public endowments (245 experiment tokens), the benefits of non-reducing choice (60 experiment tokens), and the final public loss. The final public loss depends on the number of participants who choose reducing, if and only if the numbers are no fewer than 4 (including self), the public loss is 245 experiment tokens; otherwise, it is zero. The details are shown in **Table 2**.

The individual MSW reducing revenue:

$$\text{Reducing revenue} = 245 + \text{non} - \text{reducing benefits} - \text{final public loss}.$$

The individual total MSW revenue:

$$\text{Total revenue} = \text{sorting revenue} + \text{reducing revenue}.$$

Experimental Procedures

The experiment was conducted in lab 419 of Experimental Economics, Nanhu Complex Building, Central China Normal University. Before the experiments, the participants were informed that they were completely anonymous during the whole experiment, and their personal information and decision-making information would be kept strictly confidential. No personal information, such as the name or student ID, was recorded during the experiments. After the experiments were completed, an independent experimental team would transfer the money through Alipay, and the experimental revenue

TABLE 1 | Experimental design.

Treatment No.	Treatments	Monetary incentives	Social identities	Group conditions	N
①	No publicity education, No-group conditions	0.015x	–	–	24
②	Publicity education, No-group conditions	0.015x	–	–	24
③	Publicity education, In-group conditions	0.015x	Households Tenants	Pure households	12
				Pure tenants	12
④	Publicity education, Out-group conditions	0.015x	Households Tenants	Tenants-households mixed	24

[4]The publicity education means the norms, which convey that waste sorting and reducing are pro-environment, called "injuctive norms" by psychologists (Cialdini et al., 1990).

TABLE 2 | Municipal solid waste (MSW) sorting and reducing payoff table.

The total numbers of sorting in the 6-person interactions (excluding self)							
Sorting decision		0	1	2	3	4	5
	Sorting	0	0	0	245	245	245
	Non-sorting	60	60	60	60	305	305
The total numbers of Non-reducing in the 6-person interactions (excluding self)							
ReducingDecisions		0	1	2	3	4	5
	Non-reducing	305	305	60	60	60	60
	Reducing	245	245	245	0	0	0

TABLE 3 | Experimental procedures for four experiments.

Treatment No.	Part 1	Part 2	Part 3			Questionnaire
			No-group	In-group	Out-group	
①	×	×	√	–	–	√
②	√	×	√	–	–	√
③	√	√	–	√	–	√
④	√	√	–	–	√	√

was the personal information for all the participants. The participants were not allowed to communicate during the experiment.

Each experiment consists of three parts, and there are differences in the experimental process of different experimental treatments, as shown in **Table 3** for details.

Each participant was only asked to take part in the experiment one time, and the experiment consisted of three parts, each of which might be different. As the participants arrived at the laboratory, each randomly drew an ID card and then sat on the computer corresponding to the number. After the participants read the instructions for the first and second parts of the experiment, the experimenter read the whole experiment instructions again in combination with the software instructions. After reading the instructions in Part 3, the participants were given a piece of paper and a pencil to calculate the benefits of the experiment and to complete a self-test. After all the participants confirmed the experimental instructions, the experiment officially began.

In Part 1 of the experiment, all the participants had to be independent learners and study for 10 min by the video of publicity education related to the pro-environmental behavior of MSW and publicity manual on the sorting and reducing of MSW in Wuhan, and six test questions were completed within 3 min. In Part 2, the participants who completed the slider task with higher accuracy than average were awarded the title of household, who obtained tenant status below the average. In Part 3, 6 people were randomly divided into groups in each round, and 6 participants in the group completed a series of environmental decision-making tasks. The in-group condition means that all 6 participants in the group are households or tenants; the out-group condition means that there are 3 households and 3 tenants among the 6 participants in the group, and the no-group condition means that the 6 participants in the group have no rent-purchase status. The order of the environmental behavior decisions of MSW sorting and reducing appeared randomly. When participants make decisions, the historical information of their own and other participants' behavior choices and average returns will be displayed on the decision page. In addition, the participants in the experimental group were asked to rate their sense of belonging to their household group and to the tenant group at the beginning and end of the third part of the experiment.

At the end of the experiment, the participants were asked to complete a questionnaire. The contents included human statistics, experimental strategies, a grouping of social groups, and difficulty of slider tasks. The total duration of each experiment was no more than 90 min, and the average income of the experiment was 65.8 yuan.

RESULTS

Demographic Results

The demographic personal information of the participants was collected through a questionnaire. The majority of economics is denoted as 1, other majors as 0; 1 for girls and 0 for boys; Bachelor's is marked as 1, other education levels are marked as 0; age is the average age of all the participants in each treatment. The statistical results are shown in **Table 4**. The Gamma independent homo-distribution test showed that the four variables mentioned above did not show significant differences among all experimental sites, ensuring that they were not the cause of the differences in experimental results.

Pro-environmental Behavior and Frame Effects

Table 5 illustrates the frequency of 24 participants in each experimental session, choosing two kinds of PEB in 50 stages of decision-making. In treatment ①, the frequencies of sorting

TABLE 4 | Demographic information of the four treatments.

Treatment code	Major	Gender	Education level	Age
①	50.0%	87.5%	83.3%	20
②	58.3%	70.8%	87.5%	21
③	62.5%	95.8%	66.7%	21
④	58.3%	83.3%	91.7%	20
Gamma test	0.18	0.20	0.24	0.14

TABLE 5 | Pro-environmental behaviors (PEBs) and framework effects.

	Treatment codes				Bi-test
	①	②	③	④	= 67%
Sorting (%)	45.93	55.23	75.71	57.55	$p = 0.00$
Reducing (%)	35.07	27.46	61.20	48.75	$p = 0.00$
Non-parametric single factor test	0.00	0.00	0.00	0.00	–

and reduction were 45.93 and 35.07%, respectively. The results of the binary test show that the probability of spontaneous formation of the two kinds of pro-environmental behavior norms is far less than 67% ($p = 0.00$) of the condition of social norm formation, which shows that it is difficult to spontaneously form pro-environmental behavior norms, and Hypothesis 1(a) is valid. The last row of **Table 5** shows that there are significant differences between the two PEB in each experimental session ($p = 0.00$), and the sorting behaviors of each experimental group are significantly better than the reducing behaviors, which indicates that the two environmental behaviors have a significant framing effect, which is consistent with Hypothesis 1(b), and is consistent with the previous experimental results (Andreoni, 1995; Sell and Son, 1997; Dufwenberg et al., 2011; Ellingsen et al., 2012).

Publicity Education and Pro-environmental Behavior

In order to test the influence of publicity education on pro-environmental behavior, this part compares experimental treatment ① and experimental treatment ② with non-parametric tests, and the results are shown in **Table 6**. We found that publicity education significantly promoted the sorting behavior of MSW ($p = 0.00$) but had a negative effect on the behavior of reducing ($p = 0.00$). **Hypothesis 2** was only partially verified. Publicity education only has a positive impact on personal PEB to a certain extent, which is mainly reflected in the obvious increase in the number of people who choose MSW sorting (Zhou et al., 2015; Mishal et al., 2017; Zhang et al., 2020). However, we cannot improve the behavior of MSW reduction, perhaps because the amount of MSW is closely related to the quality of life. Reducing means low consumption, and the recognition obtained by reducing consumption is not enough to make up for the cost of sacrificing consumption (Xu et al., 2017; Wu and Ge, 2019; Xu and Ling, 2019). In the period of continuous improvement of living standards, publicity education alone is not enough to reduce people's consumption desire, and the formation of PEB norms has a long way to go.

Group Identity and Pro-environmental Behaviors

Manipulation Checks

Group identity can be measured by four indicators of the sense of belongingness to groups, which include the sense of belongingness to own a property group before the decision-making of Part 3, the sense of belongingness to own a property group after the decision-making of Part 3, the sense of belongingness to the other property group before the decision-making, and the sense of belongingness to the other property group after the decision-making. Here, two 0–10 value rating questionnaires (0 means nothing at all, 10 means extremely strong) are used to obtain the assignment of each index. **Table 7** reports the average values of the four indicators. The results show that participants' sense of belonging to their own property group is significantly higher than that of belonging to the other property group before and after the decision-making. It is proven that the second part of the slider task can successfully stimulate group identity ($p = 0.00$). In addition, there is no difference between the sense of belonging to the own property group and the sense of belonging to the other property group before and after the decision-making, which shows that the group identity of the participants will not be weakened by the decision-making task.

Tenant-Household Identities and Pro-environmental Behavior

Table 8 shows the non-parametric single-factor test results of two PEBs and tenant-household identity. After the introduction of publicity education, the sorting behavior of tenants is slightly better than that of households ($p = 0.06$), without considering the group conditions. However, the tenant's behavior of reducing is significantly better than that of the households ($p = 0.00$). Hypothesis 3 is basically verified (Xu and Ling, 2019). In terms of in-group conditions, there is little difference in sorting choice between households and tenants ($p = 0.07$). However, when out-group conditions are considered, the sorting behavior of households is significantly better than that of tenants ($p = 0.00$). This confirms the viewpoint that the increase in domestic waste is related to the quality of life. Compared with tenant owners, it has more wealth advantages and more consumption, so it is more difficult for them to reduce domestic waste.

Group Conditions and Pro-environmental Behavior

The element of publicity education was introduced into treatments ②, ③, and ④, and then all the participants in those three treatments had the same knowledge of environmental protection. Under this premise, this paper carried out tests of group conditions and PEB, and the results are shown in **Table 6**.

(1) In-group conditions and PEB. By comparing experimental treatment ② with treatment ③ by the non-parametric single-factor method, it is found that, after the condition of publicity education, compared with the no-group condition, the in-group condition has a significant positive effect on the two PEBs ($p = 0.00$). The setting of internal group conditions means that, in a pure household/tenant community, individuals with the same identity are more likely to compare and imitate one another and form some

TABLE 6 | A PEB test among four different treatments.

	Treatment codes				Non-parametric test			
	①	②	③	④	① **vs.** ②	② **vs.** ③	③ **vs.** ④	④ **vs.** ⑤
Sorting (%)	45.93	55.23	75.71	57.55	0.00	0.00	0.25	0.00
Reducing (%)	35.07	27.46	61.20	48.75	0.00	0.00	0.00	0.00

TABLE 7 | The sense of belongingness.

Treatment codes	Before Part3		After Part3	
	The sense of belongingness to own property group	The sense of belongingness to the property group	The sense of belongingness to own property group	The sense of belongingness to the property group
③	6.04	4.42	5.63	3.79
④	6.46	4.54	6.58	4.46

TABLE 8 | Tenant-household identities and pro-environmental behavior.

Frequencies of PEB Tenant-household identities	In-group conditions			Out-group conditions			Total
	Tenant	Household	Non-parametric test	Tenant	Household	Non-parametric test	Non-parametric test
Sorting (%)	73.50	77.93	0.07	63.33	51.75	0.00	0.06
Reducing (%)	55.92	66.50	0.00	38.56	58.93	0.00	0.00

kind of PEB norms with group characteristics. Therefore, the effect of in-group favoritism on the two kinds of PEB is obvious, and the conclusion is consistent with Hypothesis 4 (a) in this paper.

(2) Out-group conditions and pro-environmental behavior. By comparing experimental treatment ② with treatment ④ by the non-parametric single-factor method, it is found that, under the condition of publicity education, compared with the condition without a group, the out-group condition also has a positive effect on pro-environmental behavior, especially on the behavior of reducing ($p = 0.00$), while the number of people who choose sorting has increased, but it is not significant ($p = 0.25$). This conclusion is not completely consistent with Hypothesis 4 (b). The setting of out-group conditions means that in tenant-household binary mixed communities, individuals of different identities live together, and there are obvious differences in wealth and consumption levels among them, so the response is obviously different in the behavior of reducing (Bao and Li, 2020).

In addition, this paper also compares experimental treatment ③ with treatment ④ by the non-parametric single factor method and finds that the positive effect of in-group conditions on pro-environmental behavior is more significant than that of out-group conditions ($p = 0.00$). Under mixed living conditions, the cohesion within the group is low, the requirements of individuals for others with different identities are more stringent, and the prejudice of out-groups makes it difficult to form unified PEB norms.

Probit Regressions

In this part, we used a probit model to regress all experimental data and investigate the marginal effect of publicity education and group conditions. The two explained variables are dummy variables, namely, sorting of domestic waste and reducing. Explanatory variables include publicity education, the number of experimental periods, the ending period (whether it is the last period or not), the PEB in the previous period (sorting/reducing decision), the total number of PEB in the previous period, their own income in the previous period, the average income of other participants in the previous period, and the interactive variables among the above variables.

TABLE 9 | Probit regression results of publicity education on two PEBs.

Explanatory variable	Explained variable: PEB decisions	
	Sorting Model 1	Reducing Model 2
Publicity education (d)	0.092*** (0.002)	0.267*** (0.039)
Period	−0.000*** (0.000)	−0.001 (0.001)
Last period (d)	−0.022 (0.048)	−0.020*** (0.002)
PEB in the previous period (d)	0.318*** (0.001)	0.287*** (0.021)
The numbers of PEB in the previous period	0.099*** (0.001)	−0.063*** (0.003)
Own payoff in the last period	−0.001*** (0.000)	0.000 (0.000)
The average payoff of others in the last period	0.001*** (0.000)	−0.000 (0.000)
Publicity education X PEB in the previous period (d)	0.212*** (0.001)	−0.146*** (0.021)
Publicity education X The numbers of PEB in the previous period	−0.050*** (0.001)	−0.056*** (0.009)
Own payoff in the last period	0.004*** (0.000)	−0.002*** (0.000)
Publicity education X The average payoff of others in the last period	−0.005*** (0.000)	0.001** (0.000)
No publicity education	0.497	0.277
Obs.	2,137	2,140
Pseudo R^2	0.186	0.146

*Marginal effects:(d) The marginal effect of discrete change from 0 to 1 for dummy variables; the standard errors in brackets are: **, *** significant at the level of 5 and 1%, respectively.*

TABLE 10 | Probit regression results of group conditions on two PEBs.

Explanatory variable	Explained variable: PEB decisions	
	Sorting Model 1	Reducing Model 2
In-group conditions (d)	0.476*** (0.001)	−0.429*** (0.036)
Out-group conditions (d)	0.005 (0.006)	
Periods	0.000 (0.000)	−0.001 (0.001)
Last period (d)	−0.052*** (0.011)	−0.055* (0.024)
PEB in the previous period (d)	0.495*** (0.006)	0.120*** (0.008)
The numbers of PEB in the previous period	0.043*** (0.000)	−0.141*** (0.006)
Own payoff in the last period	0.003*** (0.000)	−0.001*** (0.000)
The average payoff of others in the last period	−0.003*** (0.000)	0.001*** (0.000)
In-group Conditions X PEB in the previous period (d)	0.409*** (0.004)	0.421*** (0.036)
Out-group Conditions X PEB in the previous period (d)	−0.592*** (0.040)	0.170*** (0.023)
In-group Conditions X The numbers of PEB in the previous period	−0.143*** (0.002)	0.170*** (0.023)
Out-group Conditions X The numbers of PEB in the previous period	0.126*** (0.012)	−0.001* (0.003)
In-group Conditions X Own payoff in the last period	−0.001*** (0.000)	−0.001 (0.001)
Out-group Conditions X Own payoff in the last period	−0.013*** (0.001)	−0.002*** (0.000)
In-group Conditions X The average payoff of others in the last period	−0.000** (0.000)	0.001 (0.001)
Out-group Conditions X The average payoff of others in the last period	0.013*** (0.001)	0.00*** (0.000)
No-group conditions	0.660	0.449
Obs.	3,225	3,225
Pseudo R^2	0.281	0.361

*marginal effects:(d) The marginal effect of discrete change from 0 to 1 for dummy variables; the standard errors in brackets are: *, **, *** significant at the level of 10, 5, and 1%, respectively.*

Publicity Education and Pro-environment Behavior Regression Analysis

Table 9 illustrates the regression result of the influence of publicity and education on PEB. Publicity education increases the probability of PEB of domestic waste sorting and reducing, with 9.2 and 26.7% (a 1% confidence level), respectively. The coefficient of pro-environmental behavior in the previous period (d) shows that the PEB of individuals is stable. If sorting and reducing occur in the previous period, the probability of making the same choice in this period will increase by 31.8 and 28.7% (a 1% confidence level), respectively. The coefficient of the total number of PEB in the group in the last period shows that the probability of sorting in the current period will increase by 10% (a 1% confidence level) for each additional person in the group in the last period. Every time one person in the last group chose reducing, the probability of reducing in the current period decreased by 6.3% (a 1% confidence level), indicating that residents are more inclined to have "free ride" under the framework of reducing. The coefficients of pro-environmental behavior (d) in the last period of variable X publicity education are 0.212 and −0.146, respectively, which shows that publicity education has a positive effect on the stability of sorting behavior, but it has a negative effect on reducing behavior. In addition, individuals do not show cyclic effects and game-ending effects on sorting and reducing PEB.

The above regression further proves our experimental results: publicity education has a positive impact on PEB, but the impact on sorting is significantly higher than that on reducing. It can be seen that publicity education can reduce opportunism and "free riding" unfriendly environmental behaviors and cultivate PEB norms.

Group Conditions and Pro-environment Behavior Regression Analysis

Table 10 shows the regression results of the influence of group conditions on PEB.

(1) Compared with the no-group conditions, the in-group conditions increase the probability of domestic waste sorting by 47.6% but decrease the probability of reducing it by 42.9%. However, the influence of out-group conditions on the two environmental behaviors can be neglected.
(2) Group conditions can alleviate the ending effect. Compared with the no-group conditions, the probability of choosing sorting and reducing at the end of the group decreased by 5.2 and 5.5%, respectively.
(3) The PEBs are stable under in/out-group conditions. The participants who chose sorting/reducing PEBs in the previous period increased their probability of continuing to

TABLE 11 | Probit regressions of publicity education and the combination of income changes on two PEBs.

Explanatory variable	Sorting	Reducing
	(1)	(2)
Publicity education (d)	0.049*** (0.001)	−0.110*** (0.000)
(no added, added) (d)	0.000 (0.002)	−0.213*** (0.000)
(added, no added) (d)	0.059*** (0.001)	−0.021*** (0.000)
(added, added) (d)	0.225*** (0.000)	−0.041*** (0.000)
Publicity education X (no added, added) (d)	0.221*** (0.001)	0.112*** (0.000)
Publicity education X (added, no added) (d)	0.077*** (0.001)	−0.205*** (0.000)
Publicity education X (added, added) (d)	−0.026*** (0.001)	0.118*** (0.000)
Last period (d)	−0.057 (0.030)	−0.078***(0.009)
No Publicity education X (no added, no added)	48.6%	28.8%
Obs.	1,914	1,915
Pseudo R^2	0.0369	0.0393

*Marginal effects:(d) The marginal effect of discrete change from 0 to 1 for dummy variables; the standard errors in brackets are: *** significant at the level of 1%.*

TABLE 12 | Group condition and the combination of income changes Probit regressions on two PEBs.

Explanatory variable	Sorting	Reducing
	(1)	(2)
In-group condition (d)	0.344*** (0.001)	0.521*** (0.001)
Out-group condition (d)	0.153*** (0.001)	0.305*** (0.001)
(no added, added) (d)	0.197*** (0.002)	−0.141*** (0.000)
(added, no added) (d)	0.122*** (0.001)	−0.290*** (0.001)
(added, added) (d)	0.185*** (0.001)	0.080*** (0.001)
In-group Condition X (no added, added) (d)	−0.170*** (0.001)	−0.451*** (0.000)
In-group Condition X (added, no added) (d)	−0.545*** (0.001)	−0.172*** (0.005)
In-group Condition X (added,added) (d)	−0.282*** (0.003)	−0.339*** (0.002)
Out-group Condition X (no added, added) (d)	−0.169*** (0.003)	−0.242*** (0.001)
Out-group Condition X (added,no added) (d)	−0.419*** (0.002)	−0.238*** (0.004)
Out-group Condition X (added,added) (d)	−0.201*** (0.000)	−0.165*** (0.002)
Last period (d)	−0.050(0.026)	−0.078***(0.026)
No-group Condition X (no added,no added)	63.6%	–
Obs.	2,876	2,876
Pseudo R^2	0.065	0.187

*Marginal effects:(d) The marginal effect of discrete change from 0 to 1 for dummy variables; the standard errors in brackets are: *** significant at the level of 1%.*

choose them by 49.5 and 12%, respectively, in this period. The coefficients of the last environmental behavior (d) of the in-group Condition X in the sorting and reducing decision regressions are 0.409 and 0.421, respectively, indicating that the in-group conditions can promote the stability of PEB. The coefficients of the environmental behavior (d) in the last period of the interactive out-group condition in the regressions of sorting and reducing decision-making are −0.592 and 0.17, respectively, which indicates that the out-group condition will weaken the stability of sorting behavior, but it has a positive effect on the stability of reducing behavior. The participants who chose two PEBs in the previous period increased their probability of continuing to choose them by 49.5 and 12%, respectively, in this period. The coefficients of the last environmental behavior (d) of the in-group condition in the sorting and reducing decision regression are 0.409 and 0.421, respectively, indicating that the intragroup condition can promote the stability of pro-environmental behavior. The coefficients of the environmental behavior (d) in the last period of the interactive external group condition in the regression of sorting and reducing decision-making are −0.592 and 0.17, respectively, which indicates that the out-group condition will weaken the stability of sorting behavior, but it has a positive effect on the stability of reducing behavior.

(4) Participants' PEB decisions will be influenced by the total number of PEBs and group conditions in the previous group. The correlation coefficients between the two PEBs of the participants in the current period and the total number of PEB in the previous group (0.043, −0.141) show that individuals are more willing to follow the positive behaviors of most people in sorting. However, they prefer to be free riders when they are in a reducing framework. The comprehensive coefficients of the in-group conditions and the total number of PEBs in the last period in the sorting and reducing regressions were 0.376 (0.476 + 0.043 − 0.143) and −0.4 (0.429 − 0.141 + 0.170), respectively. This result indicated that their influence on the current sorting decision was positive, but their influence on the reducing decision was negative. The comprehensive coefficients of the out-group conditions and the total number of environmental behaviors in the previous period in the sorting and reducing regressions were 0.169 (0.043 + 0.126) and −0.142 (−0.141 − 0.001), respectively, indicating that their influence on the current sorting decision-making was positive, but their influence on the reducing decision-making was negative.

In other words, the results of the regressions prove the stability of the experimental results. That is, the sorting probability of personal domestic waste under the in-group conditions is significantly higher than that of other cases, and it is more stable. Participants adopt reciprocity strategies to sort to improve publicity resources. Group identity stimulation is a favorable factor to promote personal PEBs. However, different group conditions have different paths to stimulate individual PEBs. In

TABLE 13 | Probability distribution of PEBs under income changes, publicity education, and group conditions.

	Publicity education				Group condition			
	NO Publicity education No group condition		Publicity education No group condition		Publicity education In-group condition		Publicity education Out-group condition	
	Sorting	Reducing	Sorting	Reducing	Sorting	Reducing	Sorting	Reducing
(No added, no added)	49%	29%	54%	18%	97%	96%	78%	75%
(No added, added)	49%	8%	76%	8%	100%	30%	82%	37%
(Added, no added)	55%	27%	68%	15%	55%	15%	48%	22%
(Added, added)	72%	25%	70%	26%	87%	52%	76%	67%

addition, the influence of group conditions is also different under different environmental behavior frameworks.

SIMULATIONS

The results of experiments and regression show that publicity education and group conditions are both important factors in adjusting individual PEBs and contribute to the formation of PEB norms, while effective social norms can straighten out the logic of collective actions and promote public environmental welfare. In a given situation, the formation of personal environmental behavior norms is determined by factors such as their own historical environmental behavior, the historical environmental behavior of others in the group, their own income changes, and the average income changes of others. Next, we used computer simulation to explore the evolution path of publicity education and environmental behavior decision-making under corresponding group conditions.

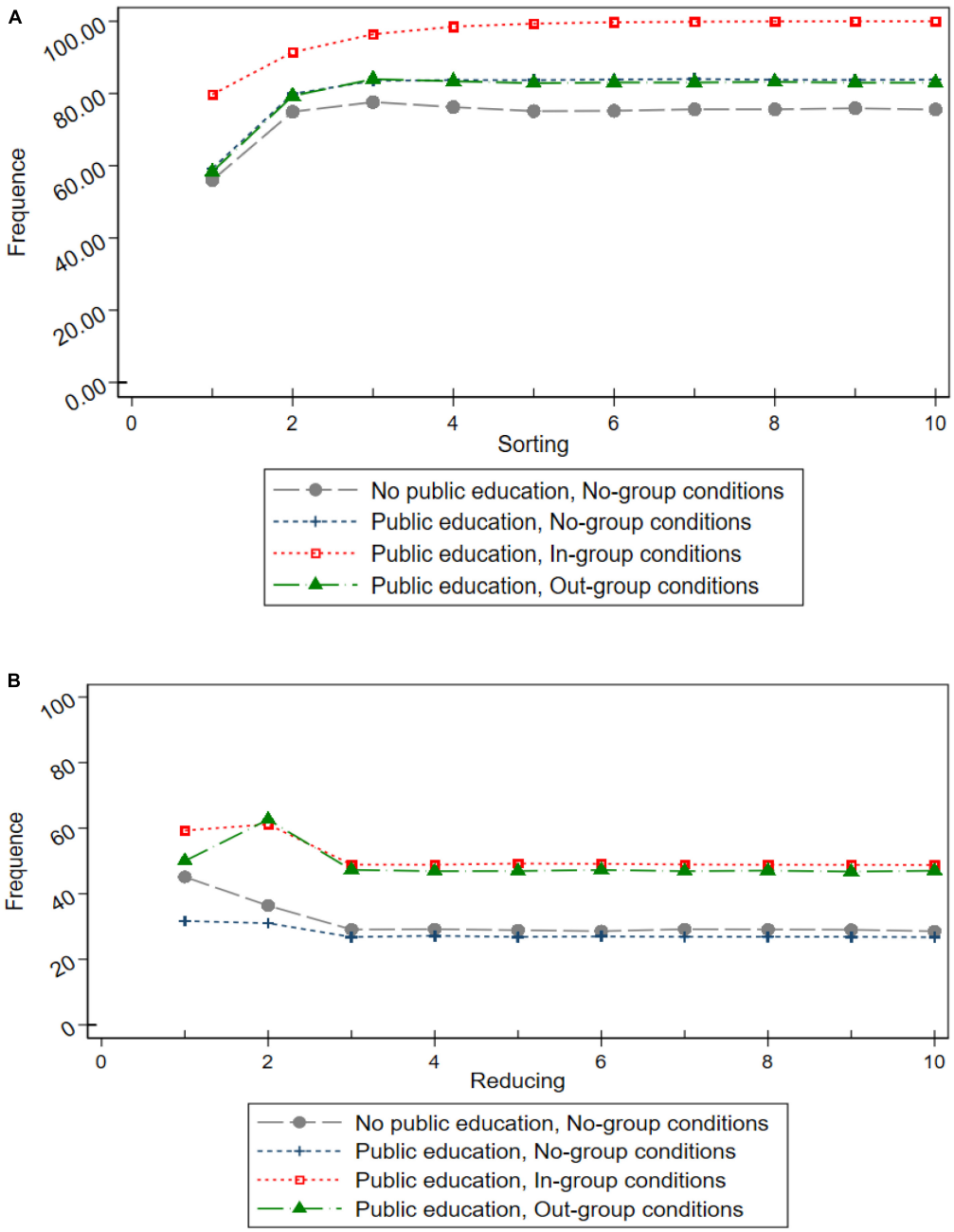

FIGURE 1 | The trend of the probability distribution of pro-environmental behaviors (PEBs). **(A)** sorting (simulations). **(B)** Reducing (simulations).

Pro-environmental Behavior Logic of the Individual Level

Before the implementation of computer simulation, this paper determines the decision logic of individual environmental behaviors based on experimental data. Because of the difference aversion, the combination situation of individual income changes is the decisive factor of environmental behavior. Therefore, in this paper, two kinds of environmental behaviors of domestic waste sorting and reducing are regarded as explained variables. Publicity education, group conditions, ending period, the combination of the income difference between the previous two periods ($\triangle\pi_i$, $\triangle\pi_{-i}$) and the interactions between them are explanatory variables. Here, if $\triangle\pi_i$ is greater than zero, noted as "added," and if $\triangle\pi_i$ is not greater than zero, noted as "no added," and so on, for each of the $\triangle\pi_{-i}$. The most intuitive probit regression models are used to deduce the participants' environmental behavior logic, and the regression results are shown in **Tables 11**, **12**.

Table 11 shows the logic of individual environmental behavior decision-making under publicity education. With the deepening of publicity education, the practice of domestic waste sorting has an obvious increasing trend, but the behavior of reducing has not improved significantly. The coefficients of (added, no added) and (added, added) of 0.059 and 0.225 indicate that, without considering the average changes of other people's income in the previous two periods in the group, there is a positive relationship between their own income changes in the previous two periods and the current sorting decision. The coefficient of (no added, no added) is −0.213, which indicates that the changes of self-income in the previous two periods are negative, and the average changes of other people's income in the previous two periods are positive, which can significantly reduce the probability of individual environmental behavior decision-making of reducing. The coefficient of the interaction of (no added, added) (d) and publicity education is 0.112, which shows that publicity education can alleviate the negative effect of income change comparison.

Table 12 shows the logic of individual environmental behavior decision-making under group conditions. Both in- and out-group conditions can significantly improve the probability of sorting and reducing domestic waste. The cases of (no added, no added), (added, no added), and (added, added) all have a positive influence on sorting decision-making, but the influence on decision-making reduction is not significant. The coefficients of the interactive variables of the combination of group conditions and income changes are all negative, which indicates that there is a mutual weakening relationship between these two variables.

Simulation Results

There are 16 ($2 \times 2 \times 4$) situations among publicity education, group conditions, the combination of income changes, and the probability distribution of two PEBs in each situation, which can be regarded as the logic of environmental behaviors in a specific situation, as shown in **Table 13**.

The computer simulation process is as follows: (1) extracting data randomly. Taking the experimental data as the parent data, 10,000 random retrievable extractions were made for each experimental treatment by the Stata bootstrap method. Each extraction included the data of five 10-subgames completed by six participants, and only the environmental behavior decision data of the first two periods of each participant were kept. (2) Simulating the environmental behavior decisions from the third to tenth periods. The participants' third-stage environmental behavior decision-making is determined by the situation under the combination of the characteristics of the experimental treatment and the combinations of income changes in the previous two periods and is determined by the probability distribution of environmental behavior under this situation. By analogy, the final simulation produced 1.2 million ($6 \times 10 \times 5 \times 10,000 \times 4$) ($= 6 * 10 * 5 * 10{,}000 * 4$) observations. (3) Deriving the evolutionary path of individual pro-environmental behavior. The evolution path is shown by the probability distribution trend of pro-environmental behavior, and the results are shown in **Figure 1**.

CONCLUSION, SUGGESTIONS, AND PROSPECTS

The World Bank report predicts that with rapid urbanization, population growth, and economic development, the global waste volume will reach 2.59 billion tons in 2030 and 3.4 billion tons in 2050. Currently, the top three countries producing municipal solid waste (MSW) are the United States of America (258 million metric tons), China (220 million metric tons), and India (169 million metric tons). Five of the top 10 domestic waste producers are developing countries (China, India, Brazil, Indonesia, and Mexico) (Statista, 2020). Different geographical cultures, living habits, levels of consumption, and economic development are the roots of differences in waste generation and composition. Developed countries often produce much more MSW *per capita* than developing countries and third world countries because the waste generation rate depends on the economic and social prosperity of a country, such as the United States, 2.58 kg/capital/day. In other words, the *per capita* generation of MSW varies among different income groups across the world. On the other hand, the proportion of inorganic components in MSW increases with the increase in gross national income (Baker, 2012; Aleluia and Ferrão, 2016). Organics can account for 65% of MSW from low-income groups, compared with only a quarter from high-income groups (Baker, 2012). Furthermore, the composition determines the heating value of MSW. The heating value of MSW in developing countries is low, mainly because of the high content of organic matter and water in MSW (Gerassimidou et al., 2013; Kumar and Samadder, 2017).

Internationally, the levels of MSW management are the same, that is, reducing/reducing sources, reuse, recycling/composting, waste recycling/energy, and disposal/landfill. However, the present status of MSW management methods varies from country to country, and the efficiency of MSW management depends on the characteristics, composition, and heterogeneity of wastes. Generally, it can be inferred that the recovery rate of MSW in developed countries is relatively high, which has a positive impact on reducing the generation of MSW. By region,

North America, Europe, and Central Asia have high recycling proportions (e.g., Germany and Korea have 62 and 61% waste recycling, respectively). Burning rates are high in East Asia and the Pacific (Japan is one of the leading countries for waste incineration). South Asia is the worst region for open dumping, with a larger proportion than sub-Saharan Africa (Bangladesh and Thailand); and compost disposal is high in South Asia and Europe and Central Asia (the United States and China have higher landfilling percentages of 53.8 and 60.16%, respectively) (Mian et al., 2017). For each country, no matter what kind of MSW management method is chosen, source reduction is the key first step, and MSW classification and MSW emission reduction are the main approaches. Therefore, it is of academic value and practical significance to study how to encourage people to participate in MSW classification and reduction.

As the report pointed out, many cities in China are facing a serious crisis of garbage siege (more than two-thirds).[5] Incineration is one of the major ways to dispose of MSW, and air pollutants and greenhouse gases emitted from incineration are two main problems that may cause severe harm to human health (Williams, 2005; Yang et al., 2012). In addition, it is notable to reduce greenhouse gas emissions to achieve a promise for carbon peaking and neutrality. The technology of MSW incineration still has a long way to go in China. This fact, once again, reinforces the importance of source reduction, which includes MSW sorting and reduction. Classifying solid waste before disposal will reduce greenhouse gas emissions by 24%. This article focused on the pro-environmental behavioral norms (MSW sorting and reducing) cultivation of residents in cities, and topics, such as publicity education, group identity, and group conditions, are covered in more detail.

Based on an experiment on the environmental behaviors of subjects, this paper validates the predicaments and framing effect of spontaneous environmental behaviors and the effects of publicity and education and group conditions on individual environmental behaviors. Regression and computer-based simulations were conducted to test the robustness of the results. The following conclusions were drawn:

(1) The experimental results show that, without intervention, it is very difficult for individuals and groups to develop PEBs and norms. Despite a high correlation between the two domestic waste environmental behaviors, the framing effect was still highly distinct, and the sorting behavior was significantly better than the non-increasing behavior, with the former being more stabilized than the latter in in-group cooperation. In addition, the tenant or purchaser identity further differentiated the two environmental behaviors, with property owners being more unwilling to reduce their consumption levels to lower the output of domestic waste.
(2) After introducing the publicity and education variable, it was found that publicity and education could improve individual and group environmental behaviors to a certain extent but with different effects. Publicity and education helped improve the probability of the individuals' sorting PEB, but with a limited effect on the non-increasing behavior. From the long-term evolution results, publicity and education could not effectively increase the probability of non-increasing behavior.
(3) After the groups were classified by tenant and purchaser identities, the group conditions improved individual and group environmental behaviors. Environmental behaviors exhibited significant in-group favoritism, and in-group conditions had a facilitating effect on the stability of both environmental behaviors. However, as seen from the evolution results, the non-increasing behavior has been flat. No distinct out-group bias was found in the out-groups. The out-group conditions only had a facilitating effect on the stability of the non-increasing behavior, and the long-term evolution results confirmed the experimental conclusion. This means that long-term interaction creates a probability of punishing non-cooperative behaviors and that the potentially high deterrent of out-group conditions increases the probability of the occurrence of PEBs more than otherwise.

Based on the empirical discussion and experimental conclusions stated above, the following suggestions are proposed: ① the construction of zero-waste cities requires the formation of PEB norms among urban residents, but PEB is difficult to develop spontaneously, and the framing effect also plays a role. While introducing MSW management rules, it is also necessary to increase governance efforts and exercise separate governance over sorting and non-increasing behaviors. As domestic waste is largely produced within communities, further attention should be given to different environmental behaviors caused by tenant and purchaser identities in communities. ② Publicity and education are effective approaches to cultivate residents' PEB norms and are characterized by good economic efficiency and high feasibility. Given the positive effects of publicity and education on waste sorting behavior, governmental departments may step up their efforts and expand the scope of such publicity. However, non-increasing behavior entails individuals' quality of life; thus, the effect of publicity and education is limited. Introducing market approaches can be considered to impose constraints on affluent groups, such as using the quota system to fulfill higher payments for higher emissions. ③ The structures of urban community popularity are diversified due to tenant and purchaser identities. Thus, measures, such as economic incentives, social engagement, and strict law enforcement, should be adopted based on the characteristics of the residents' environmental behaviors in mixed or non-mixed communities to normalize their environmental behaviors and ensure the fulfillment of collective environmental protection actions. ④ The positive social norms that are not closely related to economic factors are easy to form (MSW classification), but the positive social norms that are highly related to economic factors are more difficult to form, which is similar to the PEB norms of reducing (those results are consistent with the World Bank report, which implies high-income people would be less likely to practice the

[5] Data source: https://www.hbzhan.com/news/detail/107410.html.

PEB norms of reduction). Therefore, this study can apply a series of topics about the effects of wealth on the formation of social norms, which are constructed on social dilemmas and cooperation issues.

Compared with previous related studies, the innovation of this study and its significance to follow-up research is mainly reflected in three aspects: first, in our study of pro-environmental behavior norms, we pay much attention to behavioral economic theories and methodologies, which combine the two PEB of source reduction with the two frameworks of public goods. It provides a research paradigm and enriches the literature on pro-environmental behavior. Second, a large number of studies on pro-environmental behavior issues focus on static behavior in a certain situation, while this study places more emphasis on the dynamic process of pro-environmental behavior adjustments. Clearly, our study places a higher value on quantitative research rather than qualitative research. This study could provide a reference for future pro-environmental behavior research with respect to the analysis. Third, the issues of environmental behavior research are relatively simple, with only one kind of behavior. However, our study asks participants to make two PEB at once, which implies that the two decisions are not completely independent. This design in our experiments gives more chances to perform comparative analysis from many angles. This study might bring some fresh ideas to create experiments of PEB.

The limitations of our study and suggestions for subsequent research can be summarized as follows: In this paper, a laboratory experimental method was used to examine the factors influencing individual environmental behaviors. The conclusions of this research are internally valid. Future research may focus on field experiments on property owners and tenants in real communities instead of undergraduate students. In addition, this paper mainly focuses on the effects of domestic waste management rules and publicity and education on urban residents' environmental behaviors. However, other economic approaches, such as quota allocation and pricing, can also exert important effects on individual environmental behaviors. Future studies may consider incorporating market regulation approaches into the design mechanism for cultivating individual environmental behavior norms.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Central China Normal University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

QW and HD contributed to conception and design of the study. QW collected the data, performed the statistical analysis, and wrote the first draft of the manuscript. Both authors contributed to manuscript revision, read, and approved the submitted version.

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The Board Faultlines and Corporate Innovation Strategies Under the Influence of Property Rights Background and Institutional Environment

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This study takes the Chinese technology-intensive listed companies from 2009 to 2019 as the research sample to study the relationship between board faultlines and innovation strategy decisions of companies, and examines the impact of property rights background and institutional environment on the above relationship from the perspective of external governance environment of Chinese-listed companies. The results show that social-related faultlines of the board of directors have a negative influence on corporate innovation strategy decisions; cognitive-related faultlines have a positive effect on corporate innovation strategy decisions. At the same time, this research proves that the property rights background and institutional environment have a regulating role in the relationship between board faultlines and innovation strategy decisions, and can play an active role in the board faultlines.

Keywords: social-related faultlines, cognitive-related faultlines, innovation strategy decision, property right background, institutional environment

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INTRODUCTION

In recent years, scholars in the field of corporate governance at home and abroad have been deepening relevant studies on the board of directors. A large number of scholars mainly focus on the board of directors and the relationship between the board of directors and the company value or the company performance (Olson et al., 2006; Hutzschenreuter and Horstkotte, 2013). Among them, researchers pay more attention to the composition, size, and characteristics of the board of directors, as well as the influence of the board of directors' shareholding status and the dual chairman/CEO on the performance of the company and value creation (Sur et al., 2013; Vandebeek et al., 2016; Gupta et al., 2018). However, in the practices of many companies, such problems are found. Although the composition and characteristics of the board of directors of a company are similar and the internal and external environment of the company's operation is similar, there may be significant differences in the decision-making of the board of directors of a company, which may lead to major differences in the future performance of the company (Veltrop et al., 2015; Georgakakis et al., 2017). This reality shows that the existing studies still cannot fully explain the impact of the composition, size, and characteristics of the board of directors on corporate performance and value creation.

In recent years, China has achieved the second-largest economy in the world with its rapid development. However, a series of social and environmental problems have accompanied its

economic and social development. The emergence of such problems as low utilization rate of resources and environmental pollution urgently requires the Chinese enterprises to improve their production technology level, formulate strategic decisions for innovative development, and facilitate the transformation of China's economic growth mode (Bruton et al., 2021). In the current situation, the Chinese government attaches great importance to the formulation and implementation of innovation development strategy, and also promotes Chinese enterprises, especially scientific and technological innovation enterprises, to continuously increase their work in technology and management innovation (Zhang et al., 2021).

As a special form of group decision-making, the board of directors needs to carry out in-depth communication and obtain sufficient information in the process of decision-making. The interaction among the members in the process of decision-making has a significant impact on the result of decision-making. Therefore, it is necessary to open the "black box" of the board of directors on the basis of traditional research, and change from the traditional research on the board of directors' decision-making results to the research on the board of directors' decision-making process and behavior. At the same time, it is necessary to study the internal mechanism of the board of directors and explore the decision-making process and the mechanism of the board of directors. Although a large number of studies have studied the influence of differences in the composition, size, and characteristics of the board of directors on decision-making, this interpretation is not enough to reflect the process of decision-making within the board of directors. As the group faultlines can be used as the basis to understand and study the diversity composition and efficiency of the group, it has a good application in revealing the dynamic behavior of the group members (Van Peteghem et al., 2018; Richard et al., 2019). Therefore, in the study of the decision-making process of the board of directors, we can use the research ideas and methods of the group faultlines for reference and introduce the concept of group faultlines into the board of directors.

This study will explore and analyze three key issues in the decision-making process of board innovation strategy based on board faultlines. First, how the communication, information, and resource acquisition among the members of the board of directors take place. Second, how the board faultlines affects the company's innovation strategy decision. Third, whether the external environment of the company, such as the property rights background and regional system environment of the company, has an impact on the relationship between the board faultlines and the company's decision-making.

BASIC THEORY AND RESEARCH HYPOTHESIS

Generation, Concept, and Connotation of Board Faultlines

The research on board faultlines stem from the dilemma of board diversity and board heterogeneity. The diversity and heterogeneity of the board of directors mainly refers to the diversity and difference of the board members in terms of gender, age, race, professional background, specialty, personality, and values. However, domestic and foreign scholars often reach inconsistent or even contradictory conclusions on the diversity and heterogeneity of the board of directors. For example, some scholars have found in their studies on board heterogeneity and corporate value creation that the differences of board members' gender and race have a positive impact on corporate value creation (Carter et al., 2007; Miller and del Carmen Triana, 2009). However, some scholars hold a different view that there is no significant correlation between the differences of board members in terms of gender, race, age, and the value creation of the company (Van der Walt and Ingley, 2003; Rose, 2007). This is because these studies do not study the co-existence of multiple characteristics of team members, but only study the diversity and heterogeneity of the board of directors based on demographic characteristics (Lau and Murnighan, 1998; Georgakakis et al., 2017). However, the group faultlines can be used to study the group differentiation caused by the diverse characteristic combination of group members, which has become a new perspective of researching group diversity, and this concept has been valued in recent years (Richard et al., 2019).

The definition of the group faultlines has been given by pioneering studies. The group faultlines is a set of imaginary dividing lines dividing the group into several sub-teams based on one or more characteristics of the group members (Lau and Murnighan, 1998). Therefore, the board faultlines divides the board of directors into several sub-teams by the combined characteristic index. Moreover, the interior of each sub-team is relatively homogeneous and the sub-teams are heterogeneous to each other. Each sub-team has different behavioral characteristics. They interact with each other in the process of activities within the board of directors, resulting in communication, disagreement, alienation, or contradiction (Vandebeek et al., 2016; Van Peteghem et al., 2018).

Board Faultlines and Corporate Innovation Strategy Decisions

Innovation strategy refers to the overall planning and action of companies to carry out various innovation activities, which usually involves the improvement and innovation of companies' products or services (Carpenter and Westphal, 2001). As the core of the corporate governance mechanism, the board of directors plays an important role in the allocation of strategic resources, the provision of creative thinking, and the establishment of connections with the outside world (Johnson et al., 2011). Traditional upper echelon theory holds that company decision-makers are the key to the success of company's strategic decision-making and implementation, and their demographic characteristics and heterogeneity are the important factors influencing the strategic decision-making. The core of this theory is that the characteristics of the decision-making subject reflect their cognition, and then affect their decision-making (Hambrick, 2007). In other words, the innovation strategy decision of a company is related to the composition

characteristics of the decision-makers of the company and the potential relationship based on the characteristics of board members (Gupta et al., 2018).

According to the concept and connotation of board faultlines, the purpose of using board faultlines is to divide the board members with combined characteristic indices, and then to study the characteristics, behavior process, and the results of different sub-teams. Therefore, how to select the combination characteristics to form different types of board faultlines becomes the key to study. Some studies believe that group faultlines can be divided based on the work-related characteristics and physiological characteristics of group members, forming task-related faultlines and physiological characteristics faultlines (Hutzschenreuter and Horstkotte, 2013). At the same time, this study also shows that task-related faultlines and physiological characteristics faultlines have an impact on the expansion strategy decision of companies (Hutzschenreuter and Horstkotte, 2013). There are some studies that divided the board faultlines into structural dimensions and cognitive dimensions from the perspective of legal sources of board members and different cognitive characteristics (Li and Zhou, 2014). In addition, some studies have also classified the group faultlines, some of which divided the board faultlines into shallow faultlines and deep faultlines based on the demographic characteristics, capability, and personality of board members (Molleman, 2005). Some studies divided the group faultlines into social categories and task-related faultlines from intra-group conflicts. According to this study, social classification faultlines and task-related faultlines have different functional mechanisms within the group, and the two types of faultlines are related to relationship conflict and task conflict, respectively (Choi and Sy, 2010). Based on the study of faultlines at home and abroad, the existing studies usually divide the faultlines according to the combined characteristic indices. The mechanism of action of different types of faultlines and their behavioral results are different. Therefore, considering the combined characteristic indices selected by scholars at home and abroad, in the division of faultlines, this study investigated the influence of board faultlines on the innovation strategy of Chinese-listed companies under the Chinese scenario. Finally, this study determined that the board faultlines was divided into social-related faultlines and cognitive-related faultlines from the two dimensions of social classification and cognitive ability of the board members.

The social-related faultlines refers to the faultlines formed by the social characteristics of the board members. These social characteristics, such as age, gender, ethnicity, or race, can be directly perceived by social groups and change little (Crișan-Mitra et al., 2015). When making innovative strategy decisions, the board members need to communicate with each other about innovative ideas, real-time information, etc., while the existence of social-related faultlines will affect the innovative strategy decisions from two aspects. First, according to the relevant research of social psychology, the cognition, attitude, and emotion formed by group members toward other members are derived from explicit social characteristics. According to the theory of social classification and social identity, individuals make self-examination and self-evaluation by comparing themselves with other individuals. When individuals are found to have similar characteristics with other individuals, differences between "inside group" and the "outside group" will be formed. Individuals show strong identification with "inside group" members and exclude "outside group" members (Messick and Mackie, 1989; Veltrop et al., 2015). The social-related faultlines formed by the social classification between board members will affect the interaction among the members, lead to prejudice and discrimination between the sub-teams of the board, and hinder the process of innovation strategy decision-making (Duft and Durana, 2020; Grant, 2021; Nica and Stehel, 2021). Second, the similarity attraction paradigm also explains the formation of social-related faultlines from another perspective. According to this paradigm, similar individuals can form strong attraction and promote communication and interaction between individuals. Individual differences reduce this attraction, leading to less communication and interaction (Hutzschenreuter and Horstkotte, 2013). At the same time, the more similar characteristics are between individuals, the higher is the degree of communication within such "inside group," and the more obvious are the faultlines between sub-teams. Thus, it can be seen that the social characteristic of the board of directors will divide the board of directors into sub-teams with different social characteristics. The greater is the difference between sub-teams, the deeper is the faultlines. Faultlines lead to lack of communication and interaction among sub-teams, and produces prejudice and discrimination, which is ultimately unfavorable for the board of directors to make innovation strategy decisions of the company. To sum up, this study proposes the following hypothesis:

H1: Social-related faultlines has a negative impact on the innovation strategy decisions of company.

The cognitive-related faultlines refers to the faultlines caused by differences in the knowledge and views of board members due to differences in professional skills, knowledge background, and functional background (Tuggle et al., 2010; Li and Zhou, 2014). The more diverse the board members are in terms of their professional, intellectual, and functional backgrounds, the more abundant the professional knowledge and perspective they bring. This has a positive effect on the company's innovation strategy. When a company makes innovation strategy decisions, board members will face and deal with a large number of different types of information and data. The existence of cognitive-related faultlines will help the board members to understand and absorb different types of market information and make innovation strategy decisions. Based on the hypothesis of cognitive diversity, the existing studies believe that cognitive diversity can bring advantages to group process and output, including creativity, decision-making quality, and problem-solving ability (Williams and O'Reilly, 1998; Li and Zhou, 2014). The differences of board members in professional skills, knowledge background, and functional background will help the members to generate innovative ideas due to the collision of ideas, and avoid the phenomenon of "group thinking" in the group decision-making process. At the same time, the perspective of cognitive

information processing can also explain the faultlines formed by board members based on different cognitive abilities, which enable the board members to have different understandings of the company's innovation strategy and hold different views on how to make decisions (Fan and Du, 2015; Richard et al., 2019). The cognitive-related faultlines increases the value of information possessed by board members, facilitate the flow, exchange, and sharing of knowledge and information among board members, and facilitate the company to form high-quality innovation strategy decisions. To sum up, this study proposes the following hypothesis:

H2: Cognitive-related faultlines has a positive impact on the innovation strategy decisions of company.

Activation of Faultlines by Property Rights Background and Institutional Environment

Lau and Murnighan (1998) first proposed the concept of "activation of faultlines." According to the research, there are several potential faultlines within the group, which do not always play a role, but are "activated" in a specific situation (Lau and Murnighan, 1998). For example, when the board discusses the decision-making of retirement and old-age care, the faultlines formed by the aggregation of age characteristics of directors will be stimulated and play a role. Similarly, when a company is faced with major problems, such as the introduction and distribution of scarce resources, the faultlines formed by the aggregation of functional characteristics of directors will be stimulated and play a role. Based on the previous studies, later scholars formally defined the concept of faultlines activation, and clearly proposed the two groups of concepts of "potential faultlines" and " activation of faultlines" (Jehn and Bezrukova, 2010). Some scholars have taken it a step further; they believed that the differences of individual characteristics are subconsciously influenced by some specific environment or factors in the group, and thus the division of teams is formed within the group. This process from the generation of differentiation awareness to the division of the group is the activation process of the faultlines (Bezrukova et al., 2010). But only when group faultlines are activated, these potential faultlines will affect the group's behavior or decision-making and have an impact on the organizational performance (Ionescu, 2021). Other studies have expounded that the potential faultlines are only an objective internal division line, which does not have an actual impact on the group. They put forward "activation efficiency of faultlines," which mainly elaborated the difficulty degree of various influencing factors to activate the faultlines (Fan and Du, 2015).

Activation of Property Rights

The property rights system can reflect the background and environment of the company. The property rights system mainly refers to a kind of institutional arrangement of the company's property rights formed through the combination of the property rights relationship and the property rights rules, which can effectively organize and protect the company's property rights.

In the practice of Chinese enterprises, the property rights system of the company is usually determined according to the attributes of the investors. Different investors have different property rights backgrounds. Different property rights of a company may lead to differences in performance. Due to the different property attributes of Chinese enterprises, companies with different property attributes will be subjected to government intervention in different degrees (Liu et al., 2003). Later, other Chinese scholars pointed out in their research that the differences in the property rights of a company cause different impacts on the decision-making behavior of the company. It can be seen that the property right background has a significant influence on the decision-making behavior of the company and other related operations (Li et al., 2011).

In the research on corporate property rights in China, the measurement of property rights is mainly about the division of property rights, and most of the research is about the classification of enterprise property rights into two categories, that is, state-owned enterprises and non-state-owned enterprises. In China, state-owned enterprises are large enterprises that are invested by the state or local governments and have a certain degree of control. State-owned enterprises are of great significance to the economic and social development, and they have two main functions. First, state-owned enterprises should serve the growth and development of the national economy and ensure the basic needs of the livelihood of people. Second, state-owned enterprises also need to guarantee the appreciation of state assets. Therefore, it can be known that state-owned enterprises need to be responsible for the country and the people, and their development direction and business philosophy will be subjected to government intervention to varying degrees. In contrast with state-owned enterprises, non-state-owned enterprises have no national or government background and have a higher degree of freedom in development and operation. They only have to meet the laws of the state and the rules of business. However, the major shareholders and founders of non-state-owned enterprises have a strong influence on the company. Therefore, non-state-owned enterprises are more deeply affected by the intervention and influence of major shareholders, company founders, and other individuals (Li et al., 2008).

The property rights background brings different external environment for the operation of the company. State-owned enterprises are more supported by government policies and funds, while non-state-owned enterprises lack the economic foundation of state-owned enterprises (Cooper et al., 2014). The company's investment in the technological innovation and change is long-term and risky. To ensure the company's technological innovation and change can be promoted continuously and achieve certain results, the company needs a large number of continuous resources as a guarantee. However, compared to state-owned enterprises, non-state-owned enterprises in China lack stable and long-term financial resource or information support, and the information barrier of companies in innovation and change is higher than that of the state-owned enterprises. However, non-state-owned enterprises have stronger driving force for innovation and reform, and the executive order has relatively few constraints

on them. Considering the different property rights backgrounds of enterprises, the state-owned enterprises need to undertake more social functions, and the board of directors will be subjected to more policy intervention from the government in the decision-making process. In the process, the policy will of the government will guide and objectively require board members to make decisions in line with the positioning of state-owned enterprises. In contrast, non-state-owned enterprises have no such constraints and restrictions. In the decision-making process, the board members have more freedom of thought and will.

Based on the above analysis, this study proposes the following hypothesis:

H3a: The property rights background has a moderating effect on the relationship between social-related faultlines and innovation strategy decision-making. Compared to state-owned enterprises, the social-related faultlines have a stronger negative influence on the innovation strategy decision-making of non-state-owned enterprises.

H3b: The property rights background has a moderating effect on the relationship between cognitive-related faultlines and innovation strategy decision-making. Compared to state-owned enterprises, cognitive-related faultlines have a stronger positive influence on the innovation strategy decision-making of non-state-owned enterprises.

Activation of Institutional Environment

The corporate innovation strategy decision is a kind of high uncertain strategy decision. Therefore, the company needs a good market environment and competition to improve the predictability of innovation strategy decision-making results (Ma et al., 2016). The better the regional institutional environment is, the lower is the uncertainty degree of enterprise technological innovation and R&D risk; the higher the enthusiasm of enterprise technological innovation and product research are, the higher is the enterprise capital investment (Liu and Li, 2012). However, China has a vast territory, and its market environment varies greatly in different regions. The higher the degree of regional marketization, the more mature the regional legal system, factor market, and financial market will be, which can provide a fairer and orderly environment for enterprises to make innovative decisions (Zhang et al., 2021). On the one hand, in a market with a better institutional environment, individuals with different characteristics are more likely to express their personalities and attitudes, and the sub-teams divided by social-related faultlines are more obvious, which are not conducive to the formation of corporate innovation strategy. On the other hand, a good institutional environment can stimulate individuals' awareness of innovation and recognition of innovation strategy decision-making. Besides, the activation theory of faultlines believes that the faultlines are objectives, but they need to be stimulated by specific factors; otherwise, the fault zone will be in a dormant state. The company's institutional environment can be regarded as a motivating factor. The cognitive-related faultlines formed by board members with different professional skills, knowledge background, and functional background in the institutional environment will be stimulated. The cognitive-related faultlines prompt board members to have more views and discussions on the issue of corporate innovation, which is conducive to the formation of corporate innovation strategy decisions.

Based on the above analysis, this study proposes the following hypothesis:

H4a: The institutional environment negatively regulates the relationship between social-related faultlines and innovation strategy decision-making. The better the institutional environment the enterprise is in, the stronger is the negative influence of the social-related faultlines on the company's innovation strategy decision.

H4b: Institutional environment positively regulates the relationship between cognitive-related faultlines and innovation strategy decision-making. The better the institutional environment the enterprise is in, the stronger is the positive influence of the cognitive-related faultlines on the company's innovation strategy decision.

RESEARCH DESIGN

Sample Selection and Data Sources

Considering the Chinese situation of the study, this study takes the Chinese technology-intensive enterprises as samples, and the classification of such enterprises has been done based on the study by Lu and Dang (2014). At the same time, considering that China's listed companies have been required by China securities regulatory commission to disclose information about the company's R&D expenditure, data of A-share listed companies in electronics, machinery, equipment, instruments, medicine, biological pharmacy, other manufacturing industries, and information technology industry from 2009 to 2019 are selected in this study. The company data needed for the research were collected from the annual report of each company and from the Chinese stock market and accounting research database. This study also supplements and evidences research data from authoritative media, such as Sina Net, Phoenix Net, and the annual reports of listed companies with the same board members. To improve the rigor of the study, the sample data are processed as follows:

First, we excluded ST and *ST (special treatment due to financial problems) companies and companies whose main business changes no longer belong to the above industries. Second, we excluded the incomplete disclosure of R&D data, financial data, and governance data in the database. Third, we excluded companies whose listing time is later than the research window. Finally, this study obtained 3,322 samples from 302 companies from 2009 to 2019. To eliminate the influence of extreme values, the continuous variable was treated with winsorized values at the level of 1%.

Variable Definition and Measure

Dependent Variable

Innovative strategy decisions (*ISD*s). Based on the existing research (David et al., 2001; Olson et al., 2006), this study selects the company's innovation investment as the proxy variable

of innovation strategy decisions. The innovation investment of the company is mainly decided by the board of directors, which reflects the decision of the board of directors on resource allocation of the innovation strategy and is the direct result of the decision of the company's innovation strategy (Cunningham, 2021; Galbraith and Podhorska, 2021; Kovacova and Lăzăroiu, 2021). There are two main measures of innovation investment (Daellenbach et al., 1999). The first is the scale of R&D investment, expressed in the natural logarithm of the amount of R&D expenditure. The second is the intensity of R&D investment, which is measured by the proportion of R&D expenditure in operating income, the proportion of R&D expenditure in total assets, or the proportion of R&D expenditure in the enterprise market value. As operating income is vulnerable to management manipulation and sample data are unreliable, the proportion of R&D expenditure in the total assets of the company is adopted to measure the level of innovation strategy decision-making.

Independent Variables

Social-related faultline (*SRF*). According to the above analysis, social-related faultlines are measured by the age, gender, race, and other characteristics of board members. However, given that the racial differences in the samples selected by this study are relatively small, racial characteristics are not used as a measurement factor for the rupture of social-related faultlines.

Cognitive-related faultline (*CRF*). Members with different professional backgrounds and education degrees in diverse groups can generate knowledge collision and integration (Pelled, 1996; Cooper et al., 2014; Richard et al., 2019). Therefore, this study selected professional background and education degree to measure cognitive-related faultlines.

The classic measurement method is used to measure the social-related faultlines and cognitive-related faultlines (Lau and Murnighan, 1998). According to the method, group faultlines are measured using a bisection pattern, which divides the group into two sub-teams according to the criteria. The reason is that when the group size is small, the group can hardly be divided into three or more sub-teams (Thatcher et al., 2003). Therefore, the equation for *SRF* and *CRF* is as follows:

$$Fau_{\mathrm{g}} = \frac{\sum_{j=1}^{p}\sum_{k=1}^{2} n_k^{\mathrm{g}}(\bar{x}_{jk} - \bar{x}_j)^2}{\sum_{j=1}^{p}\sum_{k=1}^{2}\sum_{i=1}^{n_k^{\mathrm{g}}}(x_{ijk} - \bar{x}_j)^2} \quad (1)$$

$$g = 1, 2, 3, \ldots, S$$

For a board of directors with n members, the classification of faultlines is 2^{n-1} - 1. In Equation (1), n stands for the number of members on the board; p stands for the total number of features examined; g stands for the classification; n_k^g represents the number of members in sub-team k, which is classified by way of g; $\bar{x}_j$ represents the average value of all board members on characteristic j; $\bar{x}_{jk}$ represents the average value of members in sub-team k on characteristic j; x_{ijk} represents the value of member i on characteristic j in sub-team k; Fau_g is the degree of board faultlines under the g classification and is between 0 and 1. The larger the value, the stronger are the faultlines, and vice versa.

Regulating Variables

Property rights background (*Own*). Chinese enterprises have different property rights systems according to different investors and actual control. According to the actual control of the company, this study divides the research object into two types of enterprises, which are state-owned enterprises and non-state-owned enterprises (including private, collective, foreign capital, and others). For this variable, the samples are grouped according to the actual control of the company. If the sample companies are ultimately controlled by state-owned enterprises, *Own* = 0. If the sample companies are ultimately controlled by non-state-owned enterprises, *Own* = 1.

Institutional environment (*Institute*). This study refers to the relevant research of Chinese scholars and measures the institutional environment of each region through quantitative measurement of market indices in China (Fan et al., 2011). Considering that this study used the data of technology-intensive enterprises from 2009 to 2019 as samples, but the index compiled by Fan et al. (2011) was not continuously updated. Therefore, this study uses the practice of Li et al. (2012) to replace the undisclosed data with the current data. In this study, the marketization index of each region is processed by calculating the average value of marketization index of each region first, and then grouping each region according to the value of marketization index higher or lower than the average value. The value of marketization index of the region higher than the average value is 1, and the value of marketization index of the region lower than the average value is 0. This study deals with the marketization index of each region. First, the study calculated the average value of each region's marketization index. Then, each region was grouped according to the value of marketization index higher or lower than the average value. If the value of marketization index is higher than the average value, *Institute* is equal to 1, and if the value of marketization index is lower than the average, *Institute* is equal to 0.

Control Variables

Earnings of the previous year (ROA_{t-1}). The earning situation of the previous year will have an impact on the corporate strategy (Geng and Wang, 2021; Grant, 2021).

Company size (*Size*). The company's size is directly proportional to the company's resources. The larger the company is, the more abundant the resources are, which can provide more support and guarantee for the company's innovation (Liu and Li, 2012; Bruton et al., 2021).

Board size (*Bsize*). The size of the board of directors to some extent reflects the diversification level of the background of members in the board of directors, which may have an impact on the company's innovation decisions (Sur et al., 2013; Zhang et al., 2021). This study takes it as a control variable and measures it with the number of board members at the end of the year.

Company growth ability (*Growth*). According to existing studies, a company's ability to grow will also affect its innovation strategy. Andriopoulos and Lewis (2009) believed that the innovation of a company is positively correlated with the future growth of the company. High-growth companies pay more attention to innovation and tend to make a greater investment

in innovation (Andriopoulos and Lewis, 2009). Therefore, the growth ability is selected as the control variable and included in the research model. The growth ability of the company is measured by the growth rate of its main business revenue.

Ownership concentration (*Herf*). According to the existing studies (Li et al., 2008; Cooper et al., 2014), the main components of the company's major decisions have an important impact on the company's innovation decisions. In view of this, this study considers the shareholding ratio of the first major shareholder (*Herf1*) and the shareholding ratio of the second-largest shareholder (*Herf2-10*) of the company as the measurement index of ownership concentration, and takes these two variables as control variables into the research model. In this study, the Herfindahl index method is selected for calculation. The calculation method of this index is shown in Equation (2):

$$H(n) = \sum_{i=1}^{n} \theta^2 \tag{2}$$

In Equation (2), $H(n)$ stands for the degree of ownership concentration of the former n major shareholders, θ^2 stands for the square of the shareholding ratio of shareholder i, and $\sum_{i=1}^{n}$ stands for the square sum of the former n shareholder's shareholding ratio. When $H(n) = 1$, all of the company's equity is concentrated in the hands of the top n major shareholders. The larger the Herfindahl index, the more the company's equity is concentrated among the top n largest shareholders.

Asset liability ratio (*Leverage*). According to relevant studies (Georgakakis et al., 2017; Van Peteghem et al., 2018), the company's debt situation will have an impact on the company's operation. When a company has a high level of debt, its creditors may have an influence on the company and thus control or intervene in the company's free decision-making. Similarly, when the corporate debt levels are low, corporate creditors are less likely to intervene or influence corporate decisions. Therefore, this study chooses the company's asset liability ratio as the control variable, and the calculation method of asset liability ratio is shown in Equation (3):

$$\begin{aligned} \text{Asset liability ratio} = {} & \text{Total liabilities/total assets} \\ & \textit{of the company} \times 100\% \end{aligned} \tag{3}$$

Length of establishment of the company (*Age*). This study believes that the company's innovation-decision is related to the life cycle of the company, and the development stage of the company will have an impact on the company's innovation strategy decision. Therefore, this study selects the length of the establishment of the company to measure (Geng and Wang, 2021).

Year (*Year*). Considering the influence of different years, the time variables were controlled and 11 dummy variables from 2009 to 2019 were set (Geng and Wang, 2021).

The dependent variables, independent variables, regulating variables, and control variables are shown in **Table 1**.

Model Setting

To test the action mechanism of social-related faultlines and cognitive-related faultlines on innovative strategic decision-making, as well as the activation mechanism of property rights background and institutional environment on board faultlines, the following research model is established to test the research hypothesis proposed in this study, as shown in Equation (4):

$$\begin{aligned} ISD = {} & \alpha + \beta_i \textit{Independent Variables} \\ & + \gamma_j \Sigma \textit{Control Variables} + \varepsilon \end{aligned} \tag{4}$$

Among them, *ISD* is the dependent variable, representing the company's innovation strategy decisions; *Independent Variables* represents social-related and cognitive-related faultlines; Σ*Control Variables* represents the control variables. β_i is the coefficient of the explanatory variable; γ_i is the coefficient of the control variable; α is the intercept term; and ε is the residual term. *Own* and *Institute* are tested by grouping, so there is no interaction term.

DATA ANALYSIS AND RESULTS DISCUSSION

Descriptive Statistics and Correlation Test

The descriptive statistical results of the main variables in this study show that the mean value of *ISD* is 0.0219 and the standard deviation is 0.0251. The mean value of *SRF* is 0.5349 and the standard deviation is 0.0588. The mean value of *CRF* is 0.2261 and the standard deviation is 0.0910. At the same time, by testing the correlation coefficient of the main variables, the test results show that the social-related faultlines and cognitive-related faultlines were related to the company's innovation strategy decision. In addition, the correlation between independent variables is relatively low, all of which are no more than 0.4. It is preliminarily proved that there is no serious multiple collinearity among the variables in the research model, which can be further studied. The correlation coefficient matrix of the sample company's main variables is shown in **Table 2**.

Regression Analysis

In this study, multiple linear regression analysis was used in Stata 14.0 software to analyze the relationship between social-related faultlines, cognitive-related faultlines, and enterprise innovation strategy decision-making, as well as the influence of property rights background and institutional environment on the above relations. Considering the possible heteroscedasticity of the sample data, this study uses the ordinary least square regression of robust standard deviation modified to test the hypotheses. The stratification regression results are shown in **Table 3**. Model 1 only conducts regression analysis on control variables and innovation strategy decisions. Based on model 1, models 2 and 3 were, respectively, added into *SRF* and *CRF* for regression tests. The variance inflation factor (*VIF*) of all variables in the

TABLE 1 | Main variables.

Variable type	Abbreviation	Variable name	Variable description
Dependent	*ISD*	Innovation strategy decision	Proportion of R&D cost to total assets
Independent	*SRF*	Social-related faultline	Investigation of age and sex characteristics
	CRF	Cognitive-related faultline	Investigation of professional background and educational level
Regulating	*Own*	Property rights background	For state-owned enterprises, the value is 0, for non-state-owned enterprises, the value is 1
	Institute	Institutional environment	Using the marketability index
Control	ROA_{t-1}	Earnings of the previous year	Company's earnings in the previous year
	Size	Company size	Total company capital
	Bsize	Size of the board of directors	Members of the board at the end of the year
	Growth	Company growth ability	Growth rate of the company's main business income
	Herf1	Proportion of largest shareholder	Using the Herfindahl index
	Herf2–10	Proportions of second to 10th largest shareholders	Using the Herfindahl index
	Leverage	Asset liability ratio	Ratio of total liabilities to total amount of company assets
	Age	Length of establishment of the company	Time of company's establishment
	Year	Year	The annual change

model was lower than 2, and the mean value was 1.35, which was significantly lower than the critical multicollinearity threshold of 10.0 recommended by Neter et al. (1996). It was proved again that the variables selected in this study did not have multicollinearity. Model 2 shows that the social-related faultlines (*SRF*) ($\beta_1 = -0.3933$, $p < 0.01$) is significantly negatively correlated with the innovation strategy decision (*ISD*). Model 3 shows a significant positive correlation between cognitive-related faultlines *CRF* ($\beta_2 = 0.2088$, $p < 0.01$) and innovative strategic decision (*ISD*). Therefore, the H1 and H2 of this study were verified.

Models 4 and 5 were used to examine the influence of the property rights background on the relationship between the social-related faultlines and the company's innovation strategy decision. When the regression samples were state-owned enterprises, *Own* = 0, and when the confidence level was 90%, the social-related faultlines (*SRF*) was significantly negatively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = -0.3792$, $p < 0.1$). When the regression samples were non-state-owned enterprises, *Own* = 1, and in 95% confidence level, the social-related faultlines (*SRF*) of the board was significantly negatively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = -0.3990$, $p < 0.05$). By comparing the regression results of Models 4 and 5, it can be found that the

TABLE 2 | Correlation coefficient of each variable.

Variable	1	2	3	4	5	6
(1) *ISD*	1					
(2) *SRF*	−0.0928**	1				
(3) *CRF*	0.0763***	−0.0720*	1			
(4) *Bstock*	0.0726**	−0.0152*	0.0215**	1		
(5) ROA_{t-1}	−0.0266**	−0.0274*	0.0267***	0.1710	1	
(6) *Size*	0.0555***	0.0393***	−0.0423**	0.0372**	0.0053**	1
(7) *Bsize*	0.0161**	0.0140**	−0.0156**	−0.0283**	0.0480**	0.0613***
(8) *Growth*	−0.0731***	0.0652**	0.0068*	−0.3139*	−0.2976*	0.0474**
(9) *Herf1*	−0.0370**	−0.0822**	0.0917**	0.0975*	0.1559**	0.0753**
(10) *Herf2–10*	−0.0428*	−0.0920*	−0.0017*	0.1030*	0.1323*	0.1271**
(11) *Leverage*	0.0016***	−0.042**	0.0864**	−0.1045*	0.0569**	−0.0888*
(12) *Age*	0.1294***	0.1426**	0.1426**	0.0215**	0.0040	−0.0553***
Variable	**7**	**8**	**9**	**10**	**11**	**12**
(7) *Bsize*	1					
(8) *Growth*	0.0606***	1				
(9) *Herf1*	0.1287***	0.1197**	1			
(10) *Herf2–10*	0.0996**	0.1013*	0.2774**	1		
(11) *Leverage*	−0.1266**	0.0536**	0.1823***	0.2093**	1	
(12) *Age*	−0.0743***	0.0283**	−0.3139*	−0.2987***	0.1530**	1

**Significant at 10% level; **significant at 5% level; ***significant at 1% level.*

TABLE 3 | Board faultlines and innovation strategy decisions.

Variable	Model 1	Model 2	Model 3
SRF		−0.3933***	
		(−3.62)	
CRF			0.2088***
			(2.14)
ROA_{t-1}	0.0001***	0.0001***	0.0000***
	(1.27)	(1.46)	(1.52)
Size	−0.0144**	−0.0139**	−0.0162**
	(−2.24)	(−2.60)	(−2.28)
Bsize	0.0029***	0.0035***	0.0019***
	(0.41)	(0.28)	(0.36)
Growth	0.0127**	0.0124	0.0139
	(0.44)	(0.42)	(0.57)
Herf1	0.0001***	0.0000***	0.0001***
	(3.31)	(3.00)	(3.27)
Herf2–10	0.0001***	0.0002***	0.0000***
	(5.38)	(5.76)	(5.61)
Leverage	−0.0160***	−0.0158***	−0.0160***
	(−5.39)	(−5.40)	(−5.36)
Age	−0.0001	−0.0000	−0.0000
	(−0.20)	(−0.19)	(−0.19)
Year	Control	Control	Control
R^2	0.3323	0.3630	0.3638
Adj-R^2	0.3124	0.3362	0.3348
F-value	84.69***	87.43***	86.49***
N	3322	3322	3322

***Significant at 5% level; ***significant at 1% level.*

confidence level of regression test increased from 90–95% in the samples of non-state-owned enterprises. It can be seen that the company's property rights background is the activation factor of the board faultlines, which can effectively affect the influence of the social-related faultlines on the company's innovation strategy decision. It can be concluded from Models 4 and 5, the property right background plays a regulating role in the relationship between the social-related faultlines and the innovation strategy decision-making. Compared with state-owned enterprises, the social-related faultlines has a stronger negative influence on the innovation strategy decision of non-state-owned enterprises. Therefore, the hypothesis H3a in this study can be verified.

Models 6 and 7 were used to examine the influence of the property rights background on the relationship between the cognitive-related faultlines and the company's innovation strategy decision. When the regression samples were state-owned enterprises, *Own* = 0, and when the confidence level was 95%, the cognitive-related faultlines (*CRF*) was significantly positively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = 0.1326$, $p < 0.05$). When the regression samples were non-state-owned enterprises, *Own* = 1, and in 99% confidence level, *t* the cognitive-related faultlines (*CRF*) was significantly positively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = 0.2339$, $p < 0.01$). By comparing the regression results of Models 6 and 7, it can be found that the confidence level of regression test increased from 95 to 99% in the samples of non-state-owned enterprises. This result shows that the property rights background factor of the company is an activation factor of the board faultlines, which can promote the board cognitive-related faultlines to play an activation role and play an active role in the company's innovative strategic decision-making. The test of Models 6 and 7 can prove that the property rights background has a regulating effect on the relationship between the cognitive-related faultlines and the innovation strategy decision. Compared to state-owned enterprises, the cognitive-related faultlines of the board have a stronger positive influence on the innovation strategy decision of non-state-owned enterprises. Therefore, the hypothesis H3b in this study can be verified. The details are shown in **Table 4**.

TABLE 4 | Impact of property right background on the relationship between board faultlines and innovation strategy decisions.

Variable	Model 4	Model 5	Model 6	Model 7
	(*Own* = 0)	(*Own* = 1)	(*Own* = 0)	(*Own* = 1)
SRF	−0.3792*	−0.3990**		
	(−0.59)	(−3.50)		
CRF			0.1326**	0.2339**
			(2.24)	(2.69)
ROA_{t-1}	0.0009***	0.0010***	0.0010**	0.0002***
	(1.24)	(1.30)	(1.10)	(1.73)
Size	−0.0091**	−0.0158**	−0.0136**	−0.0188**
	(−2.36)	(−2.60)	(−1.69)	(−1.50)
Bsize	0.0019**	0.0044**	0.0120**	0.0036***
	(1.48)	(1.69)	(0.28)	(0.49)
Growth	0.0119*	0.0141	0.0119*	0.0140
	(0.50)	(0.62)	(0.45)	(0.68)
Herf1	0.0001***	0.0000***	0.0001***	0.0001***
	(1.90)	(3.66)	(2.29)	(3.44)
Herf2-10	0.0002***	0.0002**	0.0001**	0.0002***
	(5.67)	(5.86)	(5.06)	(5.88)
Leverage	−0.0130*	−0.0127**	−0.0145**	−0.0176
	(−5.39)	(−5.57)	(−5.43)	(−5.40)
Age	−0.0000	−0.0000	−0.0000	−0.0001
	(−0.25)	(−0.18)	(−0.11)	(−0.30)
Year	Control	Control	Control	Control
R^2	0.2853	0.3914	0.2750	0.3418
Adj-R^2	0.3025	0.3484	0.2813	0.3495
F-value	29.79***	62.32***	30.41***	38.91***
N	1375	1947	1375	1947

**Significant at 10% level; **significant at 5% level; ***significant at 1% level.*

Models 8 and 9 were used to examine the impact of institutional environment on the social-related faultlines and the company's innovation strategy decision. When the level of institutional environment is poor, *Institute* = 0, and in 95% of the confidence level, the social-related faultlines (*SRF*) was significantly negatively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = -0.3852$, $p < 0.05$). When the level of institutional environment is good, *Institute* = 1, and in 99% of the confidence level, the social-related faultlines (*SRF*) were significantly negatively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = -0.3996$, $p < 0.01$). Compared to the regression results of the two groups of samples, the confidence level of the regression test was improved from 95 to 99% in areas with a better institutional environment. This result shows that the institutional environment factor is an activation factor of the board faultlines, which can activate the further deepening of the influence of the social-related faultlines. Models 8 and 9 show that the institutional environment negatively regulates the relationship between the social-related faultlines and the innovation strategy decision. The better the institutional environment the enterprise is in, the more negative impact the social-related faultlines will have on the company's innovation strategy decision. Therefore, the hypothesis H6a in this study can be verified.

Models 10 and 11 were used to examine the impact of institutional environment on the relationship between the cognitive-related faultlines and the company's innovation strategy decision. When the level of institutional environment is poor, *Institute* = 0, in 90% of the confidence level, the board cognitive-related faultlines (*CRF*) were significantly positively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = 0.2487$, $p < 0.1$). When the level of institutional environment is good, *Institute* = 1, under 99% of the confidence level, the cognitive-related faultlines (*CRF*) are significantly negatively correlated with the company's innovation strategy decision (*ISD*) ($\beta_1 = 0.2839$, $p < 0.01$). Compared to the regression results of the two groups, the confidence level of the regression test was improved from 90 to 99% in areas with a better level of institutional environment. This result shows that the institutional environment factor is an activation factor of the board faultlines, which can activate the further deepening of the influence of the cognitive-related faultlines. Models 10 and 11 show that the institutional environment positively regulates the relationship between the cognitive-related faultlines and the innovation strategy decision. The better the institutional

TABLE 5 | Impact of institutional environment on the relationship between board faultlines and innovation strategy decisions.

Variable	Model 8	Model 9	Model 10	Model 11
	(*Institute = 0)*	(*Institute* = 1)	(*Institute = 0)*	(*Institute* = 1)
SRF	−0.3850**	−0.3996***		
	(−0.72)	(−3.25)		
CRF			0.2487*	0.2839***
			(1.22)	(2.20)
ROA_{t-1}	0.0010**	−0.0010***	−0.0010**	−0.0001***
	(−1.39)	(−1.22)	(−1.38)	(−1.20)
Size	−0.0315**	−0.0310***	−0.0313**	−0.0177**
	(−1.72)	(−1.52)	(−1.66)	(−2.01)
Bsize	0.0042**	0.0045**	0.0033**	0.0007***
	(2.04)	(2.23)	(2.24)	(0.89)
Growth	−0.0108*	−0.0140*	−0.0116*	−0.0148
	(−0.56)	(−0.77)	(−0.65)	(−0.80)
Herf1	0.0001**	0.0000***	0.0001**	0.0001***
	(1.30)	(2.37)	(1.46)	(3.34)
Herf2-10	0.0001*	0.0002***	0.0002**	0.0001***
	(1.86)	(3.77)	(1.03)	(3.06)
Leverage	−0.0130*	−0.0128**	−0.0130*	−0.0122**
	(−5.38)	(−5.32)	(−5.35)	(−5.20)
Age	−0.0000	−0.0000	−0.0000	−0.0000
	(−0.16)	(−0.09)	(−0.09)	(−0.02)
Year	Control	Control	Control	Control
R^2	0.2748	0.3318	0.3546	0.3448
Adj-R^2	0.3140	0.3183	0.2972	0.3100
F-value	27.69***	57.32***	23.69***	57.65***
N	1375	1947	1375	1947

**Significant at 10% level; **significant at 5% level; ***significant at 1% level.*

environment the enterprise is in, the more positive impact the cognitive-related faultlines will have on the company's innovation strategy decision. Therefore, the hypothesis H6b in this study can be verified. The details are shown in **Table 5**.

Robustness Check

To ensure the robustness of the research results, this study carried out the robustness test. The robustness test is mainly carried out from two aspects: the measurement of variables and endogenous control.

With regard to the remeasurement of dependent variables, this study selected the degree of R&D investment of the company as the alternative variable of the company's innovation strategy decision. To test the stability, two methods were selected to measure the dependent variable. One is to use the ratio of corporate R&D expenditure to corporate operating income as a measure. The second method is to use the ratio of the company's R&D expenditure to the company's market value as a measurement method. It is found that the regression results are consistent with the results obtained in this study. With regard to the remeasurement of independent variables, this study remeasures the independent variables in the study separately. For the social-related faultlines, this study uses gender and working terms of directors to replace gender and age to calculate the faultlines. For the cognitive-related faultlines, this study uses the educational level and professional experience to replace the educational level and professional background. In this study, the regression test of the board faultlines by the new measurement method is carried out, and the test results are consistent with the previous regression results.

In endogenous control, considering the possible endogeneity between independent variables and dependent variables, dealing with data in a lag stage can solve this problem. Therefore, this study deals with board faultline data in a lag phase. Regression analysis shows that the research results are not affected.

At the same time, to eliminate the influence of the missing variables that do not change over time, this study adopts the fixed effect model at the company level to perform regression on the variables mentioned above. The re-regression analysis shows that the directivity of several regression coefficients among board faultline, innovation strategic decision, property rights background, and institutional environment has not changed, and they are all significant at the level of 0.05, which can verify the regression conclusion mentioned above. It can be seen that there is no serious endogenous problem between independent variables, dependent variables, and moderating variables.

The new analysis of the regression model proves that the conclusion of this study has certain stability and reliability.

Regression Results Discussion

Regression analysis results verify the hypotheses H1 and H2 of this study. The greater is the degree of social-related faultlines, the more serious is the prejudice and discrimination between different sub-teams formed by the board of directors, resulting in the lack of in-depth communication and interaction within the board of directors. This is not conducive to in-depth analysis and discussion of problems in the strategic decision-making process of the board of directors, and ultimately is not conducive to innovation strategy decision-making. The greater is the degree of cognitive-related faultlines, the greater is the difference between different subteams formed by the board of directors, which can avoid the phenomenon of "group thinking" in decision-making, which facilitates the exchange and sharing of knowledge and information among the directors, and promote the formation of innovation strategy decision-making.

According to the regression analysis results of Models 4 and 5, the negative impact of social-related faultlines on the innovation strategy decision-making of non-state-owned enterprises is stronger than that of state-owned enterprises, and the hypothesis H5a proposed in this study is proved. The results confirmed that although the state-owned enterprises have a solid capital base and guarantee, can provide strong support for the company to choose innovation decision-making, but state-owned enterprises get more administrative constraints, need to take the necessary social services for economic and social development, such as functions, these factors affect the company's innovation strategy. According to the regression analysis results of Models 6 and 7, cognitive-related faultlines has a stronger positive influence on the innovation strategy decision of non-state-owned enterprises than the state-owned enterprises, and the hypothesis H5b is proposed in this study is proved. The results of this study prove that in the non-state-owned property rights environment, the decision-making of the board of directors is less subjected to policy intervention, and the members of the board have more

freedom of thinking and opinion. Therefore, the non-state-owned property rights background is conducive to the formation of the company's innovative ideas.

According to the regression analysis of Models 8 and 9, the institutional environment negatively regulates the relationship between the social-related faultlines and the innovation strategy decision. This result supports Hypothesis H6a. The results show that in markets with better institutional environments, individuals with different characteristics are more likely to express their personalities and attitudes. The differences among sub-teams formed by social-related faultlines based on social characteristics are more obvious, which are not conducive to the formation of innovation strategy. This study proves that the institutional environment is the activation factor of the social-related faultlines. The stronger the institutional environment the company is in, the stronger is the negative impact of the social-related faultlines on the company's innovation strategy decision. It can be seen from the regression analysis of Models 10 and 11 that the institutional environment positively regulates the relationship between the cognitive-related faultlines and the innovation strategy decision. This result supports the hypothesis H6b proposed in this study. The research results reflect that in an open and free-market environment, board members' knowledge, skills, etc., will be activated, generating more new ideas and opinions, and the cognitive-related faultlines will be further activated. The stronger the institutional environment the company is in, the greater is the positive impact of the cognitive-related faultlines on the company's innovation strategy decision.

CONCLUSION AND ENLIGHTENMENT

This study verifies the relationship between the board faultlines and the company's innovation strategy decision, which is of great theoretical and practical significance for the current lack of innovation-decision and lack of R&D investment in China's technology-intensive enterprises. First, the board faultlines become an important variable to measure the board governance level after the traditional board composition and diversity study. At the same time, this study changes from the traditional research on the decision-making results of the board of directors to the research on the decision-making process of the board of directors and discusses the influence of bias, communication, interaction, information acquisition, and other behaviors in the decision-making process of the board of directors. Second, this study, respectively, discusses the influence of social-related faultlines and cognitive-related faultlines on innovation strategy decision-making. The research conclusion is helpful for technology-intensive enterprises to pay more attention to the governance of the board of directors, promote enterprises to form a reasonable level of social-related faultlines and cognitive-related faultlines, and constantly optimize the quality of director recruitment. Third, this study believes that the property rights of the company will play an active role in the influence of social-related faultlines and cognitive-related faultlines on the company's innovation strategy decision. Compared to state-owned enterprises, the social-related faultlines has a stronger negative influence on the innovation strategy decision of non-state-owned enterprises, and the cognitive-related faultlines have a stronger positive influence on the innovation strategy decision of non-state-owned enterprises. In corporate practice, the board of directors should find an appropriate balance between negative and positive influences to ensure the level of innovation strategic decision-making. In terms of the innovation environment, it is found that the innovation environment is also an important factor influencing the decision-making of the board faultlines on the company's innovation strategy. Therefore, governments at all levels and market regulatory departments should promote the degree of regional marketization, establish an orderly market pattern, create a fair and just competitive environment, and improve the level of innovation and marketization.

The research still has the following limitations. First, this study chooses to use the proportion of R&D expenditure in the total assets of the company to measure the company's innovation strategy decision. This variable can also be considered from the number and proportion of the company's R&D personnel and the number of patents applied by the company. In future research, these factors can be included into the measurement of innovation strategy decision-making. Second, through literature review and relevant theoretical analysis, this study selected two characteristic indicators of age and gender, educational level, and professional background of directors as the basis for the division of board faultlines. In fact, characteristics, such as directors' values, personalities, and emotions, can be used to measure the board faultlines. However, considering factors, such as data acquisition, other possible measures are not adopted in this study. In fact, characteristics, such as directors' values, personalities, and emotions, can be used to measure the board fault. However, considering factors, such as data acquisition, other possible measures are not adopted in this study. The inadequacies and limitations of the above studies will be the focus of future research, which needs to be further expanded in future research.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

YZ proposed the research questions, designed the research scheme, collected data, conducted the statistical analysis, and wrote the draft of the manuscript. LM provided valuable suggestions and revised the manuscript. Both authors have approved the version of this manuscript.

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Research on the Influence of Network Position on Corporate Social Responsibility: Moderating Effect Based on Ownership Concentration

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Based on the social network theory and the institutional theory, this study examines the influence of corporate network position on corporate social responsibility (CSR), and further explores the moderating role of ownership concentration. Given the characteristics of CSR in different aspects, this study explores the relationship between corporate network position and economic CSR, environmental CSR, and social CSR from the two aspects of the centrality and structural holes of interlocking directorate network based on the data of 1,034 Chinese A-share listed companies from 2010 to 2019. The results show that the centrality and structural holes of interlocking directorate network have positive effects on the overall level of CSR, and the impacts on economic CSR and environmental CSR are stronger than that on social CSR. In addition, ownership concentration has a positive moderating effect on the relationship between corporate network position and CSR. These findings enrich the depth of research on CSR, clarify the influence of the characteristics of interlocking directorate network on CSR in different dimensions, and supplement the knowledge of existing research.

Keywords: interlocking directorate network, centrality, structural hole, corporate social responsibility (CSR), ownership concentration

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INTRODUCTION

All enterprises are in the social network, and the interlocking directorates are the bridge connecting an enterprise with others. Directors who hold directorships in both companies at the same time are called interlocking directorates (Mizruchi, 1996). Interlocking directorates play an important role in information exchange and the diffusion of business practices. As interlocking directorates hold directorships in more than one enterprise, they form a social network among the companies they serve, that is, interlocking directorate network, which constitutes a reliable and low-cost information transmission mechanism among enterprises (Haunschild, 1993). Meanwhile, the nature of a small world network of interlocking directorates network shows that the speed of information diffusion among enterprises is fast and the efficiency of obtaining resources is high in the formed interlocking directorate network (Newman and Strogatz, 2001; Battiston, 2004; Conyon, 2006; Durbach, 2009; Prem Sankar and Asokan, 2015; Sankowska, 2016). In addition, many studies (Chiu and Teoh, 2013; Srinivasan and Wuyts, 2018) have proved that interlocking directorates have played an important role in the profitability (Larcker and So, 2013;

(Ortiz-de-Mandojana and Aragon-Correa, 2015), innovation ability (Zaheer, 2005; Huang and Zhang, 2020), and the ability to cope with changes in the external environment of enterprises (Carpenter, 2001; Ortiz-de-Mandojana et al., 2012; Martin and Gözübüyük, 2015). For the interlocking directorate network, this study examines the impact of the position of interlocking directorate network on corporate behavior from the two dimensions of centrality and structural hole according to the practices of Martin and Gözübüyük (2015) and Wang et al. (2019b).

The emergence of interlocking directorates has made relationship network become an important way for enterprise development and an important influencing factor to fulfill their corporate social responsibility (CSR) (Besser, 2011). Sheldon (1924) proposed CSR first and believed that the concept of "shareholder first" which has always been supported by managers is no longer suitable for the current goal of enterprise development. In addition to paying attention to the interests of shareholders, enterprises should pay attention to the interests of employees, government, community, environment and other groups as well. CSR is that enterprises coordinate their own interests with social interests to realize the common sustainable development of enterprises and society. Normally, CSR behavior includes charitable donations, social assistance, environmental protection, etc. (Roeck et al., 2014), and we emphasize the overall contribution of enterprises to stakeholders, environment and society in production and operation. From the meaning of CSR in this study, it can be seen that CSR emphasizes meeting the expectations of multiple stakeholders (Aguinis, 2012). Therefore, we make an in-depth study from three dimensions, namely, economic CSR, environmental CSR, and social CSR.

In recent years, the results of studies on CSR have similarly shown that interlocking directorate network also affects the fulfillment of CSR (Ortiz-de-Mandojana and Aragon-Correa, 2015). In terms of the relationship between interlocking directorate network and CSR, most studies emphasize that interlocking directorates are conducive to improving the level of CSR (Ortiz-de-Mandojana et al., 2012; Mandojana and Aragon, 2015). However, some studies hold different opinions (Ben Barka, 2015). Marquis (2013) found that the characteristics of management and directors will affect the charitable donation of enterprises through the analysis of top 500 enterprises, and the board structure restricts the charitable behavior of company members. The divergence of existing research conclusions led scholars to investigate the possible impact of organizational boundary conditions. Martin and Gözübüyük (2015) took industry uncertainty as a moderating variable to explore the relationship between interlocking directorate network and firm performance. The research of Zona and Gomez-Mejia (2018) indicated that interlocking directorates may exert either a positive or a negative effect on firm performance, depending on the firm's relative resources, power imbalance, ownership concentration, and CEO ownership. Therefore, on the basis of exploring the impact of centrality and structural hole of interlocking directorate network on the three dimensions of CSR, we add the moderating effect of ownership concentration, to investigate the role of the internal relationship structure of the board of directors on the relationship between interlocking directorate network position and corporate behavior.

Specifically, we use the multiple regression method to explore the influence of interlocking directorate network on CSR behavior from the perspective of dual attributes of social network—centrality and structural hole. This method can intuitively explore the correlation between the two. To a certain extent, interlocking directorate network determines the future of an enterprise (Chuluun and Prevost, 2017), and more and more enterprises also rely on their corporate image in the "circle of friends" to strengthen their comprehensive strength and improve their competitiveness (Dass et al., 2014). Supported by Freeman's (1978) social network theory and Burt's (1992) structural hole theory, enterprises with high centrality have more ties with other enterprises in the network, which are easier to obtain key information; and the enterprises with more structural holes are in the key "hub" position in the network and have the right to dominate the information obtained. Therefore, to further explore the impact of interlocking directorate network on CSR, the first purpose of this study is to examine the impact of interlocking directorate network on CSR from two aspects: network centrality and network structural hole.

Next, we discuss whether there are differences on the influence of interlocking directorate network on enterprise economic CSR, environmental CSR, and social CSR. Corporate social responsibility is essentially a multi-dimensional concept (Carroll, 1991), and enterprises should also meet environmental and social requirements (Elkington, 1998) when pursuing economic benefits. Economic CSR involves the interests of the enterprise's direct stakeholders and is closely related to the enterprise's economic development (Carter, 2002). Environmental CSR promotes the enterprises to be more environment-friendly, which not only affects the reputation of enterprises but also helps enterprises to gain the legal recognition of other enterprises, to promote good cooperation among enterprises (Buysse, 2003), to gain the recognition of consumers and other stakeholders, and to enhance the brand recognition of enterprises and increase consumers' purchase intention. Social CSR is the expectation of the government, the public and the media, which covers social charitable donations, community activities, etc. It does not increase the interests of the enterprise directly, and this is different from the effect of economic CSR and environmental CSR. Therefore, it is necessary to explore the relationship between interlocking directorate network and different dimensions of CSR.

In addition, we also discuss the moderating role of ownership concentration in the relationship between interlocking directorate network and CSR. Shropshire (2010) believes that the relative power of the board of directors and the CEO will affect the role of interlocking directorates in the enterprise, which is especially reflected in that the duality of CEO and chairman has a significant impact on firm performance (Duru and Iyengar, 2016). In some enterprises, the board system is nothing but an empty shell, which is difficult to play important roles. As the directors failed to give full play to their functions of providing important suggestions and consulting for enterprise

strategy, the possibility of interlocking directorates playing an active role decreased. Therefore, the setting of corporate leadership structure has become an important factor affecting the role of interlocking directorates in CSR. Although China has strengthened the supervision of major shareholders, the phenomenon of high concentration of ownership structure is still common. As for the influence of major shareholders on enterprises, the existing views mainly focus on the "incentive effect" and the "entrenchment effect" (Claessens and Djankov, 2000). In the process of interlocking directorates influencing CSR, what role does the major shareholders play, and whether the relationship between interlocking directorates and CSR is based on the incentive effect or the entrenchment effect needs to be further explored. Ownership concentration is the most common measurement of ownership structure, and the higher the ownership concentration, the higher the shareholding ratio of major shareholders. This determines whether the shareholders have the right to make decisions and whether they have the right to dominate the resources. Therefore, it is necessary to directly discuss the moderating effect of ownership concentration, so as to further our understanding of the differences in the impact mechanism of CSR of corporates with different ownership structures in the interlocking directorate network. Also, we further test whether the ownership concentration of corporates determines the relationship between interlocking directorate network and CSR.

This study makes several contributions to related research. First, we explore the impact on CSR from the two perspectives of the centrality and structural hole of the interlocking directorate network, which theoretically enhances the explanation of the internal mechanism of the research variables. Few scholars directly explore the relationship between interlocking directorate network and CSR. This study enriches the relevant research. Second, we also test the moderating effect of ownership concentration. Corporates with high ownership concentration have stronger motivation to undertake CSR behaviors, which deepens our understanding of the boundary conditions of the influence of interlocking directorate network on CSR. Third, the content of CSR in the existing literature (Sun et al., 2020) is relatively incomplete and does not take into account the internal differences of CSR. This study subdivides CSR into three dimensions, namely, economic CSR, environmental CSR and social CSR, which is conducive to distinguish the differences between different dimensions of CSR and overcome the possible errors caused by the overall concept, so as to explore the impact of interlocking directorate network on different dimensions of CSR. Also, this provides a guidance and suggestions to enterprises participating in CSR, and also further enriches the literature on CSR.

The rest of this study is detailed as follows: We put forward the research hypothesis on the basis of theoretical analysis at first. Then the research methods and empirical results are described in detail. The "Discussion" section elaborates on the theoretical and practical significance of this article, and eventually the limitations of the study and new directions for the future research are detailed.

THEORETICAL BACKGROUND AND HYPOTHESES

Wellman (1988) proposed social network and believed that network is a series of social relations connecting participants, who have formed a relatively stable social structure. Social networks are closely related to access to business knowledge, information, and other resources. The location of network members is different, and the ability to obtain a variety of rare resources is also various. The way and efficiency of resource flow would be affected by the quantity, density, and intensity of social relations and the position of individuals in the network. As an invisible bridge between enterprises, interlocking directorates are important human capital and social resources, who have high professional quality and professional skills. Mizruchi (1996) proposed the interlocking directorate network in his research, and then it was quickly recognized by most scholars. It is generally believed that an interlocking directorate network among enterprises is one of the main channels of information transmission and exchange in the process of rapid social development (Chiu and Teoh, 2013). The interlocking directorate network formed by the relationship of part-time directors is full of rich social capital and information resources, which has an important impact on the operation and management decision-making of enterprises.

As for the position of enterprises in the interlocking directorate network, most of the existing studies describe it from the following two aspects: Centrality and structural hole. "Centrality" means whether the enterprise is in the center or edge of the network, and "structural hole" refers to the discontinuity between some nodes in the network (Martin and Gözübüyük, 2015). On the one hand, centrality measures the importance of individuals in the network, and concretizes the degree of enterprises acting as the central hub of the network and the degree of resource acquisition and control (Haunschild, 1998). On the other hand, the focus of structural hole is different from that of centrality. Structural hole does not emphasize direct connection, but pays more attention to the relationship mode with self-connected enterprises. That is, if an enterprise can connect the enterprises that cannot be directly connected, it indicates that this enterprise occupies the position of the structural hole in the interlocking directorate network (Burt, 1992). This study explores the impact on CSR from the following two aspects: Centrality and structural hole.

Interlocking Directorate Network and CSR

Social network theory holds that the strategic decision-making of enterprises is affected by the social network embedded in enterprises (Granovetter, 1985), which is embodied in the information acquisition, social behavior, innovation output, and so on. The position in the network reflects the control and influence of the enterprise, and has an impact on the efficiency of obtaining information and resources, thus affecting the behavior of the enterprise. The centrality of interlocking directorate network is a variable to measure whether individuals are easy to be noticed in the network and whether their position is critical. The mutual imitation and learning among corporates

in the network is the result of information transmission and resource sharing, which leads to the "peer effects" of corporate behaviors (Hallock, 1997; Kang, 2008; Bizjak and Lemmon, 2009; Yang, 2011; Chiu and Teoh, 2013). A study on stock market migration reveals that strong ties to in-group members reduced the impact of identity-discrepant cues, while strong ties to out-group members enhanced the impact (Rao and Davis, 2000). Meanwhile, the enterprise in the central position reflects a strong ability to capture key information in interlocking directorate network. The higher the network centrality of the enterprise, the higher the exposure of the enterprise in this "circle." Normally, enterprises will choose other enterprises with good reputation to cooperate instead of those with bad reputation, so as to protect their reputation from the influence of enterprises with bad reputation. As pressure from relevant enterprises on CSR, the target enterprises actively fulfill CSR to obtain the legal recognition of relevant enterprises and maintain and strengthen the relationship with important stakeholders (Buysse, 2003). Whether to increase the interests of shareholders, donate to the society or participate in charity activities, the role of CSR is to gain the recognition of the government, media, and stakeholders (Robinson and Irmak, 2012; Jones and Willness, 2014), so as to obtain a positive evaluation of the corporate image and reputation.

Institutional theory holds that organizations in the institutional environment will inevitably be under the pressure of the institutional environment (Meyer, 1977). To obtain the legitimacy recognition of its stakeholders, enterprises must abide by the institutional pressure brought by the institutional environment and take actions that can obtain legitimacy (Meyer, 1977). In other words, social network has a restrictive effect on the behavior of the participants in the network, and enterprises in the center of the network will be subject to more pressure from all aspects (Wang, 2011). This urges enterprises to actively undertake CSR to maintain a good corporate image (Li et al., 2015a). When enterprises appear in the public view with a very high frequency without timely CSR behavior, the public and the media will make bad comments on their behavior, resulting in bad reputation and image. Other enterprises cooperate with them will leave as well, gradually damaging the company's business performance. Therefore, we hold that enterprises with higher network centrality will actively fulfill their CSR due to the influence of "reputation mechanism."

Hypothesis 1a: There is a positive relationship between the centrality of interlocking directorate network and the level of CSR.

The importance of an enterprise in the network depends not only on the number of enterprises it is directly connected to but also on whether it is in a key position in the network that controls the transmission of information, that is the number of structural holes owned by the enterprise. The directors in key transmission positions have the right to choose when to start and to end the exchange of information among enterprises, as well as the content of the exchanged information (Burt, 2000; Markóczy et al., 2013). Enterprises with structural holes can connect the unconnected enterprises in the network so as to shorten the information transmission path between enterprises, speed up the flow of information, and promote the dissemination and utilization of resources (Uzzi, 1997). Compared with the enterprises at the edge of the interlocking directorate network, the enterprises occupying the position of structural holes have more competitive advantages, which can obtain information advantage and control advantage by manipulating the structural holes, so they occupy the dominant position (Burt, 1992). The advantage of information is that enterprises occupying the position of structural holes can significantly improve the efficiency of information transmission in the case of uncertain business environment, which is conducive to the learning of advanced technology and management experience (Mol, 2001); the advantage of control comes from the fact that enterprises occupying the position of structural holes can effectively control the information flow between different enterprises and selectively arrange the information of surrounding enterprises, that is, control the content, time, and quantity of information sharing (Gilsing et al., 2008). In addition, the richness of structural holes emphasizes the number of "non-redundant" connections of enterprises (Burt, 1992). The resources and information obtained by the enterprises occupying the position of the network structural holes and those in the network center are heterogeneous, and the enterprises in the position of the structural holes can obtain more non-redundant information. That is, the higher the level of the structural gap for a company in the interlocking directorate network, the more redundant information inflow is reduced. When the enterprises are in the position of structural holes, they can grasp the initiative of resource flow and have the power to control the information exchange and resource transmission between the individuals directly connected to them, while the peripheral enterprises do not have the abilities. Therefore, enterprises with more structural holes have higher control and intermediary abilities, and the necessity and motivation to undertake CSR will be greater and stronger.

Hypothesis 1b: There is a positive relationship between the structural hole of interlocking directorate network and the level of CSR.

Interlocking Directorate Network and CSR in Different Dimensions

There are differences in the impact of different dimensions of CSR on the interests of affiliated companies. Economic CSR involves the interests of the corporate's shareholders, employees, customers, suppliers, and other direct stakeholders, which is the expectation of these stakeholders (Carter, 2002; Buysse, 2003). Studies (Larcker and So, 2013; Kaustia, 2015) have shown that enterprises in interlocking directorate network will obtain information through their own network advantages, reduce the environmental uncertainty faced by enterprises, promote cooperation between enterprises, and finally achieve the purpose of improving enterprise economic benefits. Enterprises in the center of the network often have many direct connections with other enterprises, so they can fully and timely obtain key information and have absolute influence to make its affiliated enterprises to imitate (Leary, 2014). At the same time, enterprises

in the structural hole position will also gain the trust of edge enterprises by information and control advantages, thereby improving their business performance. In short, the fundamental purpose of performing economic CSR for enterprises is to improve the economic benefits of the enterprise, and the performance of economic CSR is the most direct short-term behavior related to the economic benefits of enterprises.

Social CSR covers donation, charity and other activities to meet the expectations of indirect stakeholders such as the community, the public, and the government. The research shows that the impact of donation on enterprises shows that the cumulative excess rate of return of the enterprise has increased significantly (Wang, 2011). It can be seen that enterprises can send positive signals to indirect stakeholders by fulfilling social CSR, so as to obtain goodwill and trust. When the peripheral companies cannot directly connect with the companies in the center of the network or in the structural hole position, they often judge whether the enterprise is a trustworthy organization and whether they can establish long-term cooperative relations with it later through the fulfillment degree of social CSR. Enterprises in the center of the network are closely connected with the surrounding enterprises and have higher influence and visibility. In addition to having a strong influence on other enterprises, enterprises with "high visibility" often get more attention from others (Zhang and Marquis, 2016). The government and the public hope that such enterprises can play an exemplary role, so they will have more and higher expectations that enterprises will take on more social CSR for the masses and the country (Wang et al., 2019b). Therefore, to get the support of other enterprises and the government, such enterprises will be more willing to fulfill social CSR.

Environmental CSR mainly refers to improving technology, reducing pollution, and making enterprises develop toward environment-friendly focus. The legitimacy theory holds that enterprises will be expected by responsibility from upstream and downstream enterprises. If downstream enterprises do not have enough awareness and corresponding actions on environmental protection, it is difficult to win the favor of suppliers, and actively fulfilling environmental CSR will continuously improve the willingness of suppliers to cooperate. At the same time, from the perspective of suppliers, suppliers usually do not choose to cooperate with enterprises with environmental reputation stains or scandals to protect their reputation. Therefore, suppliers, upstream and downstream enterprises, and investors will actually put pressure on the environmental CSR of the target enterprise. The attention and brilliance of public opinion brought by the influence of enterprises in the central position of the network or occupying the position of structural holes also make enterprises have to fulfill their environmental responsibilities. Furthermore, social norms and institutional theory regards legitimacy as the requirement for organizations to follow reasonable norms (Besser, 2011), which urges enterprises to actively fulfill environmental CSR to obtain the trust of peripheral companies and related resources. In addition, it is a long-term behavior for enterprises to undertake environmental CSR. The public may pay increasing attention to environment with the country's admiration for the concept of national green development. Moreover, the laws and regulations also urge enterprises to fulfill their environmental CSR to a greater extent. Compared with the CSR of other dimensions, environmental CSR is closely related to national policies. China aims to achieve carbon peak and carbon neutralization, so environmental CSR is more prominent with media and government supervision. Therefore, the closer to the network center, the stronger the supervision of environmental CSR, and the stronger the social pressure to fulfill environmental CSR. The enterprises in the center of the network and occupying the position of structural holes usually respond positively and implement the corresponding environmental CSR behavior.

Hypothesis 2: The centrality and the structural hole of interlocking directorate network have different impact intensity on different dimensions of CSR, and on what dimension of the CSR does the position in the interlocking directorate network have the strongest impact?

Interlocking Directorate Network, Ownership Concentration and CSR

The agency theory holds that major shareholders have more motivation and ability than minor shareholders to supervise the management and operation activities of the corporate to promote the growth of the corporate's value under the same conditions (Shleifer, 1986). Based on the consideration of the long-term interests of the enterprise, the major shareholders can directly supervise and control the behavior of the management to ensure that the strategic behaviors such as investment decision-making take the sustainable development as the core and run in the direction that meets the expectations of major shareholders. Enterprises with higher centrality occupy a more important position in the entire interlocking directorate network, and their exposure will increase with the enhancement of centrality. Affected by the "reputation mechanism," enterprises, as "public stars," tend to actively respond to the pressure of social CSR, and attach importance to the suggestions provided by interlocking directorates. With the advantage of direct-control right, major shareholders promote the fulfillment of CSR by participating in the decision-making or supervising the management, so as to maintain a good relationship with stakeholders, form a good corporate reputation, improve the ability to obtain resources and finally promote the long-term development of the enterprise. On the one hand, the social reputation recognized by the peers will accumulate a wider network of contacts, open up more information channels, and obtain better career prospects and more board seats for the major shareholders (Engelen and Neumann, 2016). On the other hand, in terms of corporate image, major shareholders are the "image spokesperson" of the company, and the image of shareholders also represents the image of the company. Now, the personal reputation of major shareholders is tied to the reputation of the organization, forming the "reputation duplicate effect," which further urges enterprises to fulfill their social CSR.

However, from the perspective of "entrenchment effect," the major shareholders will be driven by their own short-term opportunistic behavior, and regard CSR as a series of behaviors that cannot obtain returns in short term, but constitutes

corporate expenditure when the equity is highly concentrated (Waddock, 1997). Therefore, they are not willing to pay too much attention or even ignore this kind of behaviors. Because of the absolute controlling rights, major shareholders overhead the rights and interests of minor shareholders (Claessens and Djankov, 2000); thus, led the enterprises lose the diversity of decision-making of the board of directors, aggravate the agency problem and reduce the decision-making efficiency of the board of directors. When an enterprise is in the center of social network, it means that the operation of this enterprise is connected with many related partners. As the centrality of interlocking directorate network can enhance the coordination and cooperation among organizations, the probability of damage to enterprises caused by the capital flow breakdown and the impact of environmental change of high centrality enterprises is greater compared with enterprises with low centrality. That is, the economic interests of major shareholders are damaged, which is obviously not in line with the expectations of major shareholders. To ensure that enterprises can cope with the impact of the capital flow breakdown and environmental change, major shareholders will instead invest in projects that increase the economic benefits of enterprises and reduce the "useless" ability of CSR.

Hypothesis 3a: Ownership concentration moderates the positive relationship between the centrality of interlocking directorate network and CSR, such that the position relationship is stronger when ownership concentration is higher.

Hypothesis 3b: Ownership concentration moderates the negative relationship between the centrality of interlocking directorate network and CSR, such that the position relationship is weaker when ownership concentration is higher.

CSR is a signal that enterprises are constantly transmitting good economic operation and development prospects to stakeholders in the external economic environment. The establishment of this good image silently attracts customers, potential investors, employees, the public and the media, and constructs the competitive advantage of the enterprise to a certain extent (Brammer, 2008). Based on the incentive effect of large shareholders, when the ownership concentration is high, the interests of major shareholders are closely related to the prosperity and loss of the enterprise. Therefore, major shareholders often have "interest linkage effect" with enterprises in this situation, so as to urge enterprises to improve legitimacy through CSR. In addition, affected by the "embeddedness mechanism" of social network, whether enterprises can maintain good competitiveness in the market depends on the resources of their stakeholders (Pfeffer and Salancik, 1976), which makes enterprises with rich structural holes actively fulfill CSR to obtain the resources and trust of peripheral companies.

However, no matter how abundant the resources in the social network relationship are, it will still cause adverse effects if there is no reasonable supervision and utilization (Granovetter, 1985). Being in the position of the structural holes means that the enterprises have the control ability and intermediary ability (Burt, 2000). Compared with high network centrality enterprises with dense networks and redundant information, the networks around companies in the structural hole position are sparse, but this kind of enterprises have strong right of information control, and its dependence on the resources of its affiliated enterprises and the government will become weaker (Reitz, 1979). These stakeholders are the source of the pressure of CSR. In other words, the monopoly of their own resources will reduce the pressure on the legitimacy of enterprises in the social environment (Battilana, 2012). The information advantage of structural hole enables the enterprises who are in this position to have preferential access to implicit and unique resources. Driven by selfish nature and interests, major shareholders often choose to monopolize resources to avoid supervision, and only support behaviors and decisions that are obviously beneficial to the economic benefits of the company.

Hypothesis 4a: Ownership concentration moderates the positive relationship between the structural hole of interlocking directorate network and CSR, such that the position relationship is stronger when ownership concentration is higher.

Hypothesis 4b: Ownership concentration moderates the negative relationship between the structural hole of interlocking directorate network and CSR, such that the position relationship is weaker when ownership concentration is higher.

MATERIALS AND METHODS

Source of Data

We mainly take the China's A-share listed companies from 2010 to 2019 as the research samples, and take data from China Stock Market & Accounting Research Database (CSMAR) database and corporate responsibility rating sores of Hexun.com as the main data sources, which covers a total of 4,042 listed companies. The original data of the interlocking directorate network comes from the basic information of the company executives in the part of governance structure of CSMAR database. Then, Pajek software is used to process the original data to obtain the characteristic index of the interlocking directorate network. To ensure the validity of the study, the initial samples are deleted according to the following conditions. First, excluding sample enterprises with ST at any time during 2011–2019; second, excluding sample enterprises that were delisted at any time from 2011 to 2019; third, excluding sample enterprises with missing core variables. Finally, a total of 9,931 effective observations of 1,034 companies in 10 years are obtained, accounting for 25.58% of the original sample enterprises.

Measures

Corporate Social Responsibility

At present, the measurement methods of CSR mainly include content analysis method, reputation index method, professional agency rating method, and KLD index, which is an evaluation index of CSR proposed by Kinder, Lydenberg and Domini (Zhou et al., 2016; Park and Jeun, 2019; Joo, 2020). The professional agency rating method is used commonly, which is mainly measured by corporate responsibility score of "Hexun.com" or Runling global corporate responsibility rating. The data about CSR in this study uses the method of Python to capture the score of CSR from the social responsibility scoring standard of listed companies published by Hexun.com. The professional evaluation system of CSR report of listed companies of

Hexun.com is divided into the following five aspects: Shareholder responsibility, employee responsibility, supplier, customer and consumer responsibility, environmental responsibility, and social responsibility. We use the total score of the five aspects to represent the corporate's degree of CSR.

The dimension division of CSR in this study is based on the view of triple bottom line (Park and Jeun, 2019). According to this basis, shareholder responsibility, employee responsibility, supplier, customer and consumer responsibility belong to the responsibility of direct interests, which is defined as economic CSR in this study. The data is from the sum of the rating scores of the three kinds of responsibility in Hexun.com.

Different from economic CSR, "Hexun.com" distinguishes industries when scoring environmental CSR, and focuses on different scoring standards for manufacturing and service industries in environmental and social CSR. Specifically, for the manufacturing industry, the environmental CSR is empowered by 30% and the social CSR is 10%; for the service industry, the environmental CSR is empowered by 10% and the social CSR is 30%; for other industries, the environmental CSR and social CSR are both empowered by 20%. Considering the accuracy of the data, we calculate the weight according to the industry of the enterprises, and get the environmental CSR and social CSR scores of each enterprise.

Centrality

Network centrality includes degree centrality, closeness centrality and betweenness centrality (Freeman, 1978). Degree centrality describes the number of individuals who have direct connections in the network, and reflects the ability of the actor to interact with other actors (Hochbergy et al., 2007); closeness centrality takes the "distance" between the enterprise and other member enterprises in the network as the measurement index to measure the speed of information flow in the network; and betweenness centrality takes the degree that an enterprise in the network is between any other two member enterprises as the measurement standard to investigate the intermediary position of enterprises in the network (Burt, 1992). Specifically, degree centrality indicates the connection between the enterprise and other enterprises in the network. The higher degree centrality means the more individuals directly associated with the enterprise, which depicts the activity and visibility of the enterprise in interlocking directorate network (Fan et al., 2021). Therefore, given the practice of Dijkstra (1959) and Hochbergy et al. (2007), we use degree centrality to measure the centrality of interlocking directorate network. The specific calculation formula is as follows:

$$Degree_m = \frac{\sum_{m \neq n} X_{mn}}{g - 1}$$

where m refers to one of the directors of the enterprise; n refers to one of the other directors except for m director; g refers to the total number of board of directors in that year; X_{mn} refers to a network tie, which is 1 when at least one tie exists between director m and director n; otherwise, it is 0.

Before calculating the degree centrality of interlocking directorate network, we firstly collect and sort out the data of the enterprises' shareholders who are also shareholders of other listed enterprises from CSMAR database, and form the 2-mode data of "company-director." Then, we convert the 2-mode data into a 1-mode matrix of "company × company" by the social network analysis software "Pajek." Finally, we calculate the degree centrality and use the maximum degree of centrality to represent the social network centrality.

Structural Hole

The content of structural holes includes effective size, efficiency, constraint, and hierarchy. The constraint is the most important, which reflects the ability of individuals to use structural holes in the network. It also is the mainstream measurement of calculating structural (Burt, 1992). Constraint can effectively measure the lack of structural holes, and the higher the degree of constraint, the fewer structural holes the enterprise has. Based on the practice of Zaheer (2005), we use "1—constraint" to measure the richness of structural holes. The specific calculation formula is as follows:

$$SH_{AB} = 1 - \sum_B \left(P_{AB} + \sum_C P_{AC} P_{CB}\right)^2 \ (C \neq A,\ B)$$

where P_{AB} indicates the strength of direct relationship between company A and company B; P_{AC} and P_{CB} indicate the strength of indirect relationship between company A and company B, respectively, through company C; $P_{AB} + \sum_C P_{AC} P_{CB}$ indicates the sum of all the direct and the indirect relationships between company A and company B. The larger the difference of the formula, the richer the structural holes in interlocking directorate network.

Ownership Concentration

Generally, the measurement of ownership concentration mostly selects the sum of the shareholding proportion of the first major shareholder, the shareholding proportion of the top three shareholders and the shareholding proportion of the top 10 shareholders as the evaluation index (Li et al., 2015b; Wang et al., 2019a; Rojahn, 2022), which show the distribution and concentration of the company's equity. The smaller the numerical value of the index is, the more dispersed the equity is. On the contrary, the larger the numerical value is, the more concentrated the equity is. Referring to the common practice, we take the sum of the shareholding proportion of the top three shareholders as the measurement index of ownership concentration.

Control Variables

Based on the practices of Desender et al. (2013) and Peng (2014), we control the variables that may affect CSR in corporate characteristics and corporate governance: company size, risk, financial performance, nature of equity, profitability and liquidity ratio at the level of company characteristics, and board size, number of independent directors and CEO duality at the level of corporate governance. In addition, we also control the possible impact of the industry and year.

TABLE 1 | Meaning of variables.

Type	Name	Symbol	Formula
Dependent	CSR	CSR	Comprehensive score of CSR from Hexun.com
	Economic CSR	EC	Score of economic CSR/weight from Hexun.com
	Environmental CSR	EN	score of environmental CSR/weight from Hexun.com
	Social CSR	SC	score of social CSR/weight from Hexun.com
Independent	centrality structural hole	DC SH	Degree centrality "1−constraint"
Moderating variables	Ownership concentration	OC	The sum of the shareholding proportion of the top three shareholders
Controls	Size	Size	ln (total assets at the end of the year)
	Risk	Risk	ln (total liabilities/total assets)
	Financial performance	roe	Net profit/net assets×100%
	Nature of equity	st	State-owned enterprise is 1; otherwise, it is 0
	Profitability	*P*	Net profit/total income
	Liquidity ratio	L	Total current assets/total assets
	Board size	Board	Total number of directors
	Independent directors	ID	The number of independent directors
	CEO duality	DU	Chairman and CEO is one of the two staff, is 0; otherwise, it is 1
	Industry	Ind	17 dummy variables
	Year	Year	10 dummy variables

Source from the author's collection.

All variables and their descriptions are summarized below. **Table 1** lists all the variables.

Methods

To test the hypotheses discussed here, we use STATA to conduct multiple regression to explore the impact of interlocking directorate network position on CSR, and adds year and industry fixed effect to control the characteristics of changes over time and different industries. Given that all variables were collected at the firm level, data quality was analyzed prior to regression to ensure that the data were normally distributed. In the test of moderating effect, the interaction is introduced and the individual effect is controlled to identify the significance of moderating effect.

RESULTS

Descriptive Statistics and Correlation Analysis

Table 2 presents means, standard deviations, and correlations. The magnitude of the correlations indicates that multicollinearity is not a serious problem. The results are generally consistent with the hypotheses discussed here: The network position of corporate plays a positive role in promoting CSR, and has a stronger role in promoting economic CSR and environmental CSR. Specifically, the centrality and structural hole of interlocking directorate network are significantly positively correlated with the variables of CSR and its three dimensions (economic CSR, environmental CSR, and social CSR) at the confidence level of 1%, and the correlation coefficients are 0.23, 0.23, 0.08, 0.34, 0.28, and 0.16, respectively. Therefore, there is a significant correlation between the variables studied in this study. In addition, the magnitude of Variance Inflation Factor (VIF) is less than 10[1] (Kalnins, 2018), which indicates that multicollinearity is not a serious problem.

Hypothesis Testing

Test of Main Effects

Table 3 presents the basic regression results on how network position affects CSR. Specifically, the regression coefficients of the centrality and structural hole of interlocking directorate network for CSR are 0.415 and 18.675 respectively, which indicates that there is a significant positive impact at the confidence level of 1%, supporting Hypothesis 1a and Hypothesis 1b. Columns marked as Model 2A, Model 2B, Model 3A, Model 3B, Model 4A, and Model 4B in **Table 3** show the effects of the centrality and structural hole of interlocking directorate network on economic CSR, environmental CSR, and social CSR. The results show that, consistent with Hypothesis 2, the network position of corporate has a different impact on CSR in the three dimensions.

It can also be seen from **Table 3** that network centrality and structural holes have a more significant impact on economic CSR and environmental CSR, which may be due to the fact that economic CSR and environmental CSR belong to basic responsibility and they are related to the direct stakeholders of the enterprises and the interests that directly affect firm performance. All enterprises pursue profit maximization, and the economic CSR is easier to meet the economic benefits of enterprises and the fulfillment of environmental CSR will make it easier for enterprises to obtain the favor of stakeholders. By contrast, social CSR is a kind of high-level responsibility, which is more based on empathy and moral constraints. It is closer to the moral level, which is high-level responsibilities without mandatory provisions. Enterprises can be praised for their active performance, but will not be punished by laws and regulations and criticized by the public opinion if they do not actively fulfill this kind of responsibilities. Therefore, compared with social CSR, enterprises often take more positive response measures to economic CSR and environmental CSR.

In addition, we also carried out standardized regression on the original models and obtained the standardized regression coefficients. The results also indicate that there is a positive effect of the centrality and structural hole of interlocking directorate network on the level of CSR, and the positive effects on economic CSR and environmental CSR are stronger compared with social CSR. The details are shown in **Appendix**.

Considering the robustness of the results discussed here and ensure the reliability and authenticity of the research conclusions, the robustness test is carried out by changing the regression model. In the robustness test, we perform regression on the

[1]When VIF < 10, it indicates that there is no multicollinearity.

TABLE 2 | Results of descriptive statistics and multicollinearity test.

	Mean	Std.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.CSR	24.68	16.46	1.00															
2.EC	30.21	17.93	0.96	1.00														
3.EN	7.34	20.19	0.82	0.74	1.00													
4.SC	36.55	32.17	0.39	0.23	0.04	1.00												
5.DC	10.54	7.40	0.25	0.23	0.23	0.08	1.00											
6.SH	0.62	0.24	0.35	0.34	0.28	0.16	0.10	1.00										
7.OC	−0.91	0.60	0.95	0.91	0.77	0.37	0.23	0.34	1.00									
8.risk	22.49	1.42	0.01	−0.07	0.10	−0.02	0.03	0.00	0.00	1.00								
9.size	0.04	0.52	0.29	0.28	0.20	0.08	0.08	0.10	0.27	0.45	1.00							
10.roe	8.83	1.78	0.15	0.18	0.02	0.10	0.02	0.06	0.14	−0.07	0.04	1.00						
11.board	0.41	0.17	0.13	0.13	0.13	0.02	0.02	0.06	0.12	0.12	0.25	0.02	1.00					
12.st	0.09	0.82	0.14	0.10	0.15	0.03	0.03	0.06	0.13	0.27	0.32	0.00	0.25	1.00				
13.P	0.55	0.21	0.10	0.13	0.02	0.04	0.01	0.04	0.11	−0.04	0.09	0.12	0.01	0.01	1.00			
14.L	3.88	1.21	0.03	0.03	−0.08	0.12	−0.01	0.01	0.03	−0.07	−0.15	0.05	−0.15	−0.14	0.00	1.00		
15.ID	0.77	0.42	0.03	0.04	0.03	0.00	−0.01	0.02	0.03	0.10	0.20	−0.01	0.41	0.13	0.00	−0.10	1.00	
16.DU	0.47	0.50	0.06	0.04	0.07	0.01	0.02	0.02	0.06	0.13	0.14	−0.02	0.16	0.29	0.01	−0.09	0.06	1.00

characteristic index of interlocking directorate network with a lag of one period, and test the impact of network centrality and structural holes on CSR. The results in **Table 4** show that the research conclusions will not be disturbed by the reverse causality.

Test of Moderating Effects

Consistent with Hypothesis 3a, the interaction coefficient between network centrality and ownership concentration (OC_DC = 0.121, $p < 0.05$) is significantly positive in **Table 5**, indicating that the ownership concentration of enterprises positively moderates the relationship between network centrality and the level of CSR. The higher the level of ownership concentration, the stronger the positive relationship between the network centrality of the enterprise and the level of CSR. At this time, the incentive effect of shareholders is dominant, and the "reputation superposition effect" is confirmed. In addition, the interaction coefficient between structural holes and ownership concentration (OC_SH = 16.310, $p < 0.001$) is also significantly positive, which shows that the ownership concentration of enterprises positively moderates the relationship between network structural holes and the level of CSR. Hypothesis 4a is supported. Therefore, it is concluded that the higher the level of ownership concentration, the stronger the positive relationship between the structural holes and CSR, and the "interest linkage effect" has been effectively confirmed.

Further Study

The whole samples are classified according to the nature of property rights and industries to test the impact of the characteristics of interlocking directorate network on the level of CSR respectively. The results show that the network centrality and the structural holes have more significant impacts on the CSR of state-owned enterprises than that of private enterprises. This may because the ownership of state-owned enterprises is owned by the state, which has a stronger exemplary effect and plays an exemplary role than private enterprises. In addition, the positive impact of characteristics of interlocking directorate network on the level of CSR in manufacturing industry is significantly stronger than that in Information Technology (IT) enterprises. This is because the products of IT enterprises are more dependent on their technical and scientific content, rather than relying too much on reputation mechanism and resources of stakeholders. In contrast, manufacturing enterprises have strong substitutability, so they rely more on corporate image to gain the preferences of the public, and their resource dependence on stakeholders is far stronger than that of IT enterprises. Therefore, the characteristics of interlocking directorate network in manufacturing enterprises have a more significant positive impact on the fulfillment of CSR.

DISCUSSION

Based on social network theory and institutional theory, this study examines the impact of director network position on CSR. Due to the heterogeneity of information and resources transmitted by network centrality and structural holes, the research focuses on the impact of the two aspects on CSR. In addition, it also analyzes the different performances of interlocking directorates in economic CSR, social CSR, and environmental CSR. Finally, the moderating effect of ownership concentration on this effect is tested. By analyzing the data of 1,034 Chinese listed companies for 10 years, the results show that the higher the centrality and structural hole of interlocking directorate network, the more actively the enterprises can fulfill their social CSR, and have a deeper impact on environmental CSR. In addition, the ownership concentration positively moderates the relationship between the network position and CSR. The stronger the ownership concentration, the greater the impact of the network position on CSR. Through the investigation, the results have theoretical

TABLE 3 | Results of regression analysis for interlocking directorate network position and CSR.

Var	CSR		EC		EN		SC	
	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B	Model 4A	Model 4A
DC	0.415*** (19.37)		0.412*** (17.84)		0.495*** (16.58)		0.298*** (7.54)	
SH		18.675*** (34.14)		19.162*** (32.21)		18.761*** (27.78)		17.417*** (12.14)
Risk	−4.669*** (−17.11)	−4.276*** (−16.34)	−7.11*** (−22.78)	−6.706*** (−22.35)	−0.221 (−0.70)	0.160 (0.51)	−3.930*** (−6.25)	−3.547*** (−5.72)
Size	5.053*** (33.85)	4.843*** (33.87)	5.961*** (37.30)	5.736*** (37.23)	3.944*** (19.29)	3.784*** (19.06)	3.541*** (11.90)	3.286*** (11.13)
Board	0.325** (3.22)	0.261** (2.69)	−0.392*** (3.57)	0.327** (3.10)	0.272* (2.10)	0.206 (1.62)	0.052 (0.24)	−0.005 (-0.02)
Roe	2.558** (3.01)	2.311** (2.97)	3.495** (3.21)	3.240** (3.18)	−0.464 (−1.28)	−0.702* (−1.99)	4.767*** (3.52)	4.524*** (3.58)
St	1.032** (3.01)	0.779* (2.47)	0.407 (1.17)	0.150 (0.44)	1.843*** (4.46)	1.578*** (3.86)	1.881** (2.49)	1.659* (2.21)
P	1.343** (3.05)	1.209** (3.09)	1.868** (3.15)	1.730** (3.19)	0.029 (0.09)	−0.104 (−0.31)	1.607* (2.40)	1.480* (2.36)
L	4.929*** (5.73)	4.586*** (5.49)	6.750*** (7.22)	6.399*** (7.04)	−2.948** (−2.67)	−3.292** (−3.02)	13.577*** (7.39)	13.258*** (7.26)
ID	−0.373** (−2.74)	−0.406** (−3.08)	−0.403** (−2.70)	−0.436** (−3.01)	−0.350* (−2.02)	−0.394* (−2.31)	−0.193 (−0.63)	−0.212 (−0.07)
DU	0.535 (1.61)	0.673* (2.08)	0.301 (0.82)	0.440 (1.23)	0.593 (1.49)	0.748 (1.90)	1.961* (2.47)	2.071* (2.62)
Ind	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES
Obs	9,684	9,684	9,684	9,684	9,684	9,684	9,684	9,684
R^2	0.2953	0.3334	0.3015	0.3374	0.2193	0.2351	0.1020	0.1138

*t-values are in parentheses; ***p < 0.001, **p < 0.01, *p < 0.05.*

TABLE 4 | Results of robustness.

Var	CSR		EC		EN		SC	
lag_DC	0.219*** (9.74)		0.229*** (9.47)		0.267*** (9.04)		0.065* (2.52)	
lag_SH		9.770*** (16.01)		10.740*** (16.18)		9.844*** (13.25)		4.697** (3.22)
Control	YES	YES	YES	YES	YES	YES	YES	YES
Ind	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES
obs	8,504	8,504	8,504	8,504	8,504	8,504	8,504	8,504
R^2	0.2619	0.2724	0.2780	0.2896	0.1767	0.1808	0.0960	0.0970

*t-values are in parentheses; ***p < 0.001, **p < 0.01, *p < 0.05.*

and practical significance for the future research. The results of this study provide a richer perspective for social network theory and institutional theory. In the context of social network, the legitimacy recognition of institutional theory is one of the necessary conditions for the survival and development of enterprises. Enterprises will obtain the continuous inflow of key information and resources in the network by undertaking CSR, so as to obtain the legitimacy recognition. They obtain the continuous resources and then reduce the impact of the environment and promote investment and cooperation. This will have theoretical and practical significance for the future research.

Theoretical Contributions

This study has made the following contributions to the related research of CSR. First, the research reveals the relationship between the network position and CSR from the aspects of centrality and structural holes, which enriches the research on the effectiveness of CSR at the level of social network. Although

TABLE 5 | Results of moderating effect.

	CSR			
DC	0.415*** (19.37)	0.013 (0.66)		
SH			18.675*** (34.14)	−3.233*** (−5.36)
OC		88.137*** (112.35)		77.026*** (60.97)
OC_DC		0.121* (2.37)		
OC_SH				16.310*** (9.37)
Control variable	YES	YES	YES	YES
Ind	YES	YES	YES	YES
Year	YES	YES	YES	YES
R^2	0.2953	0.9047	0.3334	0.9061

*t-values are in parentheses; ***p < 0.001, **p < 0.01, *p < 0.05.*

more and more studies emphasize the importance of interlocking directorate network (Cai et al., 2014; Howard and Withers, 2017), few studies pay attention to the relationship between interlocking directorate network and different dimensions of CSR. Through empirical analysis, this study preliminarily investigates the impact of the characteristics of interlocking directorate network on CSR, and also enriches the research corporate governance in the field of social norms.

Second, this study emphasizes the impact of network position on different dimensions of CSR, and the empirical test shows that the characteristics of interlocking directorate network have a more significant impact on economic CSR and environmental CSR compared with social CSR. This situation shows that under the background of China's economic transformation, enterprises form a community of interests through the interlocking directorate network so as to reduce transaction costs and improve communication efficiency (Shipilov and Greve, 2010). For the environmental CSR and economic CSR, which are helpful to increase the possibility of cooperation with other enterprises and are in an increasingly important position, the enterprises will put their energy into the fulfillment of these kinds of CSR, while for the high-level social CSR such as charitable donation, which may have adverse effects on the economic interests of the enterprises, the enterprises will not show a particularly positive attitude.

Third, from the perspective of ownership structure, the study also reveals the boundary conditions of the impact of network position on CSR. We put forward the positive and negative hypothesis based on the incentive effect and entrenchment effect of major shareholders when studying the moderating effect of ownership concentration. Previous studies rarely consider the effects of the two effects at the same time, but this study explains the mechanism of the moderating effect through the two effects, which enriches the existing research. Specifically, the results show that the higher the ownership concentration of enterprises, the stronger the positive impact of network position on CSR. The research of enterprise ownership concentration complements the contingency of the impact of social network position on CSR. From this perspective, it can be inferred that the future research can start with other boundary conditions of social network position to explore the impact on CSR.

Practical Implications

The study has important implications for enterprise practice as well. At first, as the external governance mechanism of the company, the centrality and structural hole of interlocking directorate network can be designed and changed for enterprises. We can give full play to the governance mechanism of the interlocking directorate network. Existing researches show that the characteristics of directorate network will have a positive impact on CSR. Therefore, enterprises should make full use of it based on the advantages of social capital brought by the informal system (Cheung et al., 2013). When an enterprise is in the period of transition, interlocking directorates are more able to observe the impact of external environmental changes on the enterprise, and fully participating in the network can effectively alleviate the external impact (Parsons and Sulaeman, 2018). At the same time, the appointment of interlocking directorates is also one of the important tasks: interlocking directorates with "high-quality" and "good reputation" will bring enterprises huge value. On the contrary, board of directors with "low-quality" virtually breaks the whole interlocking directorate network of the company, causing huge losses. Absolutely, enterprises should employ interlocking directorates and layout their position reasonably in the social network. CSR should be a polishing tool of enterprises to perform within their own capabilities.

Next, the research results highlight the impact of corporate ownership concentration on the relationship between network position and CSR, which indicates that the rational allocation of shareholder power and management power is also noteworthy (Buertey, 2021). When shareholders hold the decision-making power alone, it will affect the decision-making of the board of directors and the response measures of executives to market changes, resulting in short-term opportunistic behavior (Anderson, 2003); If the executive power is too large, it will overhead the power of shareholders, resulting in damage to shareholders' rights and interests (Adams and Licht, 2011), which will also affect the value of the enterprise. When shareholders have the right to make decisions alone, it will affect the decisions of the board of directors and the executives' response measures to market changes, resulting in short-term opportunistic behavior. However, if the executives' power is too great, it will overhead the power of shareholders and damage shareholders' rights and interests, which will also affect the enterprise value. Briefly, shareholders and executives can carry out effective supervision and play a positive role in promoting enterprise development only when the two kinds of powers are fully checked and balanced.

Limitations and Future Directions

Generally speaking, the research supports the argument that the characteristics of interlocking directorate network have a positive impact on the level of CSR in theoretical and empirically, and has

been verified in three dimensions of CSR, but there are still some defects in the research.

First, there are many factors that affect the level of CSR. It is not enough to explore the factors only from the level of external governance mechanism. The joint efforts of the government and enterprises are needed to form a good CSR atmosphere. It is better to formulate a series of policy measures to guide enterprises to fulfill their social responsibilities and promote outstanding demonstration enterprises to share successful experiences (Lin, 2010). Second, we only consider the interlocking directorate network among enterprises, but there are still many ways for enterprises to form social networks. Therefore, whether the conclusions of this study are established in other social networks remains to be further studied, and it should be analyzed in combination with various network forms in the future. Third, the research adopts the CSR score from "Hexun.com," which depends on whether the social responsibility report disclosed by the enterprise is accurate. Although the rating is relatively authoritative in Hexun.com, the accuracy, omission and lack of data will still have a certain impact on the research results.

The fulfillment of CSR is a long-term development process, which requires the joint efforts of enterprises and society. The practice of CSR in China is in an exploratory period, and there is no systematic conclusion yet. Therefore, the research on CSR needs to be expanded. In addition, the rational allocation of shareholder power and management power is also noteworthy. The concept of separation of powers and checks and balances has always occupied the mainstream position. The power of enterprise shareholders, board of directors and management should be reasonably allocated. The imbalance of rights will inevitably damage the interests of enterprises. Both sides carry out effective supervision only when the powers are fully checked and balanced. Therefore, it is better to focus on the impact of the company's central position in the ownership network on CSR, and explore the direct impact of corporate ownership structure on social responsibility behavior.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: https://www.gtarsc.com; https://www.hexun.com.

AUTHOR CONTRIBUTIONS

LQ, YX, and YG completed the research design together. LQ provided research assistance and support. YX and YG collected and analyzed the data and wrote the manuscript. All authors contributed to manuscript revision and agreed to publish the study.

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APPENDIX

TABLE A1 | Results of standardized regression analysis for corporate network position and CSR.

Var	CSR		EC		EN		SC	
DC	0.187*** (19.37)		0.171*** (17.84)		0.181*** (16.58)		0.069*** (7.54)	
SH		0.274*** (34.14)		0.258*** (32.21)		0.222*** (27.78)		0.130*** (12.14)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Ind	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES
obs	9,684	9,684	9,684	9,684	9,684	9,684	9,684	9,684
	0.2953	0.3334	0.3015	0.3374	0.2193	0.2351	0.102	0.114

*t-values are in parentheses; ***p < 0.001, **p < 0.01, *p < 0.05.*

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Does External Innovation Promote the Exports of Private Enterprises? A Market Stakeholder Perspective

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Using the theoretical perspective of market stakeholders, we analyze the impact of external innovations from upstream enterprises, downstream enterprises, and competitors on the exports of private enterprises. By using data from the China Industrial Enterprises Database, we find that external innovations from upstream suppliers, downstream customers and horizontal competitors show positive impacts on the export propensity, intensity and scale for private enterprises. The results of a heterogeneity analysis indicate that the positive relationships between the external innovations of stakeholders and the exports of private enterprises are stable in different factor-intensive industries. In addition, while the exports of private enterprises are positively correlated with their external innovations in the eastern and central regions, this relationship is not significant in the western region. Further, the mechanism analysis confirms that enterprise innovation played an important mediating role for the external innovations of stakeholders to promote the exports of private enterprises. This study provides useful policy implications for enhancing the export competitiveness of private enterprises.

Keywords: stakeholder, external innovation, private enterprises, export propensity, export intensity, export scale

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INTRODUCTION

In recent years, the prices of the exports of Chinese enterprises have been gradually becoming less competitive due to the continuous increases in the costs of land, wages, and other factors. While exports of traditional manufacturing and services such as clothing are facing fierce competition from countries and regions such as Southeast Asia, India, South America and Africa, China's export enterprises face increasingly stringent trade blockades and technology restrictions on high-tech intermediates (Essaji, 2008; Bao and Chen, 2013). Private enterprises have become the backbone of exports as their contribution to overall import and export growth has exceeded 50%. Thus, how to maintain and expand the exports of private enterprises has become a hot topic for both policymakers and scholars.

However, intensifying trade wars and tech blockades have put enterprises that lack independent innovation at greater risk of trade disruptions. Therefore, improving the competitiveness of enterprises' exported products and services through innovation has become a key path for private enterprises to move toward a higher position in the global value chain. According to the endogenous growth theory, innovation is the key factor that determines the export competitiveness of enterprises (Grossman and Helpman, 1993).

Innovation helps to meet the diversified needs of overseas consumers, thus enhancing the price competitiveness of exported products (Dai et al., 2020). It also helps to break the technology blockade and patent protection in developed countries, and it enables enterprises to export to a higher value chain (Jacobides et al., 2006). Overall, upgrading technology and product diversity through independent innovation can reduce production costs and overcome a foreign technology blockade, which further helps private enterprises obtain export advantages (Caldera, 2010). This view has been supported by extant studies, which have found that enterprise innovation has been the main driving force to promote upgrading the quality of enterprise exports and realizing the steady growth of export volume (Cockburn et al., 2016).

Prior studies have mainly focused on how an enterprise's own innovation has affected its exports, and they rarely have examined the role of the external innovation of market stakeholders. The term "market stakeholders" has been used to refer to upstream suppliers, horizontal competitors and downstream customers, which can affect other enterprises or be affected by others through market exchange (Sharma and Henriques, 2005; von der Heidt and Scott, 2011; Li et al., 2018).

In this study, we propose that the exports of private enterprise are not only affected by their own innovations, but also closely related to the external innovations of their market stakeholders. First, overseas customers' preferences and demands for the exported products are closely related to the innovation of the products, which depends not only on the innovation efforts of the enterprises themselves, but also on the innovation of the upstream and downstream enterprises and even the competitive enterprises.

For instance, the technological breakthroughs of the domestic upstream enterprises in the cutting-edge equipment, basic components and special materials can increase the technological complexity of enterprises' exported products and decrease the cost of intermediate products by breaking the foreign technological monopoly, thus enhancing the competitive advantages of export enterprises (Spencer and Raubitschek, 1996; Edeh et al., 2020). Moreover, the external innovations of market stakeholders may promote the exports of private enterprises by promoting the latter's innovation: the external innovations of market stakeholders are thought to promote the innovation of enterprises through mechanisms such as resource exchange, knowledge spillovers and pressure transmission (Li et al., 2018). And the innovation of enterprises can promote their exports (Faruq, 2010). Therefore, enterprise innovation may be an important mediating mechanism for external innovation to promote the exports of private enterprises.

For our analysis, we used data from the China Industrial Enterprise Database and calculated the degrees of external innovation of upstream suppliers, downstream customers and competitive enterprises (Li et al., 2018). We then undertook a three-phrased approach. First, we examined the effects of three types of external innovation on the export propensity, volume and intensity of private enterprises. Second, we analyzed the heterogeneity of the relationship between external innovations and private enterprise exports based on industrial and regional factors, which enriched the conclusions of our study. Third, we examined the mediating roles of enterprise innovation in the relationships between three types of external innovation and the exports of private enterprises. These conclusions provide useful policy implications for the comprehensive impacts of external innovations on the exports from the perspective of the value chain.

Our paper offers several contributions to the literature. First, by investigating the external innovation of stakeholders, we help expand our understanding of how stakeholder theory impacts enterprise behavior. According to the classical stakeholder theory, the competitive advantage of enterprises depends not only on their internal resources and capabilities, but also on the resource supply capacity and the quality of suppliers, customers, creditors and other stakeholders. On this basis, we directly locate the role of stakeholders in the field of innovation, and we discuss the relationship between external innovation and enterprise exports. While the extant literature has focused on whether the stakeholder orientation of enterprises contributes to their innovation (Gould, 2012; Flammer and Kacperczyk, 2016), we aimed to investigate how a stakeholder's innovation affects enterprise behavior (i.e., exports). Although Li et al. (2018) explored the relationship between the external innovation of market stakeholders and enterprise innovation, it seems that very little research has been done to link the external innovation of stakeholders with the exports of private enterprises. In this paper, we propose that stakeholders' external innovations can enhance the core competitiveness of private enterprises and thus promote their exports. This view enriches our understanding of the effect of stakeholders' theory on the behavior of enterprises.

Second, prior research has noted that technological innovation is an important method of enhancing the exports of private enterprises. We propose that the enhancement of export competitiveness of private enterprises is not only based on their own innovation, but also closely related to the external innovation of their market stakeholders. In other words, the innovation activities of upstream suppliers, downstream customers and competitors can improve the export performance of private enterprises. These conclusions supplement the prior literature, which has largely ignored the influence of stakeholders on enterprise exports. Thus, we provide a beneficial inspiration for private enterprises to promote their exports by encouraging external innovation of stakeholders.

The remainder of this paper is arranged as follows: The second section describes the literature and hypotheses; the third section discusses the research model and variable descriptions; the fourth section reports results; and the fifth section provides our conclusions and implications.

LITERATURE REVIEW AND HYPOTHESES

Since China joined the World Trade Organization in December 2001, Chinese enterprises – especially private enterprises – have quickly entered the global market with the advantages of low costs and a flexible response to market demands. Chinese private enterprises have mainly engaged in low-end value

chain activities with low-tech and labor-intensive characteristics (Levchenko, 2007; Nunn, 2007; Zhang et al., 2021), and their independent technological capabilities have been relatively weak. Thus, Hanson et al. (2005) suggested that the comparative advantage of Chinese enterprises in exports depends on the relatively low cost of labor and other factors, rather than the ability of independent innovation.

However, due to the continuous increase in factor costs (e.g., wages), the high growth of labor-intensive product exports is difficult for Chinese enterprises to maintain (Faruq, 2010; Zhang et al., 2021). Hence, the role of independent innovation in enterprise exports is increasingly valued by scholars in the field. Some studies have suggested that if an enterprise lacks independent innovation and core technology and relies too much on foreign technology transfer, it may be locked in the dilemma of a low-end value chain and mainly export primary processed products (Spencer and Raubitschek, 1996). Many studies based on the endogenous growth theory have proposed that independent innovation can help enterprises obtain export advantages (Caldera, 2010), as technological innovation can enhance the competitive advantage of products (Jin and Cho, 2018). The innovative activities of enterprises promote the upgrading of product appearances and functions, which helps enterprises enhance competitive advantages (Liu and Xie, 2020; Zhang et al., 2021). In particular, some primary innovations may help enterprises create a "blue ocean market" and thus break through the "low-end locking" trade dilemma (Aghion et al., 2005). However, enterprises can improve production efficiency and reduce production costs by transforming the production process in the hope of successfully competing on export prices (Yeaple, 2005). Therefore, enterprise innovation has been considered as a key factor in promoting the exports of private enterprises.

Based on the extant research, our paper investigates how the exports of private enterprises are affected by external innovation of market stakeholders. We propose that the external innovations of stakeholders can directly affect the exports of private enterprises. First, the innovation of upstream suppliers can provide enterprises with higher-quality raw materials and components, which is expected to improve the diversity and quality of exported products. In particular, breakthroughs in upstream core technologies can often disrupt foreign monopolies and significantly lower the prices of intermediate products imported from abroad, thus reducing the production costs of exporting enterprises (Spencer and Raubitschek, 1996). Second, the innovation of competitors and downstream enterprises can help to enhance the overall image and reputation of local enterprises, which may form a reputation spillover effect and promote the exports of enterprises. Therefore, we propose:

> H1: *External innovations by market stakeholders can significantly promote the exports of private enterprises.*

The stakeholder theory posits that external innovation of market stakeholders can promote enterprise innovation (Li et al., 2018) – that is, the external innovation of suppliers, customers and competitors promotes enterprise innovation through resource exchange, knowledge spillover and pressure transmission.

In terms of resource exchange and knowledge spillover mechanisms, upstream suppliers have the motivation to provide and share their innovative achievements to the enterprises, hoping to improve the latter's product competitiveness and increase their sales and establish a more stable supply-demand chain relationship (Takeishi, 2001). Similarly, to promote enterprises to provide higher quality products, local downstream customers are motivated to share their innovative ideas and achievements in product development, quality control and process design with enterprises (Li et al., 2018). An enterprise can also benefit by imitating and tracking competitors' innovations (Mowery et al., 1996).

In terms of a pressure transmission mechanism, the external innovation of stakeholders will bring innovation pressure to the enterprise. For example, the innovation of competitors will bring greater competitive pressure to the enterprise, while the innovation of upstream and downstream enterprises may also drive the enterprise to update its own technology and process; otherwise, customers and suppliers may switch to cooperate with other enterprises (Li et al., 2018). Thus, external innovation may force the enterprises to strengthen innovation activities.

Further, external innovation may promote enterprises' innovation by activating social norms of managers. Specifically, social norms describe that an individual's decision is often influenced by what most people actually do or ought to do (Cialdini et al., 1990; Yin et al., 2021). Thus, if market stakeholders such as competitors engage in extensive innovation activities, the enterprise managers may regard innovation activities as one types of social norm, and thus enhance the innovation activities of their own enterprises driven by the force of norm compliance.

Moreover, the extant literature has proposed that independent innovation of enterprises helps to promote their exports (Yeaple, 2005). Therefore, we propose that an enterprise's innovation may play an important mediating role between the external innovations of market stakeholders and exports of private enterprises – that is, external innovation can promote an enterprise's exports by promoting the latter's innovation.

> H2: *The enterprise innovation plays a significant mediating role in the relationship between the external innovations by market stakeholders and the exports of private enterprises.*

Accordingly, **Figure 1** shows the conceptual model of this study.

RESEARCH DESIGN

Data Description

We used data from the 1998–2010 China Industrial Enterprise Database released by the National Bureau of Statistics. However, data from 2004 and 2008 were dropped because of missing information for new product output (the independent variable). The enterprise sample covered 31 provinces and 43 industrial industries. Following Cai and Liu (2009), we deleted the samples

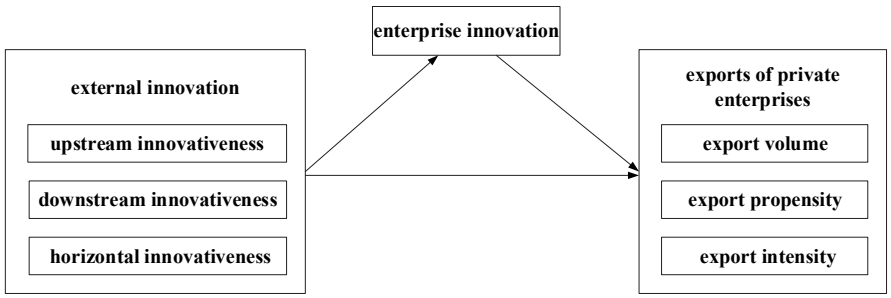

FIGURE 1 | Conceptual model.

with missing assets as well as those failing to meet the accounting standards, such as the samples in which total assets were less than current assets or net fixed assets, and the samples in which total assets were negative.

Variables

Dependent Variables

We measured the export behavior of private enterprises by three variables: *export volume*, *export propensity,* and *export intensity*. Export volume was measured by export delivery value. Export propensity was a dummy variable, which equaled 1 when the export delivery value was greater than 0; otherwise, it equaled 0. To control the impact of scale factors, we selected export intensity as a dependent variable. Export intensity was the ratio of the enterprise's export delivery value to the sales value; the higher the export intensity, the more inclined the enterprise would be to export.

Independent Variables

Similar to Li et al. (2018), we calculated three independent variables, i.e., *upstream innovativeness*, *downstream innovativeness* and *horizontal innovativeness,* to measure the degrees of external innovation of upstream enterprises (represented by suppliers), downstream enterprises (represented by customers) and competitive enterprises (in the same industry), respectively. The above independent variables were measured at the region-industry level – that is, the market stakeholders were from the same region and related industries (upstream industry, downstream industry and the same industry) the target export enterprise. The industry codes in this paper were based on the GB/T4754-2002.

Specifically, *horizontal innovativeness* was used to measure the degree of innovation of competitors, which was measured by the sum of new product output values of all enterprises in the same region-industry except for the target enterprises. The *upstream innovativeness* was the weighted average of the new product output value of all upstream industries in the same area, as shown in formula (1). *Upstream New Product Output*$_i$ represented the new product output value of upstream industry i in the region, and a_i was the ratio of the intermediates from the upstream industry i to the total intermediates. Compared to simply calculating the sum of new product output values of all upstream industries, the weighted average method of (1) can better describe the impact of upstream industry innovation on the industry.

Similarly, the calculation method of downstream innovativeness is shown in formula (2), where β_i represented the ratio of intermediate output (provided by the industry in which the target enterprise was located in relation to the downstream industry i) to total intermediate output (provided by the industry in which the target enterprise was located in relation to all downstream industries). The intermediate input of the upstream industry to the industry and the intermediate output provided by the industry to the downstream industry were from the national input-output basic table (the basic flow table in the input-output table) compiled by the National Bureau of Statistics in 2002, 2007, and 2012.

$$\begin{aligned} &\textit{Upstream Innovativeness} \\ &= \Sigma\, a_i^{*} \textit{Upstream New Product Output}_i \end{aligned} \tag{1}$$

$$\begin{aligned} &\textit{Downstream Innovativeness} \\ &= \Sigma\, \beta_i^{*} \textit{Downstream New Product Output}_i \end{aligned} \tag{2}$$

Control Variables

We used following control variables. (1) *Market concentration ratio* was calculated using the Herfindahl-Hirschman index (HHI) of a province. The lower the market concentration, the stronger the competition between enterprises in the same industry in the region, which may promote enterprises to seek overseas markets. (2) *Enterprise scale* was also used because it affects the production efficiency and anti-risk capacities of an enterprise (Ilmakunnas and Nurmi, 2010; Dai et al., 2020). A larger firm may have a higher export propensity and scale. In accordance with the "Measures for the Classification of Large, Medium and Small-sized Enterprises in Statistics (temporary)" issued by the National Bureau of Statistics, if an enterprise has more than 2,000 employees, the sales were more than 300 million yuan and the total assets were more than 400 million yuan, then the enterprise scale was 3; if the number of employees were between 300 and 2,000, the sales were between 30 million and 300 million yuan, and the total assets were between 40 million and 400 million yuan, then the enterprise scale value was 2; if the number of employees were less than 300, and the

sales and total assets were less than 30 million and 40 million respectively, the enterprise scale value was 0; in all other cases, the enterprise scale value was 1. (3) *Enterprise age*. The longer the enterprise had been in existence, the greater the possibility of exports (Disney et al., 2003). Therefore, the time distance from the year of enterprise establishment to the present was taken as the control variable. (4) We took *corporate financing constraints* and *capital intensity* as two control variables (Bellone et al., 2010; Zhang et al., 2018). We used the ratio of corporate accounts receivable to sales revenue to measure financing constraints, and we used the ratio of the annual average net value of fixed assets to the number of employees to measure corporate capital intensity. The two control variables were logarithmically processed. In addition, to weaken the influence of outliers on the regression results, we winsorized at the 1 and 99% levels for the above variables.

RESULTS

Main Effect

The basic estimation model was:

$$Export\ Behaviors_{pif} = a_0 + \beta Innovativeness_{pi} + \beta' X + \mu_{year} + \mu_{firm} + \varepsilon_{pif}$$

In this model, *p, i,* and *f* represented different provinces, industries and enterprises, a_0 was the intercept term; u_{year} and u_{firm} represented the year fixed effect (Year FE), firm fixed effect (Firm FE), ε_{pif} was the random disturbance term, and X represented the six control variables. $Export\ Behaviors_{pif}$ represented three enterprise-level dependent variables for measuring enterprise exports, namely export propensity, volume and intensity. $Innovativeness_{pi}$ included three independent variables: upstream, downstream and horizontal innovation. Three dependent variables and three independent variables were combined to obtain nine regression estimation models, as shown in **Table 1**. In **Table 1**, models (1) – (3), (4) – (6), (7) – (9) display the regression results of external innovation on export propensity, volume and intensity, respectively.

The results in **Table 1** demonstrate that the external innovations of stakeholders were helpful to promote the exports of private enterprises. Whether it were upstream suppliers, downstream customers or horizontal competitors, their innovation activities could promote the export tendency, volume and intensity of private enterprises, and the above relationships were all significant at the 1% level. These results were consistent with Hypothesis 1, which indicated that an enterprise's upstream and downstream innovations were conducive to improving the diversity and technical standards of an enterprise's exported products, breaking the monopoly of developed countries and reducing the price of intermediate products. The competitors' innovation also was conducive to improving the overall reputation and image of product manufacturing in the region and industry, thereby enhancing the exports of private enterprises.

In addition, the regression coefficients of control variables indicated that export propensity, volume and intensity had significant positive correlations with the age and size of enterprises, indicating that larger and more mature enterprises were more likely to export. The regression coefficients of financing constraints and capital intensity were significantly negative, indicating that financial constraints may hinder the exports of private enterprises.

Robustness Test and Heterogeneity Analysis

Robustness Test

Based on the basic estimation model in **Table 1**, two robustness tests were conducted, and the results were given in **Table 2**. First, the intermediate input of the upstream industry to the industry and the intermediate output provided by the industry to the downstream industry were processed by the extrapolation and interpolation methods (Casciaro and Piskorski, 2005; Li et al., 2018), which linearly extrapolated the input-output data of other years by the input-output tables of 2002, 2007, and 2012 (**Table 2**, Model 1). Second, we expanded the sample range of private enterprises, to include all enterprises except foreign-funded enterprises and state-owned enterprises (**Table 2**, Model 2). Specifically, if the proportion of state-owned capital were more than 50%, it was regarded as a state-owned enterprise, and if the foreign capital were more than 25%, it was regarded as a foreign enterprise. The results in **Table 2** report that, after expanding the sample range and changing the calculation method, the regression coefficients of upstream, downstream and degree of horizontal innovation on private enterprises' export propensity, volume and intensity were all positive and significant at the 1% level. This indicated that the research findings in our paper are robust.

It appears that after the expansion of the sample range of private enterprises in **Table 2**, the degree of impact of the regression coefficients on the exports of private enterprises was generally smaller in **Table 2** than in **Table 1**. Thus, we speculate that the influence of stakeholders' external innovation on the exports of private enterprises was larger than that of other types of enterprises, as the private enterprises in **Table 2** may have included other types of capital such as state-owned and collective capital, which may be affected by factors such as government intervention. This may have inhibited the influence of the stakeholders' external innovation on their exports. In contrast, purely private enterprises were more sensitive and responsive to market changes in business decision-making, so they could better adapt to the market's role in allocating resources as well as in learning and obtaining knowledge and technical resources from the stakeholders' external innovation. In other words, they seemed to have a stronger ability and motivation to improve their

TABLE 1 | Regression results of upstream, downstream, and horizontal innovation on exports of private enterprises.

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	**Export propensity**			**Export volume**			**Export intensity**		
Upstream innovativeness	0.7180*** (0.012)			0.4647*** (0.007)			0.0059*** (0.000)		
Downstream innovativeness		0.6459*** (0.012)			0.4092*** (0.007)			0.0047*** (0.000)	
Horizontal innovativeness			0.4130*** (0.009)			0.1033*** (0.002)			0.0012*** (0.000)
Market concentration	0.7861** (0.396)	1.0253*** (0.393)	2.1589*** (0.399)	0.3341*** (0.108)	0.3872*** (0.108)	0.4336*** (0.109)	–0.0016 (0.005)	–0.0011 (0.005)	–0.0006 (0.005)
Enterprise size	0.6597*** (0.092)	0.6647*** (0.091)	0.6635*** (0.091)	0.4615** (0.052)	0.4682*** (0.052)	0.4667*** (0.052)	0.0113*** (0.002)	0.0114*** (0.002)	0.0113*** (0.002)
Enterprise age	0.0120*** (0.003)	0.0098*** (0.003)	0.0101*** (0.003)	0.0036*** (0.001)	0.0031** (0.001)	0.0037*** (0.001)	0.0001** (0.000)	0.0001** (0.000)	0.0001** (0.000)
Enterprise finance constraints	–0.0176** (0.009)	–0.0165* (0.009)	–0.0214** (0.009)	–0.0266*** (0.003)	–0.0261*** (0.003)	–0.0250*** (0.003)	–0.0004** (0.000)	–0.0004** (0.000)	–0.0003* (0.000)
Enterprise capital intensity	–0.0468*** (0.011)	–0.0363*** (0.011)	–0.0453*** (0.011)	–0.0279*** (0.005)	–0.0251*** (0.005)	–0.0302*** (0.005)	–0.0017*** (0.000)	–0.0017*** (0.000)	–0.0018*** (0.000)
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	102319	102319	102319	701173	701173	701173	700679	700679	700679
R^2				0.8332	0.8326	0.8310	0.8586	0.8585	0.8584

*Robust standard errors are reported in parentheses. ***p < 0.01; **p < 0.05; *p < 0.1. Logit models are used in (1) – (3).*

exports through learning and responding to the stakeholders' external innovation.

Heterogeneity Analysis

We further analyzed the industrial and regional heterogeneities of the relationship between private enterprise exports and external innovation. **Table 3** divides the samples into labor-intensive, capital-intensive and technological capital-intensive industries. The results showed that the external innovations of stakeholders (upstream innovativeness, downstream innovativeness and horizontal innovativeness) were significantly and positively correlated with private enterprises' export propensity, volume and intensity, which indicates that the findings in our study are robust in different factor-intensive industries.

Table 4 also classifies the regions where the sample enterprises were located into the eastern, central and western regions, and explores the effects of the external innovations of upstream and downstream industries and competitors in different regions on the exports of private enterprises. The results show that in the eastern and central regions, export propensity, volume and intensity of private enterprises were positively correlated with external innovations of upstream and downstream market stakeholders and competitors. However, the positive relationship between private enterprises' export and external innovations in the western region was relatively weak: the relationships between private enterprises' export propensity, volume, intensity and horizontal innovation in the western region were not significant, nor were the relationships between export intensity and upstream, downstream innovation.

Mechanism of Enterprise Innovation

In Hypothesis 2, we asserted that the relationships between the exports of private enterprises and external innovations of stakeholders would be affected by the mediating role of enterprise innovation, because enterprise innovation is an important way to improve the competitiveness of exported products and services (Cockburn et al., 2016). Moreover, external innovations of stakeholders promote enterprise innovation through mechanisms such as resource exchange, knowledge spillover and pressure transmission (Li et al., 2018). Accordingly, **Table 5** examines the mediating effects of enterprise innovation in the relationship between three types of external innovation (upstream, downstream and horizontal) and the exports of private enterprises. The basic estimation results in **Table 1** indicate that the main effects of these three types of external innovation on the exports of private enterprises were significantly and positively correlated at the 1% level.

Based on the above findings, Model (1) in **Table 5** shows that the regression coefficients of enterprise innovation and the three types of external innovation were significantly positively correlated at the 1% level. And Models (2) – (4) indicate that enterprise innovation had positive effects on private enterprises' export propensity, which indicated that enterprise innovation played a mediating role in the relationships between the three types of external innovations and the export propensity of the private enterprises. As the regression coefficients of the three types of external innovations also were significant, enterprise innovation played a partially mediating role.

Similarly, in **Table 5**, Models (5)–(10) indicate that the partial mediating effects of enterprise innovation were also supported in the relationships between the three types of external innovations of the stakeholders and the export volume and export intensity of private enterprises, and this effect ranged from 14.47 to 37.55%. These results indicate that the external innovations of market stakeholders not only directly promoted the exports of private

TABLE 2 | Robustness tests.

Variables	Export propensity		Export volume		Export intensity	
Model	**Robustness 1**	**Robustness 2**	**Robustness 1**	**Robustness 2**	**Robustness 1**	**Robustness 2**
Upstream innovativeness	0.3190*** (0.008)	0.6124*** (0.008)	0.1468*** (0.004)	0.3849*** (0.005)	0.0018*** (0.000)	0.0054*** (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	0.8467	0.8514	0.8691	0.8711
Downstream innovativeness	0.3082*** (0.008)	0.6173*** (0.008)	0.1397*** (0.004)	0.3962*** (0.005)	0.0015*** (0.000)	0.0048*** (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	0.8466	0.8513	0.8691	0.8710
Horizontal innovativeness	0.4136*** (0.009)	0.3387*** (0.005)	0.0999*** (0.002)	0.0954*** (0.002)	0.0012*** (0.000)	0.0013*** (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	0.8465	0.8502	0.8691	0.8710
N	102994	269529	762602	1568031	762039	1566322

*Robust standard errors are reported in parentheses. ***p < 0.01. Logit models are used in (1) – (2).*

TABLE 3 | Heterogeneity analysis by industry.

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Export propensity			Export volume			Export intensity		
Type	Labor intensive	Capital intensive	Capital and technology intensive	Labor intensive	Capital intensive	Capital and technology intensive	Labor intensive	Capital intensive	Capital and technology intensive
Upstream innovativeness	0.6926*** (0.022)	0.8721*** (0.022)	0.7743*** (0.028)	0.5231*** (0.014)	0.5980*** (0.012)	0.4326*** (0.016)	0.0058*** (0.001)	0.0069*** (0.000)	0.0054*** (0.001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8342	0.8365	0.8372	0.8537	0.8649	0.8657
Downstream innovativeness	0.5438*** (0.019)	0.8728*** (0.022)	0.6556*** (0.026)	0.3706*** (0.012)	0.5905*** (0.012)	0.3461*** (0.014)	0.0032*** (0.001)	0.0065*** (0.000)	0.0042*** (0.001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8334	0.8363	0.8368	0.8536	0.8649	0.8657
Horizontal innovativeness	0.3339*** (0.015)	0.5052*** (0.016)	0.5276*** (0.024)	0.1133*** (0.005)	0.0888*** (0.003)	0.1827*** (0.010)	0.0012*** (0.000)	0.0008*** (0.000)	0.0030*** (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8322	0.8324	0.8362	0.8536	0.8647	0.8657

*Robust standard errors are reported in parentheses. ***$p < 0.01$. Logit models are used in (1) – (3).*

TABLE 4 | Heterogeneity analysis by region.

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Export propensity			Export volume			Export intensity		
Type	eastern region	Central region	Western region	eastern region	Central region	Western region	Eastern region	Central region	Western region
Upstream innovativeness	0.1517*** (0.018)	1.2836*** (0.034)	0.1881* (0.108)	0.0913*** (0.008)	1.0196*** (0.012)	0.0376** (0.017)	0.0040*** (0.000)	0.0090*** (0.000)	0.0001 (0.001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8428	0.7592	0.7990	0.8589	0.8176	0.8183
Downstream innovativeness	0.0580*** (0.017)	1.4238*** (0.037)	0.3065*** (0.116)	0.0484*** (0.007)	1.0640*** (0.013)	0.0501*** (0.017)	0.0021*** (0.000)	0.0098*** (0.000)	0.0010 (0.001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8427	0.7598	0.7990	0.8589	0.8177	0.8184
Horizontal innovativeness	0.0655*** (0.012)	0.6673*** (0.024)	– 0.0029 (0.037)	0.0267*** (0.003)	0.1624*** (0.004)	0.0008 (0.004)	0.0010*** (0.000)	0.0014*** (0.000)	– 0.0001 (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	—	—	—	0.8427	0.7215	0.7980	0.8589	0.8162	0.8183

*Robust standard errors are reported in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Logit models are used in (1) – (3).*

TABLE 5 | The mediating effect tests of enterprise innovation.

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Innovation**		**Export propensity**			**Export volume**			**Export intensity**	
Upstream Innovativeness	0.3572*** (0.005)	0.4542*** (0.014)			0.3909*** (0.006)			0.0044*** (0.000)		
Downstream innovativeness	0.2797*** (0.000)		0.3993*** (0.013)			0.3500*** (0.006)			0.0036*** (0.000)	
Horizontal innovativeness	0.1048*** (0.000)			0.2081*** (0.009)			0.0802*** (0.002)			0.0007*** (0.000)
Enterprise innovation		0.2754** (0.005)	0.2861*** (0.005)	0.3040*** (0.005)	0.2065** (0.003)	0.2117*** (0.003)	0.2207*** (0.003)	0.0041*** (0.000)	0.0042*** (0.000)	0.0043*** (0.000)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mediating effect		—	—	—	15.87%	14.47%	22.39%	24.82%	24.99%	37.55%
N	701171	102319	102319	102319	701171	701171	701171	700677	700677	700677
R^2					0.8370	0.8367	0.8355	0.8591	0.8590	0.8590

*Robust standard errors are reported in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Logit models are used in (2) – (4).*

enterprises, but also indirectly promoted the exports of private enterprises by improving enterprise innovation.

CONCLUSION AND IMPLICATIONS

Based on the theoretical perspective of market stakeholders, this paper explored the effects of external innovations on the exports of private enterprises. We found that the external innovations of upstream suppliers, downstream customers and competitors significantly promoted the export propensity, volume and intensity of private enterprises. The heterogeneity analysis further illustrated that our results were robust in different factor-intensive industries. Moreover, compared with the western region, the positive effects of external innovations in the eastern and central regions on the exports of private enterprises were even more significant. In addition, we found that enterprise innovation was an important mediator in the relationships between stakeholders' external innovations and the exports of private enterprises.

Our research findings have several important policy implications. First, we found that the external innovation of stakeholders played important roles in stimulating the exports of private enterprises. This suggested that with the intensification of global trade disputes and the rapid rise of labor and land factor costs, it would be difficult to continue expanding exports by relying on low value-added activities. Thus, our findings highlight the necessity and urgency of maintaining and enhancing export competitiveness by promoting innovation. Therefore, government should firmly implement the innovation-driven strategy. More importantly, the relevant industrial policy incentives released by government should focus on a small number of key enterprises and aim to improve the innovation technology and technological level of the overall industrial chain. In particular, policies should focus on high-tech small and medium-sized enterprises in the upstream and downstream industries of key exported products and their product activities expected to make breakthroughs in basic components, special materials and key processes. By solving the weak links in the upstream and downstream industrial chains, we assert that an enterprise can achieve a higher position in the global value chain and thus enjoy more sustainable exports.

Second, we found that the positive effects of external innovations on the exports of private enterprises in the western region were weak, indicating that the channels for private enterprises in the western region to obtain new technologies, knowledge and talents from their stakeholders' external innovations were relatively blocked. This negatively impacted their export competitiveness. One important reason for these findings is that local governments in the western region were more likely to intervene in enterprise activities, resulting in a distortion of factor allocation and limiting the ability and motivation of private enterprises to obtain and transform innovative resources. Therefore, when implementing export and innovation industrial policies in the western region, it is necessary to coordinate the forces of the government and the market, so that the resources needed for innovation – such as new technologies,

processes, information and talents – can be exchanged more efficiently at the industrial and supply chain levels. This can enhance the overseas competitiveness of exported products and services. In addition, private enterprises should maintain close relationships with the upstream and downstream enterprises as well as pay attention to and track the innovation progress of the upstream and downstream enterprises and competitors. Overall, they can transform the external innovation achievements of stakeholders into a major force to improve the technological complexity and price competitiveness of their exports.

We used data from the 1998 to 2010 China Industrial Enterprise Database in this study. However, with the change of trade environment and economic development level, the relationship between external innovation and exports of private enterprises may be influenced. Therefore, whether our findings can explain the latest corporate practices requires further support from updated data.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Data analyzed in this study is from China industrial enterprise database released by the national bureau of statistics, which can only be obtained by purchasing database. Requests to access these datasets should be directed to JH, haojie@mail.zjgsu.edu.cn.

AUTHOR CONTRIBUTIONS

SC and JH designed the research model. SC, XJ, and YW wrote the manuscript. XJ analyzed data. All authors approved the manuscript for publication.

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Inter-Firm Executive Mobility and Corporate Social Responsibility: Evidence From China

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The executives of listed firms play an important role in the fulfillment of corporate social responsibility (CSR). Based on behavioral consistency theory, this study examines the association of CSR performance among multiple firms for the same executive served at different times. By tracking the movement of executives across Chinese listed firms over the period 2010–2019, we find that there is a significantly positive association between the predecessor and the successor firm's CSR performance for the same executive, implying that an individual's value and preference for CSR maintain consistency within a certain period of time. We also find that a longer employment gap and lower internal control effectiveness will damage the association of CSR performance between the predecessor and the successor firm. Our results are robust to testing in subsamples and controlling the endogeneity problems. Our conclusion provides a new perspective to understand the influence mechanism of CSR performance in the context of inter-firm executive mobility and provides empirical evidence for listed firms to improve their decision-making in hiring and evaluating executives.

Keywords: corporate social responsibility, executive turnover, inter-firm mobility, behavioral consistency theory, employment gap

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INTRODUCTION

Corporate social responsibility (CSR) has become the focus of public attention from practice and academia since the 1980s (Lee and Carroll, 2011). In accordance with McWilliams and Siegel (2001), we define CSR as "actions that appear to further some social good, beyond the interests of firms and that which is required by law". A remarkable CSR fulfillment can promote a firm's long-term sustainable development because it is conducive to satisfying the demand of numerous stakeholders including shareholders, employees, customers, suppliers, and local community organizations (Freeman, 1984). To strengthen Chinese listed firms' attitude to fulfill their social responsibility, China Securities Regulatory Commission (CSRC) introduced guidelines on the social responsibility of listed firms in 2006. However, the overall CSR performance of Chinese listed firms has not met expectations. As a result, it is of great theoretical and practical significance to explore how to enhance the listed firms' willingness to fulfill CSR and improve the quality of CSR practices in an emerging market (Yin and Zhang, 2012; Rauf et al., 2021).

Executive turnover is necessary for the process of firm development and strategy realization. The statistics in this study show that an average of 32.3% of Chinese listed firms experience executive turnovers each year between 2010 and 2019.[1] As a major strategic adjustment of the firm, the

[1]Executives in this study refer to all members of the management team disclosed in the annual reports of listed firms.

dismission of old executives and the succession of new ones will have a certain degree of impact on CSR performance (Meng et al., 2013; Bernard et al., 2018; Rauf et al., 2021). However, the above studies only focus on the changes in CSR performance of a single firm before and after executive turnover. For example, Meng et al. (2013) and Bernard et al. (2018) show that the impact of executive turnover on CSR performance differs with the reasons for leaving and the types of succession. Rauf et al. (2021) further provide evidence on the role of corporate political embeddedness in the association between a firm's executive turnover and the quality of its CSR disclosure. Since executive turnover may lead to inter-firm executive mobility, we can identify the predecessor firm and the successor firm for a certain executive and further explore the resemblance in CSR performance of the same executive's predecessor and successor firm, which will deepen our understanding of the relationship between executive turnover and CSR performance.

According to behavioral consistency theory in social psychology, individual behavior and decision preference may display certain similarity and consistency in diverse settings (Allport, 1966; Epstein, 1979). In line with this theory, the executives' idiosyncrasies are influenced by their early experiences to some extent and cause them to make the same or similar behavioral decisions in different situations. A range of empirical findings indicate that cross-firm executives exhibit distinctive styles in corporate policies and operational decisions (Bertrand and Schoar, 2003; Bamber et al., 2010; Dyreng et al., 2010; Ge et al., 2011; Wells, 2019). For these reasons, we believe that the CSR fulfillment is likely to reflect executives' value and preference for social responsibility which may not vary significantly in the short term. Hence, as executives switch jobs to another firm, their CSR styles will impose an influence on CSR fulfillment and performance of their successor firms.

Nevertheless, adaptation-level theory states that individuals adapt their behavior in response to the changing environmental conditions (Helson, 1964; Wohlwill, 1974). When executives change to work at a new firm, in order to alleviate the stimulation and pressure rising from the new organizational environment, they may adjust their behavior accordingly, thereby reducing threats and enhancing their chances of survival. They may also learn from past failures and proactively change their behavior to improve decision accuracy (Zollo and Singh, 2004; Madsen and Desai, 2010; Gong et al., 2019). Consequently, it is an empirical question whether executives' CSR fulfillment will remain relatively stable under the influence of their early experiences and personality traits, or will change in compliance with the new organizational environment.

By tracking the movement of executives across Chinese listed firms from 2010 to 2019, we find a significantly positive association between the predecessor and the successor firm's CSR performance when they are served by the same executive at different times even if they are totally distinct firms, supporting behavioral consistency theory. Furthermore, we find that the association of CSR performance between the predecessor and the successor firm is negatively moderated by a longer employment gap and lower internal control effectiveness. Our results are robust to a series of robustness tests, including subsample tests, Propensity Score Matching (PSM) method, Heckman two-stage model, and Two-Stage Least Squares (2SLS) approach.

Our study contributes to the extant literature in several ways. Firstly, existing researches mainly focus on the determinants and economic consequences of executive turnover from the perspective of a single firm, such as the impact of incoming executives on a firm's accounting policy choices and financial performance (Moore, 1973; Murphy and Zimmerman, 1993; Pourciau, 1993; Kato and Long, 2006; Chang and Wong, 2009). Only a few studies further explore where executives are re-employed after their departures from the prior employers, however, most of them focus only on executives' ship jumping behavior from distressed firms (Fee and Hadlock, 2003; Marcel and Cowen, 2014; Jiang et al., 2017). This study extends to investigate the relevance of executives' decision-making between the predecessor and the successor firm by tracking their movements across Chinese listed firms and finds a strong behavioral consistency between incoming executives' decisions (especially those related to CSR) in the new firms and their previous work experience, expanding the research perspective of executive turnover studies.

Secondly, a number of studies underline that certain characteristics of a firm play an important role in CSR performance (Roberts, 1992; Artiach et al., 2010; Khan et al., 2013). Some studies also find that executives' heterogeneity such as demographic characteristics and personality traits will influence their participation in CSR activities (Manner, 2010; Chin et al., 2013; Tang et al., 2015; Petrenko et al., 2016; McGuinness et al., 2017; Davidson et al., 2018; Yuan et al., 2019; Shaheen et al., 2021). However, few studies have examined the impact of executives' past experience in CSR practice in prior firms on the current firm's CSR performance. Task-specific human capital theory holds that not all experiences and skills are useful for a person's job, only relevant ones matter (Gibbons and Waldman, 2004). Custódio et al. (2013) also stress the importance of relevant work experience. In this study, we explore the impact of executives' specific experience in CSR practice when they held similar positions in the predecessor firms on the CSR performance of the successor firms, enriching the literature on CSR determinants at the individual level.

Our findings also have significant implications for the design of appropriate employment and talent evaluation system for listed firms. Bernard et al. (2018) state that shareholders' expectations on CEOs are not solely economic and financial but also concern the CSR performance, and they tend to hire new CEOs and urge them to strengthen CSR fulfillment. They also suggest that CEOs should be evaluated on the basis of CSR performance and not just on accounting and stock performance. Our study provides a new perspective to recognize the value of executives' past experience in CSR practice, which echoes the view of Bernard et al. (2018) and provides empirical evidence for the executive hiring decisions of listed firms.

The remainder of this manuscript is organized as follows. First, the literature review and hypotheses development are discussed. Then, we present the research design, followed by the empirical results, additional analyses, and robustness tests. Finally, we conclude and discuss future research opportunities.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Corporate social responsibility is generally considered to be a firm's voluntary activities on social, environmental, and ethical issues (Carroll, 1999). Over the past two decades, many studies focus on the drivers of a firm's CSR performance. At the firm level, high profitability and better financial performance allow a firm for superior CSR performance since they are more affordable (McGuire et al., 1988; Pava and Krausz, 1996). Larger size and higher visibility motivate firms to engage in more CSR activities because they attract greater attention from the public (Chiu and Sharfman, 2011; Dhaliwal et al., 2011; Wang and Qian, 2011). Campbell (2007) interprets the influencing factors of CSR performance at the institutional level and suggests that a firm's engagement in CSR activities is likely to be affected by the regulations, economic conditions, and industry practices.

As the decision-maker of listed firms, executives are closely related to the fulfillment and performance of CSR. A growing number of literature have focused on how the demographic characteristics and personality traits of corporate executives influence CSR fulfillment. For instance, Chin et al. (2013) examines executives' political ideologies and finds that compared with conservative CEOs, liberal CEOs exhibit greater advances in CSR performance and tend to emphasize CSR practices even if recent financial situation is relatively poor. Tang et al. (2015) affirm that with overestimation of their own capability, hubristic CEOs are inclined to neglect resource dependence on stakeholders, resulting in a lower degree of engagement in CSR practices. Using a sample of Chinese listed firms, McGuinness et al. (2017) find that the appointments of female officers as senior managers are more likely to realize better CSR outcomes. Researchers also suggest that executives' narcissism, materialism, and managerial ability significantly influence CSR performance (Petrenko et al., 2016; Davidson et al., 2018; Yuan et al., 2019).

Behavioral consistency theory posits the persistence of individual behavior in different situations (Allport, 1966; Epstein, 1979). By tracking senior managers across different firms over time, Bertrand and Schoar (2003) assert that each executive possesses a unique and stable managerial style, namely manager fixed effects, which usually matter in operational and financial policies. Many researchers follow this study and examine the importance of managerial styles in corporate decisions such as investment and financing decisions, financial information disclosures, and accounting policy choices (Bamber et al., 2010; Dyreng et al., 2010; Ge et al., 2011; Francis et al., 2013; Wells, 2019).

Based on this theory, in addition to the personal characteristics mentioned above, the cognitive and behavioral patterns will also be driven by executives' professional experience, then influencing the decision-making in other firms (Elsaid et al., 2011; Dittmar and Duchin, 2016; Chen et al., 2017; Georgakakis and Ruigrok, 2017; Enkhtaivan and Davaadorj, 2021). For example, Elsaid et al. (2011) examine that stock market reacts positively to the hiring of an outsider with prior CEO experience. Georgakakis and Ruigrok (2017) argue that outsider CEOs with experience from a variety of industries will be better to transfer diverse industry-specific knowledge to the organization, resulting in superior financial outcomes. Enkhtaivan and Davaadorj (2021) find that the corporate liquidity policy of an executive's predecessor firm is significantly positively correlated with that of his successor firm. All these studies provide evidence that individual behavior of executives are consistent across different situations.

Given the above discussion, personal value and behavioral preference of executives cultivated or displayed in their previous organizations is likely to persist even if they switch jobs. It will pose a potential influence on their decision-making in the new organizational environment, which causes a certain resemblance between the predecessor and the successor firm in some ways. Therefore, we argue that when an executive moves to another firm, his value and preference for CSR reflected in the predecessor firm will maintain consistency and lead to similar decisions and practices about CSR at the successor firm. Given these arguments, we put forward a hypothesis as follows:

Hypothesis 1: Ceteris paribus, there is a significant positive association between the CSR performance of the predecessor and the successor firm for the same executive.

There is usually an interval of time during an executive's position change between different firms, namely, the employment gap. Understanding executive's employment gap is important because the prevalence and the length of employment gaps indicate a certain amount of frictions in the labor market (Ertimur et al., 2018). In China, the phenomenon of executive's employment gap is very common. The statistical results in this study show that 60.1% of executives experience an employment gap in the process of inter-firm mobility, with an average duration of 1.4 years from 2010 to 2019.

Marquis and Tilcsik (2013) suggest that the persistence of an individual's behavior gradually decays over time. Since the employment gap is often accompanied by work interruptions, it is more likely to lead to a deterioration in the consistency of individual behavior. Previous studies indicate that the presence and the length of the employment gap has a significant impact on the quality of executive-firm matching as well as executive compensation in the successor firms (Edin and Gustavsson, 2008; Kroft et al., 2013; Ertimur et al., 2018). Chen et al. (2017) find that the persistence of earnings management behavior of executives also decreases as the employment gap between their tenures at the two firms increases.

In addition, reinforcement learning theory proposes that repetition can promote the formation of individual reflexive behavior, enhance the mastery of knowledge, and improve confidence (Erev and Roth, 1998). Hence, executives' decision-making can also be reinforced by continuous repetition. For example, Dittmar and Duchin (2016) find that CEOs who experience continual financial distress in their predecessor firms are likely to make more conservative financial policies in their successor firms. Edin and Gustavsson (2008) also show that sitting out of the job market can lead to a decline in executives' skills as they have not been used and updated for some time.

As a result, for executives who experience a longer employment gap and have not made similar decisions for a long time, their decisions would be less influenced by the professional experience in the predecessor firms when they subsequently encounter similar situations at the successor firms.

In conclusion, we argue that in the context of executives' inter-firm mobility, a longer employment gap would inhibit the executives' behavioral consistency on the CSR fulfillment, which in turn weakens the positive association between the CSR performance of the predecessor and the successor firm. Given these arguments, we put forward a hypothesis as follows:

Hypothesis 2: Ceteris paribus, a longer employment gap weakens the positive association between the CSR performance of the predecessor and the successor firm for the same executive.

As stated in adaptation-level theory, individual behavior will change according to the changing environment (Helson, 1964; Wohlwill, 1974). As a result, in addition to the moderating effect of the employment gap which is a feature at the individual level, the differences in some firm-level characteristics of the predecessor and the successor firm may also affect the relationship between the CSR performance of these two firms.

Since fulfilling CSR means that firms undertake multiple social responsibilities to numerous stakeholders, they will try to create a public image of compliance with laws and regulations, transparency, and profit maximization while sustainable development. In order to achieve this goal, the firms need to establish a corresponding internal system (Hao et al., 2018; Li et al., 2018). As an important and comprehensive institutional arrangement of listed firms, the internal control system can effectively avoid business risks by supervising and correcting the production and operation process (Spira and Page, 2003; Doyle et al., 2007).

In recent years, Chinese listed firms are attaching importance to the construction of internal control systems to achieve sustainable development. In the "*Application Guidelines No. 4 of Enterprise Internal Control—Social Responsibility*" issued by the Ministry of Finance of China, it is specified that listed firms should fulfill their social responsibility and obligations, mainly including safety production, product quality, environmental protection, and employment promotion, which implies that CSR should be considered as a part of internal control. Therefore, it is an important function of internal control to supervise the fulfillment of CSR and safeguard the legitimate rights and interests of stakeholders.

Previous studies also provide empirical evidence that an effective internal control system can improve CSR performance because it prevents misconduct that damage corporate reputation and public image, thereby controlling social responsibility risks and promoting the successful realization of the strategic goals of CSR practice (Hao et al., 2018; Li et al., 2018). Kim et al. (2017) find that CSR firms are more likely to have an effective internal control system and less likely to have material internal control weaknesses. Moreover, internal control is generally considered as an integral component of corporate governance (Hoitash et al., 2009). Compared with firms with inferior corporate governance which are more susceptible to a material internal control weakness, a well-governed firm performs better in social responsibility due to the advantages in CSR initiatives, information processing, management monitoring, and other corporate behaviors (Johnson and Greening, 1999; Jo and Harjoto, 2011; Lau et al., 2016).

In conclusion, we argue that in the context of executives' inter-firm mobility, the successor firm's more effective internal control system than the predecessor firm could reduce executives' risk-taking behaviors and raise their initiatives to engage in CSR activities in the new working environment, which in turn strengthens the positive association between the CSR performance of the predecessor and the successor firm. Given these arguments, we put forward a hypothesis as follows:

Hypothesis 3: Ceteris paribus, a higher level of internal control system strengthens the positive association between the CSR performance of the predecessor and the successor firm for the same executive.

RESEARCH DESIGN

Data Source and Sample Selection

The sample examined in this manuscript includes Chinese listed firms publicly traded in Shanghai and Shenzhen Stock Exchanges and all their executives (including directors, supervisors, and senior management) disclosed in the annual reports. The sample period is 2010–2019 due to the data availability in the database. The data on listed firms' executive information and other financial and fundamental characteristics used in this manuscript are from the China Stock Market Accounting Research (CSMAR) database. The database contains a list of all executives for each listed firm each year, from which we can observe an executive's tenures in all listed firms and further identify an executive's inter-firm mobility (if any). The CSR performance data and internal control index are obtained from Hexun.com and Shenzhen Dibo Internal Control and Risk Management (DIB) database.

Table 1 reports the sample selection process. Firstly, we construct our data to the "executive-firm-appointment year-departure year" level. We define the first (last) year in which an executive appeared in a listed firm during our sample period as the appointment (departure) year. If an executive was re-employed by a firm after leaving it for a period of time, it constitutes two observations in our sample.[2] For observations that the executive has been in a firm until the end of the sample period, we further check whether this executive still works at the same firm in the next year. The departure year is null if the executive is still with the firm in the following year. Since we focus on the inter-firm executive mobility, the research sample is limited to executives who have worked in at least two listed firms, with a total of 56,280 observations.

[2]We also exclude observations that the predecessor and the successor firm are the same one to check the robustness in section "Subsample Tests."

TABLE 1 | Sample selection process.

	Observations
Sample of executive turnover from 2010 to 2019 with "executive-firm-appointment year-departure year" level data	56,280
Dropped: observations with non-sequential turnover	19,139
Dropped: observations with tenure less than 1 year	2,085
Remaining sample	35,056
Reorganized into "executive-predecessor firm-successor firm" level data	17,528
Number of listed firms involved	3,452
Number of individual executives involved	6,108
Dropped: observations with missing data	1,048
Dropped: singleton observations	537
Final sample	15,943

Secondly, in order to eliminate the influence of concurrent positions of executives in different firms on the results, we drop 19,139 observations with overlapping periods for an executive in the predecessor and the successor firm. In other words, we need to ensure that all executives in our sample worked for the successor firms after they left the predecessor firms, namely, a sequential turnover.[3] We also drop 2,085 observations that the newly-appointed executive served in the successor firm for less than 1 year because the former executive might have a certain impact on corporate decisions and it might be difficult for the newly-appointed executive to have an impact on the CSR performance in a short tenure.

Thirdly, we reshape the data structure of the remaining 35,056 observations into the "executive-predecessor firm-successor firm" level for the following analyses, resulting in 17,528 (35,056/2) observations. It involves 3,452 listed firms and 6,108 individual executives (including 2,872 executives who move between two firms and 3,236 executives who move between more than three firms during our sample period). Last, we drop another 1,048 observations due to missing values of variables and 537 singleton observations after including fixed effects. The final sample consists of 15,943 observations.

Variable Definition and Model Construction

Dependent and Independent Variables

We define the CSR performance of the successor firm (*P_CSR*) as the dependent variable and the CSR performance of the predecessor firm (*F_CSR*) as the independent variable. In accordance with existing studies (Yang et al., 2019; Lu et al., 2020), we utilize the CSR score and rating from HeXun's CSR Assessment System for Listed Firms to measure the overall CSR performance. Distinct from the other measures merely relying on the social responsibility report, HeXun's CSR Assessment System refers to both the social responsibility report and the annual report of listed firms, which ensures that the data is more objective and comparable (Zhong et al., 2019). Specifically, *P_CSR_S* equals the CSR score of the successor firm in the first full year of the executive's employment (/100); *P_CSR_R* equals the CSR rating of the successor firm in the first full year of the executive's employment. The CSR rating is ranging from A (highest) to E (lowest). We define the rating of A as 5, B as 4, and so on. Similarly, the CSR performance of the predecessor firm is measured by the CSR score and rating in the last year of the executive's employment (*F_CSR_S/F_CSR_R*). The higher the CSR score and rating, the better the overall CSR performance.

Moderator Variables

In this study, we take the employment gap (*GAP*) and internal control quality (*ICQ*) as the moderator variables. Referring to the prior literature (Ertimur et al., 2018), we measure the employment gap in two ways. *GAP1* is an indicator variable that equals one if an executive worked in other listed firms during the gap between his appointments in two different firms, and zero otherwise.[4] *GAP2* is an indicator variable that equals one if the employment gap year is greater than or equal to the 75th percentile of the full sample, and zero otherwise. We apply DIB internal control index which is a comprehensive measure of the internal control quality of Chinese listed firms. The DIB internal control index is formulated by a third-party professional rating agency based on the internal control disclosure and assessment of Chinese listed firms (Li et al., 2020). As a composite index of COSO's five specific elements, this index is widely used in Chinese studies to measure the efficiency and effectiveness of internal control adoption (Wang et al., 2018; Chen et al., 2019). To compare the internal control level of the predecessor and the successor firm, we define *ICQ* as the difference between the internal control index (taking the natural logarithm) of the predecessor and the successor firm. A higher *ICQ* means that the successor firm's internal control system is more effective than the predecessor firm.

Control Variables

We control for a number of firm-level and individual-level variables in the regression models according to prior literature on CSR performance. For firm-level controls, we include *SIZE*

[3]To ensure the integrity of observations, when executives move between more than three firms, we match all these firms in pairs and identify sequential turnovers. For example, for an executive worked in firm A from 2000 to 2012, in firm B from 2013 to 2015, and in firm C from 2014 to the present, both "A to B" and "A to C" constitute our research sample.

[4]Due to data limitations, we are unable to determine whether executives worked in other non-listed firms during the employment gap, but this would not have a systemic impact on the results of this manuscript.

(=natural logarithm of total assets) as larger firms face greater public pressure to take social responsibility (Dhaliwal et al., 2011). We include *LEV* (=the ratio of total debts to total assets) since a firm's debts usually play a monitoring role (Leftwich et al., 1981). As firms with higher profitability and better financial performance have more resources to practice CSR activities (McGuire et al., 1988; Pava and Krausz, 1996), we include *ROA* (=the ratio of net profit to total assets) and *AGE* [=natural logarithm of (one plus) the number of years since the firm was established]. As state-owned firms have an obligation to participate in CSR activities (Chang et al., 2021), we include *SOE* (an indicator variable that equals one if the firm is controlled by the central or local government, and zero otherwise). Following Hussain et al. (2018), we control for corporate governance variables such as *BOARD* (=natural logarithm of the number of directors on board) and *INDDIR* (=the ratio of the number of independent directors to the number of directors on board).

For individual-level controls, in line with prior literature (Manner, 2010; Tang et al., 2015; Yuan et al., 2019), we include executives' personal characteristics such as *GENDER* (an indicator variable that equals one if the executive is male, and zero otherwise), *OLD* [=natural logarithm of (one plus) the age of the executive], and *EDUC* (an indicator variable that equals one if the executive has a postgraduate degree, and zero otherwise). We also include *POSITION* (an indicator variable that equals one if the executive is the firm's chairman, CEO and CFO, and zero otherwise) to examine whether core executives have a stronger impact on CSR performance.

To minimize the effect of a firm's CSR-related decisions in the recent past (Chin et al., 2013; Tang et al., 2015), we also control for the CSR performance of the successor firm before the appointment of the new executive (*PRECSR_S/PRECSR_R*). Although we have controlled many variables that may affect CSR performance according to existing literature, there may still be endogeneity problems due to missing variables. Therefore, we use firm fixed effects (FE_{FIRM}) to control for unobserved, time-invariant corporate characteristics. We also include year fixed effects (FE_{YEAR}) to control for time-varying factors that affect CSR performance[5]. For some models that are not applicable to control for firm fixed effects, we include industry fixed effects (FE_{IND}) and province fixed effects (FE_{PROV}) to control for heterogeneity across industries and provinces. **Table 2** shows the detailed variable description.

Model Setting

To examine the relationship between the CSR performance of the predecessor and the successor firm in the context of inter-firm executive mobility, we construct the following model:

$$P\_CSR = \alpha_0 + \alpha_1 F\_CSR + Controls + FE_{FIRM} + FE_{YEAR} + \varepsilon \quad (1)$$

[5]It should be noted that the data of this study are not panel data in the strict sense because a firm may have multiple incoming executives in a given year. In spite of this, the data still have the characteristics of panel data as it contains different firms in different time periods. Therefore, we can eliminate the problem of omitted variable bias by setting dummy variables for all firms and all years separately and incorporating them into the regression model (Tao, 2007).

The dependent variable *P_CSR* captures the CSR performance of the successor firm and the independent variable *F_CSR* captures the CSR performance of the predecessor firm. In this manuscript, the CSR score (*P_CSR_S/F_CSR_S*) and CSR rating (*P_CSR_R/F_CSR_R*) are selected as proxies of CSR performance. *Controls* are a vector of corporate and individual attributes that could affect a firm's CSR performance. FE_{FIRM} and FE_{YEAR} capture fixed effects of firm and year, respectively. The Hypothesis 1 holds if the coefficient of α_1 is significantly positive.

To examine the moderating effect of the employment gap on the relationship between the CSR performance of the predecessor and the successor firm, we construct the following model:

$$P\_CSR = \beta_0 + \beta_1 F\_CSR + \beta_2 F\_CSR \times GAP + \beta_3 GAP + Controls + FE_{FIRM} + FE_{YEAR} + \varepsilon \quad (2)$$

The moderator variable *GAP* has been discussed in section "Moderator Variables". $F\_CSR \times GAP$ is the interaction term of the CSR performance of the predecessor firm and the executive's employment gap. Other variables are consistent with Model (1). The Hypothesis 2 holds if the coefficient of β_2 is significantly negative.

To examine the moderating effect of the internal control quality on the relationship between the CSR performance of the predecessor and the successor firm, we construct the following model:

$$P\_CSR = \gamma_0 + \gamma_1 F\_CSR + \gamma_2 F\_CSR \times ICQ + \gamma_3 ICQ + Controls + FE_{FIRM} + FE_{YEAR} + \varepsilon \quad (3)$$

The moderator variable *ICQ* has been discussed in section "Moderator Variables". $F\_CSR \times ICQ$ is the interaction term of the CSR performance of the predecessor firm and the differences in the internal control quality between the predecessor and the successor firm. Other variables are consistent with Model (1). The Hypothesis 3 holds if the coefficient of γ_2 is significantly positive.

Since the interaction term in the moderating effect model is likely to covary with the separate terms to some extent, prior literature recommended the Mean-centering approach to alleviate collinearity related concerns (Cronbach, 1987). Therefore, we mean-center all independent variables that constitute the interaction term (*F_CSR*, *GAP*, and *ICQ*) in all moderating effect models in this manuscript to mitigate the potential threat of multicollinearity.

EMPIRICAL ANALYSIS AND RESULTS

Summary Statistics

Table 3 reports the summary statistics of the main variables. To minimize the effect of outliers and ensure the right skewness, all continuous variables are winsorized at 1 and 99% levels. In our sample, the mean (median) of the successor firms' CSR performance are 0.244 (0.231) for CSR score (*P_CSR_S*) and 2.099 (2.000) for CSR rating (*P_CSR_R*); the mean (median) of the predecessor firms' CSR performance are 0.269 (0.224) for CSR

TABLE 2 | Variable description.

Variable	Definition
P_CSR_S	The CSR score of the successor firm in the first full year of the executive's employment (/100).
P_CSR_R	The CSR rating of the successor firm in the first full year of the executive's employment. The CSR rating is ranging from A (highest) to E (lowest). We define the rating of A as 5, B as 4, and so on.
F_CSR_S	The CSR score of the predecessor firm in the last year of the executive's employment (/100).
F_CSR_R	The CSR rating of the predecessor firm in the last year of the executive's employment.
GAP1	Indicator variable that equals one if an executive worked in other listed firms during the gap between his appointments in two different firms, and zero otherwise.
GAP2	Indicator variable that equals one if the employment gap year is greater than or equal to the 75th percentile of the full sample, and zero otherwise.
ICQ	Natural logarithm of the internal control index of the successor firm – Natural logarithm of the internal control index of the predecessor firm.
SIZE	Natural logarithm of total assets.
LEV	The ratio of total debts to total assets.
ROA	The ratio of net profit to total assets.
AGE	Natural logarithm of (one plus) the number of years since the firm was established.
SOE	Indicator variable that equals one if the firm is controlled by the central or local government, and zero otherwise.
BOARD	Natural logarithm of the number of directors on board.
INDDIR	The ratio of the number of independent directors to the number of directors on board.
GENDER	Indicator variable that equals one if the executive is male, and zero otherwise.
OLD	Natural logarithm of (one plus) the age of the executive.
EDUC	Indicator variable that equals one if the executive has a postgraduate degree, and zero otherwise.
POSITION	Indicator variable that equals one if the executive is the firm's chairman, CEO and CFO, and zero otherwise.
PRECSR_S	The CSR score of the successor firm in the year before the new executive's employment (/100).
PRECSR_R	The CSR rating of the successor firm in the year before the new executive's employment.
FE_{FIRM}	Firm fixed effects.
FE_{YEAR}	Year fixed effects.
FE_{IND}	Industry fixed effects.
FE_{PROV}	Province fixed effects.

score (*F_CSR_S*) and 2.253 (2.000) for CSR rating (*F_CSR_R*). It indicates that there is a great variation in the CSR performance of Chinese listed firms. For the moderator variables, 58.7% of sample executives had worked in other listed firms during the gap between his appointments in two different firms (*GAP1*) and 37.1% of sample executives' employment gap is more than 3 years (75th percentile of the full sample) (*GAP2*). Moreover, the internal control quality of the successor firm is generally weaker than that of the predecessor firm. The descriptive statistics of control variables are similar to the previous literature.

Correlation Matrix

Table 4 reports the Pearson correlation matrix of the main variables. The significantly positive correlation between *P_CSR* and *F_CSR* indicates that the CSR performance of the predecessor firm is positively associated with that of the successor firm, supporting H1 preliminarily. We also find that the *PRECSR* is significantly positively correlated with *P_CSR* which documents that the CSR performance exhibits strong inertia. To further test the existence of multicollinearity, we calculate the variance inflation factor (VIF) for regression variables. All the VIFs are less than 4 which are well below the acceptable limit (Kennedy, 1998), indicating that there is no serious multicollinearity problem in our study.

Regression Results

Test of Hypothesis 1

Table 5 reports the regression results of Model (1). The dependent variables in Columns (1) and (2) are *P_CSR_S* and *P_CSR_R*, respectively. There is a positive and significant association between the CSR performance of the predecessor firm in the last year of an executive's employment (*F_CSR_S/F_CSR_R*) and that of the successor firm in the first full year of an executive's employment (*P_CSR_S/P_CSR_R*) after controlling other variables, especially previous CSR performance of the successor firm. It indicates that when an executive moves to another firm, his value and preference for CSR reflected in the predecessor firm will maintain consistency and lead to similar decisions and practices about CSR at the successor firm, which is consistent with H1.

Consistent with previous literature (Manner, 2010; Dhaliwal et al., 2011; Tang et al., 2015; Hussain et al., 2018; Chang et al., 2021), we find that firms with larger scales (*SIZE*), stronger profitability (*ROA*), longer operating years (*AGE*), state-owned property (*SOE*), more independent directors (*INDDIR*), and better CSR performance in the past (*PRECSR_S/PRECSR_R*) have better CSR performance. For individual-level controls, we find that male (*GENDER*) and highly educated (*EDUC*) executives are less likely to engage in proactive CSR practices,

TABLE 3 | Summary statistics.

Variable	*N*	Mean	SD	Min	P25	P50	P75	Max
P_CSR_S	15,943	0.244	0.147	−0.045	0.176	0.231	0.281	0.746
P_CSR_R	15,943	2.099	0.542	1.000	2.000	2.000	2.000	5.000
F_CSR_S	15,943	0.269	0.192	−0.053	0.160	0.224	0.301	0.779
F_CSR_R	15,943	2.253	0.722	1.000	2.000	2.000	2.000	5.000
GAP1	15,943	0.587	0.492	0.000	0.000	1.000	1.000	1.000
GAP2	15,943	0.371	0.483	0.000	0.000	0.000	1.000	1.000
ICQ	10,567	−0.015	0.192	−0.745	−0.101	−0.012	0.078	0.677
SIZE	15,943	22.520	1.824	19.610	21.240	22.180	23.370	29.190
LEV	15,943	0.455	0.229	0.056	0.271	0.438	0.625	0.950
ROA	15,943	0.038	0.073	−0.367	0.014	0.039	0.072	0.203
AGE	15,943	2.871	0.341	1.946	2.639	2.944	3.135	3.526
SOE	15,943	0.135	0.342	0.000	0.000	0.000	0.000	1.000
BOARD	15,943	2.171	0.217	1.386	2.079	2.197	2.197	2.996
INDDIR	15,943	0.374	0.053	0.300	0.333	0.333	0.429	0.571
GENDER	15,943	0.854	0.354	0.000	1.000	1.000	1.000	1.000
OLD	15,943	3.966	0.145	3.584	3.871	3.970	4.060	4.290
EDUC	15,943	0.567	0.495	0.000	0.000	1.000	1.000	1.000
POSITION	15,943	0.114	0.318	0.000	0.000	0.000	0.000	1.000
PRECSR_S	15,943	0.246	0.161	−0.047	0.173	0.219	0.274	0.762
PRECSR_R	15,943	2.140	0.589	1.000	2.000	2.000	2.000	4.000

The decrease in the number of observations of ICQ is due to the late start year of the internal control index provided in the database and the existence of some missing values.

and senior executives (*POSITION*) have a stronger impact on the CSR performance.

As the dependent variable, *P_CSR_S*, is bounded between zero and one, and the other dependent variable, *P_CSR_R*, is an ordinal number from one to five, we also estimate a Tobit regression and an Order Logit regression for Model (1) to check the robustness, respectively.[6] The results in Columns (3) and (4) show that our findings are robust to these alternative estimation techniques.

Test of Hypothesis 2

Table 6 reports the regression results of Model (2). Columns (1) and (3) present the moderating effect of the work experience during the employment gap (*GAP1)*. The results show that the coefficients of *F_CSR_S* and *F_CSR_R* are still significantly positive, and the coefficients of interaction terms *F_CSR_S* × *GAP* and *F_CSR_R* × *GAP* are significantly negative. Similar results can be found in Columns (2) and (4) which present the moderating effect of the length of the employment gap (*GAP2*). The above results indicate that in the context of executives' inter-firm mobility, a longer employment gap would inhibit the executives' behavioral consistency on the CSR fulfillment, which in turn weakens the positive association between the CSR performance of the predecessor and the successor firm, which is consistent with H2.

[6]One shortcoming of the Tobit regression is that it cannot include firm fixed effects (Malmendier et al., 2011). Instead, we control for industry and province fixed effects in the Tobit Model, as well as in the Order Logit Model. Due to this limitation, we still use the Linear Model in the following analyses.

Test of Hypothesis 3

Table 7 reports the regression results of Model (3). Columns (1) and (2) present the moderating effect of the differences in the internal control quality between the predecessor and the successor firm (*ICQ*). The results show that the coefficients of *F_CSR_S* and *F_CSR_R* are still significantly positive, and the coefficients of interaction terms *F_CSR_S* × *ICQ* and *F_CSR_R* × *ICQ* are significantly positive. The above results indicate that the successor firm's more effective internal control system than the predecessor firm could reduce executives' risk-taking behaviors and raise their initiatives to engage in CSR activities in the new working environment, which in turn strengthens the positive association between the CSR performance of the predecessor and the successor firm, which is consistent with H3.

ADDITIONAL ANALYSES AND ROBUSTNESS TESTS

Subsample Tests

In this section, we conduct three subsample tests. First, due to the particularity of ST, delisted and financial industry firms, we exclude these firms' observations and re-examine Model (1) to ensure the quality of the data (Jiang et al., 2022). The results in Columns (1–3) of **Table 8** show that our findings are robust.

Second, when executives are re-employed by the firms that they once worked in, the association of CSR performance between the predecessor and the successor firm may be caused by the highly similar background of the same firm at different times.

TABLE 4 | Pearson correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)*P_CSR_R*	1															
(2)*F_CSR_R*	0.133[a]	1														
(3)*GAP1*	−0.065[a]	−0.019[b]	1													
(4)*GAP2*	−0.078[a]	0.123[a]	0.184[a]	1												
(5)*ICQ*	0.102[a]	−0.159[a]	−0.006	−0.082[a]	1											
(6)*SIZE*	0.242[a]	0.124[a]	0.010	0.015[c]	0.055[a]	1										
(7)*LEV*	0.067[a]	0.076[a]	−0.025[a]	−0.007	−0.054[a]	0.602[a]	1									
(8)*ROA*	0.223[a]	0.018[b]	0.024[a]	−0.007	0.251[a]	−0.091[a]	−0.400[a]	1								
(9)*AGE*	−0.010	−0.007	0.043[a]	0.056[a]	−0.022[b]	0.175[a]	0.194[a]	−0.123[a]	1							
(10)*SOE*	0.101[a]	0.047[a]	−0.051[a]	−0.009	0.021[b]	0.197[a]	0.114[a]	−0.004	0.048[a]	1						
(11)*BOARD*	0.162[a]	0.077[a]	−0.039[a]	−0.012	0.008	0.456[a]	0.276[a]	−0.028[a]	0.083[a]	0.135[a]	1					
(12)*INDDIR*	−0.005	0.012	0.012	−0.005	−0.022[b]	−0.013[c]	−0.004	−0.019[b]	−0.013[c]	−0.044[a]	−0.493[a]	1				
(13)*GENDER*	0.010	0.026[a]	−0.005	0.009	−0.001	0.065[a]	0.041[a]	−0.006	−0.018[b]	0.019[b]	0.011	0.016[b]	1			
(14)*OLD*	−0.023[a]	0.042[a]	0.228[a]	0.109[a]	−0.025[b]	0.060[a]	0.001	0.025[a]	0.015[c]	0.021[a]	0.034[a]	−0.011	0.034[a]	1		
(15)*EDUC*	−0.016[b]	0.012	0.094[a]	0.034[a]	0.001	0.030[a]	−0.057[a]	0.029[a]	−0.100[a]	−0.025[a]	0.011	0.004	0.018[b]	−0.045[a]	1	
(16)*POSITION*	0.016[c]	0.022[a]	−0.249[a]	−0.037[a]	−0.024[b]	0.037[a]	0.053[a]	−0.068[a]	0.016[b]	0.049[a]	−0.007	0.015[c]	0.054[a]	−0.238[a]	−0.068[a]	1
(17)*PRECSR_R*	0.406[a]	0.117[a]	−0.041[a]	−0.056[a]	0.041[a]	0.289[a]	0.108[a]	0.078[a]	0.030[a]	0.063[a]	0.184[a]	−0.020[b]	0.021[a]	−0.010	−0.036[a]	−0.023[a]

[a], [b],and [c] represent significance at the 1, 5, and 10% levels, respectively (two-tailed). The CSR score variables are highly positively correlated with the CSR rating variables (Pearson correlation = 0.869, $p < 0.01$). For the sake of brevity, we only present the CSR rating variables in the correlation matrix.

TABLE 5 | Regression results of Model (1).

Dep. Var:	(1)	(2)	(3)	(4)
	Linear model		Tobit model	Order logit model
	P_CSR_S	*P_CSR_R*	*P_CSR_S*	*P_CSR_R*
	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*z*-stat.)
F_CSR_S	0.010***		0.021***	
	(2.716)		(3.858)	
F_CSR_R		0.010**		0.072*
		(2.379)		(1.855)
SIZE	0.025***	0.045***	0.013***	0.327***
	(10.312)	(4.243)	(7.133)	(12.272)
LEV	−0.025**	−0.066	−0.017	−0.300
	(−2.500)	(−1.513)	(−1.525)	(−1.610)
ROA	0.531***	1.370***	0.837***	13.322***
	(32.681)	(19.023)	(21.690)	(26.040)
AGE	0.145***	0.912***	0.005	0.050
	(7.267)	(10.275)	(0.863)	(0.546)
SOE	0.026***	0.062***	0.019***	0.534***
	(6.663)	(3.570)	(2.940)	(6.229)
BOARD	0.003	0.176***	0.023*	0.546***
	(0.240)	(3.800)	(1.921)	(3.275)
INDDIR	0.188***	0.937***	0.047	0.333
	(5.866)	(6.592)	(1.132)	(0.536)
GENDER	−0.002	−0.021**	−0.004	−0.183**
	(−1.046)	(−2.080)	(−1.275)	(−2.202)
OLD	−0.006	−0.029	−0.009	−0.487**
	(−1.056)	(−1.162)	(−1.076)	(−2.390)
EDUC	−0.004**	−0.021**	0.003	−0.137**
	(−2.221)	(−2.462)	(1.096)	(−2.337)
POSITION	0.007***	0.033***	0.005	0.053
	(3.039)	(3.091)	(1.209)	(0.591)
PRECSR_S	0.181***		0.351***	
	(23.685)		(20.354)	
PRECSR_R		0.160***		1.371***
		(19.365)		(30.088)
FE_{FIRM}	*Yes*	*Yes*	*No*	*No*
FE_{YEAR}	*Yes*	*Yes*	*Yes*	*Yes*
FE_{IND}	*No*	*No*	*Yes*	*Yes*
FE_{PROV}	*No*	*No*	*Yes*	*Yes*
N	15,943	15,943	16,480	16,480
R^2/*Pseudo* R^2	0.775	0.675	−0.913	0.345

****, **, and * represent significance at the 1, 5, and 10% levels, respectively (two-tailed). The increase in the number of observations in Columns (3) and (4) is due to the fact that these models do not control for firm fixed effects and thus do not exclude singleton observations.*

Therefore, we exclude observations that the predecessor and the successor firm are the same one to ensure that the executive was appointed by a different firm. The results in Columns (4–6) of **Table 8** show that our findings are robust.

Third, compared with general executives, the core executives may pose a greater influence on CSR fulfillment decisions. Therefore, we limit our sample to the executives who serve as the firm's chairman, CEO, CFO, and board of directors in the successor firm. The results in Columns (7–9) of **Table 8** show that our findings are robust.[7]

Heckman Two-Stage Model

Since the research design of this manuscript restricts the sample to executives who worked in at least two listed firms, it only contains executives who left a firm and then were employed by another firm. In fact, there are still a lot of executives who never changed their positions or were not employed by another listed firm after leaving the previous position, which might make our sample have self-selection problems. Therefore, we use the Heckman two-stage model to address the possible problem of sample selection bias.

[7]We also try to further limit the sample to the chairman and CEO who are the most central decision-makers of listed firms. However, the remaining sample size is too small (N = 570) which may affect the efficiency of empirical tests. In spite of this limitation, we still find our findings are robust in untabulated results.

TABLE 6 | Regression results of Model (2).

Dep. Var:	**(1)**	**(2)**	**(3)**	**(4)**
	P_CSR_S		***P_CSR_R***	
	GAP = GAP1	***GAP = GAP2***	***GAP = GAP1***	***GAP = GAP2***
	Coef. (*t*-stat.)	**Coef. (*t*-stat.)**	**Coef. (*t*-stat.)**	**Coef. (*t*-stat.)**
F_CSR_S	0.010***	0.012***		
	(2.828)	(3.159)		
F_CSR_S × GAP	−0.024***	−0.020***		
	(−3.305)	(−2.738)		
F_CSR_R			0.011**	0.015***
			(2.519)	(3.427)
F_CSR_R × GAP			−0.034***	−0.041***
			(−4.053)	(−4.853)
GAP	0.001	−0.001	−0.008	−0.008
	(0.457)	(−0.402)	(−1.142)	(−1.177)
SIZE	0.025***	0.025***	0.044***	0.043***
	(10.288)	(10.257)	(4.189)	(4.128)
LEV	−0.025**	−0.025**	−0.065	−0.064
	(−2.515)	(−2.488)	(−1.499)	(−1.478)
ROA	0.531***	0.532***	1.368***	1.373***
	(32.638)	(32.693)	(19.012)	(19.085)
AGE	0.145***	0.145***	0.908***	0.905***
	(7.238)	(7.263)	(10.244)	(10.205)
SOE	0.026***	0.026***	0.062***	0.061***
	(6.651)	(6.628)	(3.532)	(3.512)
BOARD	0.002	0.002	0.175***	0.172***
	(0.196)	(0.195)	(3.780)	(3.709)
INDDIR	0.188***	0.186***	0.940***	0.923***
	(5.864)	(5.814)	(6.622)	(6.505)
GENDER	−0.002	−0.002	−0.021**	−0.020**
	(−1.077)	(−1.020)	(−2.098)	(−2.045)
OLD	−0.007	−0.006	−0.029	−0.028
	(−1.255)	(−1.082)	(−1.152)	(−1.125)
EDUC	−0.004**	−0.004**	−0.020**	−0.021**
	(−2.265)	(−2.213)	(−2.386)	(−2.438)
POSITION	0.007***	0.007***	0.030***	0.032***
	(3.068)	(3.001)	(2.838)	(3.048)
PRECSR_S	0.180***	0.180***		
	(23.548)	(23.614)		
PRECSR_R			0.158***	0.159***
			(19.198)	(19.293)
FE_{FIRM}	*Yes*	*Yes*	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*	*Yes*	*Yes*
N	15,943	15,943	15,943	15,943
R^2	0.775	0.775	0.675	0.676

**** and ** represent significance at the 1 and 5% levels, respectively (two-tailed). All independent variables that constitute the interaction term are mean-centered to mitigate the potential threat of multicollinearity.*

In the first stage, we construct a Probit model in which the dependent variable *REPOST* is an indicator variable that equals one if the executive was hired by another listed firm after he or she left the previous position, and zero otherwise. The independent variables include individual characteristics of executives such as *GENDER, OLD, EDUC, POSITION*, and characteristics of

TABLE 7 | Regression results of Model (3).

Dep. Var:	(1)	(2)
	P_CSR_S	*P_CSR_R*
	Coef. (*t*-stat.)	Coef. (*t*-stat.)
F_CSR_S	0.016***	
	(3.198)	
F_CSR_S × ICQ	0.062***	
	(2.582)	
F_CSR_R		0.016***
		(2.719)
F_CSR_R × ICQ		0.104***
		(3.622)
ICQ	0.010*	−0.003
	(1.672)	(−0.118)
SIZE	0.029***	0.029*
	(8.588)	(1.910)
LEV	−0.060***	−0.267***
	(−4.066)	(−4.097)
ROA	0.576***	1.322***
	(21.705)	(11.179)
AGE	0.160***	0.882***
	(6.138)	(7.560)
SOE	0.027***	0.070***
	(5.531)	(3.230)
BOARD	−0.016	0.075
	(−1.184)	(1.248)
INDDIR	0.085**	0.578***
	(2.071)	(3.165)
GENDER	−0.000	−0.011
	(−0.127)	(−0.829)
OLD	−0.002	−0.005
	(−0.256)	(−0.134)
EDUC	0.006*	0.024*
	(1.931)	(1.667)
POSITION	−0.008***	−0.035***
	(−3.098)	(−2.906)
PRECSR_S	0.187***	
	(19.531)	
PRECSR_R		0.182***
		(17.913)
FE_{FIRM}	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*
N	10,567	10,567
R^2	0.779	0.683

****, **, and * represent significance at the 1, 5, and 10% levels, respectively (two-tailed). All independent variables that constitute the interaction term are mean-centered to mitigate the potential threat of multicollinearity. The decrease in the number of observations is due to the late start year of the internal control index provided in the database and the existence of some missing values.*

the predecessor firms such as *SIZE*, *ROA*, *LEV*, and *PRECSR*. As the development of the industry's human capital market is also an important factor in executive recruitment, we include *PRMAR* (=change of the number of executives in an industry

TABLE 8 | Subsample tests.

Dep. Var:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Exclude ST, delisted, and financial industry firms			Exclude executives re-employed by the same firm			Sub-sample of core executives		
P_CSR	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)
F_CSR	0.009**	0.010**	0.016***	0.013***	0.014***	0.021***	0.010**	0.012***	0.016***
	(2.084)	(2.282)	(2.617)	(3.064)	(3.218)	(3.386)	(2.358)	(2.737)	(2.649)
F_CSR × GAP		−0.035***			−0.031***			−0.031***	
		(−4.043)			(−3.622)			(−3.476)	
F_CSR × ICQ			0.103***			0.101***			0.087***
			(3.465)			(3.417)			(2.953)
Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
FE_{FIRM}	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
N	15,010	15,010	10,006	15,311	15,311	10,000	14,360	14,360	9,489
R^2	0.674	0.675	0.684	0.678	0.679	0.687	0.691	0.692	0.704

**** and ** represent significance at the 1 and 5% levels, respectively (two-tailed). All independent variables that constitute the interaction term are mean-centered to mitigate the potential threat of multicollinearity. For the sake of brevity, we only present the results of CSR rating variables (P_CSR = P_CSR_R, F_CSR = F_CSR_R) and the first proxy of employment gap (GAP = GAP1).*

TABLE 9 | Heckman two-stage model (the second stage).

Dep. Var: *P_CSR*	(1)	(2)	(3)
	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)
F_CSR	0.011**	0.012***	0.017***
	(2.542)	(2.698)	(2.891)
F_CSR × *GAP*		−0.036***	
		(−4.247)	
F_CSR × *ICQ*			0.107***
			(3.686)
IMR	0.025*	0.025*	0.037**
	(1.877)	(1.879)	(2.071)
Controls	*Yes*	*Yes*	*Yes*
FE_{FIRM}	*Yes*	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*	*Yes*
N	15,552	15,552	10,330
R^2	0.675	0.675	0.683

****, **, and * represent significance at the 1, 5, and 10% levels, respectively (two-tailed). All independent variables that constitute the interaction term are mean-centered to mitigate the potential threat of multicollinearity. For the sake of brevity, we only present the results of CSR rating variables (P_CSR = P_CSR_R, F_CSR = F_CSR_R) and the first proxy of employment gap (GAP = GAP1). The decrease in the number of observations is due to the fact that some observations failed to obtain an IMR in the first stage regression.*

TABLE 10 | PSM method.

Dep. Var:	(1)	(2)	(3)	(4)
	Successor firms' matching sample and predecessor firms		Successor firms and predecessor firms' matching sample	
	P_CSR_S	*P_CSR_R*	*P_CSR_S*	*P_CSR_R*
	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)
F_CSR_S	0.001		0.001	
	(0.169)		(0.375)	
F_CSR_R		0.002		0.006
		(0.516)		(1.252)
Controls	*Yes*	*Yes*	*Yes*	*Yes*
FE_{FIRM}	*Yes*	*Yes*	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*	*Yes*	*Yes*
N	15,079	15,079	14,580	14,580
R^2	0.808	0.726	0.778	0.678

The decrease in the number of observations is due to the fact that some firms failed to find a matching firm under the PSM method.

in year *t* divided by the number of executives in an industry in year *t*−1). We also control for the year, industry and province fixed effects. The unreported results show that executives are more likely to be hired by other listed firms if they are older males with higher educational level and their predecessor firm performed well in CSR.

In the second stage, we re-estimate Model (1–3) after adding the Inverse Mills Ratio (*IMR*) calculated in the first stage as a control variable. The results in Columns (1–3) of **Table 9** show that our findings are robust when controlling the selection bias, which means that the previous findings of this manuscript are not influenced by selection bias.

TABLE 11 | 2SLS approach.

Dep. Var:	(1)	(2)	(3)	(4)
	First stage	Second stage	First stage	Second stage
	F_CSR_S	*P_CSR_S*	*F_CSR_R*	*P_CSR_R*
	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)	Coef. (*t*-stat.)
F_CSR_S (instrumented)		0.055**		
		(2.42)		
F_CSR_R (instrumented)				0.039*
				(1.71)
F_CSR_IND	1.465***		7.357***	
	(8.71)		(11.60)	
F_CSR_CITY	1.064***		4.215***	
	(9.46)		(9.73)	
Controls	*Yes*	*Yes*	*Yes*	*Yes*
FE_{FIRM}	*Yes*	*Yes*	*Yes*	*Yes*
FE_{YEAR}	*Yes*	*Yes*	*Yes*	*Yes*
N	9,535	9,535	9,535	9,535
R^2	0.324	0.806	0.330	0.723

****, **, and * represent significance at the 1, 5, and 10% levels, respectively (two-tailed). The decrease in the number of observations is due to the fact that we limit the research sample of this part to the cross-industry as well as cross-city executive turnovers.*

Propensity Score Matching Method

One alternative explanation of our findings is that the positive association of CSR performance between the predecessor and the successor firm is the result of similar corporate characteristics instead of the inter-firm executive mobility. Therefore, we adopt a PSM method to find a matching firm for each predecessor and successor firm according to *SIZE*, *LEV*, *ROA*, *AGE*, *BOARD*, and *INDDIR* in the same industry in the same year but without executive mobility. Then we repeat the regression for the successor firms and the predecessor firms' matching sample, and for the predecessor firms and the successor firms' matching sample, respectively. We expect that there is no longer a significantly positive association of CSR performance between these two groups of firms as they do not have the relevance caused by the change of the same executive.[8]

Table 10 reports the regression results of matching samples. In Columns (1–4), all coefficients of *F_CSR_S* and *F_CSR_R* are no longer significant, indicating that when two groups of firms no longer have the same executive as a connection, the CSR performance of the predecessor firm's matching sample is not associated with the successor firm, as well as the CSR

[8]We do not conduct this robustness test for moderating effect model because there is no executive turnover between the two firms under the PSM method.

performance of the predecessor firm are not associated with the successor firm's matching sample. This evidence further confirms the direct impact of individual executives' value and preference for CSR on the CSR performance of the firm they served at.

Two-Stage Least Squares Approach

Although we have controlled for a series of crucial factors that affect firms' CSR performance regarding prior studies, there may still be some omitted variables that may lead to biased model estimation results. To address the possible endogeneity issues, we re-estimate the regressions with the 2SLS approach. Following Bouslah et al. (2018) and Jia and Li (2022), we use the yearly average environmental performance score of listed firms in the same industry of the predecessor firms (*F_CSR_IND*) and the yearly average environmental performance score of listed firms in the same city of the predecessor firms (*F_CSR_CITY*) as the instrumental variables.

As environmental performance is an important part of CSR performance, it is expected that a firm's CSR performance is closely related to the environmental performance of other companies in the same industry and in the same city. The results in Columns (1) and (3) of **Table 11** show that the coefficients of both instrumental variables are positive and significant, indicating that it meets the relevance requirement for instrumental variables. Because the instrumental variables are measured by the environmental performance of listed firms in the same industry and city as the predecessor firms, and we limit the research sample of this part to the cross-industry as well as cross-city executive turnovers, *F_CSR_IND* and *F_CSR_CITY* are less likely to affect CSR performance of the successor firms in a completely different industry and city, plausibly satisfying the exclusion requirement.

To further ensure the strength of our instrumental variables, we conduct an over-identification test, the Hansen J statistic results in a *p*-value of 0.760 and 0.929, suggesting that our instrumental variables do not exhibit over-identification. The under-identification test shows a *p*-value of zero, which means that there is no under-identification problem in the estimated results. The Cragg-Donald Wald *F* statistic is significant at the 1% level, thus rejecting the null hypothesis of weak instrumental variable. The above results indicate that the instrumental variables selected in this manuscript are reasonable and valid.

Columns (2) and (4) of **Table 11** report the second-stage regression results. We find that our findings are robust when controlling the potential endogeneity problems using the 2SLS approach.

CONCLUSION

Corporate social responsibility has important strategic implications for listed firms. Well-performed socially responsible activities can help listed firms create a good reputation and public image, establish valuable stakeholder relationships, and promote the long-term development of the firm. As the decision-maker of listed firms, executives' value and preference have an essential impact on CSR fulfillment. Based on behavioral consistency theory, we examine the association of CSR performance among multiple firms for the same executive served at different times. By tracking the movement of executives across Chinese listed firms over the period 2010–2019, we find that there is a significantly positive association between the predecessor and the successor firm's CSR performance for the same executive, implying that an individual's value and preference for CSR maintain consistency within a certain period of time, and the association is influenced by executives' employment gap and corporate internal control quality.

Our study provides a new perspective for the corporate governance research based on inter-firm executive mobility and highlights the impact of executives' past experience in CSR practice on the CSR performance of other firms, enriching the literature on CSR determinants from the perspective of individual executives and behavioral consistency theory. In practice, our findings also have significant implications for the design of appropriate employment and talent evaluation system for listed firms. On the one hand, listed firms should improve the recruitment mechanisms in hiring executives, especially pay attention to their previous work experience and performance in CSR. On the other hand, a complete system for evaluating executives' performance should be established which not only focuses on the firm's accounting and stock performance, but also takes the CSR performance into consideration. In addition, a good corporate governance system can also provide an effective guarantee for the implementation of executives' CSR decisions.

Future research could focus on the impact of executives' other aspects of work experience and performance on their competitiveness in the labor market. Further, it would be important and interesting to investigate how listed firms make trade-offs when facing executive candidates with different competitive advantages, and how they choose executives that are more suitable for themselves.

DATA AVAILABILITY STATEMENT

Data used in this study are available from public sources identified in the study, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

The manuscript was written with the contributions of both authors. JW put forth great effort with regard to the project administration and the funding acquisition. JC performed the data curation and wrote the first draft. Both authors approved the final manuscript.

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The experimental research on leaders and cooperative behavior

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Leaders are critical to a team or organization, their behavior affects employees' psychology and their work effort, and then affects the efficiency and innovation of the team or organization. Previous studies have focused on the role model of leaders, ignoring the guiding role of leaders with different efforts. This paper introduces leader decision-making into the game of public goods to investigate the exemplary role of leaders in behavior decision-making. It divides them into three types by setting the investment amount of leaders to explore the mechanism of leaders' influence in behavior decision-making and behavior change of team members when facing the transformation of leaders with different investment types. This research can provide a significant reference value for enterprises and social organizations on how to play the role of leaders.

KEYWORDS

leaders, public goods game, horizontal reference point, cooperative belief, reciprocity

Introduction

Due to the changeable external environment and increasingly fierce competition, the operating mode of team form is gradually popularized (O'Neill and Mclarnon, 2018). However, an unavoidable problem with the team is the free-rider behavior of members. This behavior affects team performance and the psychology and behavior of other employees and eventually results in the overall "inefficiency" of the team. Because when members consider maximizing their private interests, they often ignore the interests of the whole team and even make behaviors that harm the team's interests. Therefore, how to reduce the free-rider behavior in the team and promote the improvement of team efficiency has become the critical problem that enterprise leaders aim to solve. Besides making decisions on various issues within the team, leaders also need to set an example for the behavior of other organizational members. Hence, they play a crucial role in teamwork.

The role of leaders has always been the focus of academia and industry. Tong (2020) explored the mechanism of its impact on the innovation climate from the perspective of leadership style and defined leadership style as transactional leadership and transformational leadership. There is also literature on the effects of leaders' negative emotions on employee performance and deviant behavior (Bartels et al., 2022). Research on self-sacrificial leadership has shown that this leadership type can stimulate the identification and trust of members in the organization (Yang et al., 2021), enable employees to cooperate with leaders actively, promote organizational change (Li et al., 2016), make prosocial behavior decisions, and even sacrifice their interests for the organization (Liang and Fan, 2020); Zeng et al.

(2020) studied the role of leaders in guiding employees' decision-making behavior from the perspective of leader role models, and divided leaders into two types: "good" leaders and "bad" leaders. The results showed that the effectiveness of leader role models was minimal because "good" leaders met "bad" followers or "good" followers met "bad" leaders. The above research perspectives on leaders mainly focus on one type, ignoring the impact of leadership type change on employees' psychology and behavior. Leadership change is also widespread in reality, and there will be significant differences in the impact of different types of leaders on members of the organization. Therefore, it is essential to investigate the effects of different types of leaders and their replacement on organization members.

There are two ways to produce leaders: endogenous and exogenous. Endogenous ways include voluntary endogenous and election endogenous. Exogenous ways mainly include random exogenous and designated exogenous. However, the endogenous leader generation way cannot ensure that leaders can be generated. Every member may be unwilling to play the role of leader under the voluntary endogenous way. The election way may also lead to failure to elect leaders due to the different opinions of team members (Lee et al., 2021). Therefore the leader is generated in an exogenous way in our experiment. Our study tells the subjects that the experimenter will randomly appoint a member as the leader at the beginning of the experiment. The way of appointing exogenous leaders is in line with the Chinese situation. Most leaders are designated by an exogenous superior organization especially in government departments.

In addition to investigating the role model of leaders, this study also divides leaders into three types low, medium and high investors and tries to analyze the investment behavior of employees under the leadership of these three investment types. The subjects were randomly divided into a group of four people in the process of the experiment. One of the members was played by the computer, and the computer decision-making was given the role of leader. The cooperative behavior of members is more out of the social preference of reciprocity or Conditional Cooperation for the two-person group (Fischbacher et al., 2001). The leader often affects and drives the decision-making behavior of other group members through the guiding role of his behavior signal in the behavior decision-making of the four-person group. Therefore, the leaders of this study are closer to the leaders of "self signaling" described by Bénabou and Tirole (2011).

Theoretical model

A sequential public goods game characterizes the leader's demonstration behavior in our study. The reason for choosing the public goods game is that leaders' key task is to promote cooperation among organization members and reduce the free-rider problem in the organization's management. In addition, this is also the game framework primarily used in the current mainstream literature (Güth et al., 2007; Rivas and Sutter, 2011).

The model assumes that an n-person group makes repeated T-period behavioral decisions. Each person is given the initial capital e before the beginning of each experimental period. He can choose to invest in public projects of his group or keep them in his private account. In addition, all funds in this period cannot be brought into the experiment of the next period. The investment decision is made with the given initial funds e at the beginning of each period of the experiment, which has nothing to do with the capital income of the previous period. If the investment amount of i in the group's public project in t period is g_{it}, the amount of funds retained in the private account is x_{it}, $i \in 1,2,\ldots,n$, $t \in 1,2,\ldots,T$ and $x_{it} + g_{it} = e$, the total investment in the group's public project is $\sum_{j=1}^{n} g_{jt}$. Assuming that the return on investment coefficient of the group's public project is α_t, and $0 \le \alpha_t < 1 < n\alpha_t$. Then the payoff of member i in t period is given by the following function:

$$\pi_{it} = x_{it} + \alpha_t\left(\sum_{i}^{n} g_{it}\right) = e - g_{it} + \alpha_t\left(\sum_{j=1}^{n} g_{jt}\right).$$

According to the constraints $0 \le \alpha_t < 1 < n\alpha_t$, if the participant is a "rational person" in the sense of economics, the above function has a unique Nash equilibrium solution, i.e., $g_{it} = 0$. The solution is also the dominant strategy to maximize the participant's payoff. However, in terms of maximizing the overall social income, the Nash equilibrium of participants is to invest all the initial funds in the group public projects, that, is $g_{it} = e$ (see the Appendix for the specific derivation process). In this dilemma, individuals are straightforward to take free-rider behavior because maximizing their interests seriously damages the group's overall and even social benefits.

To avoid collective irrational behavior caused by individual rationality, we try to influence the behavior of other members by allowing leaders to make investment decisions first, and then analyze the investment behavior of subjects under the leadership of different investment types and the change in investment amount of members from meeting "bad" leaders to "good" leaders and from meeting "good" leaders to "bad" leaders. Our study explores the internal mechanism of the leaders' role to provide an important reference and reference value for enterprises and social organizations.

Theoretical background and hypotheses development

Investment and payoff under the influence of leaders

Leaders play a very important role in a family, enterprise or social organization, even the government and international

organizations (Lin and Liao, 2020). Leaders play two roles in the market, enterprises and social organizations. One is to provide good or bad information about the project to other organization members in the case of asymmetric information. Generally, there is information asymmetry between leaders and group members, and leaders have private information about investment decisions. Leaders need to use their information advantages to guide the investment behavior of organization members to improve the organization's overall performance and payoff. For example, Vesterlund (2003) discussed the role of leaders in charitable donations. The research results found that disclosuring the donation amount of leaders with private information could improve the investment amount of others. Andreoni (2006) constructed a dynamic donation game model based on Vesterlund (2003), and believed that leaders with an information advantage could eliminated the information asymmetry among organization members by sending private information to improve the overall investment and performance of the organization.

The second is the self-sacrificing role of the leader in public goods. Leaders influence the decisions of other group members by investing before employees. Huck et al. (2001) conducted 10 periods of random collocation and fixed collocation experiments in a between-group setting; two people were in a group, one subject was a leader and the other was a follower. The leader makes the investment decision first, and the follower invests after seeing the leader's investment. The results show that the existence of the leader brings more market investment, reduces collaboration, and even improves the overall social welfare; Li et al. (2021a,b) defined the leader as the person who makes decisions first in the process of strategy selection, and believed that the leader-follower model is one of the effective mechanisms that can maintain the order of human cooperation; Nassif et al. (2021) believed that exemplary leadership could stimulate other group members to imitate their behavior and decision-making by taking the lead in investment to stimulate members' awareness of public cooperation; Van der Heijden and Moxnes (2013) studied the role model of leaders in the bad public goods game framework. The results showed that other members of the organization under the influence of leaders' decision-making behavior reduced investment in bad public goods projects, the overall cooperation level was improved, and the output of public goods projects similar to environmental pollution was restrained to a certain extent.

Leaders adopt the form of fixed collocation and partnership in this paper, and there is no information asymmetry between leaders and followers. Leaders are divided into three types: low, medium and high through computer play. Middle-type leaders' investment amount is similar to the average group investment in a non-leader setting. We come to H1 by the above analysis: compared with the benchmark setting, there are significant differences in individual investment and pay0ff between leaders and non-leader settings.

> *H1A*: the existence of low investment type leaders reduces the investment and payoff of other group members;
> *H1B*: the existence of leaders of medium investment type has no impact on the investment and payoff of other group members;
> *H1C*: the presence of high investment type leaders improves the investment and payoff of other group members.

Individual investment and payoff under the influence of leader investment type and transformation

The investment of leaders will affect the behavior and decision-making of their followers to a certain extent, and then affect the individual investment and payoff and the overall middle-type leaders' investment and return of the organization. Leadership changes caused by tenure or other reasons are also very common in real enterprises or social organizations, which may be accompanied by the change of leader type. When the leaders in the organization change from low type to high type, the followers will adopt the behavior strategy of "reciprocity" and imitate high type investors to invest more in the projects of their organization according to the positive reciprocity in the reciprocity theory; On the contrary, when the leaders in the organization change from high type to low type, other individuals in the organization will reduce their investment according to the negative reciprocity in the reciprocity theory (Walk, 2022).

Individual investment decisions are affected by the amount of investment of leaders in the presence of leaders and subject to the investment information of themselves and their peers according to the frame of reference theory. Cohn et al. (2014) and Fehr et al. (2021) divided individual reference points into three dimensions when investigating wage reference and employee effort level, namely, vertical reference point, horizontal reference point and current situation reference point. The vertical reference point is based on the salary of the leader (employer), the horizontal reference point is based on the salary of members in organizations with similar situations, and the current reference point is based on the salary standard of the previous period. The results show that the three kinds of reference have an impact on the level of individual effort, and the effect of vertical reference is greater than that of current reference; when studying the influence and mechanism of leaders, the investment of leaders are the vertical reference of individuals, the investment of other members is the horizontal reference of individuals, and their previous investment and payoff are the current reference of individuals. Individuals are affected by these three references at the same time in investment decision-making. Chen et al. (2022) regard the horizontal

reference of individuals (innovation activities) as one types of social norm, and found that if market stakeholders such as competitors engaged in extensive innovation activities, the enterprise managers might regard innovation activities as one types of social norm, and thus enhanced the innovation activities of their own enterprises driven by the force of norm compliance. However, individuals pay more attention to the leader's investment and use it as a reference for investment decision-making under the role of anchoring effect. Therefore, the transformation of the leader's investment type from low to high is bound to increase the overall investment and payoff of individuals and organizations.

The prospect theory holds that people have a "preconceived" anchoring effect on the objects they contact in advance. At the same time, people's behavior is situational dependent. The behavior decision-making response under the loss framework is significantly stronger than that under the acquisition framework (Kahneman and Tversky, 1979). The subjects have an anchoring effect on the previous high investment type leaders when the leader's investment gradually changes from high type to low type. Changing to a lower investment type is a loss for the organization members. The individual responds more strongly to the loss and will be resistant compared with the gain. Thus the negative effect of leaders with low investment is more significant than that of leaders with low investment under the scenario of gradually changing from low investment type to high investment type; on the contrary, the reference point of individuals is the investment of low investment type leaders when leaders gradually change from low to high investment type. The psychology of reciprocity makes them more willing to respond to high investment type leaders and maintain high cooperation when facing high investment type leaders. Thus, there is a significant difference in the amount of investment between the high investment type leader and the low investment type leader.

We propose the following assumptions in view of the above analysis:

> *H2A*: the type of leader's investment is significantly related to individual investment and returns;
> *H2B*: low investment type leaders under the two transformation forms have differences in individual investment and returns;
> *H2C*: high investment type leaders under the two transformation forms have differences in individual investment and returns.

Horizontal reference point, cooperation belief and individual investment under different leader types

Individuals are vulnerable to the influence of reference information in the process of investment according to reference theory. Reference information depends on information feedback, and complete information feedback can significantly improve individual investment and individual cooperation level (Irlenbusch and Rilke, 2013). Individual investment is affected by leaders type and restricted by the investment information of peers when he faces the sequential public goods game with leaders (Bahbouhi and Moussa, 2021). The investment information of leaders is the vertical reference of individual decision-making behavior, and the investment information of peers in the previous period is the horizontal reference point for individuals to decide whether to implement cooperative behavior (Cohn et al., 2014; Fehr et al., 2021). These two kinds of references will restrict individual decision-making behavior to a certain extent. The investment of followers will be restrained when the reference point of investment is low. In contrast, the investment of followers will be promoted when the reference point of investment is high.

In addition, Barr (2003) believes that cooperative behavior depends on expected and undesired motivation. He further found that expected motivation has a greater impact on cooperative behavior, and the utility brought by undesired motivation is weak by the residents of 24 villages in Zimbabwe. Fehr (2009) and Sapienza et al. (2013) divided behavioral motivation into belief-based behavior and social preference-based behavior. The belief in belief-based behavior is basically consistent with the expected motivation. The behavior based on social preference is similar to the undesired motivation. Individual behavior decision is affected by the investment information of other group members in the previous period in the public goods game. However, the individual will adjust and form his own cooperative belief after giving this information feedback. The cooperative belief here refers to the individual's estimate of the average investment of other group members, which is a belief in voluntary cooperation and good faith action. Social norms theory suggests that people voluntarily defend social norms even when their economic interests are not directly affected by norm violations (Yin et al., 2021). Individuals invest in public goods under the influence of their cooperative beliefs which is a social norm, and cooperative beliefs positively affect the voluntary contribution of public goods (Fischbacher and Gächter, 2010).

The following assumptions are put forward based on the above analysis:

> *H3A*: the investment of horizontal reference point plays a moderating role between the type of leader and individual investment.
> *H3B*: cooperative belief plays a mediating role between the investment of horizontal reference point and individual investment.

The moderating effect of risk preference between leader type and individual investment

Behavioral economics theory regards risk as an individual's psychological attitude towards risk, which is an important behavioral basis for making decisions under uncertain conditions

(Balafoutas et al., 2012). Due to the obvious differences in the attitudes of decision-makers in risk-taking and dealing with uncertainty, individuals with different risk preferences may give different behavioral decisions on the same decision-making problems (Cadsby et al., 2007). Li et al. (2021b) used loss and gain frameworks to measure risk preference, and found that risk aversion inhibited individual trust behavior, and there was the context-dependence of individual decision-making between them; Davis et al. (2016) used the five-level Likert scale to measure the risk attitude when studying the impact of the heterogeneity of risk preference of senior management team on strategic investment decision-making, and divided it into three types: risk aversion, risk neutrality and risk pursuit, and measured the heterogeneity of team risk preference according to the Blau coefficient (Blau, 1977). The results showed that the heterogeneity of team risk preference was negatively correlated with the job satisfaction of members and positively correlated with decision-making time; Teyssier (2012) believes that risk preference has a negative impact on the voluntary investment decisions of the first decision-makers; Iriberri and Rey-Biel (2019) found that individuals with higher risk preference are more willing to choose variable compensation contracts with relatively higher risk.

Risk preference is situational dependent. Therefore, different risk preferences may lead to significant behavioral differences among organizational members when investigating the impact of leader types on individual cooperative behavior. Individual investment is essentially a risky behavior in the sequential public goods game with leaders. The risk aversion individuals will adopt a conservative strategy and invest fewer funds in organizational projects to maintain a low level of cooperation when the leader's investment changes from low to high. The risk pursuit preference individuals will contribute a higher amount of investment in investment decision-making and maintain a higher level of cooperation to maximize their long-term interests because the increase of the leader's investment reduces the uncertainty of risk.

The following assumptions H4 are proposed based on the above analysis:

> *H4A*: there is a positive correlation between risk preference and individual investment;
> *H4B*: risk preference plays a moderating role between the type of leader's investment and individual investment.

Experimental design and process

Experimental design

Our study uses the sequential public goods game experimental design of Fehr and Gächter (2000) to investigate the impact of leaders and turnover on employee behavior and organizational performance. The specific framework is as follows: each session is composed of 6 4-person groups with 24 participants, of which computers play 6 decision-makers (O'Neill and Mclarnon, 2018). A total of 3 experiments were conducted when investigating the role of leaders, and each experiment was conducted for 10 periods, and the team members adopted the design of partners. The team members and numbers remained unchanged during 10 periods of each experiment (Tong, 2020). A total of 2 experiments were conducted when investigating the impact of different leadership types on employee behavior and organizational performance. Each experiment was conducted for 30 periods and regrouped every 10 periods.

Irlenbusch et al. (2019) adopted exogenous designation to generate leaders, which was in line with the current realistic situation in China. Some studies have also analyzed the difference between electing endogenous and experimenter-appointed exogenous leaders in the environment of asymmetric information. The results show that both of them can better send signals to increase the amount of donations, and the effect of the third-party appointed exogenous leader mechanism is better (Potters et al., 2007). Rivas and Sutter (2011) found the opposite conclusion that the election of endogenous leaders is better than external leaders in improving organizational donations. Güth et al. (2007) found that election endogenous and random exogenous have good effects in improving group investment. Arbak and Villeval (2013) found that leaders generated by voluntary endogenous can improve the overall investment of the organization, but this method has the disadvantage of "leader dystocia."

The above research found that leaders generated by either endogenous or exogenous methods can effectively improve the overall investment level of the organization compared with the situation where there is no leader. In addition, some studies pay attention to the exemplary role of leaders in bad public goods, such as environmental pollution. The results show that the existence of leaders significantly reduces the overall cooperation level of the organization. We use the random exogenous method to generate leaders, and the leaders are played by computers. The advantage of choosing a computer as the leader is that we can clearly distinguish the types of leaders and better separate the guiding role of different types of leaders on the behavior of organizational members and organizational performance. We told the subjects that leaders were randomly assigned in order to reflect the authenticity of leaders during the experiment.

There are 6 experimental settings in this study. In addition to 16 participants in the benchmark setting, 18 participants in other settings. One experiment is conducted in each setting, with 116 participants. The subjects were all freshmen to junior students of a university, with an average age of 22. The subjects were selected through the questionnaire and conducted gender balance. The specific settings are shown in Table 1.

Benchmark setting

This setting is a public goods experiment of 20 periods without the leader. Each experiment has 16 subjects, and each group has 4 people, and the grouping and member number remained unchanged throughout the experiment. Before the beginning of each period of the experiment, each subject is given

TABLE 1 Experiment setup and type.

Experimental setup	Leader exist	Leader investment type	Number of teams	Actual number of participants
T1	No	–	4	16
T2	Yes	Low	3	18
T3	Yes	Medium	3	18
T4	Yes	High	3	18
T5	Yes	Low → medium → high	3	18
T6	Yes	High → medium → low	3	18

The number of groups is 4 in the six settings. Since the leaders in T2, T3, T4, T5, and T6 are all played by computers, the number of groups here excludes the leaders played by computers, so it is 3; similarly, there are 6 groups in T2, T3, T4, T5, and T6. When counting the real number of participants, excluding 6 leaders played by computers, it is 18.

an initial capital of 50G$ to invest in the group project. The payoff function of subject i in the group is determined by $\prod_i = 50 - x_i + 0.5\sum_{j=1}^{4} x_j$. Where x_i represents the amount of investment that member i has invested in the group project, and $\sum_{j=1}^{4} x_j$ represents the total amount of investment that member n have made in the group project. The funds are retained by the individual belong to themselves. The funds invested in the group project are halved, but the individual can share the investment of other group members in the group project. We can better investigate the decision-making behavior and cooperation level of individuals through this setting in the case of conflict between their interests and overall interests.

Experimental setup under low investment type leaders

The payoff function of members in this setting is similar to the benchmark setting. What is different from the benchmark setting is the existence of leaders. Each experiment has 18 subjects participated and each group of 3 people conducted 10 periods of sequential public goods game. The member number and grouping remain unchanged during the whole experiment. This setting is more in line with the actual situation of the enterprise, and the conclusions are more valuable for reference. In addition, each group also has a low investment leader played by a computer. The leader is a "pioneer" in the public goods game. It is necessary to randomly select an integer from 3-5G$ as its investment in the group project. After seeing the leader's investment, the other three group members will make investment decisions. This setting can better examine group members' behavioral decision-making rules and cooperation levels when facing leaders with low investment.

Experimental setup under medium investment type leaders

This setting is the same as setting (Tong, 2020), only difference is the investment amount of the virtual leader. The investment amount of the leader of the medium investment type in the group project is randomly selected from 20 to 22G$. This setting is to be consistent with the investment amount of the benchmark setting. The research shows that people's investment in public goods generally accounts for about 40% of the initial resource endowment in reality (Ibanez and Schaffland, 2018). Therefore, the investment amount of leaders with medium is consistent with that without leaders, so as to compare it to the benchmark setting and the difference between leaders with low investment amount and leaders with high investment amount.

Experimental setup under high investment type leaders

This setting is consistent with settings (Tong, 2020) and (Bartels et al., 2022) except for the investment of leaders. We set the leader's investment in the group project to be randomly selected from 42 to 45G$ to reflect the power of the leader's role model. Frackenpohl et al. (2016) defined good leaders as leaders whose investment is close to all initial funds, and bad leaders as first decision makers whose investment is zero when studying collective leaders and individual leaders. In view of this, we set leaders with an investment of 42–45G$ as high investment leaders, and investigate their role model among group members and their impact on the level of group cooperation.

Experimental setup of low, medium and high investment type leaders

Under the background of the Chinese system, the conflict between major shareholders and management has always been the focus of attention. Cheng et al. (2020) believe that there is a positive correlation between the occupation of funds by major shareholders and the change of management personnel. Such occupation has an adverse impact on the development of enterprises. In fact, in addition to many factors affecting the change of leadership, the change of leadership will also impact employees' psychology, and then affect employees' cooperation level and organizational performance. Therefore, we try to study the inhibition or promotion of leader type on organizational member behavior and organizational performance through the change of leader type. The experiment set up 30 periods, regrouping every 10 periods, and changing the investment type of leaders. The first 10 periods are low investment type leaders, the middle 10 periods are medium investment type leaders, and the last 10 periods are high investment type leaders. The experimental setup can better investigate the impact of the change of leadership

investment type from low to high on team members' decision-making behavior and organizational performance.

Experimental setup of high, medium and low investment type leaders

The order of leaders' investment types in this setting is the opposite of that in setting (Li et al., 2016). The first 10 of the 30 periods are high investment leaders, the middle 10 periods are medium investment leaders, and the last 10 periods are low investment leaders. This experimental setup investigates the behavior change of organization members when the organization gradually changes from high investment leader to low investment leader.

Experimental process

Six experiments were set up in the laboratory of School of Management of a University from December 2017 to January 2018, and 116 college students participated in the experiment. The decision-making experiment includes two parts: computer decision-making and questionnaire survey. The programs of these two parts are realized with the help of z-Tree software (Fischbacher, 2007). Each experiment lasted about 60 min, and the average payoff of the subjects was 25 yuan.

The whole experimental process mainly includes five stages:

Plane arrangement stage before experiment

The subjects were recruited through the questionnaire star. After the subjects arrive at the laboratory and sign in, the experimental assistant will lead them to the corresponding experimental seat to avoid the subjects choosing the seat according to their preferences and interests. The experimental assistant arranges the seats for the subjects according to gender, major and college. Every two subjects are separated by two seats to ensure that the subjects do not know each other and avoid communication. At the same time, the subjects did not know their number and grouping in advance. They were only informed in the computer experiment stage to ensure the "anonymity" of the whole experimental process.

Understanding stage of experimental instructions

After all the subjects arrived, the experiment officially began. The experimental assistant will distribute the experimental instructions to each subject and give them 5 min of self-reading time. Then the experiment host explains the experiment description and answers questions privately to ensure that the subjects accurately understand the experiment description. In addition, in order to test whether the subjects really master the whole decision-making process, they also need to correctly complete the pre-designed test questions including yes/no judgment questions and blank filling questions. After the test questions are correctly completed, the experiment host will briefly answer the questions existing in the test process and explain the interface content in the process of computer experiment to avoid the delay of time or arbitrary decision-making due to the unfamiliar of the interface or misunderstood in the experimental process.

Economic decision-making stage

The economic decision-making stage and the questionnaire survey stage are collectively referred to as the computer decision-making stage. Subjects were divided into groups before making economic decisions (O'Neill and Mclarnon, 2018). The benchmark experiment setting requires the subjects to make investment decisions on their group project, and the investment amount is an integer of 0–50G$; Then, the subjects need to estimate the average investment of the other three group members (Tong, 2020). In the non-benchmark experiment setting stage, the first person in the group makes investment decisions, other subjects make investment decisions after seeing the investment amount of the first person and estimate the average investment of the other two members except the first person. After the investment decision interface is submitted, you can enter the estimation interface. The setting of investment decision before estimation avoids the possible influence of the estimated value of the investment decision (Irlenbusch et al., 2019). Information feedback interface appears after the investment and estimation decision is completed. This interface displays individual number, investment amount, payoff information, the group average investment amount, estimated value, and real value, as well as the number, investment amount and payoff information about other group members.

Information feedback draws on the personal information feedback of Sell and Wilson (1991) and adopts "partner design" (Weimann, 1994; Bigoni and Suetens, 2012; Irlenbusch and Rilke, 2013), that is, setting (O'Neill and Mclarnon, 2018; Yang et al., 2021) keep the grouping and individual number unchanged throughout the experiment, and setting (Li et al., 2016; Liang and Fan, 2020) regroup every 10 periods. By comparing setting (Tong, 2020; Yang et al., 2021; Bartels et al., 2022) with setting (O'Neill and Mclarnon, 2018), our study analyzes the impact of leader type on individual and group investment, and analyses the mechanism of leader type change on individual investment level and overall group performance by comparing setting (Li et al., 2016; Liang and Fan, 2020).

Questionnaire survey stage

Economic decision-making is followed by the questionnaire stage, which mainly includes two parts. The first part is the investigation of basic personal information, including gender, age, major, native place, family income, parents' educational background, whether they are the only child, whether they come from rural or urban areas, whether they have educational experience in economics and whether they understand game theory. The family income is in the form of a seven-level Likert scale, with asking the subjects "what do you think your family income is _____ (between 1 and 7, of which 1 represents very

poor and 7 represents very rich)"; Parents' educational background is in the form of multiple-choice questions with the form of six-level Likert scale. The options are "primary school and below, junior middle school, senior high school, junior college, undergraduate and master's degree or above."

Kurzban and Houser (2005) believes that the subjects in the public goods experiment include three types: conditional collaborators, unconditional collaborators and free riders. Repeated experiments found that unconditional collaborators invest more in group projects than conditional collaborators, and free riders have the lowest average investment in group projects among the three types. Conditional collaborators and conditional cooperation behaviors exist widely in enterprises and social organizations (Fischbacher et al., 2001; Kurzban and Houser, 2005). Fischbacher et al. (2001) first studied the problem of conditional cooperation and defined conditional cooperation as the increase of individual investment with the increase of others' investment. Individuals need to choose cooperative decision-making according to the cooperative behavior of others. The results showed that 50% of the subjects were conditional collaborators. Fischbacher and Gächter (2010) further found that although most of the subjects are conditional collaborators, they have certain "self-partiality" characteristics and they are not perfect conditional collaborators. Most conditional collaborators' investment in the group will be slightly less than the average investment of other members of the group; In addition, other studies have found that the investment amount of conditional collaborators is affected by the expected and actual value of the average investment amount of other members of the group, and there is a significant positive correlation (Croson, 2007).

Therefore, we also tested the subjects' altruistic preference, cooperative belief and risk preference in the second part. Altruistic preference is to ask the participants to answer "suppose you and any one of the other participants form a group and jointly allocate 100G$. It is up to you to decide how much to give to the other participant, and the rest is left to yourself, and the other participant can only accept it. So, how much do you decide to give to the other participant?" Cooperation belief is an individual's expectation of the average investment amount of other members of the group. The measurement of this variable is carried out in the economic decision-making stage. After the subjects invest in the group project, let the subjects answer "please estimate the average investment amount of the other three members of your group (fill in the integer from 0 to 50)," and the question becomes "please estimate the average investment amount of the other two members of your group except the leader (fill in the integer from 0 to 50)" in the leader settings (Fischbacher and Gächter, 2010; Dufwenberg et al., 2011). The measurement of risk attitude is mainly in the form of a seven-level Likert scale by asking the subjects "please give the degree of risk you are willing to take (choose between 1 and 7, 1 means very dislike and 7 means very like)."

Payoff payment and interview stage

When filling in the questionnaire, the experiment host randomly selected any one of the 10 periods and converted it into cash in the proportion of 4:1 as the experimental payoff to the subjects. Remind the subjects to remember their personal number during the experiment, the subjects were paid privately according to their personal numbers. Afterward, 3–4 subjects were randomly selected for post-experiment interviews to ask about how to make decisions and suggestions on the experiment to ensure that they fully understand the experimental process and make serious decisions.

Analysis of experimental results

Descriptive statistics and *t*-test analysis

Overall feature analysis

There were 75 females and 41 males in the whole experiment, and females accounted for about 64.7%, only children accounted for 27%, cities accounted for 30, and 87% of the subjects had economic learning experience. The educational background of fathers is slightly higher than that of mothers (2.34 *vs*. 2.16). The educational background of fathers is concentrated in junior middle school and senior high school, accounting for 67% of the total, and the educational background of mothers is concentrated in primary school and junior high school, accounting for 72% of the total; The mean value of altruistic preference is 44; The risk preference measured by the seven-level Likert scale is concentrated in the values of 3 and 4, indicating that most subjects are risk neutral.

Individual investment and payoff under different settings

Table 2 shows individuals' investment amount and payoff under the six settings. Individual investment under T4 (high leader type) is slightly higher than that under T1 (no leader). The average individual investment in other settings is less than that in

TABLE 2 The investment amount and payoff of individuals under the six settings.

Experimental setup	Sample size	Average investment		Average payoff	
		Mean value	Standard deviation	Mean value	Standard deviation
T1	320	20.775	17.464	70.775	17.764
T2	180	8.858	11.757	56.179	8.611
T3	180	14.106	12.151	66.533	10.070
T4	180	22.022	17.985	80.461	13.217
T5	540	13.917	14.866	67.725	14.663
T6	540	12.741	15.081	67.137	15.237

To master the overall investment and payoff, the average investment and payoff in the table removed the investment of the leaders in settings T5 and T6.

the experimental setting without a leader. The existence of low and medium investment type leaders reduces the investment of other group members. Only the high investment type leader setting slightly increased the investment of other group members; In terms of individual payoff, setting T4 is the highest, which is 80.461, and setting T2 is the lowest, which is 56.179. Settings 3 and 1 decrease slightly (70.775 *vs.* 66.533), and the income under settings T2 and T3 is relatively concentrated (the standard deviation is 8.611 and 10.070). Through data analysis of investment amount and payoff, H1A and H1C are basically verified, and H1B is not verified.

Table 3 shows the *t*-test results of investment amount and payoff by setting T2, T3, T4, and T1, respectively. There is no difference between T4 and T1 (*t*-value is −0.806, *p*-value is 0.421) and there are significant differences between other settings and T1 In the *t*-test of investment amount. There is a significant difference between T1 and T2 in the *t*-test of payoff. The investment amount of H1C has not been verified, other assumptions of H1 have been verified.

Individual investment amount and payoff under the influence of leader investment type transformation

It can be seen from Table 4 that when the leader's investment type is in ascending order (T5), the average value of individual investment increases from 8.716 to 15.083 and then to 17.95, and the average value of payoff increases from 56.108 to 67.642 and then to 79.425, all of which maintain an upward trend. The leader's investment type is positively correlated with individual investment and payoff. A similar situation was found in T6. The individual investment decreased from 22.094 to 11.128 and then to 5, and the payoff decreased from 81.497 to 65.664 and then to 54.25 when the leader's investment type appeared in descending order, which maintained a downward trend as a whole. It is found that the type of leader investment is positively correlated with individual investment and payoff through the data analysis of T5 and T6, which basically verifies H2A.

Comparing the individual investment amount and payoff of leaders with low investment amount in T5 and T6, it is found that the individual investment amount and payoff under the ascending order of leader investment amount (T5) are 8.716 and 56.108 respectively, and the individual investment amount and payoff under the descending order (T6) are 5 and 54.25, respectively. The individual investment amount and payoff guided by leaders with low investment amount under the ascending order are higher than those in the descending order. The *t*-test of the individual investment amount and payoff of the two settings shows that the value of *p* of the investment *t*-test is 0.001 and the value of *p* of the payoff *t*-test is 0.041, which are significant. There are significant differences between the investment amount and payoff, which basically verifies H2B.

Comparing the individual investment amount and payoff of leaders with high investment amount in T5 and T6, it is found that the individual investment amount and payoff of leaders with high investment amount in ascending order (T5) are 17.95 and 79.425, respectively, and the individual investment amount and payoff of leaders with high investment amount in descending order (T6) are 22.092 and 81.497, respectively. The individual investment amount and payoff guided by leaders with high investment amount in ascending order are lower than those in descending order; The t-test of the individual investment amount and payoff of the two settings shows that the value of *p* of the investment amount and payoff *t*-test is 0.029 and the value of *p* of the payoff *t*-test is 0.137. There is a significant difference in the investment amount and no significant difference in the payoff. In H2C, the investment part is verified, while the payoff part is not verified.

TABLE 3 The *t*-test of individual investment and payoff.

		T1 *vs.* T2	T1 *vs.* T3	T1 *vs.* T4	T5l *vs.* T6l	T5 m *vs.* T6 m	T5 h *vs.* T6 h
Investment	*T*	8.277	6.705	−0.806	3.323	3.126	−2.196
	p	0.000	0.000	0.421	0.001	0.002	0.029
Payoff	*T*	10.475	3.821	−7.223	2.057	1.870	−1.490
	p	0.000	0.000	0.000	0.041	0.062	0.137

T1 to T6 represent 6 settings, of which t5l represents 10 periods of experiments in which the leader type in setting 5 is low investment type, T5 m represents 10 periods of experiments in which the leader in setting 5 is medium investment type, and t5 h represents 10 periods of experiments in which the leader in setting 5 is high investment type. T6l, t6 m, and t6 h are similar to setting T5.

TABLE 4 The leader type transformation and individual investment and payoff.

Experimental setup	Sample size	Average investment		Average payoff	
		Mean value	Standard deviation	Mean value	Standard deviation
T5d	180	8.716	11.695	56.108	9.206
T5z	180	15.083	12.608	67.642	10.192
T5g	180	17.95	18.022	79.425	13.618
T6d	180	5	9.401	54.25	7.888
T6z	180	11.128	11.370	65.664	9.877
T6g	180	22.094	17.786	81.497	12.758

Regression analysis

Individual investment and payoff under the influence of leaders

To further test the mechanism of the existence of leaders and the type of leadership investment on individual investment, the next step is to analyze it by a regression model. The independent variables in Table 5 are the amount of individual investment in each period, and the independent variables variable setting (treat) is a dummy variable. Models 1-1 and 1-2 are the regression between leaders with no leader and leaders with low investment,

TABLE 5 Individual investment with or without leaders.

Independent variables	No leader *vs.* low type leader		No leader *vs.* medium type leader		No leader *vs.* high type leader	
	Model 1-1	Model 1-2	Model 2-1	Model 2-2	Model 3-1	Model 3-2
Treat	−12.058*** (−8.28)	−12.022*** (−7.17)	−7.669*** (−6.70)	−7.477*** (−5.64)	1.319* (0.81)	4.938*** (2.57)
Gender		1.253 (0.82)		−0.305 (−0.26)		2.068 (1.25)
Altruistic		0.169*** (3.65)		0.170*** (4.52)		0.078 (1.22)
Period		0.528*** (3.93)		0.219* (1.80)		0.520*** (3.42)
Economic		−6.413** (−2.09)		−5.078** (−2.20)		4.885 (0.96)
Income		1.189* (1.76)		0.871 (1.53)		2.045** (2.46)
Father × mother		0.168 (1.20)		−0.027 (−0.23)		0.401* (1.72)
Single		−6.896*** (−3.35)		−6.628*** (−4.51)		−11.250*** (−4.54)
N	500	500	500	500	500	500
R^2	0.121	0.223	0.062	0.150	0.001	0.108

*means significant at the level of 10%, **means significant at the level of 5%, ***means significant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

no leader takes 0, and leaders with low investment take 1; Models 2-1 and 2-2 are regression under the existence of no leader and medium investment type leader. No leader takes 0 and medium investment type leader takes 1; Models 3-1 and 3-2 are regression with no leader and high investment type leader. No leader takes 0 and high type leader takes 1. The control variables were gender (Gender), altruistic preference (altruistic), number of periods (period), economic study experience (economic), family income (income), parental education (father × mother) and single child (single). The results show that the existence of low investment type leaders and medium investment type leaders significantly reduces the amount of individual investment, and the existence of high investment type leaders significantly improves the amount of individual investment. The amount of individual investment in H1A and H1C is verified. In H1B, although there is a significant difference between the amount of individual investment in the presence of medium investment type leaders and that without leaders, it significantly reduces the amount of individual investment.

When investigating the influence mechanism of the existence of leaders on individual payoff, we take the individual payoff in each period as the dependent variables. The independent variables and control variables are the same as above. The results are shown in Table 6. The existence of low investment type and medium investment type leaders reduces the individual payoff, while the existence of high investment type leaders improves the individual payoff. H1A and H1C were verified, and H1B was not verified, but it is found that it is significantly different from the leaderless setting.

The influence mechanism of leader's investment type and transformation on individual investment and payoff

To further analyze the relationship between the type of leader investment and individual investment and payoff, we use the method of linear regression analysis. Gender (Gender), altruistic preference (altruistic), number of periods (period), economic education experience (economic), family income (income), parental education (father × mother) and single child (single) are the control variables, individual investment and payoff are the independent variables, and the type of leader investment is the dependent variable. The type of leader with low investment is 0, take 1 for medium investment type and 2 for high investment type. The results show that the type of leader's investment is significantly positively correlated with individual investment and payoff. The correlation coefficients of individual investment and payoff are 6.582 and 12.641, values of *p* are all 0.000. H2A is verified.

When investigating the impact of the transformation of leader investment type on individual investment and payoff, our study selects the three types of low, medium and high investment in setting T5 to match setting T6 respectively, and tests them by stepwise regression. The results are shown in Tables 7, 8. Model 1-1 and 1-2 is the matching of low investment type leaders under the two settings, and model 1-2 adds a series of control variables on the basis of Model 1-1, which are the same as those analyzed above. Models 2-1 and 2-2 and Models 3-1 and 3-2 matches the leaders of medium investment type and high investment type, respectively. The results show that the existence of low investment type leaders reduces the individual's investment and payoff, and the *t*-test results are significant. The *t*-value of investment *t*-test is 3.323, value of *p* is 0.001, and the *t*-value of payoff *t*-test is 2.057, value of *p* is 0.041. Support H2B. In addition, it is also found that the individual investment and payoff in the ascending investment type are greater than those in the descending order in the regression. The existence of high investment type leaders with reference is not as good as the individual investment without reference. The individual investment of high investment type leaders in ascending order is lower than that in descending order, and the t-test is significant, but the *t*-test and regression results of individual payoff are not significant, the transformation of leader investment type cannot significantly affect individual payoff. In H2C, the investment part is verified, while the payoff part is not verified.

TABLE 6 Individual payoff with or without leaders.

	Model 1-1	Model 1-2	Model 2-1	Model 2-2	Model 3-1	Model 3-2
Treat	−14.667*** (−10.48)	−12.225*** (−7.32)	−4.122*** (−3.82)	−2.700** (−2.08)	10.722*** (7.22)	12.065*** (6.80)
Gender		−0.460 (−0.30)		0.225 (0.19)		3.094** (2.03)
Altruistic		0.002 (0.04)		0.012 (0.31)		−0.004 (−0.07)
Period		0.568*** (4.24)		0.380*** (3.18)		0.566*** (4.03)
Economic		0.132 (0.04)		−2.095 (−0.93)		−3.838 (−0.82)
Income		1.212* (1.80)		0.589 (1.06)		2.533** (3.30)
Father × mother		−0.144 (−1.03)		−0.028 (−0.24)		−0.156 (−0.72)
Single		−2.001 (−0.98)		−1.980 (−1.38)		−2.728*** (−1.19)
N	500	500	500	500	500	500
R^2	0.181	0.222	0.021	0.042	0.095	0.159

Treat is taken as 0 in benchmark setting. The leader of low investment type is taken as 1 in Model 1-1 and 1-2, while the leader of medium investment type is taken as 1 and the leader of high investment type is taken as 1, respectively, in Model 2-1 and 2-1 and Model 3-1 and 3-2. *means signifcant at the level of 10%, **means signifcant at the level of 5%, ***means signifcant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

TABLE 7 Individual investment under the influence of leader's investment type order.

Independent variables	Low type leader		Medium type leader		High type leader	
	Model 1-1	Model 1-2	Model 2-1	Model 2-2	Model 3-1	Model 3-2
Treat	−3.717*** (−3.32)	−3.554*** (−3.01)	−3.956*** (−3.13)	−2.372* (−1.89)	4.144** (2.20)	5.985*** (3.16)
Gender		0.215 (0.17)		−0.068 (−0.05)		0.389 (0.19)
Altruistic		−0.021 (−0.63)		0.079** (2.21)		0.112** (2.06)
Period		−0.819*** (−4.32)		−1.463*** (−7.29)		−1.313*** (−4.33)
Economic		−0.438 (−0.24)		−4.826** (−2.45)		−1.465 (−0.49)
Income		1.310** (2.13)		1.727*** (2.65)		6.221*** (6.33)
Father × mother		0.033 (0.32)		−0.234** (−2.11)		−0.415** (−2.48)
Single		−0.310 (−0.22)		−5.244*** (−3.52)		−5.675** (−2.52)
N	360	360	360	360	360	360
R^2	0.030	0.100	0.027	0.072	0.013	0.176

*means significant at the level of 10%, **means significant at the level of 5%, ***means significant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

TABLE 8 Individual payoff under the influence of leader's investment type order.

Independent variables	Low type leader		Medium type leader		High type leader	
	Model 1-1	Model 1-2	Model 2-1	Model 2-2	Model 3-1	Model 3-2
Treat	−1.858** (−2.06)	−1.190* (−1.22)	−1.978* (−1.87)	−1.883* (−1.68)	2.072 (1.49)	2.626* (1.80)
Gender		−1.764* (−1.69)		−0.700 (−0.58)		0.288 (0.18)
Altruistic		0.018 (0.65)		−0.028 (−0.87)		−0.106** (−2.54)
Period		−0.394** (−2.52)		−0.725*** (−4.03)		−0.629*** (−2.70)
Economic		0.521 (0.34)		−0.306 (−0.17)		−2.801 (−1.23)
Income		−0.368 (−0.72)		−1.186** (−2.03)		3.035*** (4.01)
Father × mother	360	0.114 (1.31)		0.194* (1.95)		−0.107 (−0.83)
Single		−0.521 (−0.45)		0.156 (0.12)		−4.862*** (−2.81)
N		360	360	360	360	360
R^2	0.012	0.042	0.010	0.072	0.006	0.097

*means significant at the level of 10%, **means significant at the level of 5%, ***means significant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

Horizontal reference point of investment, risk preference and individual investment

In order to further analyze the role of leaders' existence and their investment types in individual investment, we take the lag of the average investment amount of other group members and risk preference as moderator variables and test their role between leaders' investment types and individual investment in stepwise regression. See Table 9 for details. According to the classification of reference standards by Cohn et al. (2014) and Fehr et al. (2021), we define the lag of the average investment amount of other group members as the horizontal reference point of investment, and risk preference is measured using a seven-level

TABLE 9 Horizontal reference point of investment, risk preference and individual investment with leaders.

Independent variables	Horizontal reference lag		Risk preference			
	M1-1	M1-2	M2-1	M2-2	M3-1	M3-2
Type	1.384* (1.89)	1.881*** (2.59)		−1.883* (−1.68)	2.495 (1.64)	2.495* (1.73)
avg(1)	0.374*** (5.41)	0.293*** (4.20)				
Risk			1.950*** (4.61)	1.338*** (2.90)	0.575 (0.92)	−0.037 (−0.06)
avg(1) × type	0.113*** (2.65)	0.115*** (2.73)				
Type × risk					1.375*** (2.85)	1.375*** (3.01)
Gender		0.569 (0.64)		0.571 (0.58)		0.571 (0.63)
Altruistic		0.072*** (2.98)		0.062** (2.33)		0.062** (2.52)
Period		−0.763*** (−4.83)		−1.198*** (−7.96)		−1.198*** (−8.64)
Economic		−1.623 (−1.21)		−1.983 (−1.35)		−1.983 (−1.46)
Income		1.767*** (3.90)		2.677*** (5.28)		2.677*** (5.72)
Father × mother		−0.166** (−2.20)		−0.256*** (−3.03)		−0.256*** (−3.29)
Single		−1.919* (−1.91)		−2.888** (−2.55)		−2.888*** (−2.77)
N	972	972	1,080	1,080	1,080	1,080
R^2	0.285	0.042	0.019	0.107	0.155	0.243

*means significant at the level of 10%, **means significant at the level of 5%, ***means significant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

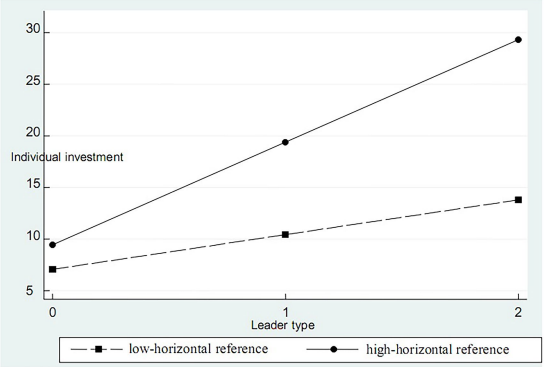

FIGURE 1
Moderator effect of horizontal reference point.

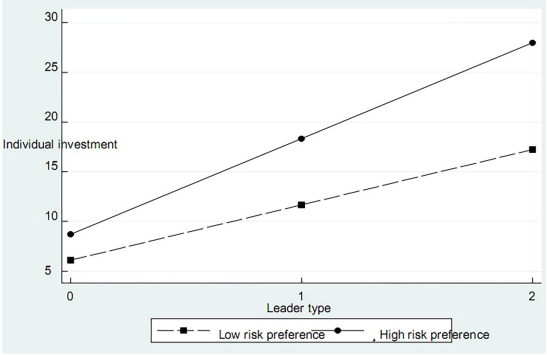

FIGURE 2
Moderator effect of risk preference.

Likert scales. According to M2-1 and 2-2 in Table 9, there is a positive correlation in risk preference and individual investment with leaders (coefficients are 1.950 and 1.338, respectively), supporting H4A. It can be seen from M1-1 and 1-2 in Table 9 that the horizontal reference point plays a positive regulatory role between the leader's investment type and the individual's investment. The larger the investment horizontal reference point, the more the individual's investment. The investment horizontal reference point is divided into low-horizontal reference investment and high-horizontal reference investment according to the average value of the investment (see Figure 1). The results show that high horizontal reference investment has a greater impact on the relationship between leader investment type and individual investment, which supports H3A. According to M3-1 and 3-2 in Table 9, risk preference plays a positive regulatory role between the type of leader's investment and individual investment. Further, the risk preference is divided into low-risk preference and high-risk preference according to whether the value of risk preference is greater than 3 (see Figure 2). The results show that individuals with high risk preference increase the amount of individual investment faster with the increase of the type of leadership investment in the relationship between the type of leader's investment and individual investment, and the H4B is verified.

Horizontal reference point of investment, cooperative belief and individual investment

The intermediary effect test of cooperative belief draws lessons from the analysis methods of Preacher and Kelley (2011), and the results of path analysis are shown in Table 10 and Figure 3 (O'Neill and Mclarnon, 2018). The horizontal reference point of investment (independent variable) significantly affects the individual's cooperation belief (intermediary variable; regression coefficient is 0.811, *t* value is 48.77); (2) the horizontal reference point of

TABLE 10 Regression results of intermediary model of horizontal reference point of investment-cooperative belief-individual investment.

	Model (1) Intermediary variable:cooperative belief	Model (2) Dependent variable:individual investment	Model (3) Dependent variable:individual investment
Horizontal reference point (independent variable)	0.811*** (48.77)	0.688*** (25.05)	−0.045 (−1.16)
Cooperative belief (intermediary variable)			0.903*** (23.33)
Constant	2.805*** (8.21)	3.956*** (7.02)	1.422*** (2.94)
Adjusted R^2	0.651	0.330	0.530

*means significant at the level of 10%, **means significant at the level of 5%, ***means significant at the level of 1%. *T* value in parentheses. *N* represents the sample size.

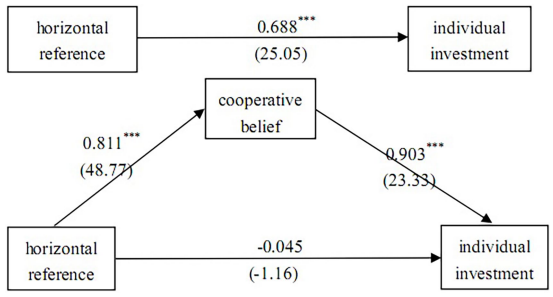

FIGURE 3
Mediation test results of horizontal reference point of investment-cooperative belief-individual investment.

investment (independent variable) significantly affects individual investment (dependent variable; regression coefficient is 0.688, *t* value is 25.05; Bartels et al., 2022). When considering the horizontal reference point of investment and cooperation belief, it is found that the correlation between individual investment and the horizontal reference point of investment is no longer significant (regression coefficient is –0.045, *t* value is –1.16), but significant with cooperation belief (regression coefficient is 0.903, *t* value is 23.33). Cooperation belief completely mediates the relationship between the horizontal reference point of investment and individual investment. H3B is verified.

To sum up, the individual investment amount of H1A, H1C, H2A, H2B, and H2C are verified except for H1B, and the relationship between the payoff part and the existence of leaders and the transformation of investment types is unstable; H3A, H3B, H4A, and H4B are verified. One of the remarkable characteristics of the public goods experiment is the vulnerability of cooperation, people's cooperation level gradually decreases with the repetition of the number of periods (Carrillo et al., 2021). Through the introduction of leaders, this study finds that the number of periods is positively correlated with individual investment. The cooperation level does not continue to decline, but shows an upward trend. The investment of only children is lower than that of not-only children in the presence of leaders, which shows the characteristics of "individual rationality" and is basically consistent with the research of Cameron et al. (2013); Previous studies have found that the cooperation level of male in public goods is higher than that of female. Our study found that there is no significant difference in the cooperation level between males and females.

Conclusion and discussion

When investigating the relationship between leaders and individual cooperative behavior, we divide leaders into three types of investment according to their investment level: low, medium and high. We use the simple public goods experiment without leadership and sequential public goods with leadership to explore the role of leaders and their influence mechanism. The main conclusions and discussions are as follows:

Leaders play two roles in the market, enterprises and social organizations. One is to provide good or bad information about the project to other organization members in the case of asymmetric information. The second is to influence the decisions of other group members by investing before employees. In order to study the demonstration effect of leaders on team cooperation, we use the sequential public goods experiment to verify whether the existence of leaders can improve the cooperation performance of the team. We found that the existence of leaders does not always improve the level of individual cooperation. This conclusion is consistent with the previous research conclusion of leader style (Tong, 2020; Zeng et al., 2020; Bartels et al., 2022). By controlling the investment of leaders, we found that only when the leader's investment is close to all his capital the employees will improve the level of cooperation and increase the investment. When the leader's investment amount is about equal to or lower than the average investment amount of employees, employees will have resistance to this, which is easier to reduce their investment amount and adopt a lower cooperation strategy.

We attempted to explain this phenomenon by the change of investment types and transformation, and leader types in our study are divided into three types: low, medium and high according to the amount of investment. Therefore, the transformation of investigation type can also be said to be the change of leader investment. It is found that when the type of leader changes from low to high, the amount of individual investment increases significantly; In addition, when individuals first encounter low type leaders and then gradually move to high

type leaders, there are differences in investment between individuals first encounter high type leaders and then encounter low type leaders, because people's horizontal reference point in decision-making changes. Therefore, it is necessary to pay attention to the situational dependence of individual decision-making behavior in research and practice.

To further explore the mechanism of leader investment influencing employee team cooperation, we have incorporated employees' personal characteristics into the research to examine the role of employee heterogeneity in leader types and individual investment. Our study found that risk preference and individual investment is a significant positive correlation in the presence of leaders; Horizontal reference point and risk preference play a moderating role in the type of leader and the amount of individual investment; Cooperative belief in social norms has a complete mediating effect in horizontal reference point and individual investment. The horizontal reference point and risk preference all play a positive role among them. Therefore, when the leader type changes from low to high, the higher the horizontal reference point, the more individual investment; the more individual risk preference, the higher the amount of investment. Cooperative belief in social norms plays an important role in individual investment behavior. It can completely mediate the horizontal reference point to affect the level of individual cooperation.

Limitations and future directions

This research has several limitations. First, when investigating the impact of leader type and change on individual cooperative behavior, we control the leader type and lacks interaction between leaders and individuals. Leaders also have the characteristics of reciprocity and altruism. In future studies, we plan to use real leaders and increase the interaction between leaders and members through communication. Second, we only focused on the impact of leaders on personal investment, but personal investment also impacts leaders' behavior and decision making. Future research can control employees' decision-making behavior and investigate its impact on leaders' decision-making behavior, that is, the behavior change characteristics of leaders when they meet good followers and bad followers. Third, given that our participants were only some college students, whether our findings could be generalized to national universities and even enterprise organizations remains an open question (Li et al., 2020). To provide solid support for the generalizability of our findings, future research should test whether these findings also apply to real business organizations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

XF and CL conceived the idea of the manuscript and designed the research. recruited subjects, and completed the experiment. XF analyzed the data and wrote the manuscript, whereas CL and JF modified the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Appendix

The payoff of function member i in t period is:

$$\pi_{it} = x_{it} + \alpha_t\left(\sum_{j=1}^{n} g_{jt}\right) = e - g_{it} + \alpha_t\left(\sum_{j=1}^{n} g_{jt}\right) = e-(1-\alpha_t)g_{it} + \alpha_t\left(\sum_{j=1, j\neq i}^{n} g_{jt}\right),$$

if the participant is a "rational person" in the sense of economics, he will maximize his own interests. According to the constraint condition of $0 \le \alpha_t < 1$, the participant will choose to invest $g_{it} = 0$ in the collective project, his final payoff is $e + \alpha_t\left(\sum_{j=1, j\neq i}^{n} g_{jt}\right)$. However, in terms of maximizing the overall social income, according to the payoff of function member i in t period

$$\pi_{it} = x_{it} + \alpha_t\left(\sum_{j=1}^{n} g_{jt}\right) = e - g_{it} + \alpha_t\left(\sum_{j=1}^{n} g_{jt}\right),$$

and $n\alpha_t > 1$, the participant will choose to invest $g_{it} = e$ in the collective project. His final payoff is $\alpha_t\left(\sum_{j=1}^{n} g_{jt}\right)$, and the overall social income is $n\alpha_t\left(\sum_{j=1}^{n} g_{jt}\right)$.

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Signaling effect in social network and charity crowdfunding: Empirical analysis of charity crowdfunding of Sina MicroBlog in China

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With the increasing number of online charity donations, research on the influencing factors of individual donation behavior has become an important topic. Social interaction information in crowdfunding has become an essential basis for potential backers to make decisions. It provides new research space for charity crowdfunding and social capital theory. The primary purpose of this study is to explore the influence of social capital, social recommendation, and other signals on charity crowdfunding performance. We obtain 4,780 project information on the charity crowdfunding of Sina MicroBlog through data collection procedures. Our research found that both external social capital and internal capital can significantly improve the fundraising performance of crowdfunding projects. Projects with more social recommendations are more likely to obtain financial support. In the case of Medical aid crowdfunding projects, the positive promotion effect of social recommendations on project fundraising ability is enhanced. To get more effective support for crowdfunding projects, it is necessary to pay attention to the construction of social capital and the cultivation of its reputation to obtain the recognition of potential backers.

KEYWORDS

online charity crowdfunding, crowdfunding performance, social capital, social recommendation, Sina MicroBlog, prosocial behavior, reciprocity

Introduction

Online crowdfunding expands the financing target to the general population, which provides new financing channels for innovation, enterprise production and operation, social welfare, and other activities. Especially in the current context of the COVID-19 pandemic, online charity crowdfunding, one of the forms of online crowdfunding, plays a vital role in charities. The 2020 China Charity Donation Report conducted by China Charity Alliance shows that Charity organizations in China raised more than 8.2 billion yuan through 20 online fundraising platforms in 2020. More than 10 billion

people participated in online donations, highlighting the vitality of "Internet + Charity." Small donations with civic participation have become a trend of charity contributions. Therefore, it is significant to study the influencing factors of individual donation behavior in the context of the Internet.

Charity Crowdfunding of Sina MicroBlog is one of largest online charity platforms in china which involve many charity crowdfunding projects such as medical needs, education assistance, and environmental protection. According to the report of *China Philanthropy Times* in 2021, over 7 million people donated on this platform and the funding were up to more than 700 million yuan. There is an abundance of data available in the charity crowdfund platform, including detailed information of charity crowdfunding projects, such as the target fund-raising amount and fund-raising time, and social interaction information, such as the fundraising experience of project sponsor and the forwarding and recommendation of project, which provide sufficient data for our research.

Current researches mainly focus on reward crowdfunding, and very little literature emphasis on charity crowdfunding (Zhang and Chen, 2019). Unlike reward crowdfunding, donors are not rewarded with money, and their funding motives are different. Existing literatures of charity crowdfunding study on emotions, values of donors and prosocial behavior, less playing emphasis on how the effect of social capital and social recommendation on the contributions of charity crowdfunding. Although some studies have paid attention to the impact of social capital on crowdfunding, it is still not clear enough to divide the boundary of social capital. These studies mainly discussed individuals' willingness to charity crowdfunding from individuals' external motivation and internal motivation. For example, Mollick (2014), Zheng et al. (2014), Colombo et al. (2015), Skirnevskiy et al. (2017) and other studies focus on reward crowdfunding projects, and do not divide social capital into external and internal dimensions. As another example, Bagheri et al. (2019) also did not discuss the social capital variable. Their work suggests that information sharing, values, ideas and beliefs, learning ability, and other factors affected the number of individual donations in charity crowdfunding (Bagheri et al., 2019).

Meanwhile, previous studies have focus on the historical information of the project sponsor, and lack for taking the dynamic sharing information of the current crowdfunding project into consideration (Skirnevskiy et al., 2017). It is essential to consider social recommendations of the crowdfunding project. Peng et al. (2022) found that the number of subsequent participants' donations was influenced by the emotions of text messages on the crowdfunding platform. The contributions of real-name donors are higher than anonymous donors. However, this study does not involve project recommendation information. Sura et al. (2017) and Li et al. (2018) discussed the impact of project characteristics and platforms on project fundraising capabilities with questionnaires. Their researches are relatively ignoring social attributes of projects. Current researches ignore individual characteristics and information such as the social connection between users.

Moreover, most researches are based on crowdfunding platforms of United States or Europe. Cultural differences between Chinese and European, and American make the previous research not applicable to charity crowdfunding in the context of China (Zheng et al., 2014).

Our study intends to filling those gaps. We collect data on Charity Crowdfunding projects of Sina MicroBlog through a data crawler program and divides social capital into internal and external. Based on the above work, we examine the influence of sponsors' social capital and potential backers' social recommendation on project fundraising performance. Firstly, we define the types of social capital, and consider the impact of external and internal social capital on the performances of charity crowdfunding. The participant type of crowdfunding projects can be divided into social interaction information between potential backers and project sponsors and social interaction information between potential backers and projects. Social interaction information between potential backers and project sponsors can be measured by social capital (Cai et al., 2021). Our research subdivides social capital into two dimensions: external social capital and internal social capital. Secondly, we consider the impact of social recommendation on crowdfunding performance. Potential backers can forward and recommend their preferred projects, reflecting users' social recommendation behavior (Kuppuswamy and Bayus, 2017; Madrazo-Lemarroy et al., 2019). Finally, we also take the effect of different project types on crowdfunding performance into account.

The remainder of this paper is arranged as follows: The second section describes theoretical model analysis; The third section introduces the literature and hypotheses; The fourth section is the study design; The fifth section discusses reports results; Finally, we provide our conclusions and implications.

Theory and model analysis

The information asymmetry in online charity crowdfunding is an important factor limiting donation activities, which lead to charity crowdfunding projects inefficient (Donovan, 2021). It is more complex to execute formal contracts in online charity crowdfunding than in traditional trading. While, the social information and historical transaction behavior of project sponsor can be observed by potential backers before online crowdfunding transaction. On this basis, potential backers can make a fundamental judgment on project sponsor's credit. Therefore, the opportunistic of Information dominant party will be effectively restrained, which can facilitate resource access to crowdfunding projects (Hildebrand et al., 2017). The informal institution formed by interactive communications between donors and beneficiary can effectively fill the lack of governance

in the formal system (Lins et al., 2017). Hence, we can investigate influencing factors of charity crowdfunding based on interactive information of crowdfunding platform.

The lack of constraints on the opportunistic behavior of participants will lead to the loss of overall social welfare in online crowdfunding. Signaling from social networks is vital to relieve this prisoner's dilemma. Social capital is endogenous because of relational structures in social networks. Resource functions and institutional effects, which are important attributes of social capital, play a vital role in governing modern social organizations and making decisions by donors in the network environment (Peng et al., 2022). Social recommendations reflect user's approval of a product or service, which is a social resource generated from informal relationships. The higher the social recommendations are, the more likely market accepted the product (Kromidha and Robson, 2016). In a crowdfunding campaign, social recommendations are mainly reflected by the "likes," "reposts" and other signals of social friends (Liu et al., 2018). The higher social recommendations are, the more likely the crowdfunding project will be accepted.

Participants can make an appropriate decision based on the social network information and the historical data of the opponent. If one party often adopts an opportunistic strategy, it will lose the opportunity to cooperate in the future. As a result, total social welfare will be reduced. Based on this consideration, it improves the classic Prisoner's Dilemma model with a social network-based game model. The relationship connection strength in the social network is λ, which can reflect the level of social capital. The network signal disclosure quality is θ, which describe the degree of social recommendation. The game structure is given in **Table 1**.

In the classic Prisoner's dilemma, the game result is (c, c) when both parties adopt the cooperative strategy, which means both parties gain c. The game result is (a, b) when one party cooperates and one party takes opportunistic behavior. Under these conditions, the cooperative party gains b, while the betraying party gains a. The payoffs satisfy the conditional constraints in the prisoner's dilemma: $b < 0 < c < a$, and $a + b < 2c$. Because of individual rationality, betrayal is the equilibrium strategy of the game, and the social welfare maximization strategy of (cooperation, cooperation) will not appear.

We define $\omega = c - a$ as the project implementation level. When the conditions of the prisoner's dilemma is$\omega = c - a < 0$, the parties have the possibility of betrayal. When $\omega > 0$, the trade will be succeeded. When two parties play a multi-stage game, the discount rate of the parties is assumed to be $\delta(0 < \delta < 1)$. In the current and subsequent future trade, the parties will maintain the cooperation strategy when "the return of implementing betrayal strategy" is less than "the sum of the discounted return of implementing cooperative strategies," which is shown as follows:

$$c + \delta c + \delta^2 c + \delta^3 c + \cdots > a \tag{1}$$

$$Since\ 0 < \delta < 1, c + \delta c + \delta^2 c + \delta^3 c + \cdots = \frac{c}{1-\delta} \tag{2}$$

The parties will adopt a cooperative strategy under conditions of $a < \frac{c}{1-\delta}$ and the game result of cooperation strategy is $(\frac{1}{1-\delta}c, \frac{1}{1-\delta}c)$.

Now we analyze the decision behavior of the parties in the social networking. The stronger ties in the social network, the more likely the sponsor's betrayal strategy is to be found. In other words, the stronger the network signal sends, the more likely the sponsor's betrayal strategy will be discovered. There is a certain probability that a betrayal will be detected. $\frac{\partial p(\lambda,\theta)}{\partial \lambda} > 0$, $\frac{\partial p(\lambda,\theta)}{\partial \theta} > 0$. The discovery probability $p(\lambda, \theta)$ is positively correlated with λ and θ. λ is the strength of relationship connection in the social network. θ is signal display quality of network. $1 - p(\lambda, \theta)$ is the probability that the party adopts a betrayal strategy without being discovered and makes the game decision in the next period.

If the party takes betrayal strategy in the first phase, they will keep the cooperation strategy from the second phase. On this condition, the return of the first phase is still a. The discounted return of the cooperation after the second phase is as follows:

$$\delta c + \delta^2 c + \delta^3 c + \cdots = \frac{\delta}{1-\delta}c \tag{3}$$

If the betrayal strategy is not discovered, the expected return is the sum of the first phrase return and the later discounted return:

$$\begin{aligned} &a + [1 - p(\lambda, \theta)] \bullet (\delta c + \delta^2 c + \delta^3 c + \cdots) \\ &= a + \frac{\delta}{1-\delta}[1 - p(\lambda, \theta)] \bullet c = a + \frac{\delta[1 - p(\lambda, \theta)]c}{1-\delta} \end{aligned} \tag{4}$$

In this case, the return of the betrayer is $a + \frac{\delta[1-p(\lambda,\theta)]c}{1-\delta}$ and the return of the partner is b. The result of the game is$(a + \frac{\delta[1-p(\lambda,\theta)]c}{1-\delta}, b)$.

If the trade is guaranteed, the benefits of cooperation between the two parties are more significant than the benefits of non-cooperation, which is shown as follows:

$$\frac{c}{1-\delta} > a + \frac{\delta[1 - p(\lambda, \theta)]c}{1-\delta} \tag{5}$$

$$\text{The equivalent inequality is } \frac{1 - \delta[1 - p(\lambda, \theta)]}{1-\delta}\text{c-a} > 0 \tag{6}$$

$$\text{That is } c - a > -\frac{\delta p(\lambda, \theta)}{1-\delta}c \tag{7}$$

Since $\omega = c - a$ is the project implementation level, it requires $c - a = \omega > 0 > -\frac{\delta p(\lambda,\theta)}{1-\delta}c$. The deal is made requires

TABLE 1 Payment matrix of two parties in social network.

		Player 2	
		Cooperative	**Non-cooperative**
Player1	Cooperative	$\frac{1}{1-\delta}c, \frac{1}{1-\delta}c$	$b, a+\frac{\delta[1-p(\lambda,\theta)]c}{1-\delta}$
	Non-cooperative	$a+\frac{\delta[1-p(\lambda,\theta)]c}{1-\delta}, b$	0,0

$\omega > 0$. Due to the existence of social connections, the constraint condition ω of the trade is relaxed to $-\frac{\delta p(\lambda,\theta)}{1-\delta}c$. The signaling effect enables some trade to be realized, which cannot been carried out previously.

$$According\ to\ inequality\ (6),\ let\ U = c - a + \frac{\delta p(\theta, \lambda)}{1-\delta}c \quad (8)$$

$$Then \frac{\partial U}{\partial \lambda} = \frac{\delta c}{1-\delta}\frac{\partial p(\lambda, \theta)}{\partial \lambda} > 0 \quad (9)$$

$$\frac{\partial U}{\partial \theta} = \frac{\delta c}{1-\delta}\frac{\partial p(\lambda, \theta)}{\partial \theta} > 0 \quad (10)$$

The two inequalities (9) and (10) indicate that the constraining force of trade will increase with the enhancement of the social relationships of project sponsors and the signal display level. The intensity of social connection and quality of network signal display will improve trade efficiencies. In online charity crowdfunding, we can infer that social capital can significantly improve the fund-raising ability of projects, and social recommendations can also promote the funding of crowdfunding projects. Next, we will analyze these two inferences.

Literature review and research hypothesis

Social capital signals and fundraising

Due to differences between social networks, their social capital is also unique. External social capital refers to social connections generated by social media associated with crowdfunding platforms, which are outside the trading platform and can be measured by the number of fans on related social platforms, such as the number of social friends on Facebook, LinkedIn, and other social media accounts. Internal social capital is interactions between potential backers in the trading platform, measured by the number of backers, endorsements, and projects supported on the crowdfunding platform (Kuppuswamy and Bayus, 2017; Madrazo-Lemarroy et al., 2019).

The inside or outside interactive information on Charity Crowdfunding on Sina Micro Blog provides an important informal institutional guarantee for crowdfunding campaigns. Outside interactive information of project sponsors, such as fans and numbers of views, can be found on Charity Crowdfunding of Sina MicroBlog, which displays social connections of project sponsor and can effectively increase the possibility of the project sponsor communicating with outside. The project sponsors inside interactive information, such as previously contributed money to crowdfunding projects, the number of backers they brought in, etc., can also be displayed on the crowdfunding platform. At this point, social capital is a crucial symbol of the project sponsor's credit and quality (Donovan, 2021). High social capital reflects the better performance of project sponsors in past trading activities, representing personal credit and ability, and offering an important basis for decisions for potential backers (Zheng et al., 2014).

In terms of external capital, each social connection represents not only a project propagandist and potential backer but also a project supervisor (Calic and Mosakowski, 2016). When there is a high level of external social capital, the project sponsor will have more channels to connect with external platforms, and the more potential backers there are. Moreover, the project sponsor is subject to more supervision and is less likely to adopt opportunistic behavior.

Internal social capital mainly obtains resources based on the reciprocal relationship between the person who has received the support of the project sponsors and the project sponsor (Colombo et al., 2015). Receivers responsible and obligated to support the project sponsors' project, which is called direct reciprocity in the reciprocity theory (Khadjavi, 2017). The integrity behaviors of the project sponsors in history will also gain the trust of individuals who are not direct beneficiaries. According to the reciprocity theory, indirect beneficiaries will also support project sponsors with the influence of indirect reciprocity. Consequently, the project will be widely spread, and obtaining funds will be more accessible (Colombo et al., 2015).

Whether external or internal social capital, social capital based on informal values or social norms recognized by groups can guide group members to cooperate and reduce transaction costs. Social capital also can restrain non-trustworthy behavior through external punishment mechanisms formed by public opinion in the social network (Mollick, 2014). The informal

institutional constraints formed by social capital may be more critical than the formal system, especial when the formal system is weak or the contract execution cost is too high (Lins et al., 2017). Social capital can significantly improve the fundraising capacity of projects in online crowdfunding. Therefore, the following research hypothesis is proposed:

> H1: Social capital has a positive effect on project fundraising ability.

> H1a: External social capital has a positive effect on project fundraising ability.

> H1b: Internal social capital positively affects project fundraising ability.

Social recommendation and fundraising ability

Unlike traditional information dissemination, social networks mainly spread information through interactions including the emotions of participants of the project (Schafer et al., 2018). The signals of social recommendation contain more identity and trust to project sponsors, such as "likes" and "reposts" on social networks. Social recommendation promotes information aggregation and resource acquisition (Hong et al., 2018). A project will gain more understanding and commendation from social recommendations in an online crowdfunding campaign when it gets more "likes." It can be relatively easy to obtain financial support from social recommendations (Wang et al., 2018). The social recommendation indicates a superior reputation, which illustrates a good market performance of this product. In this sense, it is an important basis for people to make decisions under information asymmetry.

During an online crowdfunding campaign, project sponsors with more social recommendations will get financial support more accessible. This incentive effect can reduce fundraisers' short-term opportunistic behavior. In addition, decision-makers tend to ignore their private information and imitate others' behaviors under information asymmetry (Banerjee, 1992). The phenomenon of herd behavior also exists in online crowdfunding. Potential backers are the most likely to follow others' decisions to invest in the project with high social support under the effect of herd behavior. In this sense, a project with more social recommendations is relatively easy to obtain financial support earlier (Colombo et al., 2015).

Users can forward the project information to social platforms when they see a supported project on the Charity Crowdfunding of Sina MicroBlog. The fundraising channel could be expanded when more people know about this project. People from external social media can also learn about the progress and usage of fundraising. The social recommendation of the project enables the public to play a supervisory role in a crowdfunding campaign. The platform and project sponsors will improve information transparency to gain project credibility. Due to the signals of social recommendation, the risk perception of potential backers will be reduced, and the trustworthiness of the project will enhance (Skirnevskiy et al., 2017). Social recommendations will also spread project information widely, and more potential backers are aware of the project's existence. In brief, the social recommendation can improve the fundraising ability of the project.

> H2: Social recommendation has a positive effect on project fundraising ability.

Moderating effect of project type on social recommendation signals and fundraising ability

Due to the context-dependence of individual decision-making, there may be some differences in their perception of identity brought by social recommendations (Li et al., 2021). The role of social recommendations on fundraising ability may differ when potential investors face different projects (Proelss et al., 2020). According to Maslow's Hierarchy of Needs theory, physiological, and safety needs are people's basic needs. In medical aid projects, it will threaten recipients' life safety if they can't get financial support in time. Consequently, people prefer to support these urgent and basic physiological needs projects (Proelss et al., 2020). Medical aid crowdfunding projects are often closely related to people's basic needs, which will be preferred to share, spread, and identify with the public (Hong et al., 2018). Compared with non-medical aid projects, people have a more profound recognition and concern to interactions of medical aid programs. Therefore, medical aid projects are more likely to be funded.

Crowdfunding projects mainly include medical aid, environmental protection, and education assistance on the Charity Crowdfunding of Sina MicroBlog. The disease will bring a heavy blow to the patient's physical and mental health and even threaten their life. Medical aid crowdfunding projects shared by the platform are more likely to be supported by users because of the urgent demand for funds. According to the previous analysis, projects receiving more social recommendations are more likely to get financial support. In the case of medical aid crowdfunding projects, the promotion effect of social recommendation on the project's fundraising ability will be more obvious. Hence, Medical aid crowdfunding projects have a positive moderating effect between social

recommendation and the project's fundraising ability. The following research hypothesis is proposed:

> H3: Project type plays a moderating effect on the relationship between social recommendation and project fundraising ability. In the case of medical aid crowdfunding projects, the promotion effect of social recommendation on project fundraising ability is enhanced.

Materials and methods

Data

Charity Crowdfunding of Sina MicroBlog is an online crowdfunding platform established earliest in China. The projects on the platform are authentic and reliable, benefiting from the standard procedures and strict review processes. This Crowdfunding platform contributes detailed and objective data to this research. Project information on this crowdfunding platform is mainly divided into three types: project information, social information of sponsor, and historical information of project sponsor. Project information includes the times of project forwarding, fundraising target amount explicitly, duration, project type, finally raised funds, and project fundraising ratio; The social information of the project sponsor involves the number of social friends and the number of views; Historical information of project sponsor refers to the number of projects they have supported, the number of backers they brought in, and charity points.

Since project sponsors' social information and performances will vary over time, we need to consider the project information validity carefully. Then, this study selected projects during the time from January 1, 2016 to December 8, 2017. Project information mainly includes the project fundraising goal, the duration of project funding, the number of project funds obtained, the number of social friends, the number of "likes" and other information. In data processing, we removed 527 projects which have deactivated social accounts and tested informal projects. The projects with incomplete details are also removed. This research finally obtained 4,780 projects.

Measurements

The dependent variable is the crowdfunding performance of the project, which is measured by the number of funds finally raised for the project, and represented by *Funding Raised* (Mollick, 2014). For the robustness test, this study also takes the proportion of funds raised for the project as the dependent variable (Lin et al., 2013). The proportion is the ratio of actual funds to target funds, defined as the *Funding Level*.

According to the research of Butticè et al. (2017), Hervé et al. (2019) and Madrazo-Lemarroy et al. (2019), the external social capital is measured by the number of Weibo page views. This indicator can reflect the number of a blogger's active followers and the number of real connected users, indicating the blogger's social capital outside of the crowdfunding platform. There are many inactive followers or fake followers on Weibo. These followers will not read, click a like, or comment after following Weibo bloggers, which cannot represent the external resources for bloggers. In this sense, we do not use the number of Weibo followers as the indicator of external social capital. Therefore, we select the number of Weibo views to measure external social capital. This is essentially consistent with the standard of external social capital by the number of social friends of project sponsors (Colombo et al., 2015). Referring to the research of Kim et al. (2017), Davies and Giovannetti (2018), and Madrazo-Lemarroy et al. (2019), the internal social capital is measured by two indicators. One of the indicators is the number of donors in previous projects of the sponsor; another is the charity points. The number of backers brought by sponsors is not just a measure of their fundraising ability but also a label of their trustworthiness. The charity points are based on project initiators' participation in charity campaigns, which accumulated by Sina MicroBlog Charity Crowdfunding rules. Points can be gained from original or reposted topic words of Weibo charity projects and participation in numerous charity activities. The charity points can represent their social capital, which objectively reflects sponsors' involvement in charity projects. The second indicator of internal social capital is consistent with the first one. The two indicators all represent the relationship between backers and sponsors. They can use to measure internal social capital (Colombo et al., 2015; Skirnevskiy et al., 2017).

Backers can forward crowdfunding projects on social media through Charity Crowdfunding of Sina MicroBlog. The social recommendation can be measured by the forwarding times of crowdfunding projects, which are interactions between backers and projects (Kromidha and Robson, 2016; Schafer et al., 2018). Potential backers can also recommend projects through the sharing mechanism to express their support for projects. This interaction signal between potential backers and the project can increase project trustworthiness. The more times a project is recommended, the more backers will be attracted.

The moderator variable is the project type, which is represented by *Type*. When the value of *Type* is 1, it means medical aid projects, and 0 represents other projects. In addition to the above-mentioned explanatory variables, many factors can affect fundraising ability. Based on similar literature, the control variables selected include crowdfunding goal, project duration, year of project implementation, and other indicators (Mollick, 2014). The crowdfunding goal is the amount of capital demand set by the project sponsor, which is represented by the *Goal*; The project duration is the days between the start and ends the of

TABLE 2 Definition of main variables and descriptive statistics.

Variables	Definition	Mean	Std. dev.	Min	Max
Funding raised	The number of funds finally raised for the project	3346.362	7666.479	0	50254.000
Funding level	The percentage of a project's funding level that is raised by founders	16.135%	30.474%	0	126.300%
Goal	The amount sponsors seek to raise	40418.540	32850.000	700.000	100000.000
Duration	The number of days between the start and the end of the project	54.516	13.113	0	60
Year	Dummy variable which equals the value 1 if the year is 2017, and 0 is 2016	0.335	0.472	0	1
Type	Dummy variable which equals the value 1 if the project type is medical aid, and 0 otherwise	0.839	0.367	0	1
Fans	The number of followers on the Weibo social platform	55630.100	161110.700	75	1274264
Prefunding	The number of projects which sponsors have created on the platform	2.5040	2.6404	0	9
Extcapital	The number of Weibo readings	748408.500	1096679	0	2560000
Intcapital I	The charity points	519296	5621687	6	1.55e + 07
Intcapital II	The number of backers brought by sponsors	7636.325	8891.148	0	20000
Recommend	The forwarding times of crowdfunding projects	42.455	65.601	2	474

project, which is defined as Dur; To control the possible impact of the time factor on the fundraising ability, the year of the project is also controlled, represented by *Year*. When the value of *Year* is 1, it means 2017, and 0 represents 2016.

Statistical analyses

Descriptive analyses

The main continuous variables are winsorized at 1 and 99% to eliminate the influence of extreme values. A summary of specific variables is shown in Table 2. The mean value of the fundraising ability is 3,346.362, and the variance is 7666.479; the mean value of the fundraising completion ratio is 16.135%, and the variance is 30.474%. These two indicators show a big difference in the final amount of funds obtained by the project, and the overall completion level of the project is not high. The mean value of external social capital is 748,408.500, which indicates that some project sponsors' Weibo pages have a higher number of views and are widely connected to the outside world. In contrast, others have less connection to the outside of the platform. As to the internal social capital, the standard deviation of charity points and the number of donations brought by project sponsors are enormous. The internal social capital of different project sponsors differs sharply. The mean of social recommendations is 42.455. On average, forwarding and sharing of projects are relatively active.

Regression analyses

To analyze the relationship between social connection, social recommendations, and other factors on fundraising ability, this study mainly adopts the following econometric model for regression analysis:

$$Funding\ Raised = \alpha_0 + \alpha_1 Control + \alpha_2 Extcapital + \alpha_3 Intcapital_i + \alpha_4 Recommend + \varepsilon \quad (11)$$

Control refers to a group of control variables, including crowdfunding goal, duration, and other variables.$Intcapital_i$ represents the two internal social capital, respectively: the number of Weibo views and the number of backers brought by sponsors. The variable description is shown in Table 2. To avoid bias from significant differences in variables and make the data more stable, we take the logarithm of these variables, such as crowdfunding goal, the number of followers, fundraising ability, external social capital, internal social capital, and social recommendation. We also applied the VIF test and found that the variance inflation factors were lower than 10, indicating no severe multicollinearity problem in this study.

First, we discuss the relationship between social capital and fundraising ability. The regression results are presented in Table 3. Model 1 is the regression result of the control variables, and Model 2 is the regression result of the explanatory variables and explained variables without adding control variables. Model 3 is the regression result of the explanatory variable and the explained variables with control variables. Even though other variables have been controlled, the regression results show that the coefficient between *Extcapital* and *Funding raised* is 0.184, $p < 0.001$. There is a significant positive correlation between external social capital and the fundraising ability of the project, and Hypothesis H1a is supported. The above results indicate that when the project sponsor has social connections outside the crowdfunding platform, the acquisition of funds for the project will be promoted. External social capital is a critical way to help a project obtain resources.

The coefficient between *Intcapital I* and *Funding raised* is 0.111, $p < 0.001$. The coefficient between *Intcapital II* and

TABLE 3 Regression results.

	(1) Funding raised	(2) Funding raised	(3) Funding raised	(4) Funding raised
Goal	−0.005 (-0.14)		0.009 (0.30)	0.017 (0.53)
Dur	0.006* (2.50)		−0.004 (−1.68)	−0.004 (−1.58)
Year	0.162* (2.48)		−0.0204 (−0.33)	−0.0214 (−0.35)
Type	0.298*** (3.29)		0.583*** (6.82)	0.507*** (5.65)
Fans	0.130*** (7.91)		−0.236*** (−10.26)	−0.233*** (−10.13)
Prefunding	0.0748 (1.53)		−0.462*** (−8.15)	−0.480*** (−8.41)
Extcapital		0.0325 (1.47)	0.184*** (7.01)	0.189*** (7.20)
Intcapital I		0.113*** (10.21)	0.111*** (8.61)	0.109*** (8.49)
Intcapital II		0.0477 (1.50)	0.116*** (3.37)	0.114*** (3.33)
Recommend		0.713*** (24.29)	0.789*** (26.53)	0.793*** (26.66)
*Recommend *type*				0.206** (2.72)
Constant	4.763*** (14.47)	2.194*** (15.29)	2.161*** (6.74)	2.100*** (6.54)
Adj R^2	0.034	0.174	0.204	0.205

*, **, ***Denote statistical significance at the 10, 5, and 1% levels, respectively. *T*-value is reported in parentheses.

Funding raised is 0.116, $p < 0.001$. These two regression results indicate a significant positive correlation between internal social capital and fundraising ability. Internal social capital can significantly promote crowdfunding projects to get funds. Hypothesis H1b is supported. The results also reveal that the social network inside the crowdfunding platform can provide valuable information for platform users. Internal social capital is an important signal of the trustworthiness of project sponsors and an important basis for potential backers to make a decision.

The results of model 3 show that the coefficient between *recommend* and *Funding raised* is 0.789, $p < 0.001$. There is a significant positive correlation between social recommendation and the fundraising ability of the project. Crowdfunding projects can be benefited from social recommendations significantly. Hypothesis H2 is supported.

Considering the context-dependence of potential backers' decision-making, we introduce the project type as moderating variable. Then, we will explore the relationship between social recommendation and fundraising ability. We use *recommendation* and *Type* to make an intersection and put the intersection into the regression equation. The regression results of Model 4 are given in Table 3. It shows that the intersection significantly positively correlates with fundraising ability. The result indicates that the project type has a moderating effect between social recommendation and fundraising ability. The promoting effect of social recommendations on fundraising is enhanced in the medical aid crowdfunding project. Hypothesis H3 is supported. According to the study of Dawson (2014), the moderating effect of project type is given in Figure 1. Under the medical aid crowdfunding project, the social recommendation has enhanced the positive impact on project fundraising ability.

Robustness test

This paper uses Funding Level as explained variables to verify the robustness of regression results. We further test the influence of social capital and social recommendation on the project's fundraising ability. The regression result is given in Table 4. It shows that the positive correlation between external social capital, social recommendation, and the proportion of funds raised is still significant. The moderating effect of project type also still existed. The only difference is the regression results of *Intcapital II*. *Intcapital II* has a negative coefficient with *Funding Level*. This presents that the number of backers brought by sponsors can increase the donation amount, but it cannot promote the completion of crowdfunding goals. External social capital and the first index of internal social capital can significantly improve the completion degree of project fundraising. Social capital and social recommendation still play an important role in the proportion of funds raised. The robustness test is almost entirely passed.

Discussion

Summary of main findings

Social interaction signals such as social capital, reciprocal behavior, recommendation, and sharing in charity crowdfunding campaigns affect the performance of crowdfunding projects (Skirnevskiy et al., 2017). We study the impact of project sponsors' social capital and social

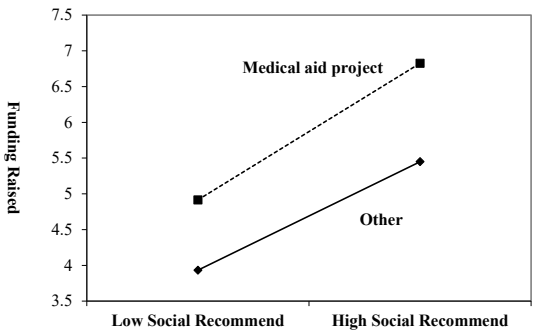

FIGURE 1
Moderating effects of project type.

TABLE 4 Robustness test.

	(1) Funding level	(2) Funding level	(3) Funding level	(4) Funding level
Goal	−0.602*** (−33.08)		−0.643*** (−35.39)	−0.639*** (−35.07)
Dur	0.000 (0.22)		−0.004** (−3.03)	−0.004** (−2.94)
Year	0.0785* (2.14)		0.057 (1.59)	0.056 (1.58)
Type	−0.062 (−1.22)		0.196*** (4.01)	0.157** (3.06)
Fans	0.035*** (3.73)		−0.033* (−2.54)	−0.032* (−2.43)
Prefunding	−0.084** (−3.06)		−0.101** (−3.12)	−0.110*** (−3.38)
Extcapital		−0.146*** (−10.12)	0.073*** (4.87)	0.076*** (5.05)
Intcapital I		0.079*** (10.91)	0.023** (3.10)	0.022** (3.00)
Intcapital II		0.030 (1.44)	−0.044* (−2.22)	−0.044* (−2.26)
Support		0.463*** (24.21)	0.481*** (28.26)	0.483*** (28.37)
*Support*type*				0.106* (2.45)
Constant	7.646*** (41.34)	0.596*** (6.38)	6.423*** (35.01)	6.392*** (34.77)
Adj R^2	0.267	0.157	0.373	0.374

*, **, ***Denote statistical significance at the 10, 5, and 1% levels, respectively. *T*-value is reported in parentheses.

recommendations on the project's fundraising ability. The data of this research is from 4,780 crowdfunding projects on Charity Crowdfunding of Sina MicroBlog. The conclusions are as follows: First, both external social and internal social capital significantly impact the fundraising ability of charity crowdfunding projects. An effective social network can help project sponsors attract potential supporters on the platform and expand fundraising channels for crowdfunding projects. In particular, social friends of project sponsors outside the platform can promote the acquisition of crowdfunding project resources. External social capital plays a significant role in project fundraising (Borst et al., 2018); Historical information about the sponsor's involvement in crowdfunding projects can improve the trustworthiness of a crowdfunding campaign. Internal social capital also can significantly enhance the number of funds raised (Yin et al., 2019). Experienced project sponsors are more likely to be supported by potential backers.

Second, the communication mechanism of social recommendation can significantly promote the project's fundraising ability. Potential backers can read and comment about the project during the crowdfunding campaign. Potential backers' recommendations and forwarding can make the project spread more widely. Social recommendations also increase the opportunity to get project resources. The project is more recommended, the more chance it will be supported by potential backers (Vismara, 2018). The recommendation of a project becomes an important signal of project quality, which enhances the trust of potential backers in the project. Consequently, it improves the project obtaining funding (Schafer et al., 2018). Project forwarding, liking, and other communications are necessary for the charity crowdfunding campaign. Social recommendation is an effective communication mechanism (Yin et al., 2019). Social interaction improves the enthusiasm of potential backers to support the project (Kim et al., 2017).

Third, the social recommendation can effectively improve the fundraising ability in medical aid crowdfunding projects. The promotion effect of social recommendation on project fundraising performance is amplified in the medical aid crowdfunding project. Investment decisions of potential backers are context-dependence. Medical aid is related to people's lives and health. This kind of demand is more likely to touch donors' emotions. A medical aid crowdfunding project is easier to accept by the public. This conclusion also proves the context-dependence of individual decision-making, revealing that prosocial behavior plays a crucial role in charity crowdfunding (Hong et al., 2018).

Implications for research

First, this study introduces the external and internal social capital to explore the charity crowdfunding influencing factors. We expand the influencing factors of charity crowdfunding performance from the perspective of social capital. Our findings enrich relevant research. The current research on crowdfunding mainly focuses on reward crowdfunding and neglects the influencing factors of charity crowdfunding from the perspective of social interaction.

Zheng et al. (2014) is one of the first to examine the effects of the three dimensions of social capital on crowdfunding performance. Their research has inspired the follow-up research, which offers a good lens for understanding crowdfunding. However, there are still some shortcomings that could be improved. For example, there are overlaps between different dimensions of social capital. The boundaries of different dimensions of social capital are ambiguous (Madrazo-Lemarroy et al., 2019). Thus, a precise classification of social capital is needed better to understand crowdfunding (Cai et al., 2021).

The studies of Colombo et al. (2015) and Skirnevskiy et al. (2017) focused on social capital within the platform and paid relatively little attention to social capital outside the platform. Moreover, Mollick (2014), Zheng et al. (2014), Colombo et al. (2015) and Skirnevskiy et al. (2017), and other studies are based on reward crowdfunding projects, while this study is based on charity crowdfunding projects. Our research divides social capital into external and internal dimensions, which can help us better investigate social capital's promotion effect on charity

crowdfunding projects. Our analysis also extends the social capital theory application field (Mollick, 2014; Zheng et al., 2014; Colombo et al., 2015; Skirnevskiy et al., 2017).

Second, this study expands previous research on charity crowdfunding in terms of social recommendations. We discuss the influencing factors of charity crowdfunding performance from the perspective of social recommendation (Sura et al., 2017; Li et al., 2018; Peng et al., 2022). Research on traditional charity crowdfunding is mainly based on platform characteristics, fundraising goals, project description, narrative style, and other information. Existing literature rarely include social interaction information between backers and projects. Whether structural social capital or relational social capital, previous studies based on social capital theory are not directly related to the current project. Moreover, the factors are relatively static external information and do not include the current crowdfunding project's dynamic process of social activities (Skirnevskiy et al., 2017).

Dynamic signals such as Likes and forwards received by the project indicate the support level of the project and the sponsors' trustworthiness. It is also an important factor affecting the fundraising ability of the project (Wang et al., 2018). When investigating the influencing factors of crowdfunding performance, this study considers recommended information for the project.

Third, Our study obtains the microscopic behavior data of project on crowdfunding platform through the web crawler program. Then, we explore influencing factors of fundraising ability in a charity crowdfunding project based on actual objective data. We provide objective data for understanding the operation process of charity crowdfunding. Based on the operation data of crowdfunding platforms, this paper analyses the influencing factors of charity crowdfunding in China. The conclusion may be inconsistent with the existing law because there is a deviation between individual subjective judgment and actual behavior. It is also a significant limitation of traditional questionnaire research. Sura et al. (2017), Li et al. (2018), and Bagheri et al. (2019) mainly employ questionnaires to discuss the impact of project fundraising performance which are not real projects on crowdfunding platforms.

Implication for practice

First, social media users are the foundation for projects to raise funds. Social media users are not only potential backers but also an important symbol of project trustworthiness. Their social interaction can also transmit valuable signals and attract more potential backers. For project sponsors, they need to pay attention to the value of their social friends. On the one hand, project sponsors can take advantage of their resources to get as many social friends as possible, which will increase the number of potential backers and project advocates. On the other hand, project sponsors need to use their social friends well. For example, project sponsors adopt a specific incentive mechanism to encourage social friends to attract more social media users. Social media users can become new social friends who can pay attention to charity crowdfunding projects.

Second, internal social capital is also a remarkable factor in improving the fundraising ability of projects. The interaction between sponsors and potential backers can improve potential backers' comprehensive understanding of the project. Project sponsors need to focus on cultivating the quality of internal social capital and the strength of relationships with social friends. For example, project sponsors can conduct propaganda and promote their crowdfunding projects through platforms such as Weibo, which will improve the quality of the relationship with potential backers.

Third, the social recommendation of the project can significantly promote the project to access funds. The project sponsors need to get more support from social friends. In this case, project sponsors can set up some incentive mechanisms to get social recommendations. For example, with the help of live broadcasting, reward-forwarding behavior, or building communication groups, the project can get as much recognition from social media users as possible, spreading the project effectively. To gain the trust of more potential backers, project sponsors must also pay attention to building relationships and burnishing their reputations.

Fourth, considering the efficiency and convenience of network information dissemination, social norms derived from network are more likely to affect more people. In network, people's decision-making behaviors are recorded, and some information forms social capital and social recommendations. These are important social norms in network which bind people's behaviors. As concluded in this study, social capital and social recommendations have a significant impact on crowdfunding performance, social norms in network motive people's positive behaviors and contribute to social harmony and stability. Therefore, we need to pay attention to how to cultivate social norms in network and take full advantages it.

Limitations and future research

There are many factors influencing project crowdfunding performance. This study mainly focuses on the crowdfunding projects on Charity Crowdfunding of Sina MicroBlog. Future research can select crowdfunding projects on other social platforms to further verify the effect of social capital, social recommendation, and other factors on fundraising ability. The measurement of social capital is of great importance to this study. However, there may be limitations in measuring social capital caused by data acquisition limitations. To better investigate the impact of social capital on fundraising ability,

various data mining methods need to be fully utilized in the following research.

Conclusion

Current studies mainly focus on reward crowdfunding projects. The impact of social networks on the fundraising ability of charity crowdfunding projects is rarely discussed using crowdfunding platforms' data. Taking the crowdfunding projects in Charity Crowdfunding of Sina MicroBlog in China as a sample, this paper analyses how social capital and social recommendation influence the performance of crowdfunding projects. This study contributes to the research on the influencing factors of the fundraising ability of charity crowdfunding.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article/supplementary material.

Author contributions

CL and JW conceived the idea of the manuscript, designed the research, collected, analyzed the data, and wrote the manuscript. MP, XL, and WG modified the manuscript. All authors have read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Peer effect of enterprise innovation: Empirical evidence from China

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Innovation investment is crucial to enterprise development and economic growth. As peer enterprises face similar market environment and development prospects, they pay attention to the innovation activities of peer enterprises in the industry because of economic rationality or the idea of seeking advantages and avoiding disadvantages. This paper aims to investigate the interaction and channel of enterprise innovation behavior of peer effect based on the data of Chinese share-listed enterprises from 2010 to 2021. The results show that peer effect exists in the innovation behavior of enterprises. We also provide evidence that managerial ability is the mechanism of the peer effect of enterprise innovation. In addition, we find that small-scale enterprises are more likely to be affected by the innovation behavior of peer enterprises compared with large enterprises. More importantly, we reveal that economic policy uncertainty significantly negatively regulates the peer effect of enterprise innovation.

JEL classification: G30, G31, O31

KEYWORDS

peer effect, enterprise innovation, managerial ability, enterprise size, economic policy uncertainty

Introduction

Innovation is the key factor to promote economic development and an important means to maintain the company's competitive advantage (Kim and Koo, 2018). The realization of the national innovation development strategy and upgrading of economic structure depend on continuous R&D investment and the improvement of innovation ability (Wang et al., 2019). Enterprise innovation ability is one of the important factors that affect the company value and business performance. Positive innovation strategies can provide a continuous driving force for the healthy and sustainable development of enterprises. In 2021, there are 298 thousand enterprises with valid invention patents

in China, an increase of 52 thousand over the previous year, and the enterprise has 1.908 million effective invention patents, with a year-on-year increase of 22.6%. What drives an enterprise innovative and what makes enterprises more involved in innovation investment have attracted the attention of more and more academic researchers over the last decades. It is increasingly important for policymakers and academic researchers to master the determinants of R&D investment driven by enterprises, as it is the basis of various R&D issues (Peng et al., 2020).

Innovation is the result of enterprises' ability to absorb and apply both internal and external knowledge to business purposes (Wang and Chung, 2013). In a highly international environment, Chinese enterprises can compete effectively only when their innovation ability is better than main competitors in the international market (Wang and Chung, 2020). Scholars have proved theoretically and empirically that innovation has a positive impact on enterprise performance (Peng and Tao, 2022), export of enterprise (Chen S. et al., 2022), enterprise value (Hao et al., 2022), structure upgrading (Ye et al., 2020), and economic development (Bilgin et al., 2021). In addition, existing literature has studied the influencing factors of innovation at all levels, such as the characteristics of managers (Chen X. H. et al., 2022), enterprise level (Xia et al., 2022), and inter-enterprise level (Woods et al., 2022). Most empirical studies on enterprise innovation are based on the assumption that R&D investment choices are often made independently of peer enterprise behavior or affected by enterprise-specific determinants (Leary and Roberts, 2014). However, previous studies show that peer enterprises have frequent competition and interaction, and the similar market and institutional environment make it have the basic conditions to imitate peer behavior. Therefore, in the decision-making process, enterprises not only consider their own factors, but also pay attention to similar decisions of enterprises with similar status. Enterprises choose to follow other enterprises with similar characteristics to avoid risks such as uneconomical cost and uncertain results caused by individual ability and resource constraints. That is, their innovation decision-making is greatly affected by the external environment (Joo et al., 2016; Mai and Lin, 2021). Therefore, the R&D investment policy choice of enterprises is affected by the behavior of peer enterprises (Xue and Zhao, 2021).

This phenomenon is called peer effect (Manski, 2000). The research on peer effect originated from sociology and gradually expanded to the fields of economics and management. Peer effect refers to the interaction between individuals in the same group, and the behavior and results of an individual are affected by their peer behavior and results (Gyimah et al., 2020). People's behavior is affected by consciousness (Smith et al., 2012; Habib et al., 2021), but their behavior is also social (Göckeritz et al., 2010) because of the social relationship (Blay et al., 2018), and their decision-making will be affected by other people in the group (Yin et al., 2021). Therefore, there is an active interaction between the decision-maker and peers in behavioral decision-making. The spillover effect of peer behavior causes the fluctuation of decision-makers' behavior at the reference group level to be several times that at the individual level (Zhong and Zhang, 2018). It can be seen that the main source of peer effect lies in the limited rationality of managers and the uncertainty of decision-making results. Peer effect breaks the relevant assumptions of independent decision-making and believes that enterprises in the same group face a similar living environment. They have the conditions and motivation to compete or imitate learning, which makes enterprises consciously pay attention to the behavior of peer enterprises. In this way, enterprises can avoid the costs and risks of independent decision-making (Gortner and Weele, 2019; Gyimah et al., 2020), obtain more information related to decision-making, and maintain their competitive advantage (Lieberman and Asaba, 2006).

Relevant studies have found that there is an obvious peer effect in enterprise decision-making. Lieberman and Asaba (2006) explain business imitation behavior from information theory and competition theory. From the perspective of information theory, incomplete information is the main reason for enterprise imitation. Enterprises will follow other peer enterprises with superior information. From the perspective of competition theory, enterprises imitate the decisions of other enterprises to maintain a relative position in the market. According to Chen and Ma (2017), peer effects affect enterprises' investment decisions if enterprises are faced with fierce competition from peer groups and higher quality of information disclosure. Leary and Roberts (2014) conclude that peer effect is important than other factors that affect the decision of corporate capital structure. The impact of this clustering effect also exists in other important decisions of the enterprise, such as capital structure (Fairhurst and Nam, 2018), cash holding (Qiu and Wan, 2015; Chen et al., 2019), corporate investment (Frésard and Valta, 2016; Bustamante and Frésard, 2021), debt maturity structure (Duong et al., 2015), stock split line (Kaustia and Rantala, 2015), and dividend policy (Grennan, 2019; Yan and Zhu, 2020). However, how this peer effect affects the innovation decision-making of enterprises has not received enough attention. Few studies take the innovation behavior of peer enterprises as an important factor affecting the competitiveness of enterprises to study the interaction between them, and the enterprise innovation mechanism is still in a "black box" state. Few of the existing studies take enterprise innovation as an important factor affecting enterprises and study the interaction between them. In addition, the innovation effect of peer enterprises is often ignored in the existing empirical research. Therefore, we study whether the innovation decisions of peer enterprises can have an impact on the innovation behavior of a single enterprise.

The innovation behavior of enterprises has strong sociality, which makes the innovation achievements have strong spillover effect (Park et al., 2020). Previous studies have shown that

innovation investment can create positive externalities in the form of innovation and technology spillovers (Sun et al., 2021). Therefore, technological knowledge spillovers can reduce R&D costs and encourage other enterprises to increase innovation investment (Lin et al., 2021). Previous empirical studies on enterprise innovation have assumed that innovation decisions are made independently within the enterprise, which ignore the contribution of external factors that play an important role in the competitive market (Turner et al., 2010). Therefore, it is necessary for enterprises to formulate innovation strategies to keep up with the development of the industry, which contain all available information about the innovation activities of their peers. In addition, enterprises pay attention to the R&D behavior of industry competitors and adjust their R&D decisions accordingly to maintain market competitiveness. It is worth noting that although the literature has studied the determinants of enterprise innovation from many aspects (Xue et al., 2021), the impact of peer innovation behavior has not been thoroughly discussed.

Our study speaks to three strands of existing literature. First, this paper provides a new idea for studying enterprise innovation behavior from the perspective of peer effect. Previous studies have reported evidence of peer effects on capital structure, cash holding, corporate investment, debt maturity structure, stock split line, and dividend policy. Unlike Chen S. et al. (2022), who focus on the impact of external innovation of stakeholders such as upstream enterprises, downstream enterprises, and competitors on enterprise exports, we extend the peer effect to enterprise innovation, because imitation is irreversible and has a high degree of information asymmetry, which requires a lot of capital investment over very long periods, resulting in higher imitation costs. It is important to focus on the impact of peers on enterprise innovation, because industry dynamics or strategic interaction can amplify the positive and negative impacts unique to enterprises within and between industries, which is particularly important in the field of innovation. Given that enterprise innovation is increasingly becoming the main driver of economic growth, it is crucial to understand how innovation dynamics in the industry affect peer enterprises. We extend peer effect to the field of enterprise innovation and focus on whether there is peer effect in enterprise innovation behavior. More particularly, we further analyze whether this peer effect is different in enterprises of different sizes.

Second, we contribute to the existing literature by providing new evidence about the mechanism of peer effect of enterprise innovation. Although the previous literature confirms that enterprise innovation is affected by other enterprise in the industry (Brown et al., 2009; Bui et al., 2021), it is not clear through which channel peer effect of enterprise innovation. The inherent uncertainty of innovation activities makes managers' evaluation of innovation investment crucial. Managers may hesitate to adopt innovative strategies when uncertainty is high. As a reflection of managers' handling of complex problems and decision-making behavior, managerial ability may be an important channel for enterprises to innovate companion enterprises. Therefore, we further explore the mechanism of managerial ability in the peer effect of enterprise innovation. By testing the role of managerial ability, we find that peer enterprises affect the innovation decisions of other enterprises in the industry through managerial ability.

Our third contribution is to expand the research on innovation by studying the impact of economic policy uncertainty on the peer effect of enterprise innovation. Although previous studies mostly discussed the influencing factors of enterprise innovation investment behavior from the perspective of internal factors or external macro environment (Yang and Yang, 2010; Sung, 2019; He and Wang, 2020), these studies cannot determine whether the peer decision-making of innovation investment is different when enterprises are faced with different degrees of uncertainty in the economic policy environment. Therefore, we bring the macroeconomic environment into the analysis framework and further study the regulatory effect of economic policy uncertainty on the peer effect of enterprise innovation. This study highlights a new influencing factor of innovation, which can enrich our understanding of peer effect and enterprise innovation decision-making.

The remainder of this paper is the following. Section "Theoretical background and research hypothesis" introduces theoretical background and hypothesis development. Section "Empirical design" describes data sources and sample selection, definition of variable, and model design. Section "Empirical results" provides empirical results, including descriptive statistics, analysis of regression results, and robustness tests. Section "Further analysis" presents further analysis, including heterogeneity of enterprise size and moderating effect of economic policy uncertainty. Section "Conclusion and implications" concludes the paper and some policy implications.

Theoretical background and research hypothesis

Peer effect of enterprise innovation

Information asymmetry theory holds that there are differences in the information obtained by individuals in economic activities, and the amount of information has an impact on future decision-making. According to the uncertainty reduction theory, individuals identify with some groups because they feel uncertainty. They reduce or control the uncertainty they feel by identifying with others (Hogg, 2007). Considering the cost and uncertainty of obtaining information, enterprises may refer to the decisions of other enterprises in the same industry or with similar attributes, which is called peer effect

(An et al., 2016). Therefore, enterprises pay close attention to the behavior of industry competitors and adjust their relevant decisions accordingly to maintain market competitiveness (Mark et al., 2014). The competitive relationship between peers enables them to have frequent and strong interaction, which makes the behavior decision-making between organizations stimulating and radiating. Meanwhile, the highly competitive market environment leads to an increase of bankruptcy risk. At this time, the management strategy of peer enterprises helps to reduce the risk of decision-making failure, which makes enterprises have a higher enthusiasm to follow suit and imitate peer enterprises (Chen and Ma, 2017). When behavior is uncertain, such as making innovation decisions, individual behavior is significantly affected by other individuals in the group and enterprises will imitate the innovation decisions of enterprises with similar characteristics. Therefore, imitation is an important way to promote innovation diffusion. The theory of technological imitation represented by Mansfield holds that the diffusion of technological innovation can be realized through the imitation of innovation (Mansfield, 1985). Additionally, innovation is crucial to the long-term development of enterprises. Innovation has a significant impact on the future production and operation of enterprises and even changes the industrial competition pattern.

Enterprises in the same industry face similar market environment and development prospects. They not only need to seize the market and form defense barriers through innovation competition, but also need innovation to resist market risks and achieve consumption leadership (Leary and Roberts, 2014). On the one hand, enterprise innovation is a kind of exploratory behavior, which leads to strong uncertainty in decision-making and behavior results. However, peer enterprises face the same industry and market environment. The complexity of innovation investment decision-making and the uncertainty of results urge enterprises to refer to the corresponding behavior of similar groups to reduce uncertainty. On the other hand, innovation is an important strategy of an enterprise. The innovation level of enterprises has a significant impact on their future production and operation and even changes the competitive pattern of the industry. Therefore, enterprises pay close attention to the innovation decisions of peer enterprises and respond positively to maintain its competitive position. Compared with enterprises with good performance, enterprises with poor performance are more motivated to get out of trouble through innovation strategy. This means that the performance of an enterprise can be used as the boundary condition for imitating the innovation behavior of its learning peers. In addition, innovation activities are highly specialized. Whether the business is similar is an important standard for enterprises to choose imitation learning objects (Dierynck and Verriest, 2020). Consequently, the business differences between enterprises affect the degree of imitation and learning from the innovation behavior of peer enterprises. However, it is difficult for enterprises to obtain all the information about the innovation behavior of peer enterprises in time. Therefore, enterprises should always pay attention to the innovation decisions of peer enterprises (Sharapov and Ross, 2019). Enterprise can reduce the cost of searching information by imitating the R&D activities of peer enterprises (Marvin and Lieberman, 2006). This can not only maintain the existing market position of enterprises, but also avoid risks to maintain core competitiveness. Therefore, the innovation decision-making of enterprises is affected by the innovation behavior of peer enterprises. Based on the above analysis, this paper puts forward the following hypothesis:

> Hypothesis 1. There is peer effect in enterprise innovation behavior.

The mediating effect of managerial ability

Neoclassical economic theory believes that managers are homogeneous and can be completely replaced. The choices made by the enterprise are exactly the same if the external environment is the same. However, there are differences in the decision-making behavior of enterprises in the real market, and this difference cannot be explained by the factors of company characteristics and industry characteristics (Cheng and Wang, 2019). According to the differences of enterprise management and the bounded rationality of people, Hanbrick and Mason put forward the Upper Echelons Theory in 1984. This theory believes that the characteristics of management differences will affect enterprise decision-making and then affect enterprise performance. The managerial ability not only reflects the knowledge, experience, and cognition of managers, but also reflects the managerial ability to deal with complex problems and make decisions. Therefore, the managerial ability is the comprehensive embodiment of the diversity of managers, which inevitably affects the realization of enterprise innovation decision-making (Zhang, 2021) and performance goals (Duan, 2021). Previous studies have shown that the managerial ability significantly affects the correctness of decision-making (Hambrick, 2007; Demerjian et al., 2013). In particular, the complex and changeable industry and market environment makes the innovation investment decision-making of enterprises have certain risks. Therefore, managerial ability plays an important role in the innovation decision-making process of enterprises.

The long cycle and high uncertainty of innovation investment mean that enterprises need sufficient market information support when making R&D decisions. The complex information in the market increases the cost of searching information for enterprises, resulting in managers' excessive reliance on decision-making information in the industry (Sushil et al., 1998). Managers with high ability can timely capture

market changes. They integrate the internal and external resources of the enterprise and make reasonable R&D decisions to promote the development of the enterprise when the market information is scarce. With these individual advantages, these managers reduce the imitation behavior of enterprises in the process of innovation investment (Peter et al., 2012). Enterprises with information advantages are in an active position and grasp the resources with potential economic value, which make them better predict the market development direction and make investment decisions by taking advantage of market opportunities. Under the leadership of competent managers, the information advantage of enterprises has been strengthened, which makes it easier for enterprises to seize innovative investment opportunities and grow into leaders with higher positions in the industry. The R&D behavior of these industry-leading enterprises has attracted the attention of industry followers, resulting in more imitation behavior.

In addition, the highly competitive market environment increases the uncertainty of enterprise management. The management strategy of peer enterprises helps to reduce the risk of decision failure, which makes enterprises have a strong enthusiasm to imitate peer enterprises (Chen et al., 2019). Managers with high ability have rich experience in corporate governance, so that they can be keenly aware of the information contained in the changes in the market environment, identify the potential risks in innovative investment projects, and adjust innovation strategies to avoid the failure of innovative investment. In addition, these competent managers can find various potential factors in the company's resources that promote the success of innovation investment activities in the process of innovation, which can improve the level of enterprise innovation. Meanwhile, enterprise managers attach great importance to maintaining their own reputation, and enterprises lacking innovative spirit will be abandoned by the public or even eliminated by the market. Therefore, enterprise managers have the motivation to make innovation investment that is not lower than the average level of peer enterprises, which can avoid damage to their own reputation and establish a good social image. Against this background, this paper puts forward the following hypothesis:

> Hypothesis 2. The managerial ability is an important mechanism of enterprise innovation peer effect.

Empirical design

Data sources and sample selection

China's R&D investment data have been disclosed since 2009. Therefore, we use the data of China's A-share-listed enterprises from 2010 to 2021 as the research sample. The final sample is obtained by screening this sample with the following conditions: (1) financial and insurance listed companies are excluded; (2) listed companies with relevant data are excluded; (3) ST companies are removed; (4) industries with less than two enterprises in the same year are eliminated; (5) major events and business changes that have occurred in the data range are deleted. The final sample observation value is 6,888. In addition, all continuous variables are winsorized at the level of 1 and 99% to avoid the interference of outliers. The data required for the study are mainly from China Stock Market and Accounting Research Database and Wind Database. Some missing data can be found and supplemented through the official websites of Shanghai Stock Exchange, Shenzhen Stock Exchange, listed companies, and Sina Finance website.

Definition of variable

R&D innovation needs a long process with cycle and uncertain results. Some innovation inputs may not be capitalized and eventually transformed into intangible assets. Based on the research of Liu and Jiang, R&D expenditure/total operating revenue is used to measure enterprise innovation (Liu and Jiang, 2016).

Following Leary and Roberts (2014), we regard enterprises in the same industry as peers and take the average value of innovation of other enterprises in the same industry as the proxy variable of innovation level of peer enterprises. This measurement method avoids the endogenous problem of the model, highlights the cross interactive relationship between enterprises in the same industry, and more accurately tests the peer effect of enterprise green technology innovation.

Referring to the method of Demerjian et al. (2012) and Demerjian et al. (2013), we use data envelopment analysis (DEA) and Tobit model to measure the managerial ability. First, DEA is used to calculate the total efficiency of enterprise operation (*Score*). Among them, the output variable is the enterprise's operating revenue (*Sales*), and the input variable includes net value of fixed assets (*Ppe*), net value of intangible assets (*Intan*), R&D expenses (*R&D*), operating cost (*Cost*), sum of sales and management expenses (*Sae*), and net goodwill (*Gw*). The calculation is as shown in Eq. 1,

$$Max\_Score_t = \frac{Sales_t}{\varphi_1 PPe_t + \varphi_2 In\tan_t + \varphi_3 R\&D_t + \varphi_4 Cost_t + \varphi_5 Sae_t + \varphi_6 Gw_t} \quad (1)$$

Second, the managerial ability is estimated, because the *Score* calculated by DEA analysis is affected by both enterprise factors and manager factors. Therefore, we establish model (2)

to control the influencing factors at the year and enterprise level, and the residual after regression ε_t is the managerial ability.

$$\text{Tobit}\,(Score_t) = \alpha_0 + \alpha_1 Size_t + \alpha_2 Fcf_t + \alpha_3 Ms_t + \alpha_4 Fcl_t + \alpha_5 Age_t + \alpha_6 Div_t + \sum Year + \sum Industry + \varepsilon_t \quad (2)$$

Size is the natural logarithm of the total assets of the enterprise. *Fcf* is the enterprise free cash flow level. If the enterprise free cash flow is positive, the index value is 1; otherwise, it is 0. *Ms* is the market share, which is measured by the proportion of enterprise operating revenue in industry operating revenue. *Fcl* refers to the degree of internationalization, which is measured by the proportion of overseas sale revenue in operating revenue. *Age* is the natural logarithm of the year of establishment of the enterprise. *Div* is the business complexity of the enterprise, which is measured by the sum of the square of the income of each business department divided by the total income of the enterprise.

Referring to the existing literature (Zhang, 2015; Guney et al., 2017), we control some variables that affect enterprise innovation. These control variables include return on total assets (*Roa*), tangible asset ratio (*Tang*), cash asset ratio (*Cash*), enterprise age (*Age*), asset-liability ratio (*Lev*), and Tobin *Q* value (*Tobin'Q*). The measurement method of corresponding variables of peer enterprises is consistent with that of peer enterprises. The variables and their definitions in this paper are shown in **Table 1**.

Model design

To examine Hypothesis 1, we estimate the model (3):

$$Rd_{i,t} = \alpha + \alpha_1 Mrd_{i,t} + \alpha Controls_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (3)$$

To investigate the mediating effect of managerial ability, we construct the following model:

$$Ma_{i,t} = \alpha + \alpha_1 Mrd_{i,t} + \alpha Controls_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (4)$$

$$Rd_{i,t} = \alpha + \alpha_1 Mrd_{i,t} + \alpha_2 Ma_{i,t} + \alpha Controls_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (5)$$

where the indices $_i$ and $_t$ denote enterprise and year, respectively. The dependent variable $_{Rd_{it}}$ is the innovation level of enterprise $_i$ in year $_t$. The independent variable $_{Mrd_{it}}$ is peer enterprise's innovation level. The mediating variable $_{Ma_{it}}$ represents the transmission path of enterprise innovation peer effect. $_{Control_{it}}$ is a set of control variables. $_{Industry_{it}}$ and $_{Year_{it}}$ represent the fixed effect of industry and year, respectively, and $_{\varepsilon_{it}}$ is the error term.

In Eq. 3, the coefficient $_{\alpha_1}$ represents the peer effect of enterprise innovation. In Eqs 4, 5, $_{\alpha_1}$ and $_{\alpha_2}$ denote mediating effect of managerial ability.

Empirical results

Descriptive statistics

Table 2 presents the descriptive statistics of variables in this paper. The average of *Rd* is 0.043, the maximum value is 0.075, and the minimum value is 0, which shows that R&D investment scale of Chinese enterprises is not high. The maximum value of *Ma* is 0.040 and the minimum value is 0, which indicates that there are great differences in enterprises. The values of the control variables are shown in **Table 2**. We also calculate the variance inflation factors (VIF) of the variables to ensure unbiased regression results. It is found that the VIF value of all variables is less than 3, suggesting that multicollinearity is not a serious problem in this paper.

Analysis of regression results

Peer effect of enterprise innovation

The peer effect of enterprise innovation is shown in **Table 3**. Column (1) shows that the regression coefficients of *Mrd* are 0.224 and significant at the 1% level. A 1 SD increase in innovation investment of peer enterprises leads to 22.4 % point increase in the innovation investment of other enterprises in the industry. This result means that there is peer effect in enterprise innovation behavior, that is, innovation activities have spillover effects. Other enterprises in the industry increase innovation investment when peer enterprises carry out innovation activities. Therefore, Hypothesis 1 is supported. In addition, *Roa*, *Cash*, *Mroa,* and *Mlev* have a significantly positive effect on *Rd*, whereas *Tang*, *Age*, *Mtang,* and *Mcash* have a significantly negative effect on *Rd*. In addition, the coefficients of *Lev*, *TobinQ*, *Mage,* and *MtobinQ* are not significant at the significance level. The results of the control variables are consistent with the existing literature (Hang et al., 2016; Jiang and Zhang, 2018; Mo et al., 2020).

The mediating effect of managerial ability

Columns (2) and (3) of **Table 3** report the mediating effect of managerial ability in the peer effect of enterprise innovation. Column (2) shows that the regression coefficients of *Mrd* is 0.158 and significant at the 10% level, which suggests that a 1% increase in innovation investment of peer enterprises, and the managerial ability will increase by 0.158. This means that there is a positive correlation between the innovation activities of peer enterprises and managerial ability. Column (3) shows that the regression coefficients of *Mrd*

TABLE 1 Definition of variables.

Name	Symbol	Definition
R&D	*Rd*	R&D expenditure/total operating income
R&D in the same industry	*Mrd*	Average R&D of other enterprises in the same industry
Managerial ability	*Ma*	Referring to the method of Demerjian et al. (2012) and Demerjian et al. (2013)
Return on total assets	*Roa*	Net profit/total assets
Tangible asset ratio	*Tang*	Total tangible assets/total assets
Cash asset ratio	*Cash*	Cash assets/total assets
Enterprise age	*Age*	Years of establishment
Asset liability ratio	*Lev*	Total liabilities/total assets
Tobin'Q	*Tobin'Q*	Market value/net assets
Return on total assets in the same industry	*Mroa*	Average value of *Roa* of peer enterprises
Tangible asset ratio in the same industry	*Mtang*	Average value of *Tang* of peer enterprises
Cash asset ratio in the same industry	*Mcash*	Average value of *Cash* of peer enterprises
Enterprise age in the same industry	*Mage*	Average value of *Age* of peer enterprises
Asset liability ratio in the same industry	*Mlev*	Average value of *Lev* of peer enterprises
Tobin'Q in the same industry	*Mtobin'Q*	Average value of *Tobin'Q* of peer enterprises
Industry	*Ind*	Dummy variable
Year	*Year*	Dummy variable

TABLE 2 Descriptive statistics.

	Mean	S.D.	Max	Min
Rd	0.043	0.052	0.075	0.000
Mrd	0.040	0.037	0.168	0.000
Ma	−0.028	1.112	0.209	−0.373
Roa	0.037	0.052	0.195	−0.159
Tang	0.956	0.067	1.000	0.612
Cash	0.152	0.121	0.595	0.008
Age	17.139	5.278	27.000	9.000
Lev	0.433	0.218	0.872	0.051
Tobin'Q	2.190	1.815	9.967	0.000
Mroa	0.040	0.028	0.088	−0.031
Mtang	0.928	0.034	0.982	0.786
Mcash	0.158	0.049	0.350	0.076
Mage	17.202	1.573	21.387	14.429
Mlev	0.428	0.087	0.631	0.239
Mtobin'Q	2.176	0.715	4.875	0.932

This table lists the mean, standard deviation (S.D.), maximum (Max), and minimum (Min) values of variables in this paper.

are 0.234 and significant at the 1% level, and regression coefficients of *Ma* are 0.183 and significant at the 5% level. It can also be seen from the regression results that enterprise innovation behavior affects the innovation decision-making of peer enterprises through the managerial ability. In the context of information asymmetry, the stronger the ability of managers, the more conducive to give play to the advantages of searching information and reduce the degree of information asymmetry between enterprises and the market. Therefore, Hypothesis 2 is supported.

Robustness test

Alternative measures of enterprise innovation

Referring to the research of He and Wintoki (2016) and Xu and Zhao (2019), we use the ratio of R&D expenditure to operating revenue to measure enterprise innovation. The results of peer effect of enterprise innovation are shown in column (1) of **Table 4**. The coefficient of *Mrd* is 0.314 and significant at the 1% level, which is consistent with the above research conclusion. This shows that the peer effect of enterprise innovation is robust. The results of the mediating effect of managerial ability are shown in column (2) and column (3) of **Table 4**. The coefficient of *Mrd* and *Ma* is significant, demonstrating that the regression results are robust.

Endogenesis

Based on the research of Leary and Roberts (2014), we choose stock return alpha as the instrumental variable of enterprise innovation to avoid endogenous problems. The information of enterprise's innovation investment is reflected in the change of stock price, especially after excluding external factors such as market and industry, the change information of enterprise's own stock price can be presented more accurately (Sood and Tellis, 2009). It can be seen that the stock returns of peer enterprises are only related to the innovation level of peer enterprises, but not to the innovation level of a certain enterprise. Therefore, we take the average stock return alpha (*Malpha*) of peer enterprises as the instrumental variable of peer enterprise innovation (*Mrd*).

Columns (4) and (5) in **Table 4** report the results of instrumental variable regression. The test results of weak

TABLE 3 Regression results.

Variable	*Rd*	*Ma*	*Rd*
	(1)	(2)	(3)
Mrd	0.224*** (4.036)	0.158* (1.727)	0.234*** (4.229)
Ma			0.183** (2.310)
Roa	0.013*** (3.559)	0.008* (1.701)	0.026*** (3.343)
Tang	−0.018* (−1.759)	0.002 (1.014)	−0.020* (−1.773)
Cash	1.220* (1.887)	1.315 (1.208)	1.359* (1.821)
Age	−0.582*** (−2.837)	−0.746** (−2.125)	−0.438** (−2.004)
Lev	0.120 (0.024)	0.143 (0.127)	0.162 (0.031)
Tobin'Q	−0.002 (−0.724)	0.005 (0.536)	−0.001 (−0.683)
Mroa	0.164* (1.855)	0.037 (1.008)	0.125* (1.723)
Mtang	−1.112** (−2.347)	0.083 (1.001)	−1.228* (−1.724)
Mcash	−0.121* (−1.837)	0.097 (0.903)	−0.129 (−1.603)
Mage	−0.546*** (−3.714)	−0.630* (−1.690)	−0.425** (−2.338)
Mlev	0.373 (0.278)	0.204 (0.128)	0.371 (0.283)
Mtobin'Q	−0.010 (−0.353)	0.001 (0.582)	−0.012 (−0.435)
Year	Yes	Yes	Yes
Indu	Yes	Yes	Yes
Adjusted R-squared	0.187	0.201	0.192

***, **, and * indicate significant at the level of 1, 5, and 10%, respectively. T statistics are enclosed in parentheses.

TABLE 4 Robustness test.

Variable	*Rd*1	*Ma*	*Rd*1	*Mrd*	*Rd*
	(1)	(2)	(3)	(4)	(5)
Mrd	0.314*** (4.537)	0.128* (1.782)	0.327*** (4.662)		0.236*** (4.115)
Ma			0.206** (2.332)		
Malpha				0.125* (1.714)	
Roa	0.025** (2.402)	0.004 (1.616)	0.021** (2.330)	0.016** (2.013)	0.008** (2.159)
Tang	−0.013* (−1.751)	0.001 (1.230)	−0.026* (−1.849)	−0.020* (−1.738)	−0.037* (−1.782)
Cash	1.342** (2.450)	1.001 (1.075)	1.286* (1.725)	1.237** (2.339)	1.536* (1.839)
Age	−0.552*** (−3.016)	−0.479*** (−2.864)	−0.463*** (−2.945)	−0.455*** (3.187)	−0.508*** (−2.997)
Lev	0.153 (0.057)	0.107 (0.139)	1.008 (0.071)	1.231 (0.083)	0.105 (0.079)
Tobin'Q	−0.001 (−0.787)	0.010 (0.349)	−0.005 (−0.886)	−0.007 (−0.758)	−0.022 (−0.680)
Mroa	0.197* (1.836)	0.015 (0.902)	0.210* (1.873)	0.118* (1.828)	0.155* (1.773)
Mtang	−0.997*** (2.756)	0.065 (1.233)	−1.317* (−1.895)	−1.039* (−1.743)	−1.208* (−1.826)
Mcash	−0.287** (−2.334)	0.020 (0.820)	−0.315** (−2.001)	−0.336** (−2.164)	−0.106* (−1.728)
Mage	−0.305** (−2.300)	−0.528** (−2.057)	−0.473** (−2.132)	−0.552** (−2.006)	−0.336*** (−3.983)
Mlev	0.264 (0.227)	0.353 (0.158)	0.371 (0.225)	0.289 (0.341)	0.389 (0.205)
Mtobin'Q	−0.008 (−0.336)	0.001 (0.523)	−0.007 (−0.250)	−0.009 (−0.397)	−0.017 (−0.405)
Year	Yes	Yes	Yes	Yes	Yes
Indu	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.210	0.223	0.225	0.189	0.203

***, **, and * indicate significant at the level of 1, 5, and 10%, respectively. T statistics are enclosed in parentheses.

instrumental variables show that the *F* value is 103.227, which is greater than 10 and significant at the level of 1%, indicating that the selected instrumental variables have a strong correlation with the innovation of peer enterprises. It can be seen from column (2) that the coefficient of *Malpha* is 0.022 and significant at the 1% level. This result means that the average alpha of peer enterprises is positively correlated with the average innovation of peer enterprises. The results

of column (3) can be found the coefficient of *Mrd* is 0.326 and significant at the 1% level, which shows that the average innovation level of peer enterprises improves the R&D intensity of enterprises.

Further analysis

Heterogeneity of enterprise size

Enterprise size is an important factor affecting the level of innovation investment. Enterprises in different sizes have different influences and responses to innovation investment of peer enterprises. First, enterprises in different sizes have adopted different innovation investment strategies. Large enterprises have the advantages of abundant funds and mature management, which makes them tend to carry out exploratory research to achieve industry-leading breakthrough innovation. Compared with large enterprises, small enterprises are unable to afford scientific research projects with large costs. However, small enterprises have more flexibility than large enterprises, which makes them tend to incremental innovation (Cockburn and Hederson, 2001; Koberg et al., 2003). Second, because large enterprises have huge social networks, they can obtain more information in the process of contacting upstream and downstream enterprises. This information is helpful to the generation of innovative investment ideas and the formulation of innovative investment strategies (Kim et al., 2009). Due to the limited social network of small enterprises, they cannot grasp the information on the market in time. It may be that only after large enterprises have carried out innovation investment, they can obtain relevant information and follow large enterprises in innovation investment.

Therefore, large enterprises not only have the ability to bear the high risks and large expenses brought by R&D, but also have more information on innovation investment. This makes large enterprises more inclined to carry out breakthrough innovation projects that require large-scale investment, which is conducive to the output of innovation achievements. However, small enterprises have insufficient R&D resources, weak access to information, and insufficient funds, leading them to follow their peer enterprises in innovation investment. It can be seen that enterprise size plays a stronger exemplary role in peer enterprises. Following Sung (2019), we use the total assets of enterprises to measure the enterprise size. According to the regulations on the classification standards for small- and medium-sized enterprises issued by the Ministry of Industry and Information Technology of China in 2011, we divide enterprises into two groups. Enterprises with less than 1,000 employees or operating income of less than 400 million Yuan are classified as small- and medium-sized enterprises, and others are large enterprises. The estimation results are in **Table 5**. The coefficient of *Mrd* is not significant in subsample of large enterprise, while the regression coefficient of *Mrd* is 0.462 and it is significant at the 1% level in susbample of small enterprise. It can be seen that the innovation behavior of smaller enterprises is more significantly affected by peer enterprises. Compared with large enterprises, small enterprises have less innovation investment information and investment scale, which makes it easier for them to follow the innovation decisions of their peer enterprises.

TABLE 5 Subsample grouping regression results with different enterprise sizes.

Variable	Large enterprise		Small enterprise	
	Coefficient	*t*	Coefficient	*t*
Mrd	0.257	1.258	0.462***	3.067
Roa	0.020**	2.269	0.038***	3.698
Tang	−0.019*	−1.887	−0.012**	−2.061
Cash	1.306*	1.829	1.429*	1.863
Age	−0.552**	−2.063	−0.616**	−2.668
Lev	0.130	0.012	0.121	0.057
Tobin'Q	−0.003	−0.682	−0.005	−0.091
Mroa	0.128*	1.773	0.203*	1.895
Mtang	−1.139**	−2.209	−1.220**	−2.671
Mcash	−0.206*	−1.782	−0.268*	−1.808
Mage	−0.338**	−2.287	−0.439***	−2.652
Mlev	0.297	0.435	0.304	0.550
Mtobin'Q	−0.009	−0.442	−0.008	−0.429
Ind	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

***, **, and * indicate significant at the level of 1, 5, and 10%, respectively.

Moderating effect of economic policy uncertainty

All activities of enterprises are carried out in the environment, and the important feature of the environment is uncertainty. China's economy is in a period of transformation from high-speed growth to high-quality development, which makes enterprises in a highly uncertain environment and increases the risk of enterprise innovation activities (Cheung et al., 2010). Enterprise innovation is an investment activity with high risk, large investment, and long-term characteristics. Therefore, enterprise innovation activities are vulnerable to changes in the market environment, and economic policy uncertainty is an important incentive for the changing market environment (Francis et al., 2014). Economic uncertainty refers to the uncertainty caused by the inability of enterprises to reasonably predict and accurately evaluate the expected changes in the economic

system and the future distribution of economic results (Jurado et al., 2016).

Economic policy uncertainty may affect the innovation activities of peer enterprises through the acquisition and transmission of information. Enterprise innovation activities have stronger uncertainty when the degree of economic policy uncertainty is relatively high (Ghosh and Olsen, 2009). At this time, the problem of market information asymmetry is more serious, which limits the same group effect under competitive motivation. The improvement of market information asymmetry increases the difficulty of enterprise management in predicting the future economic policy situation and strengthens the perception of external risks (Gulen and Ion, 2016). Therefore, enterprises feel pessimistic because it is difficult to predict future earnings and risks and then reduce or even give up innovation investment to hedge risks.

It takes time for enterprises to obtain innovation-related information from their peer enterprise. Enterprises are habitually rigid when facing threats from the external market environment (Soh, 2009). The higher the uncertainty of the economic policy, the higher the search cost and difficulty of this search activity, because high economic uncertainty means that it is difficult for enterprises to grasp the external economic policy environment. At this time, the cost and risk of technology transfer between enterprises are relatively large, but the efficiency of technology transfer is relatively low, which is not conducive to learning and communication between enterprises (Zeng et al., 2020). Therefore, the higher the degree of economic policy uncertainty, the greater the restrictions on enterprises' access to resources and information through peer enterprise R&D signals, which inhibits the enterprise's innovation momentum. At the same time, the high uncertainty of economic policy hinders the information transmission of innovation activities among peer enterprises. The peer effect of enterprise R&D investment will be weakened when the information flow between enterprises is blocked.

Therefore, economic policy uncertainty has an inhibitory effect on the peer effect of enterprise innovation. Drawing on the research of Baker et al. (2016), we use the macroeconomic policy uncertainty index jointly released by Stanford University and the University of Chicago to measure China's economic policy uncertainty (*Epu*). The index is based on the South China Morning Post in Hong Kong, China, and is widely used in research on policy uncertainty. Since the economic uncertainty index is monthly data, we use the geometric average of monthly data within a year to process this index as an annual measurement index to better match the sample data. The regression results are shown in **Table 6**. The coefficient of *Epu* is −0.035, which is significant at the 10% level, and the coefficient of *Mrd* × *Epu* is −0.156, which is significant at the 1% level. This finding shows that with the increase of economic policy uncertainty, enterprise innovation is less affected by the same group of enterprises. Therefore, economic policy uncertainty negatively regulates the peer effect of enterprise innovation.

TABLE 6 Moderating effect of economic policy uncertainty.

Variable	*Rd*	
	Coefficient	*t*
Mrd	0.551***	3.996
Epu	−0.035**	−2.338
Mrd × *Epu*	−0.156***	−7.672
Roa	0.017***	4.016
Tang	−0.008**	−2.143
Cash	1.703*	1.829
Age	−0.517*	−1.776
Lev	0.380	0.062
Tobin'Q	−0.017	−0.175
Mroa	0.534**	2.230
Mtang	−1.817*	−1.758
Mcash	−0.339**	−2.302
Mage	−0.671**	−2.157
Mlev	0.446	0.683
Mtobin'Q	−0.004	−0.550
Ind	Yes	Yes
Year	Yes	Yes

***, **, and * indicate significant at the level of 1, 5, and 10%, respectively.

Conclusion and implications

Conclusion

According to the empirical results, the conclusion of this paper are as follows: (1) Peer effect exists in the innovation behavior of enterprises, and the innovation behavior of enterprises in the same industry can drive each other. (2) Managerial ability plays an important mediating effect in the peer effect of enterprise innovation. The information advantage of enterprises has been strengthened under the leadership of competent managers, which makes it easier for enterprises to seize innovative investment opportunities and grow into leaders with higher positions in the industry. The R&D behavior of these industry-leading enterprises has attracted the attention of industry followers, resulting in more imitation behavior. (3) There are differences in the impact of enterprises of different sizes on the innovation investment behavior of peer enterprises. Compared with large enterprises, the innovation behavior of smaller enterprises is more significantly affected by peer enterprises. (4) Economic policy uncertainty significantly negatively regulates the peer

effect of enterprise innovation, that is, economic policy uncertainty weakens the convergence of innovation among enterprises. The peer effect of enterprise innovation is more significant when the economic policy is relatively stable. The peer effect of enterprise innovation will be weakened when economic policies fluctuate violently.

Policy implications

The implications of this paper are as follows:

(1) Our empirical results show that the peer effect of innovation behavior enables innovation activities to spread among enterprises. It is suggested that policymakers adopt peer learning mechanism to guide and encourage enterprise innovation. We should use the peer effect to promote enterprise innovation and turn passive innovation activities into voluntary behaviors of enterprises. Peer effect can promote enterprises' active innovation, in which the innovation vitality of market players has been stimulated and their creativity has been continuously enhanced. Government departments can promote the exchange of innovation information among peer enterprises by creating a group innovation atmosphere to promote the level of regional innovation.

(2) We confirm the mediating effect of managerial ability in the peer effect of enterprise innovation. Therefore, it is necessary to give full play to the mediating effect of enterprise managers in the process of using peer effect to promote enterprise innovation. Enterprises need to cultivate managers' awareness of innovation and make managers realize the importance of innovation to the long-term development of enterprises. Meanwhile, enterprises should encourage managers to use social networks to timely understand the innovation information of other enterprises and actively learn from the innovation investment experience of peer enterprises.

(3) We find that there are differences in the response of enterprises of different sizes to the innovation behavior of peer enterprises. The Chinese government can set up innovation benchmarks in various industries, improve the innovation level of the whole industry and society through these benchmark enterprises, and focus the incentive on those benchmark enterprises with exemplary role to improve the effect of government promoting enterprise innovation investment.

(4) The Chinese government needs to reasonably control the frequency of economic policy adjustment to maintain the relative robustness of economic policy, which can reduce the negative impact of economic policy uncertainty on enterprise innovation peer effect. Relevant departments should strive to build a good external economic environment to help enterprises give better play to their innovation vitality. For example, relevant departments should pay attention to the role of government subsidies and increase support for enterprises with innovation potential, which can improve the operating conditions of enterprises and better promote enterprise innovation.

Data availability statement

Publicly available datasets were analyzed in this study. These data can be found here: https://www.wind.com.cn/portal/en/Home/index.html and https://www.gtarsc.com/.

Author contributions

LL formulated the conceptual framework, designed the model, analyzed the data, and wrote the manuscript. JY formulated the conceptual framework, designed the model, obtained inference, and wrote the manuscript. MZ and LJ analyzed the data and provided editorial supports. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Celebrity CEOs and firm innovation investment: Evidence from Chinese-listed companies

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In today's commercial-oriented world, intense social attention makes it easier for CEOs to become celebrities. This social escalation and characteristic change of CEOs into celebrities tend to influence their motivation and behavior, and thus the strategic decisions and results of firms. Despite the significance of recognizing CEOs' social identity, the impact of celebrity CEOs on innovation strategy remains unknown. Integrating identity and upper echelons theories, this study examines and provides empirical evidence on how celebrity CEOs affect firm innovation investment using data of Chinese listed companies from 2015 to 2020. We argue that celebrity CEOs' engagement in innovation investment is driven by their motivation for preserving celebrity status. Further, we show that analyst coverage plays a positive moderating role between celebrity CEOs and innovation investment, and the positive effect of celebrity CEOs on innovation investment becomes weaker in state-owned enterprises. This study confirms the important role of CEOs' specific social identity in firm innovation strategy, which is motivated by celebrity CEOs' attempt to maintain their established status and reputation. The results expand the research on the influencing factors of firm innovation investment that focus on executives' social characteristics. They also provide managerial implications for board of directors to recruit and supervise a celebrity CEO.

KEYWORDS

celebrity CEOs, innovation investment, analyst coverage, SOEs, Chinese context

Introduction

Traditionally, a celebrity is a social actor who is more likely to work in the entertainment industry, receives widespread and public attention, and has profit-generating value (Treadway et al., 2009). However, recently, the business community has also captured the public's attention, particularly, executives who lead successful companies and achieve great firm performance (Lovelace et al., 2018; Kim and Lee, 2022). Such executives are conferred with various top awards by social media, thus obtain the celebrity status and become celebrities (Hayward et al., 2004; Wade et al., 2006). The growing popularity of both Internet technology and social media has provided the public with more information channels and faster speeds for information transmission to know celebrity executives. Consequently, some outstanding CEOs have become household names at both local and global levels

(Lovelace et al., 2018). Using their celebrity status as a form of enhanced social position legitimized and reinforced by the media and public opinion, such celebrity CEOs have garnered widespread attention and developed positive image (Rindova et al., 2006; Lee et al., 2020).

Celebrity CEOs have enormous and continuous influence on their firms (Treadway et al., 2009). Early research on celebrity CEOs examined their roles and the impact of their celebrity status on firm and individual interests. Celebrity CEOs bring intangible assets to their firms, such as signaling improved development prospects, increasing investor confidence, attracting extra resources, and promoting stock prices (Rindova et al., 2006). Such valuable intangible assets and CEOs' ability to manage them create more value for organizations (Vatamanescu et al., 2022). Meanwhile, they receive benefits such as higher compensation, increased stock options, additional board seats in other firms, and better job opportunities (Hayward et al., 2004; Wade et al., 2006). Recently, some scholars studied the impact of celebrity CEOs on organizational behaviors and outcomes, such as acquisition premiums, corporate social responsibility, managerial risk-taking, and firm performance (Cho et al., 2016; Shi et al., 2017; Wei, 2021). However, little research has been undertaken to investigate the influence of celebrity CEOs on firms' innovation activities.

Innovation is crucial to ensuring the survival of a company and promoting its development (Balkin et al., 2000). In particular, R&D expenditures have been shown to improve firm performance (Camison and Villar-Lopez, 2014; Hatzikian, 2015). Thus, improving the innovation capabilities of enterprises has attracted considerable attention from both researchers and practitioners. The upper echelons theory argues that firm behavior is an expression to the values and cognitive abilities of top managers (Hambrick and Mason, 1984). As one of the most important decision makers in a firm, the CEO's cognitive pattern and value orientation, shaped by personal background and life experience, can influence strategic decisions (Li, 2013). Particularly, top managers' characteristics have impact on firms' innovation activities, such as technical background, education, tenure, age, and career horizon (Hambrick and Mason, 1984; Hambrick, 2007; Lin et al., 2011; Heyden et al., 2017). However, few studies have investigated the effect of CEOs' celebrity status on innovation strategy and the psychological mechanisms underlying this process.

Based on upper echelons and identity theories, this study addresses the gap in the existing literature by investigating the relationship between celebrity CEOs and firm innovation, while considering the factors of analyst coverage and nature of firm ownership. Based on the panel data of Chinese firms listed on the Shanghai and Shenzhen stock exchanges from 2015 to 2020, we hypothesize that celebrity CEOs tend to increase innovation investment, as an effective method to promote firm performance, to maintain their public image as successful and visionary business leaders. Further, we postulate that when celebrity CEOs perceive higher expectations from either the public or themselves regarding their identity, they will have an increased motivation to engage in innovation activities. Hence, analyst coverage could be a key factor in promoting firm innovation investment through raising the celebrity CEOs' perceived expectations. Additionally, we argue that firms' ownership nature could also influence the relationship between celebrity CEOs and innovation investment, since the innovation willingness and motivation of executives are different between state-owned enterprises (SOEs) and non-SOEs.

This study makes the following contributions to the current literature. First, by introducing identity theory into the research framework of upper echelon theory, it analyzes the mechanism through which celebrity CEOs affect firm innovation investment from a psychological perspective. It expands the research on post-economic effects of CEOs' celebrity status and provides unique insights into executives' behavioral motivation in different social status. Second, we clarify the relationship between executives' social characteristics and firms' innovation strategy. The results contribute to the research field of innovation management by exploring the antecedents of innovation input, revealing executives' social status as a decision-making reference for firms' innovation strategy. Moreover, it provides unique insights into principle-agency conflict from the perspective of social expectations and executives' self-supervision. CEOs' celebrity status create an additional and informal governance mechanism that disciplines executives' behaviors through their motivation to maintain their celebrity status, making stakeholders' long-term interests consistent with the CEOs' personal interests.

Theoretical model and hypotheses development

Celebrity CEO and firm innovation investment

According to upper echelons theory, executives make strategic decisions with partially personalized perspective that is derived from their individual experiences and characteristics (Hambrick and Mason, 1984; Hambrick, 2007). Scholars have explored the effect of CEO awards on their organizations (Wade et al., 2006; Graffin et al., 2008; Malmendier and Tate, 2009). For instance, corporate social responsibility (CSR) is heightened by the presence of celebrity CEOs (Lee et al., 2020). Moreover, companies with such CEOs tend to pay smaller premiums in mergers and acquisitions (M&A) of targeted firms, unless the prior firm performance has been either extremely high or low (Cho et al., 2016).

Although an award is a non-financial incentive that can motivate people, being celebrities will bring CEOs enormous financial benefits (Gallus and Frey, 2016; Shi et al., 2017). CEO's social identity and influence will rise rapidly after winning business awards and getting the celebrity status (Hayward et al., 2004). As ambition for social recognition and celebrity status is a basic human instinct, CEOs are delighted to accept the celebrity status and also, the benefits that come with awards

(Frey, 2007). First, celebrity CEOs can demand richer compensation packages after becoming celebrities (Graffin et al., 2008; Malmendier and Tate, 2009). Second, owing to their perceived power in the minds of stakeholders and the public, celebrity CEOs assume greater control over their firms (Cho et al., 2016). For instance, since directors usually do not have sufficient information about strategic decision and sufficient time for their board duties, they are inclined to trust celebrity CEOs who are considered to own good reputation and observe social norms, thus giving CEOs more power to implement the decisions they have chosen (Stevens, 2002; Yin et al., 2021). Third, their celebrity status helps them mobilize greater support for decisions that they make and provide more resources for their present and proposed actions (Wade et al., 2006). Finally, it provides advantages for recruitment of more valuable employees, developing relationships with suppliers, and obtaining extra financial resources (Hayward et al., 2004; Rindova et al., 2006). These benefits may encourage CEOs to cultivate such status enhancements and to take actions to preserve celebrity status (Cho et al., 2016).

From a psychological perspective, identity theory provides further interpretation of the impact of celebrity CEOs on firms' behavior. It argues that an identity is built based on processes that have prompted humans to categorize, classify, or name themselves as part of certain social groups (Burke, 1991). The core of this identification process is categorizing an individual as someone who plays a specific social role that creates meanings and expectations for that role and associated behaviors (Thoits, 1986). These social roles have criteria that guide individual actions (Burke, 1991). If an individual does well in a specific role and gain a higher sense of self-esteem and self-efficacy, the results will be a higher level of self-consistency and self-regulation of behavior (Burke and Stets, 1999). In other words, people tend to preserve their identity when they perform well and feel comfortable while fulfilling a specific social role. However, according to social norm theory, if individual deviates from the expectations and norms of this specific role, punishment would be imposed both by people whose interests are affected and by third parties who are unaffected (Piskorski and Gorbatai, 2017; Blay et al., 2018). It may cause individuals to be separated from the social group they belong and lose the associated benefits (Yin et al., 2021).

Awards for CEOs become part of an identification process as celebrity CEOs, prompting the recipients to internalize the values and meanings attached to this celebrity identity and establish self-cognition consistent with the expectation from the public and the media (Owens et al., 2010; Lee et al., 2020). A celebrity CEO is usually an outstanding person who is better at business than most of his or her peers and tend to seek for collaboration only with similar counterparts, which further enhances self-consistency and self-regulation (Burke and Stets, 1999; Vatamanescu et al., 2020). Hence, celebrity CEOs tend to behave in a manner consistent with the celebrity identity that corresponds with the expected views of themselves and the stakeholders (Rindova et al., 2006; Zavyalova et al., 2017). Moreover, the public and the media are more likely to attribute excellent past performance to the celebrity CEO's leadership rather than other factors that could have affected the overall standing of the firm in the market (Quigley and Hambrick, 2015; Lee et al., 2020). However, the downside of such attribution is that stakeholders and the media will routinely undeservedly blame celebrity CEO for failure and declining performance (Hayward et al., 2004; Graffin et al., 2008). Therefore, most celebrity CEOs carry a psychological burden in their role since the public and stakeholders invariably put pressure and expectation on them to continuously improve firm performance (Wade et al., 2006; Fralich and Papadopoulos, 2020). In particular, the greater the celebrity position of a CEO, the more closely the CEO is related to firm performance (Hayward et al., 2004; Graffin et al., 2008).

Meanwhile, celebrity status is not permanent, especially when the CEOs cannot keep or improve firm performance (Lovelace et al., 2018). If celebrity CEOs deviate from social norms and expectations that celebrity group should meet, they are in great danger of losing their existing identity and status (Yin et al., 2021). Such CEOs who have achieved a high level of performance have better understanding of the difficulties in achieving higher performance and the possible loss of the benefits offered by celebrity status (Lee et al., 2020). To preserve the eminent status, celebrity CEOs tend to take action that will help them maintain a consistently higher level of performance (Humphrey and Aime, 2014). There is a significant positive relationship between innovation input and firm performance (Wang et al., 2017; Lazaroiu et al., 2020). Innovation is the driving force for a firm's survival and development. Firms can increase innovation input sustainably to obtain long-term competitive advantages, mitigate negative social influences, meet stakeholders' expectations and achieve a substantial improvement in performance (Ballot et al., 2006; Lazaroiu et al., 2020). Therefore, under the pressure of performance expectations and identity psychological burden, celebrity CEOs are more likely to increase innovation investment to achieve better performance.

Furthermore, celebrity CEOs tend to become overconfident about their own abilities and strategic decisions that had brought about their celebrity status (Hayward et al., 2004). In some cases, celebrity status could generate overconfidence and enhance narcissistic behavior (Chatterjee and Hambrick, 2011), leading celebrity CEOs to trust that they are able to manage risky strategies (Cho et al., 2016). In particular, celebrity CEOs have great confidence in their abilities relevant to innovation strategy (Lovelace et al., 2018), and they may be more likely to overestimate the probability of success and profitability from investing in new products (Camerer and Lovallo, 1999). Previous research has suggested that there is a positive and significant correlation between overconfident CEOs and innovation input (Li and Zhang, 2022). Hence, we argue that celebrity CEOs are more likely to increase innovation investment, compared to non-celebrity CEOs. Thus, we propose the following hypothesis:

> *H1:* Celebrity CEOs are positively related to innovation investment of firms.

Moderating effect of analyst coverage

Securities analysts make evaluations and recommendations about firms and offer relevant information to investors (Hong et al., 2000). They influence not only the investors' expectations and decisions, but also executives' preferences and the strategic decisions of firms (Benner and Ranganathan, 2012). Prior studies have verified the impact of analyst coverage on organizational behavior and results. Analyst coverage promotes firms' investment and financing decision and decreases information asymmetry and capital cost (Kelly and Ljungqvist, 2012; Derrien and Kecskes, 2013). When there is a reduction in analyst coverage, firms voluntarily disclose more information than mandated, and subsequently improves liquidity (Balakrishnan et al., 2014). Therefore, as important information intermediaries, analysts can play an external governance role and serve as an effective monitoring function (Bradley et al., 2022). Increasing analyst coverage leads to better financial reporting quality (Irani and Oesch, 2013), decreases in value-reducing acquisitions (Chen et al., 2015), and declines in earnings management (Yu, 2008).

From a principal-agent perspective, executives tend to have a negative attitude toward innovation strategy owing to the risky, uncertain, and long-term nature of innovation (Balkin et al., 2000). Conversely, investors prefer companies that excel in innovation activities (Gentry and Shen, 2013). Particularly, in China's institutional environment, innovation is considered the primary driver of economy and prioritized by the government as a development strategy. Innovation-based firms can obtain substantial policy support, such as R&D subsidies and tax preferences (Genin et al., 2021). In addition to investors, analysts have higher enthusiasm and expectations for the innovation signals of firms (Frankel and Li, 2004). Sustainable innovation practice can be regarded as a signal of strong competitive advantage and positive future development, which is an effective assessment criterion for analysts (Kliestik et al., 2020; Lazaroiu et al., 2020). Greater analyst coverage brings about more supervision and lessens agency problems. A reduction in innovation investment, once discovered by analysts, may negatively influence the investors' interest and the firm's market value (Chauvin and Hirschey, 1993). To avoid bad evaluation from analysts, executives are likely to promote innovation input under greater analyst coverage (Gentry and Shen, 2013).

From the perspective of identity theory, greater analyst coverage may stimulate celebrity CEOs' identity control mechanism which extends identity theory and argues that individuals perceive and internalize identity-related values and expectations when interacting with the external society (Burke, 1991). Hence, celebrity CEOs have sufficient motivation to change others' views on themselves through identity control mechanisms if the external expectations change (Lee et al., 2020). Meanwhile, special attention from analysts creates higher expectation, leading to conflict between celebrity CEOs' identity standards and actual self-view (Galvin et al., 2010). However, not meeting the analysts' expectations is often considered as managerial failure and can create negative impact on the capital market (Qian et al., 2019). Moreover, greater analyst coverage strengthens the association between firm performance and CEO turnover (Farrell and Whidbee, 2003). Facing greater analyst coverage of their firms, celebrity CEOs recognize that there are higher standards for maintaining their identity and status with the public as well as their own self-identity (Humphrey and Aime, 2014). Consequently, celebrity CEOs will take actions to reduce the dissonance between their individual performance and external expectations, in case of the loss of celebrity identity (Stets and Burke, 2000). The CEOs' subsequent decisions and behaviors will be reflected in firms' strategies (Cho et al., 2016). They will become more daring in terms of investments in innovative practices to satisfy the needs of analysts and investors and further improve firm performance. In light of these arguments, we put forward the following hypothesis:

> *H2:* Analyst coverage positively moderates the relationship between celebrity CEOs and firms' innovation investment.

Moderating effect of the nature of firm ownership

Firms' behaviors and strategies are closely related to the nature of enterprise ownership (Gelfand et al., 2007). In China, SOEs are an important part of national economy and bear a large number of policy burdens to support governmental policies (Wei, 2021). SOEs are mainly distributed in pillar industries and controlled by the state through the State-owned Assets Supervision and Administration Commission of the State Council (SASAC), which has the power to appoint and remove SOEs' directors and executives (Bruton et al., 2015). Thus, CEOs in SOEs have to consider the general policy of government and SASAC's orientation when he/she develops and implements his or her firm's strategies (Bai et al., 2006). Hence, it inevitably leads to a decline in the influence of celebrity CEOs' individual motivation on firm decision-making (Li and Zhang, 2022).

Additionally, as the business objectives and governance mechanisms of different ownership enterprises in China are various, CEOs have different degrees of innovation willingness (Li, 2013). Unlike non-SOEs, the operating goal of SOE is not entirely profit maximization (Ghosh and Whalley, 2008). The government set various sociopolitical goals to SOEs, such as job creation, infrastructure development and maintenance, improving public services, contributing to social welfare, and maintaining social stability (Bai and Xu, 2005). SOEs' executives has a dual identity: economic and political, as they are not only firms' top managers, but also officials in the government. There are personnel circulation channels between SOEs and government departments, which allow managers and officials to realize identity exchange. Therefore, the assessment and incentive mechanisms of executives in SOEs are not completely related to firm performance (Bruton et al., 2015). Different form non-SOEs, the development of their career path and political future depends on the realization of

social goals and political missions (Shao et al., 2020). These CEOs are more driven to maintain their political identity by completing established social or political tasks, since the political identity is more conducive to personal interests and future development in the Chinese institutional environment. Moreover, the political burden in SOEs lead executives to waste extra resources to enhance their political performance at the expense of innovation activities (Song et al., 2015; Bertrand et al., 2018). Consequently, without performance pressure, Celebrity CEOs in SOEs do not need to maintain their celebrity status through excellent firm performance, leading to weak motivation to increase innovation investment. Further, the dual identities of SOEs' managers prompt them to become more involved in low-risk projects with short-term payoffs, at the expense of a decrease in long-term and higher risk innovation activities and R&D investment (Wang et al., 2018). Owing to the lack of ownership, it is difficult for SOEs to supervise executives effectively, which further exacerbates their tendency of risk aversion. Substantial evidence from previous research shows that CEOs with more political connections reduce R&D intensity and innovation efficiency (Lin et al., 2014; Zhang et al., 2015).

Some studies have demonstrated the inefficiency of government participation in terms of corporate innovation, with R&D efficiency being higher in non-SOEs than in SOEs (Zhou et al., 2017; Zhang et al., 2020; Genin et al., 2021). Zhang et al. (2020) used the sample of listed companies in Chinese manufacturing industry from 2011 to 2015 to demonstrate that most SOEs' size are higher than private-owned enterprises (non-SOEs), but the growth, profitability and R&D intensity of non-SOEs are better. They found that the average R&D intensity, which is measured as the ratio of R&D expenses and total asset, is 0.018 in SOEs, lower than 0.021 in non-SOEs. For comparison, we divide our sample firms into SOE and non-SOE sub-samples, and measure R&D intensity with the same measurement method. The R&D intensity is 0.018 in SOEs, lower than 0.024 in non-SOEs, meaning that the difference between SOEs and non-SOEs in innovation investment is huge. Private enterprises are more independently operated than SOEs, and their CEOs have more power in firm's daily operations and decision-making (Li and Zhang, 2022). Hence, in the private sector, the impact of celebrity CEOs' personal motivation and decision preference on firm strategies faces fewer constraints and restrictions.

Although the impact of central planning has greatly diminished with the deepening of reform and opening-up, government as the most authoritative institution, still actively leads economic development and constantly adjust firms' environment through regulatory policies and allocation of scarce resources (Liang et al., 2015; Zhou et al., 2017). In this institutional context, the nature of state-owned property of firms can exert crucial influence on innovation strategy, since the state provides more innovation resources to SOEs than to other firms (Bruton et al., 2015; Ramamurti and Hillemann, 2018; Hu et al., 2019). SOEs are able to receive resources, such as financial and human capital, research funding, bank lending, technological equipment procurement, national research and knowledge platform, access to specific industry and other government policy benefits, which are all necessary for innovation activities (Li et al., 2018; Liu et al., 2018). State ownership and its advantages not only reduce the transformation efficiency from plentiful resource into innovation investment (Zhou et al., 2017; Genin et al., 2021), but also weaken celebrity CEOs' important role of providing additional resources to their firms. Additionally, state affiliation of firms is more likely to restrict the integration and utilization of CEOs' social resources, thus negating the benefits of CEOs' celebrity status on innovation investment (Li et al., 2018). Unlike SOEs, non-SOEs often lack of access to innovation resources and face relatively higher innovation barriers such as asymmetrical information and financial constraints (Howell, 2016). To achieve innovation goals, non-SOEs typically seek more social resources than political ones, which highlights celebrity CEOs' resource advantage (Kroll and Kou, 2019; Lazzarini et al., 2021). CEOs' celebrity status as a kind of intangible resource can provide more resources for innovation strategy (Lee et al., 2020; Kim and Lee, 2022), and non-SOEs have been shown to be more efficient in terms of resource utilization (Howell, 2020). Therefore, non-SOEs tend to efficiently transform these valuable scarce resources brought by celebrity CEOs into innovative investment. In light of these arguments, we expect that the association between celebrity CEOs and innovation investment is more significant in Chinese non-SOEs. Therefore, we develop the following hypothesis:

> *H3:* Compared to SOEs, celebrity CEOs of non-SOEs have a more significant impact on innovation investment.

Materials and methods

Sample selection and data sources

This study uses a panel dataset of firms listed on the Shanghai and Shenzhen stock exchanges in China from 2015 to 2020. The vast majority of Chinese listed companies are concentrated in Shanghai and Shenzhen stock exchanges. And such listed firms are more mature and stable with better transparent data disclosure. They are also larger and more probable for recruiting or cultivating celebrity CEOs. So, the selection of firms listed on the Shanghai and Shenzhen stock exchanges is universal and representative. In 2015, the Chinese government introduced specific guidance documents to promote the innovative development strategy that was the most important policy to encourage firms' innovation activities in recent decades. After that, the innovation in Chinese firms are facing a new era of major development and major changes. In order to cope with the changes of external institutional environment, innovation input are crucial and significantly increased in Chinese firms during this period. Therefore, we chose 2015 as the starting point of the sample interval. Meanwhile, there is a one-year lag between the independent and dependent variables. Since 2021 is the last year for available data of Chinese listed firms, we chose 2020 as the end point.

Data of celebrity CEOs were hand-collected from resumes, personal profiles, corporate annual reports, firm websites, social media, news reports, and search engines on the Internet. Other CEO information and firm-level data were collected from China Stock Market and Accounting Research Database (CSMAR) as well as databases of the Shanghai and Shenzhen Stock Exchanges. First, we excluded financial and insurance companies because of the particularity and complexity of financial indices and operational objectives. Second, firms whose data on key variables were incomplete were omitted from the study. Then, we eliminated samples where the CEOs' tenure was less than 12 months, as such a CEO would have had little time to exert influence over the company's strategies and operations. Afterwards, we omitted listed companies under special treatment to avoid the impact of extreme values on the analysis results. Our final sample comprised 10,677 firm-years. Finally, we winsorized all continuous variables at the top and bottom 1% of the sample to eliminate the effect of outliers.

Measures

Dependent variable

Innovation investment. Our main hypotheses addressed the impact of celebrity CEOs on innovation investment, which were measured as the expenditures spent by a firm on innovative practices. Considering the heterogeneity in terms of the company size, R&D intensity was widely used to measure innovation investment, estimated as R&D expenditures divided by operation revenue (Heyden et al., 2017). The existing literature has shown that firms' innovation input lags behind strategic decisions, and the impact of CEO's personal characteristics on decision-making also has a significant lag (Wal et al., 2019). Hence, a lag of one period is adopted to treat the dependent variable.

Independent variable

CEO celebrity. Previous studies have defined celebrity status using the results of annual CEO award competitions from various prestigious business journals, including Financial World, Business Week, Chief Executive, and Morningstar (Lee et al., 2020). Winning a business award from the media provides a reliable assessment of the CEO by a group of experts in society and business, which can accurately capture the celebrity status (Wade et al., 2006; Malmendier and Tate, 2009; Cho et al., 2016). Based on this measurement, we used relevant top awards issued by authoritative business media as a proxy, including China Central Television (CCTV), Finance Channel, Forbes China, China Business Channel, Fortune China, and China Times. Further, we extended the current measurement method by considering China's unique institutional environment. In the Chinese context, awards issued by government departments are far more persuasive and influential than those issued by the media, such as "Outstanding Entrepreneurs," "Model Worker," and "Outstanding Youth.." Therefore, we incorporated national and provincial top honorary awards into the measurement to expand its applicability in the Chinese context. Then, being a celebrity CEO was measured as a dummy variable, which was coded as 1 if the CEO had an award before focal year t, and 0 otherwise.

Moderating variables

*Analyst coverage. A*nalyst coverage was measured as the number of securities analysts who issued earnings forecasts for sample firms during the study's period (Gentry and Shen, 2013). To overcome the data skewness, the natural logarithm was taken after adding 1 to the obtained data. A higher value of this measure indicated a higher level of analyst coverage.

Nature of firm Ownership. The nature of firm ownership was estimated as a dummy variable. If the actual controller of a sample firm was the state or an institution representing the state, we coded it as 1; otherwise, 0 (Wang et al., 2022).

Control variables

Drawing on previous studies on CEO individual characteristics and innovation investment, we employed control variables from firm financial level, corporate governance level, and CEO individual level (Galasso and Simcoe, 2011; Wang et al., 2017; Rodrigues et al., 2020; Zhang et al., 2021). The firm-financial-level control variables included the return on total assets (ROA), total assets turnover (ATO), cash flow ratio (CFR), liabilities-to-assets ratio (Lev), firm size (FS), and firm age (FA). The corporate-governance-level control variables included board size (BS), board independence (BI), large shareholders' control (LSC), and the pay gap of top management (Gap). The CEO-individual-level control variables included CEO gender (Gender), CEO age (Age), and CEO's political connection (PC). We also controlled for year and industry fixed effects. The above variables and explanations are shown in Table 1.

Model construction

To test the impact of celebrity CEO on innovation investment as well as the moderating effects of analyst coverage and nature of firm ownership, we constructed and employed the following models:

$$RD_{t+1} = \alpha_0 + \alpha_1 CCEO_t + \sum \alpha Controls_t + \varepsilon \quad (1)$$

$$RD_{t+1} = \beta_0 + \beta_1 CCEO_t + \beta_2 AC_t + \beta_3 CCEO_t \times AC_t + \sum \beta Controls_t + \varepsilon \quad (2)$$

Among them, α and β represent the coefficients of each variable. Controls indicate all the control variables. CCEO * AC denotes the interaction term between celebrity CEOs and analyst coverage. Model (1) was employed to test the effect of

TABLE 1 Definition and measurement of variables.

Variable type	Variable name	Symbol	Measurement method
Dependent variable	R&D intensity	RD	R&D investment/ operating income
Independent variable	Celebrity CEO	CCEO	CEO won an award = 1, CEO not won an award = 0
Moderating variables	Analyst Coverage	AC	Ln (number of analysts cover the firm +1)
	Nature of firm ownership	SOE	State-owned enterprises = 1, non-state-owned enterprises = 0
Control variables	Return on total assets	ROA	Net profit/total assets
	Total assets turnover	ATO	Operating income/total assets
	Cash flow ratio	CFR	Operating cash flow/ total assets
	Asset-liability ratio	Lev	Total liabilities/total assets
	Firm size	FS	Ln (total assets)
	Firm age	FA	Ln (Actual firm age of the year)
	Board size	BS	Ln (Number of formal members of the board of directors)
	Board independence	BI	Proportion of independent directors
	Large shareholder control	LSC	Number of shares held by the largest shareholder/total shares
	Pay gap of top management	Gap	Sum of top three executives' compensation/all executives' compensation
	CEO gender	Gender	Male = 1, Female = 0
	CEO age	Age	Ln (Actual CEO age in the year)
	CEO's political connection	PC	CEO hold or previously held a position in the government =1, otherwise = 0

celebrity CEO on innovation investment, and model (2) was used to estimate the moderating effect of analyst coverage on the relationship between celebrity CEO and innovation investment. To assess the moderating effect of the nature of firm ownership, we used model (1) to test SOEs and non-SOEs separately.

Results

Descriptive statistics

Table 2 reports descriptive statistical results of the main variables. As shown in Table 2, the mean value of R&D intensity (RD) is 0.051, the minimum value is 0, and the maximum value is 5.452, indicating substantial differences in innovation investment for different firms. The mean value for celebrity CEOs (CCEO) is 0.066, indicating that only few CEOs obtain awards issued by top business media and the government. The mean value of analyst coverage (AC) is 1.493, the minimum value is 0, and the maximum value is 4.331, indicating significant differences in analyst coverage among the samples. The ratio of SOE in our sample is 0.328, indicating that about a third of the sample firms are SOEs.

Correlation analysis

Table 3 shows the Pearson test on the correlation of main variables. The absolute value of correlation coefficients between all variables is below 0.6, indicating the suitability of using these variables in our models simultaneously. We also estimated the mean variance inflation factor (VIF) for regression analysis. The maximum VIF value is 1.86, far below 10, indicating very limited multicollinearity.

Empirical results

Table 4 presents the regression results of fixed-effect analyses controlling for year and industry. As shown in the first column of Table 4, the correlation coefficient between celebrity CEOs and innovation investment is 0.0075 and significantly positive at the 1% level. That is, R&D intensity is stronger in firms controlled by celebrity CEOs, indicating that celebrity CEOs increase firms' innovation investment. Hypothesis 1 is thus supported.

The second column reports the moderating effect of analyst coverage on the relationship between celebrity CEO and innovation investment. The interaction term coefficient is 0.0035 and significantly positive at the 1% level. This indicates that the promoting effect of celebrity CEOs on R&D intensity could be strengthened with the increase in a firm's analyst coverage. That is, analyst coverage plays a positive moderating role between celebrity CEO and innovation investment. Hypothesis 2 is thus supported.

Furthermore, we examined the differences in the impact of celebrity CEOs on innovation investment among firms with different ownership natures. The third and fourth columns report the regression results for celebrity CEO and R&D intensity in SOEs and non-SOEs separately. For the SOEs sample, the correlation coefficient between celebrity CEO and

TABLE 2 Descriptive statistical results of variables.

Variable	Obs.	Mean	S.D.	Min	Max
RD	13,546	0.051	0.089	0	5.452
CCEO	13,546	0.066	0.248	0	1
AC	13,546	1.493	1.135	0	4.331
SOE	13,546	0.328	0.469	0	1
ROA	13,546	0.047	0.060	−0.389	0.244
ATO	13,546	0.642	0.398	0.044	2.777
CFR	13,546	0.047	0.066	−0.196	0.258
Lev	13,546	0.393	0.198	0.046	0.990
FS	13,546	22.070	1.235	18.330	28.540
FA	13,546	2.833	0.326	1.792	3.555
BS	13,546	2.118	0.194	1.609	2.708
BI	13,546	0.376	0.053	0.308	0.600
LSC	13,546	0.340	0.144	0.084	0.755
Gap	13,546	0.456	0.166	0	1
Gender	13,546	0.938	0.241	0	1
Age	13,546	3.901	0.137	3.258	4.382
PC	13,546	0.188	0.391	0	1

R&D intensity is 0.0069 and positively significant at the 5% level. Meanwhile, for the non-SOE sample, the correlation coefficient is 0.0077 and significantly positive at the 1% level. As both correlation coefficient and significance level of the non-SOEs groups are higher than those of the SOEs' group, it indicates that the promoting effect of celebrity CEOs on innovation investment is more significant in non-SOEs, thus supporting Hypothesis 3.

Robustness tests

Propensity score matching method

Since firms with strong willingness to innovate strategy may be more likely to hire a celebrity CEO than other firms, the endogenous choice of celebrity CEOs are more likely to have affected the analysis results. Following previous studies, we employed the propensity score matching (PSM) method to solve this potential problem. For each firm with a celebrity CEO, we identified a matched control firm without a celebrity CEO and calculated the average difference in R&D intensity for all matched pairs. To find the matched firms, we employed a 1:4 nearest neighbor matching technique. Our matching covariates included all control variables in the baseline model. We used the treated group and matched samples data to rerun the whole model. Table 5 reports the results of the PSM robustness test. There is a positive association between Celebrity CEOs and firms' innovation investment. And the promotion effect of celebrity CEOs on innovation investment is also positively moderated by analyst coverage. The correlation coefficient of celebrity CEOs in the SOE group is less than in the non-SOEs group, indicating that the promoting effect of celebrity CEOs on innovation investment is more significant in non-SOEs. The results ensure the robustness of the baseline regression of this study.

Two-stage least squares method

We employed the Two-Stage Least Squares (2SLS) method to solve the endogeneity problem. We used advertising expenditure as an instrument variable in our model, which was measured as the ratio of annual advertising expenses to revenue. More advertising expenditure will not only reduce the use of negative words on firms and their leaders in the media, but also encourage the media to help CEOs attract the attention and favor of the society and improve their possibility of winning awards and being celebrities (Gurun and Butler, 2012; Beattie et al., 2021). Also, advertising expenditure is exogenous to the innovation input. While running the first-stage regression analysis, the instrument variable shows significant correlation with celebrity CEOs but not with the R&D intensity, which ensures that it could be an effective instrument. Table 6 reports the results of the second-stage 2SLS model. There is a positive association between celebrity CEOs and firms' innovation investment. The analyst coverage strengthens the promotion effect of celebrity CEOs on innovation investment. For the results of grouping regression, the correlation coefficients of celebrity CEOs are both significant in SOE group and non-SOE group. But the correlation coefficient is larger for non-SOEs than for SOEs. The results are consistent with the baseline regression results, and they pass the underidentification and weak identification test, indicating that endogeneity is not a relevant concern in this study.

Replacing the measure of innovation investment

In the main test, the innovation investment was measured as R&D expenditures divided by operation revenue. Following prior research, we employed another measurement of innovation investment: R&D expenditures divided by a firm's total assets (Lin et al., 2011). The variable was also treated with a 1-year lag. We then reconducted all base models. Table 7 reports the regression results of replacing the measure of innovation investment. The correlation coefficient between celebrity CEOs and innovation investment remains significantly positive. The interaction term of celebrity CEOs and analyst coverage remains significantly positive as well. The correlation coefficients between celebrity CEO and innovation for both SOEs and non-SOEs are significantly positive. However, the correlation coefficient is larger for non-SOEs than for SOEs. These results are consistent with our primary analysis.

Additional lagged effects

The dependent variable was lagged for one period in our baseline models. However, it may take more time for CEOs to influence firms' innovation strategy and increase innovation investment. Therefore, we added a two-year lag to the dependent

TABLE 3 Correlation analysis results.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.RD	1																
2.CCEO	0.023***	1															
3.AC	0.014*	0.072***	1														
4.SOE	0.120***	−0.003	0.030***	1													
5.ROA	−0.022**	0.023***	0.236***	0.188***	1												
6.ATO	−0.181***	0.015*	0.084***	−0.069***	0.184***	1											
7.CFR	−0.041***	0.023***	0.142***	0.040***	0.420***	0.142***	1										
8.Lev	−0.186***	0.039***	0.017*	−0.329***	−0.390***	0.169***	−0.173***	1									
9.FS	−0.148***	0.091***	0.243***	−0.395***	−0.070***	0.091***	0.045***	0.543***	1								
10.FA	−0.073***	0.007	−0.045***	−0.209***	−0.075***	0.029***	0.025***	0.146***	0.165***	1							
11.BS	−0.063***	0.000	0.053***	−0.268***	−0.036***	0.032***	0.014	0.168***	0.275***	0.077***	1						
12.BI	0.026***	0.032***	0.009	0.055***	0.003	−0.029***	0.005	−0.022**	−0.021**	−0.041***	−0.566***	1					
13.LSC	−0.098***	−0.024***	0.020**	−0.217***	0.092***	0.097***	0.093***	0.062***	0.174***	−0.070***	0.004	0.056***	1				
14.Gap	0.044***	0.015*	−0.060***	0.007	0.032***	0.001	0.097***	−0.103***	−0.139***	0.155***	−0.223***	0.100***	−0.008	1			
15.Gender	0.001	−0.004	0.011	−0.058***	−0.014	0.029***	−0.026***	0.044***	0.056***	−0.017**	0.081***	−0.062***	−0.021**	−0.067***	1		
16.Age	0.005	0.063***	0.022**	−0.105***	0.002	−0.009	0.043***	0.018**	0.098***	0.120***	0.050***	0.012	0.041***	0.054***	0.030***	1	
17.PC	−0.024***	0.103***	0.027***	0.102***	0.018**	−0.020**	0.016*	−0.018**	−0.013	−0.006	−0.016*	0.028***	−0.017**	0.021**	−0.043***	0.058***	1

*$p < 0.1$, **$p < 0.05$; ***$p < 0.01$.

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TABLE 4 Regression analysis results.

Variables	RD_{t+1}			
	(1)	(2)	(3)	(4)
			SOEs	Non-SOEs
CCEO	0.0075***	0.0006	0.0069**	0.0077***
	(4.46)	(0.22)	(2.33)	(3.92)
AC		0.0042***		
		(5.17)		
CCEO*AC		0.0035***		
		(2.63)		
ROA	−0.0981	−0.1163*	−0.0632	−0.1149
	(−1.52)	(−1.73)	(−0.89)	(−1.29)
ATO	−0.0263***	−0.0267***	−0.0295***	−0.0247***
	(−17.37)	(−17.62)	(−8.37)	(−18.60)
CFR	−0.0189*	−0.0216*	−0.0226	−0.0166
	(−1.65)	(−1.86)	(−1.04)	(−1.25)
Lev	−0.0640***	−0.0630***	−0.0626***	−0.0646***
	(−7.51)	(−7.49)	(−3.68)	(−6.85)
FS	−0.0014*	−0.0027***	−0.0011	−0.0015
	(−1.71)	(−3.13)	(−0.79)	(−1.56)
FA	−0.0164***	−0.0154***	−0.0131	−0.0180***
	(−3.88)	(−3.74)	(−1.38)	(−4.22)
BS	−0.0011	−0.0008	−0.0066	0.0013
	(−0.38)	(−0.28)	(−1.28)	(0.37)
BI	0.0147	0.0140	0.0318	0.0053
	(1.16)	(1.10)	(1.52)	(0.31)
LSC	−0.0172*	−0.0151	−0.0274***	−0.0120
	(−1.76)	(−1.51)	(−2.88)	(−0.87)
Gap	−0.0119**	−0.0118**	−0.0061	−0.0145**
	(−2.35)	(−2.33)	(−0.76)	(−2.26)
Gender	0.0017	0.0017	0.0017	0.0014
	(0.92)	(0.93)	(0.53)	(0.66)
Age	0.0140**	0.0137**	0.0212	0.0100
	(2.18)	(2.14)	(1.42)	(1.61)
PC	−0.0051***	−0.0053***	−0.0020	−0.0066***
	(−2.95)	(−3.06)	(−0.45)	(−4.79)
Constant	0.0850***	0.1050***	0.0486	0.1052***
	(3.41)	(4.16)	(0.84)	(4.11)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.133	0.136	0.115	0.146
N	13,546	13,546	4,442	9,104

Robust standard errors in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

TABLE 5 Robustness test: Propensity score matching analysis.

Variables	RD_{t+1}			
	(1)	(2)	(3)	(4)
			SOEs	Non-SOEs
CCEO	0.0076***	0.0071**	0.0077**	0.0121***
	(4.28)	(2.13)	(2.42)	(5.17)
AC		0.0041***		
		(4.56)		
CCEO*AC		0.0031*		
		(1.89)		
ROA	0.0005	−0.0109	−0.0349	0.0339
	(0.02)	(−0.35)	(−0.66)	(0.91)
ATO	−0.0228***	−0.0283***	−0.0214***	−0.0283***
	(−12.92)	(−16.91)	(−6.59)	(−14.47)
CFR	−0.0031	−0.0285*	−0.0080	−0.0224
	(−0.22)	(−1.88)	(−0.36)	(−1.16)
Lev	−0.0440***	−0.0477***	−0.0318***	−0.0549***
	(−5.91)	(−6.21)	(−2.99)	(−5.40)
FS	−0.0011	−0.0049***	−0.0020	−0.0029***
	(−1.43)	(−5.97)	(−1.45)	(−3.05)
FA	−0.0108***	−0.0129***	−0.0064	−0.0148***
	(−4.29)	(−4.79)	(−1.25)	(−4.59)
BS	−0.0060	−0.0047	−0.0214**	0.0017
	(−1.36)	(−0.96)	(−2.56)	(0.29)
BI	0.0324**	0.0435***	0.0354	0.0417**
	(2.27)	(2.71)	(1.35)	(2.10)
LSC	−0.0263***	−0.0412***	−0.0300***	−0.0445***
	(−4.82)	(−6.87)	(−2.94)	(−6.19)
Gap	−0.0029	−0.0098	0.0088	−0.0165*
	(−0.40)	(−1.28)	(0.61)	(−1.85)
Gender	0.0015	0.0030	−0.0017	0.0052
	(0.58)	(0.96)	(−0.37)	(1.38)
Age	0.0097*	−0.0001	0.0237**	−0.0078
	(1.67)	(−0.02)	(2.29)	(−1.02)
PC	−0.0046***	−0.0094***	−0.0049	−0.0090***
	(−2.84)	(−5.45)	(−1.54)	(−4.38)
Constant	0.0684**	0.2279***	0.0403	0.2155***
	(2.26)	(7.21)	(0.85)	(5.34)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.317	0.380	0.307	0.183
N	3,747	3,747	1,208	2,539

Robust standard errors in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

variable before reconducting the regression. Table 8 reports the regression results of the additional lagged effects. There is a significant positive correlation between celebrity CEOs and innovation investment. Additionally, the interaction term of celebrity CEO and analyst coverage remains significantly positive. The correlation coefficient between celebrity CEOs and innovation for non-SOEs is greater than for SOEs. Therefore, all robustness tests support the results of our main analysis.

Discussion and conclusion

Some previous studies have argued that the celebrity status of CEOs have a positive impact on firms by attracting social attention and enhancing the prestige of organizations, leading to greater investor confidence, the acquisition of extra resources, and an increase in stock prices (Fralich and Papadopoulos, 2020; Lee et al., 2020; Kim and Lee, 2022). Celebrity CEOs also result

TABLE 6 Robustness test: Two-stage least squares analysis.

Variables	RD_{t+1}			
	(1)	(2)	(3)	(4)
			SOEs	Non-SOEs
CCEO	0.0136***	0.0042	0.0123***	0.0142***
	(5.20)	(0.85)	(2.82)	(4.37)
AC		0.0042***		
		(5.67)		
CCEO*AC		0.0049**		
		(2.14)		
ROA	−0.0730	−0.0921	−0.0471	−0.0855
	(−1.16)	(−1.40)	(−0.67)	(−0.99)
ATO	−0.0295***	−0.0299***	−0.0305***	−0.0290***
	(−27.85)	(−28.29)	(−15.36)	(−23.56)
CFR	−0.0315***	−0.0339***	−0.0349*	−0.0297**
	(−3.11)	(−3.32)	(−1.82)	(−2.55)
Lev	−0.0694***	−0.0682***	−0.0672***	−0.0704***
	(−7.53)	(−7.50)	(−3.79)	(−6.75)
FS	−0.0024***	−0.0036***	−0.0023	−0.0024***
	(−2.90)	(−4.27)	(−1.50)	(−2.59)
FA	−0.0150***	−0.0138***	−0.0126	−0.0161***
	(−4.61)	(−4.34)	(−1.61)	(−5.36)
BS	−0.0045	−0.0043	−0.0111**	−0.0015
	(−1.48)	(−1.40)	(−2.17)	(−0.41)
BI	0.0187	0.0174	0.0379*	0.0084
	(1.39)	(1.29)	(1.76)	(0.46)
LSC	−0.0417***	−0.0395***	−0.0516***	−0.0367***
	(−4.68)	(−4.32)	(−5.18)	(−2.98)
Gap	0.0175***	0.0183***	0.0139	0.0193***
	(4.20)	(4.36)	(1.63)	(4.10)
Gender	0.0042**	0.0043**	0.0030	0.0047**
	(2.19)	(2.21)	(0.86)	(2.02)
Age	0.0118*	0.0118*	0.0174	0.0089
	(1.73)	(1.73)	(1.18)	(1.28)
PC	−0.0081***	−0.0084***	−0.0053	−0.0093***
	(−4.84)	(−5.00)	(−1.25)	(−6.78)
Constant	0.1560***	0.1743***	0.1379**	0.1660***
	(5.80)	(6.49)	(2.18)	(6.65)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.301	0.303	0.277	0.315
N	13,546	13,546	4,442	9,104

Robust standard errors in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

in distinctive firm decisions and behaviors, including managerial risk-taking, acquisition premiums, and corporate social responsibility, which influence firm performance (Cho et al., 2016; Shi et al., 2017; Wei et al., 2018). However, few studies have explored firms' innovation investment from the perspective of CEOs' celebrity identity and status. Moreover, most studies used samples in developed countries and regions. Therefore, extending the line of current research, we investigated the effect of celebrity status on firms' innovation investment in the context of China's economic and institutional environment. Further, we explored the moderating effect of analyst coverage and ownership nature on the relationships between celebrity CEO and innovation investment.

Consistent with our theoretical arguments, we found that celebrity CEOs tend to support more innovation investment as a means of maintaining and promoting their identity and status as celebrities compared to CEOs without the celebrity label. Since celebrity CEOs have to act consistently with their identity standard as an outstanding entrepreneur after internalizing roles and expectations attached to the celebrity (Zavyalova et al., 2017; Lee et al., 2020). Otherwise, they are more likely to be punished by social norms, and may lose their celebrity identities and the huge benefits coming with it Innovation activities can not only capture public attention and improve the corporate reputation, but have also proven to be an effective tool for improving firm performance and obtaining future advantages for the company (Camison and Villar-Lopez, 2014; Nguyen et al., 2019). Therefore, celebrity CEOs have strong motivation to invest more in R&D for preserving their social status. Simultaneously, greater analyst coverage create more expectations and monitoring, lead celebrity CEOs to perceive more pressures and invest more in innovative activities because of self-protection motives. We also observed that the influence of CEO celebrity status on innovation investment tend to dissipate in SOEs. That is because the firms' state-owned nature and executives' dual identity as both executives and officials prompt CEOs to focus on political goals rather than performance (Bruton et al., 2015). Also, the resources and benefits brought by celebrity identity are far less than the advantages of state ownership. These findings shed light on the influencing mechanism and boundary conditions between celebrity CEOs and firm innovation strategy.

Theoretical contributions

This study has several critical implications for management research and theory. First, by introducing identity theory into the research framework of upper echelon theory, this study analyzes the effect and underlying influence mechanisms of celebrity CEOs on firms' innovation investment from a psychological perspective. It extends the research on the economic effects of CEOs' celebrity status and the relationship between executives' social characteristics and firm strategies. Specifically, it provides unique insights into executives' decision-making motivation, managerial behavior, and differentiated corporate strategies in different social identities and status. We also examined the facilitating and constraining conditions that may affect the association between celebrity CEOs' and innovation investment. Our study suggests that various organizational and environmental conditions can be key factors influencing CEOs' celebrity effect, which in turn amplifies or inhibits celebrity CEOs' motivation to engage in innovation strategy. By identifying the influencing mechanism and boundary conditions that celebrity CEOs' effort in firm

TABLE 7 Robustness test: Replacing the measure of innovation investment.

Variables	RD_{t+1}			
	(1)	(2)	(3)	(4)
			SOEs	Non-SOEs
CCEO	0.0049***	0.0019	0.0044***	0.0052***
	(6.87)	(1.59)	(3.74)	(5.73)
AC		0.0016***		
		(8.78)		
CCEO*AC		0.0015**		
		(2.47)		
ROA	0.0148*	0.0079	0.0224**	0.0112
	(1.77)	(0.91)	(2.18)	(0.99)
ATO	0.0087***	0.0085***	0.0072***	0.0094***
	(12.63)	(12.45)	(4.99)	(13.41)
CFR	0.0161***	0.0151***	0.0229***	0.0129***
	(4.43)	(4.17)	(4.22)	(2.71)
Lev	−0.0100***	−0.0096***	−0.0093***	−0.0104***
	(−5.50)	(−5.34)	(−2.79)	(−4.95)
FS	−0.0018***	−0.0023***	−0.0021***	−0.0016***
	(−8.19)	(−10.67)	(−6.52)	(−5.89)
FA	−0.0030***	−0.0027***	−0.0014	−0.0038***
	(−4.55)	(−4.04)	(−1.10)	(−4.96)
BS	0.0019	0.0020	−0.0009	0.0030**
	(1.53)	(1.63)	(−0.37)	(2.09)
BI	0.0128***	0.0125***	0.0129*	0.0119**
	(3.22)	(3.16)	(1.80)	(2.51)
LSC	−0.0072***	−0.0064***	−0.0083***	−0.0066***
	(−4.39)	(−3.87)	(−2.68)	(−3.44)
Gap	−0.0056***	−0.0055***	−0.0075***	−0.0046**
	(−3.63)	(−3.60)	(−2.96)	(−2.36)
Gender	0.0017**	0.0017***	0.0026**	0.0012
	(2.56)	(2.58)	(2.29)	(1.56)
Age	0.0029**	0.0028**	0.0019	0.0032**
	(2.32)	(2.24)	(0.87)	(2.15)
PC	−0.0013**	−0.0014**	0.0005	−0.0022***
	(−2.25)	(−2.40)	(0.33)	(−4.72)
Constant	0.0342***	0.0418***	0.0460***	0.0295***
	(5.61)	(6.86)	(4.33)	(3.95)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.221	0.227	0.186	0.250
N	13,473	13,473	4,424	9,049

Robust standard errors in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

TABLE 8 Robustness test: Additional lagged effects.

Variables	RD_{t+2}			
	(1)	(2)	(3)	(4)
			SOEs	Non-SOEs
CCEO	0.0108***	0.0054*	0.0090***	0.0119***
	(5.88)	(1.70)	(2.97)	(4.99)
AC		0.0034***		
		(5.19)		
CCEO*AC		0.0027*		
		(1.79)		
ROA	0.0282	0.0094	0.0278	0.0279
	(0.74)	(0.23)	(0.70)	(0.52)
ATO	−0.0250***	−0.0252***	−0.0238***	−0.0256***
	(−13.27)	(−13.42)	(−10.04)	(−10.08)
CFR	0.0031	0.0018	−0.0008	0.0057
	(0.15)	(0.08)	(−0.04)	(0.19)
Lev	−0.0411***	−0.0406***	−0.0374***	−0.0432***
	(−6.19)	(−6.16)	(−3.93)	(−4.89)
FS	−0.0026***	−0.0036***	−0.0030***	−0.0025***
	(−3.62)	(−4.43)	(−2.94)	(−2.60)
FA	−0.0036	−0.0028	−0.0050	−0.0029
	(−1.43)	(−1.09)	(−1.23)	(−0.88)
BS	0.0006	0.0008	0.0008	0.0011
	(0.20)	(0.27)	(0.17)	(0.29)
BI	0.0250**	0.0245**	0.0335*	0.0220
	(2.20)	(2.17)	(1.78)	(1.56)
LSC	−0.0231***	−0.0215***	−0.0331***	−0.0186***
	(−5.67)	(−5.28)	(−5.18)	(−3.65)
Gap	−0.0001	0.0000	0.0013	−0.0015
	(−0.03)	(0.00)	(0.17)	(−0.25)
Gender	0.0046***	0.0046***	0.0049**	0.0043*
	(2.62)	(2.64)	(2.00)	(1.84)
Age	0.0020	0.0020	0.0028	0.0011
	(0.60)	(0.60)	(0.42)	(0.29)
PC	−0.0029	−0.0030	−0.0021	−0.0032
	(−1.53)	(−1.61)	(−0.65)	(−1.34)
Constant	0.1030***	0.1170***	0.1057***	0.1036***
	(5.00)	(5.48)	(2.80)	(4.25)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R^2	0.179	0.182	0.225	0.165
N	10,550	10,550	3,452	7,098

Robust standard errors in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

behaviors, we advance research on identity theory and upper echelon theory.

Second, we contribute to the innovation management literature by exploring the executives' psychological factors on innovation practices and investment. Previous studies have mainly focused on the effect of executives' demographic characteristics on innovation activities (Hambrick, 2007; Lin et al., 2011; Heyden et al., 2017). Recently, scholars have investigated how strategy decisions and activities are directly influenced by psychological traits, including overconfidence, narcissism, and hubris (Park et al., 2018; Tang et al., 2018; Li and Zhang, 2022; Wang et al., 2022). In line with these studies in the subfield of innovation management, we explored the impact of CEOs' celebrity status on firm innovation investment by suggesting social status as a behavioral reference for decision-making. Our results revealed that the CEOs' internalization process of celebrity status into their

own identity and desire for preserving celebrity identity are significant determinants of firm innovation activities. It extends the research on the antecedents of innovation input, and contributes to the literature on the relationship between executives' psychological traits or their individual social needs and firm innovation activities.

Third, our results may offer a potential solution for agency issues. They revealed that innovation activities of firms are not only affected by executives' demographic characteristics, but also by the interaction between executives and society. Compared to demographic characteristics, social characteristics is more guidable and exploitable, which can be used to strengthen firms' innovation activities. According to agency theory, the core problem of corporate governance is the contradiction between agents' short-term personal interests and firms' long-term profitability (Matta and Beamishi, 2008). Since innovation strategy tend to be high-risk, high-input, long-term, uncertain, and does not always result in the desired future performance, it can contribute to risk averseness on the part of CEOs and their selection of activities that lead to short-term returns (Lin et al., 2011). However, media reports and the desire to receive awards and become a business celebrity can establish intangible standards and expectations that are attached to executives with celebrity identity (Zavyalova et al., 2017). Such standards and expectations constitute in effect an external corporate governance mechanism outside the board of directors and the company, which can serve to discipline the behavior of executives through their desire to maintain their celebrity status. Such mechanism can restrain CEOs' risk aversion preferences, make firms' long-term interests consistent with the CEOs' personal interests. The source of this external corporate governance restraint is the significance of the reputation and status of the CEO, which is monitored by the whole society relying on moral restraints. Thus, the discrepancy between the long-term interests of a firm and executive's aversion to risk can be resolved through the mechanism of the executives' celebrity status. We build a promising thought that resolves the principal-agent issue according to identity theory. This insight presents a possible method that could reconcile the varying interests of both firms' stakeholders and CEOs.

Practical implications

Our findings also provide practical implications. With the growing number of well-known business leaders frequently receiving media attention, celebrity CEOs can play a vital role in listed companies and society. This study reveals the economic significance in the relationship between celebrity CEOs and firms' innovation strategies. It provides practical insights for boards of directors on making decisions about executives' recruitment. The boards should ensure that the motivation of CEOs and their decisions are in accordance with the firms' innovation strategy. To improve innovation capabilities and achieve a technical advantage, the directors should recruit a celebrity CEO or encourage their current CEO to get an award. However, when celebrity CEOs cannot meet the expectations of firms' stakeholders and the society, they tend to realize that there is a possibility of losing their status and reputation. They may excessively engage in innovation without careful strategic considerations of costs and risks, which is more likely to damage firms' interests. Moreover, the celebrity status, which can lead to CEOs' overconfidence and narcissism, will further exacerbate this tendency. Thus, the board of directors should also monitor the CEOs' risk-taking behavior to prevent any potential loss owing to the excessive risk-taking behaviors exhibited by celebrity CEOs to achieve personal goals.

Limitations and future research

This study has the following limitations. First, we only employed R&D intensity to measure innovation input which also includes research staff, innovation platform, research cooperation etc. Our measurement can only partially represent firms' innovation willingness and limits the research between celebrity CEOs and innovation. Future research should employ more variables to measure innovation input from various perspectives. Second, we did not investigate to what extent greater engagement in innovation investment by celebrity CEOs would actually benefit to maintain their status and reputation. The association between innovation input and CEOs' celebrity status has not been built directly. Therefore, future studies should further explore how different degrees of increase in R&D expenditures positively affect celebrity CEOs' social position or the likelihood of maintaining their celebrity status. Third, we did not consider the time effect of celebrity status. However, external praise of celebrity CEOs becomes less frequency and less important over time, making it difficult to provide sufficient motivation for identity control (Lovelace et al., 2018). A recently acquired celebrity status is more likely to have a significant impact on the CEO's decision-making than an earlier one (Cialdini and Goldstein, 2004). The time effect may complicate the impact of celebrity CEOs' on innovation input. In future research, it would be interesting to examine the effect of time on celebrity CEOs' engagement in innovation investment.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

DS and KL contributed to the theoretical framework, writing and formatting of the research. KL and SZ contributed to the supervision and review. DS, SZ, and SW contributed to the editing

and analysis of the research. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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A study on the relationship between compensation gap within the top management team and corporate performance: An empirical research based on the moderation effect of fairness preference

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This study explores the relationship between the compensation gap within the top management team (TMT) and corporate performance. We focus on how the fairness preference of the TMT moderates this relationship. The existing researches on the relationship between the compensation gap within the TMT and corporate performance are inconclusive. The reason may be that the traditional tournament theory is based on the hypothesis of self-interest preference of homo economicus. In the research, the fairness preference theory is added to the traditional tournament model, and a more realistic tournament model considering fairness preference is constructed. Based on the analysis of the theoretical model and the empirical regression analysis of the panel data of 733 non-financial A-share listed companies in Shanghai and Shenzhen stock markets from 2014 to 2020, we draw the following main conclusions: (1) There is an inverted U-shaped relationship between the TMT compensation gap and the corporate performance. Within the optimal compensation gap, there is a significant positive correlation. The larger the compensation gap, the better the corporate performance will be. When the optimal compensation gap is exceeded, there is a significant negative correlation. The larger the compensation gap, the worse the corporate performance will be. (2) The fairness preference of the TMT will weaken the correlation between the TMT compensation gap and corporate performance.

Within the optimal compensation gap, the fairness preference will weaken the positive relationship between them, and when it exceeds the optimal compensation gap, the fairness preference will also weaken the negative relationship between them.

KEYWORDS

tournament theory, fairness preference, the compensation gap within the top management team (TMT), FS model, social preference

Introduction

In the context of asymmetric information, how to design an effective incentive mechanism to motivate managers to take action and maximize the principal's utility has become one of the focus issues in theory and practice. Under symmetric information, neoclassical economic theory advocates that marginal output determines the level of compensation. However, in the case of asymmetric information, managers can attribute low profits to unfavorable exogenous influences, thus evading the accusation of the principal and causing the "moral hazard" problem. Lazear and Rosen (1981) proved that if the agent's performance is relevant, the rank-order tournaments can eliminate more uncertain factors, to make the principal's judgment on the manager's effort level more accurate. When greater rewards are provided for high performers, tournament theory suggests that improved effort and performance can be attained (Lambert et al., 1993). The introduction of performance-related pay systems typically leads to an increase in the dispersion of wages. Several empirical studies on the relationship between the compensation gap of the top management team (TMT) and corporate performance have not reached uniform conclusions. Some studies show that there is a linear positive relationship between the compensation gap and corporate performance, which supports the tournament theory (Main et al., 1993; Lin et al., 2003; Lallemand et al., 2004; Lu R., 2007; Mahy et al., 2011; Li et al., 2012; Huo et al., 2019; Niu et al., 2019; Huang et al., 2022). Other empirical studies have come to the opposite conclusion, arguing that the expansion of the compensation gap will damage corporate performance, and there is a linear negative relationship between them (Cowherd and Levine, 1992; Siegel and Hambrick, 2005; Zhang, 2007, 2008; Fredrickson et al., 2010; Liu et al., 2017; Eidd and Abou-Moghlie, 2021; Li and Jiao, 2021). In addition, others provide evidence that there is a nonlinear relationship between the compensation gap and corporate performance. For example, Bingley and Eriksson's (2001) research on Danish enterprises and Chen and Zhang's (2010) theoretical and empirical study found an inverted U-shaped relationship between them. In this nonlinear relationship, the positive relationship, in reality, indicates that it is in the nonoptimal rising stage, and the negative relationship indicates that it is in the nonoptimal falling stage. Some scholars have also demonstrated the opposite positive U-shaped relationship (Grund and Westergaard-Nielsen, 2008; Hu and Fu, 2018).

Despite a growing body of research, our knowledge of the issue remains woefully limited. The inconclusive conclusions make us confused. Should we increase or reduce the compensation gap of the TMT in the pay structure design? It is essential to explore the relationship between the compensation gap within the TMT and corporate performance. We focus on the internal influence mechanism of the TMT compensation gap on corporate performance. The reason for the inconclusive conclusion of empirical studies may be that the traditional tournament theory is only limited to the hypothesis of homo economicus without considering the fairness preference of agents. Behavioral experiments such as ultimatum game, gift exchange game, trust game, and public good game show that the pursuit motivation of individual economic interests alone can not fully explain the behavior of participants. The pursuit of "fairness" is also an important explanatory factor of their behavior, that is, individuals have fairness preferences. Scholars have gradually begun to pay attention to the incentive effect of agents' non-pure self-interest preference, but there are few studies on the application of fairness preference to tournament theory, most of which are just model construction and theoretical analysis. There are few studies using the data of listed companies to empirically test the moderating effect of fairness preference in real economic operations. Based on the traditional tournament model, we take fairness preference into account discussing a theoretical tournament model on the fairness preference of agents. We also conduct an empirical test with 733 nonfinancial A-share listed companies in Shenzhen and Shanghai stock markets from 2014 to 2020 as research samples to investigate the relationship between the compensation gap within the TMT and the corporate performance under fairness preference.

The study is structured as follows: following the study pattern, the section "Introduction" presents the research background and the purpose of the study. Section "Literature review" presents the theoretical basis and a literature review. Section "Theoretical analysis and hypotheses" introduces the

theoretical model deduction and develops the study hypotheses. Section "Methodology and results" presents the study sample and research methodology. The findings of the study are also presented in the section. Section "Discussion" compare the results with other studies. The "Conclusion" section summarizes the study conclusions. Section "Implications" concludes the study with its limitations, future directions, and management implications.

Literature review

Tournament theory

Rank-order tournaments or tournament theory is a compensation system based on relative performance evaluation, which was first proposed by Lazear and Rosen (1981). The incentive mechanism proposes to rank the outputs of all participants in order and gives a promotion bonus to the participants with relatively more output, to achieve the purpose of motivating the participants to win the competition by making efforts, thereby improving the corporate performance. The basic hypotheses of the theory are: first, the success or failure of the competition depends on the comparison of the relative performance of the participants; second, the higher the overall compensation level of the management and the larger the internal compensation gap, the better the incentive effect of the mechanism; third, the compensation gap within management team should increase with the increase in the number of people participating in the competition and position levels. These hypotheses are supported by relevant studies (Bull et al., 1987; Eriksson, 1999; Conyon et al., 2001). At the same time, a potential hypothesis of tournament theory is that the agents are purely self-interested, and their utilities depend on the individual's compensation and the corresponding cost, rather than the comparison with other participants.

Tournament theory explains the phenomenon that the compensation of senior executives increases significantly after promotion. Since it is difficult to measure the performance of senior executives and monitor their efforts, the gap between compensation levels can motivate the effective efforts of senior executives, thus promoting the consistency of interests between principals and agents and reducing agency costs. Since then, several scholars have applied this theory to the research on the salary gap of other positions within enterprises and achieved a lot of results. The main contributions of the theory are: first, when the risk preference of participants is risk neutral, the system can achieve the same resource allocation efficiency as the marginal output system; second, it is easier to observe relative marginal outputs sequentially than to directly measure the marginal outputs of each player, especially if monitoring costs are high. It can not only greatly reduce the monitoring cost of agents but also achieve the ideal result of motivating the efforts of participants (Lazear and Rosen, 1981; Rosen, 1986). In addition, the promotion bonus, that is, the compensation gap is the attraction and encouragement for managers to participate in the ranking competition, which can motivate competitors consciously make greater efforts and reduce the necessity of enterprise monitoring.

According to the tournament theory, enterprises should increase the compensation gap between position levels in order to reduce the principal-agent cost and improve corporate performance. Leonard (1990), Lambert et al. (1993), and Eriksson (1999) found that when the internal compensation gap of senior management remains unchanged, simply increasing the compensation level of senior executives could not improve their efforts, which supports the theoretical proposition that the key to encouraging managers to improve performance is the internal compensation gap. The research of Tsou and Liu (2005) believes that when the compensation gap in the enterprise is small, the turnover rate of employees is high, which also supports the design of increasing the compensation gap.

Fairness preference theory

In the 1980s, many classical game experiments, such as the ultimatum game experiment (Güth et al., 1982), dictator game experiment (Andreoni and Miller, 1993; Forsythe et al., 1994), trust game experiment (Berg et al., 1995), gift exchange game experiment (Akerlof, 1982), and public good game experiment (Marwell and Ames, 1979; Fehr and Gächter, 2000) strongly demonstrated the existence of social preferences including fairness preference, reciprocity preference, and altruism preference. Social preference theory has relatively complete and mature economic models, such as the fairness preference model (result oriented), reciprocity preference model (motivation oriented), and social welfare preference model (altruism oriented). It has extensive influence and strong academic vitality, among which fairness preference theory is particularly attractive (Chen et al., 2012).

Fairness preference, also known as inequality aversion preference, is a social preference oriented by the result of income distribution. It assumes that participants only pay attention to the fairness of the result, regardless of the goodwill of the opponent. Under this preference, participants have the motivation to narrow the income gap with others. The proposals of the classical FS model and BO model indicate the maturity of fairness preference theory (Loewenstein et al., 1989; Bolton, 1991).

The FS model was proposed by Fehr and Schmidt (1999). According to the model, income inequality will hinder the individual's utility level. When people find that their income is lower than others through comparison, there is a loss of utility due to disadvantage inequality or jealousy. When they find that their income is higher than others, they will feel the utility loss due to advantage inequality or sympathy. The results of the

model show that when the income gap between the participant and others is zero, their utility is maximized, that is, individuals will strive to pursue the indifference of income.

The BO model was proposed by Bolton and Ockenfels (2000), also known as the ERC (equity, reciprocity, and competition) model. The model is similar to the FS model but depicts the environmental background of incomplete information and uses a nonlinear form. It holds that individual utility is not only influenced by absolute income but also a function of relative income. The results of the model show that participants will strictly prefer the average income value of the reference group, that is, they will make their income share tend to the average level through practical actions.

Both the FS model and BO model believe that in the case of fairness preference, the equal income of participants is the optimal solution. The difference between the two is that the FS model measures the absolute income gap between individuals, while the BO model explores the relative share of individual income in the overall income. Among them, the FS model has been recognized and widely used by many scholars because it can more reasonably explain the behavior results in various game experiments, and the model structure is simple and easy to apply.

The compensation gap within the top management team and the corporate performance

Scholars in China and abroad have carried out a lot of research on whether the compensation gap within the TMT can have a positive effect on corporate performance, but the conclusions are not consistent. A considerable number of studies have found that the compensation gap within the TMT positively affects corporate performance, which is consistent with the opinions of tournament theory. Eriksson (1999) conducted empirical research on 210 enterprises in Denmark and pointed out that the widening of the compensation gap between CEOs and submanagers contributed to the improvement of sales profit margin, and its contribution was about 4–5%. Lee et al. (2008) used 10 years' data of American listed companies and found that the compensation difference within the TMT could positively predict corporate performance, and this relationship was more significant in an effective governance structure. Xu et al. (2016) pointed out in the research based in China that the positive correlation between the two existed only in non-state-owned enterprises. Heyman's (2005) research on the data of 10,000 managers showed that executive compensation dispersion positively affected profits, and the results of Sanchez-Marin and Baixauli-Soler (2015) using Spanish data also supported this opinion. Burns et al. (2017) used multinational samples to show that the trophy structure, that is, the compensation gap between CEOs and other senior executives, varied with national cultural characteristics and was positively related to corporate performance. Lin et al. (2003) empirically found that the larger the compensation gap between the CEO and other senior executives was, the higher the corporate future performance. Lu H. (2007, 2009) and Liu et al. (2011) reached the same conclusion. The research of Zhang and Li (2018) showed that the compensation gap of the senior executive team could send a positive signal of the corporate performance to market investors and reduce the bond issuance spreads. Ma et al. (2020) proposed that local tournaments could promote corporate performance, and this result was equally applicable to CEOs and CFOs. Zhong et al. (2021) also proved internal vertical compensation gap promotes firm innovation performance, but CEO's power weakens the positive effect between them.

Second, some theoretical and empirical studies believe that the expansion of the compensation gap will be harmful to organizational performance. Lazear (1989) further proposed based on the tournament model that sabotage was a basic feature of the tournament system. When the employees' behaviors can influence each other, they may sabotage in order to win. This behavior has a double negative impact on corporate performance because it damages others' output and their own output at the same time and becomes more intense with the increase in promotion bonuses (Harbring and Irlenbusch, 2008). A study of executive compensation levels by O'Reilly et al. (1988) showed that the results did not conform to the tournament theory but strongly supported the social comparison theory. Fredrickson et al. (2010) also supported the inverse relationship between executive compensation dispersion and corporate performance from the perspective of social comparison theory. Carpenter and Sanders (2004) found that the compensation gap between CEOs and the senior executive team had a negative effect on performance in the coming years. Siegel and Hambrick (2005) further believed that this situation would be more serious in high-tech enterprises due to the requirements for the interdependence of the TMT members. Zhang (2007, 2008) and Zhang and Li (2007) focused on the compensation gap of core members of the senior executive team of listed companies, and the results showed that it had a limited impact on corporate performance. Mei and Zhao (2016) pointed out that both vertical and parallel compensation gaps of senior executives would increase the turnover rate of vice presidents, further reducing corporate performance.

With the further development of research, other scholars believe that there is a nonlinear inverted U-shaped relationship between the compensation gap and corporate performance. In fact, Lazear and Rosen (1981) and Grund and Sliwka (2005) have proposed the theoretical value of the optimal compensation gap in the analysis of the tournament model. Lin et al. (2003) proved that there was a linear relationship between the CEO compensation gap and corporate performance, but they believed that this was only because the compensation gap during the investigation period was far from the optimal value, and its negative effects had not yet appeared. The relationship

between the compensation gap and future performance was likely to be a quadratic curve. Qin (2009) deduced that the relationship between the compensation gap within the TMT and the expected return of the enterprise was positive at first and then negative through the reestablishment of the multiagent compensation contract model. The empirical research found that the degree of compensation inequity had not yet approached the inverted U-shaped inflection point. Chen and Zhang (2010) took destructive behavior into account in the tournament model, and Huang (2012) further deduced the tournament model. They both concluded that the theoretical relationship between the compensation gap and corporate performance is inverted U-shaped. The former also investigated the interval effect between them through empirical methods, which is in line with the results of Bingley and Eriksson (2001) based in Denmark. Chen et al. (2019) proposed that there is a significant inverted U-shaped relationship between the compensation gap and corporate performance, and the correlation between the two is more significant in enterprises with higher performance.

In addition, a few scholars have reached other different conclusions. Empirical studies by Grund and Westergaard-Nielsen (2008) and Ridge et al. (2015) supported that compensation dispersion played a positive U-shaped role in corporate performance. Similarly, Hu and Fu (2018) used the OLS method and 2SLS method to conclude that the compensation gap within the enterprise (including the senior executive team and senior executive-employee) had a U-shaped relationship with corporate accounting performance and market performance and was moderated by factors such as operational risk. The long-term study by Connelly et al. (2016) showed that the effects of compensation dispersion on the short-term performance and long-term performance of the company are completely opposite. Lu (2011) and He and Zhang (2017) believed that the positive and negative relationships between the compensation gap of the senior executive team and corporate performance were determined by the degree of risk and debt.

Fairness preference, the compensation gap within the top management team, and the corporate performance

In recent years, some scholars have begun to introduce fairness preference into the tournament theory and have made pioneering research on incentive theory. Kräkel (2000) analyzed the effort level of agents in the tournament model based on the theory of relative exploitation and pointed out that the income comparison between agents and their colleagues was a greater motivation for agents to make efforts. Demougin and Fluet (2003) believed that the agent's jealousy might be beneficial to the principal, and this possibility depended on the cost of performance evaluation. Grund and Sliwka (2005) integrated the FS model into the tournament model and discussed the impact of fairness preference on employees' effort provision and corporate profits. They argued that when the bonus was given, the corporate profits in the condition of competition of fairness preference agents are higher than that in the condition of self-interest preference agents. If the bonus structure could be adjusted, the incentive effect would disappear completely and the participation effect would be dominant. Gill and Stone (2010) integrated tournament theory, fairness theory, and loss aversion theory to model the agent's competitive behavior based on the self-value evaluation. Through the discussion of the relationship between fairness preference and self-value, it was found that one reason why tournaments were widely accepted was the formation of internal reference points of self-value evaluation. Eisenkopf and Teyssier (2013) used the game experimental method and confirmed that jealousy and loss aversion would lead agents to pay extra effort to avoid disappointment and lower returns, and some agents with loss aversion preference would greatly reduce efforts. In general, fairness preference would lead to a reduction in total utility and tournament incentive efficiency.

Chinese scholars Wei and Pu (2006) introduced the FS model into the tournament model with the behavior of sabotage. The conclusion was that fairness preference would reduce the agent's effort provision and the behavior of sabotage. Compared with pure self-interest, the expected income of the principal with fairness preference was lower, so it was best for enterprises to implement the tournament system among agents with pure self-interest or weak fairness preference. Similar to the conclusion, Liu et al. (2014) constructed a more complex three-stage tournament model with the introduction of fairness preference and found that the change direction of effort and sabotage was the same, while the impact of fairness preference and compensation gap between them was quite opposite. The former reduced them and the latter improved them. Wei and Tang (2017) studied the effect of tournaments in the condition of heterogeneous preferences and suggested that principals carefully identified the preference types of participants because the expected profit of implementing group competitions based on heterogeneous preferences was greater than that of pooled tournaments.

Theoretical analysis and hypotheses

The relationship between the compensation gap and the corporate performance based on traditional tournament model

In our research, the tournament model without fairness preference (Lazear and Rosen, 1981; Grund and Sliwka, 2005; Wei and Pu, 2006) is called the traditional tournament model,

which is used as the basic model and comparison of derivation, and its derivation process and conclusion are listed. Based on the potential reason for the behavior of sabotage is likely to be fairness preference, so the traditional tournament model discussed in this article does not include sabotage.

Considering the simple traditional tournament model of two-person competition, there are two homogeneous agents A and B in this model. Their output function $Q(e)$ and cost function $C(e)$ are exactly the same, both of which are functions of effort level e. The output function is $Q(e_i) = F(e_i) + \varepsilon_i$, $F(e_i)$ is a concave function, $F' > 0$, $F'' < 0$, ε_i is independent and identically distributed; the cost function $C(e_i)$ is convex, $C' > 0$, $C'' > 0$, and $F(0) = C(0) = 0$. In the tournament between agents A and B, the amount of promotion bonus is WD. The winner in the tournament will receive monetary compensation W_H, and the loser will receive monetary compensation W_L, that is, $WD = W_H - W_L$. Furthermore, the probability of victory for agent i is P_i^H.

Under the pure self-interest hypothesis, the utility of the agent is only related to the reward. The agent's utility in winning the competition is: $U^H = \mathrm{W}_H - \mathrm{C(e)}$, while the agent's utility in losing the competition is: $U^L = \mathrm{W}_L - \mathrm{C(e)}$. Therefore, the expected utility of agent i can be expressed as:

$$EU_i = P_i^H U^H + \left(1 - P_i^H\right) U^L = P_i^H WD + W_L - C(e_i)$$

where the probability of victory $P_i^H = p\left(Q_i > Q_j\right)$

$$= p\left(F(e_i) + \varepsilon_i > F\left(e_j\right) + \varepsilon_j\right)$$

$$= p(\varepsilon_j - \varepsilon_i < F(e_i) - F(e_j))$$

The random variable $\xi = \varepsilon_j - \varepsilon_i$ obeys the probability distribution function $\mathrm{G}(\cdot)$ with the probability density $\mathrm{g}(\cdot)$, $E\xi = 0$, $\mathrm{g(-x)} = \mathrm{g(x)}$, so $P_i^H = G\left(F(e_i) - F\left(e_j\right)\right)$, $EU_i = G\left(F(e_i) - F\left(e_j\right)\right) WD + W_L - C(e_i)$.

Under a given compensation structure, agents maximize their expected utility by choosing the degree of effort they make, that is, let $\frac{\partial EU_i}{\partial e_i} = 0$, we get

$$\mathrm{g}\left(\mathrm{F(e_i)} - \mathrm{F}\left(\mathrm{e_j}\right)\right) F'(e_i)\, WD - C'(e_i) = 0$$

$$\mathrm{g}\left(F\left(e_j\right) - F(e_i)\right) F'\left(e_j\right) WD - C'\left(e_j\right) = 0$$

From the symmetry of pure strategy Nash equilibrium, we get $e_i = e_j$, then the maximization condition of the agent's expected utility can be expressed as:

$$\frac{C'}{F'} = \mathrm{g}(0)\, WD \tag{1}$$

At this time, the probability of victory $P_i^H = G(0) = \frac{1}{2}$, $EU_i = \frac{1}{2} WD + W_L - C(e_i)$.

Equation 1 is called incentive compatibility constraint (Wei and Pu, 2006), and further derivation of e to the left of the equal sign can be obtained $\left(\frac{C'}{F'}\right)' = \frac{C''F' - C'F''}{F'^2} > 0$. When the compensation gap WD to the right of the equal sign expands, $\frac{C'}{F'}$ increases and the effort degree e also increases. This shows that the agent's effort provision depends on the compensation gap WD. The larger the compensation gap, the more effort provision will be.

At the same time, the agent will withdraw from the competition if the expected utility is lower than the minimum reservation utility; that is, $EU_i \geq U_0$, and in equilibrium,

$$W_L + \frac{1}{2} WD - C(e) \geq U_0 \tag{2}$$

Equation 2 is called participation constraint (Wei and Pu, 2006), and it can be seen that when the loser's compensation W_L remains unchanged and the compensation gap WD increases, the effort provision will also promote.

When the agent chooses to make efforts independently, the principal's income is $Per = Q_i + Q_j - (W_H + W_L)$, and the expected income is

$$EPer = 2F(e) - 2W_L - WD \tag{3}$$

The principal should try to set an optimal compensation gap to maximize the expected income. According to Grund and Sliwka (2005), the participation constraint in equilibrium, that is, Equation 2 should be equal. Otherwise, the principal will reduce the loser's compensation W_L and finally make the Equation 2 equal. Therefore, we can get:

$$W_L + \frac{1}{2} WD - C(e) = U_0 \tag{4}$$

The derivation of WD on both sides of Equation 4 can be obtained:

$$\frac{1}{2} - C' \frac{\partial e}{\partial WD} = 0 \tag{5}$$

From Equation 1, $C' = \mathrm{g}(0)\, WDF'$, and we substitute it in Equation 5 to get:

$$\frac{\partial e}{\partial WD} = \frac{1}{2\mathrm{g}(0) WDF'},$$

$$\text{so } \frac{\partial EPer}{\partial WD} = 2F' \frac{\partial e}{\partial WD} - 1 = \frac{1}{\mathrm{g}(0)\, WD} - 1 \tag{6}$$

When the expected income is maximized, $\frac{\partial EPer}{\partial WD} = 0$, thus, the optimal compensation gap without fairness preference is: $WD = \frac{1}{\mathrm{g}(0)}$. This shows that even under the pure self-interest hypothesis, the compensation gap has an interval effect on corporate performance. When the compensation gap WD is less than $\frac{1}{\mathrm{g}(0)}$, the larger the compensation gap, the higher the corporate performance will be. When it is greater than $\frac{1}{\mathrm{g}(0)}$, the larger the compensation gap, the lower the corporate performance will be. As a result, there is an inverted U-shaped relationship between the compensation gap and corporate performance, which is positive first and negative later.

Tournament model based on fairness preference of agents

FS model

In this study, we choose the FS model of fairness preference theory model. The specific contents of the model are as follows:

$$U_i = x_i - \frac{\alpha_i}{n-1}\sum_{j\neq i}\max\left(x_j - x_i, 0\right) - \frac{\beta_i}{n-1}\sum_{j\neq i}\max\left(x_i - x_j, 0\right)$$

where U_i is the utility function of participant i and x_i is the income obtained by participant i. Both α and β are fairness preference intensity, and α is the disadvantage inequality aversion coefficient or jealousy intensity. The second term $\frac{\alpha_i}{n-1}\sum_{j\neq i}\max\left(x_j - x_i, 0\right)$ to the right of the equal sign represents the jealousy disutility of participant i affected by other $(n-1)$ participants. β is the advantage inequality aversion coefficient or sympathy intensity. The third item $\frac{\beta_i}{n-1}\sum_{j\neq i}\max\left(x_i - x_j, 0\right)$ to the right of the equal sign represents the sympathy disutility of participant i affected by other $(n-1)$ participants. There is a hypothesis $\alpha \geq \beta$, indicating that jealousy is often stronger than sympathy, and $0 \leq \beta < 1$, indicating that although participants are sympathetic, they also like having a higher income than others. In particular, when the number of participants is two, the model is specifically expressed as:

$$U_i = x_i - \alpha_i\max\left(x_j - x_i, 0\right) - \beta_i\max\left(x_i - x_j, 0\right)$$

At this time, for a single participant, only one of the second or third terms to the right of the equal sign exists.

Tournament model based on fairness preference of agents

Introducing the FS model into the traditional tournament model, in the simple two-person model, it is assumed that the jealousy intensity and sympathy intensity between the two agents are the same, respectively. At this time, the agent will also compare with others' incomes. The result of the comparison will have an effect on utility, which is specifically shown as follows:

When he(she) wins: $U^H = W_H - \beta WD - C(e)$

When he(she) fails: $U^L = W_L - \alpha WD - C(e)$

Then, his(her) expected utility: $EU_i = (1 + \alpha - \beta)P_i^H WD + W_L - \alpha WD - C(e_i)$

Dato et al. (2018) proved that behavioral symmetric equilibrium was reasonable even if participants had loss aversion based on expectation. Therefore, there is still:

When the expected utility is maximized:

$$\frac{C'}{F'} = g(0)(1 + \alpha - \beta)WD \tag{7}$$

Equation 7 shows that when WD is fixed, the increase in jealousy intensity α will improve the effort provision, while the increase in sympathy intensity β will reduce the effort provision. Since $\alpha > \beta$ in general, fairness preference under incentive compatibility constraints will improve the effort provision.

At the same time, under the participation constraint, there is:

$$W_L + \frac{1}{2}(1 - \alpha - \beta)WD - C(e) \geq U_0 \tag{8}$$

where $(\alpha + \beta)$ is generally less than 1 (Grund and Sliwka, 2005), therefore, the positive relationship between effort provision e and compensation gap WD has not been changed. At the same time, Equation 8 also shows that under a given compensation gap WD, the greater the jealousy intensity α or sympathy intensity β is, the more the agent tends to reduce the effort provision e to meet the minimum reservation utility, that is, under the participation constraint, fairness preference will reduce the effort provision; for the principal, it is necessary to increase the compensation gap WD or compensation of loser W_L to ensure that the agent can participate in the competition.

Research hypotheses

The relationship between the compensation gap within the top management team and the corporate performance based on the tournament model considering fairness preference of agents

First, the tournament model based on fairness preference is analyzed in the same steps as the traditional tournament model:

Making the Equation 8 take the equal sign, we will get Equation 9:

$$W_L + \frac{1}{2}(1 - \alpha - \beta)WD - C(e) = U_0 \tag{9}$$

The derivation of WD on both sides of Equation 9 can be obtained:

$$\frac{1}{2}(1 - \alpha - \beta) - C'\frac{\partial e}{\partial WD} = 0 \tag{10}$$

From Equation 7, we know $C' = g(0)(1 + \alpha - \beta)WDF'$, then substitute it into Equation 10 to obtain:

$$\frac{1}{2}(1 - \alpha - \beta) - g(0)(1 + \alpha - \beta)WDF'\frac{\partial e}{\partial WD} = 0$$

So

$$\frac{\partial e}{\partial WD} = \frac{1 - \alpha - \beta}{2g(0)(1 + \alpha - \beta)WDF'} \tag{11}$$

Then, the principal's expected income is $EPer = 2F(e) - 2W_L - WD$, and the derivation of WD is:

$$\frac{\partial EPer}{\partial WD} = 2F'\frac{\partial e}{\partial WD} - 1 = \frac{1 - \alpha - \beta}{g(0)(1 + \alpha - \beta)WD} - 1 \tag{12}$$

It can be seen that when the expected income is the largest, the value of the optimal compensation gap is $WD = \frac{1-\alpha-\beta}{g(0)(1+\alpha-\beta)}$.

This shows that there is still an optimal compensation gap based on the fairness preference hypothesis, that is, the compensation gap still has an interval effect on corporate performance, which is consistent with the result in the traditional tournament model mentioned above. Based on this, we propose Hypothesis 1 as followings:

> **Hypothesis 1:** There is an inverted U-shaped relationship between the TMT compensation gap and corporate performance.

> **Hypothesis 1a:** Within the optimal compensation gap, the TMT compensation gap is positively related to corporate performance, and the larger the compensation gap, the higher the corporate performance will be.

> **Hypothesis 1b:** When the optimal compensation gap is exceeded, the TMT compensation gap is negatively related to corporate performance, and the larger the compensation gap, the lower the corporate performance will be.

Moderating effect of fairness preference

Next, we discuss the moderating effect of fairness preference on the strength of the inverted U-shaped relationship between the compensation gap within the TMT and corporate performance. According to Equation 6, the derivative of expected income to compensation gap without fairness preference is $\frac{1}{g(0)WD} - 1$, and according to Equation 12, the derivative of expected income to compensation gap with fairness preference is $\frac{1-\alpha-\beta}{g(0)(1+\alpha-\beta)WD} - 1$. The analysis shows that $\frac{1-\alpha-\beta}{g(0)(1+\alpha-\beta)WD} - 1 < \frac{1}{g(0)WD} - 1$, and this indicates that for the same level of compensation gap, due to the existence of fairness preference, its marginal contribution to corporate performance becomes smaller.

In order to investigate the influence of psychological intensity of fairness preference, we continue to take the derivation of fairness preference intensity with Equation 12, then obtain:

$$\frac{\partial^2 EPer}{\partial WD \partial \alpha} = \frac{-2+2\beta}{g(0)(1+\alpha-\beta)^2 WD} < 0$$

$$\frac{\partial^2 EPer}{\partial WD \partial \beta} = \frac{-2\alpha}{g(0)(1+\alpha-\beta)^2 WD} < 0$$

This means that for each level of compensation gap *WD*, the greater the jealousy intensity$_\alpha$ or sympathy intensity$_\beta$ is, the lower the derivative of the principal's expected income to the compensation gap is, that is, the marginal contribution of the compensation gap is lower.

In conclusion, the existence of fairness preference will reduce the marginal contribution of the compensation gap compared with that of pure self-interest, and the increase in fairness preference intensity will further reduce this marginal contribution. However, it is not certain whether this change includes the effect caused by the change of the extreme point. Therefore, Hypothesis 2 is proposed:

> **Hypothesis 2:** Fairness preference moderates the correlation between the TMT compensation gap and corporate performance.

> **Hypothesis 2a:** Within the optimal compensation gap, fairness preference will weaken the positive relationship between them.

> **Hypothesis 2b:** When the optimal compensation gap is exceeded, fairness preference will strengthen the negative relationship between them.

Methodology and results

Sample and data collection

This study selects the panel data of A-share listed companies in Shenzhen and Shanghai stock markets from 2014 to 2020 as the research sample. The data are from the company research series database in the China Stock Market and Accounting Research (CSMAR) series research database. The industry classification is subject to the 2012 version of the China Securities Regulatory Commission. For the samples with missing executives' annual compensation and educational background, a manual supplementary search is conducted on the webpage; the proportion of all kinds of personnel, including the proportion of technical staff, the proportion of undergraduate and above employees, and the proportion of management personnel, are all from the WIND database.

First, based on the original samples, this study preliminarily carried out the following processing: (1) nonfinancial industries and non-ST enterprises during the sample observation period were selected to make the samples more robust and eliminate the influence of outliers; (2) the enterprise samples with missing compensation data were excluded; and (3) enterprises with fewer than 100 employees were excluded to make the samples more representative.

Second, because the compensation gap within the TMT is a core variable of this study, so it is particularly important to identify the members of the TMT. Through the analysis of the theoretical model, employees holding the positions such as general manager, deputy general manager, board secretary, and so on, were selected as the members of the TMT, which does not include non-part-time directors and supervisors. On this basis, further processing was done as follows: (1) in view of the definition of a team, samples with less than 2 senior executives

were excluded; (2) referring to the practice of Chen and Zhang (2010), the samples whose highest annual compensation is non-CEO in the TMT were excluded. So far, the sample data of 733 corporate executives have been obtained.

Finally, referring to the general data processing methods of empirical study, we carried out winsorizing of 0.01 up and down for continuous variables. Additionally, the unbalanced panel data of 3,093 effective observations of 733 A-share listed companies from 2014 to 2020 were obtained.

Model construction

The inverted U-shaped relationship between the compensation gap within the top management team and the corporate performance

For the test of inverted U-shaped relationship, the squared term of the explanatory variable, including the one-degree term of the explanatory variable and other control variables, must be added to the compact model. After the regression, the analysis and judgment are made according to the significance and symbol of the one-degree term and the squared term in the results. Therefore, referring to the test model developed by Chen and Zhang (2010), we first established Model 1 to verify the relationship between the compensation gap *WD* within the TMT and the corporate performance *PER*:

$$\text{Model 1: } PER_{i,t} = \alpha_0 + \alpha_1 WD_{i,t} + \alpha_2 WD_{i,t}^2 + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

For the explained variable corporate performance *PER*, according to Gao and Lu (2015), the market performance with less incentive effect on executives was not used, and the three indicators of *ROA* (Lin et al., 2003), *EPS* (Zhang, 2007), and *ROE* (Lu H., 2007; Li et al., 2014) were used as the explained variable of the research subject. For the explanatory variable, the compensation gap *WD* within the TMT, referring to the research of Chen and Zhang (2010) and Yang and Wang (2014), two absolute indicators were used to measure. The first was *WDl*, which was used to measure the difference between the highest and the lowest compensation in the team, and the second was *WDa*, which was used to measure the difference between the highest and the average compensation in the team. So far, six groups of specific models as followings have been included:

$$\text{Model 1-1: } ROA_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 1-2: } ROA_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 1-3: } EPS_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 1-4: } EPS_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 1-5: } ROE_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 1-6: } ROE_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 C_{i,t} + \varepsilon_{i,t}$$

Measurement of fairness preference intensity

Yan and Jin (2014) believed that the degree of compensation inequity and educational background could reflect the fairness preference intensity of senior executives in state-owned enterprises, so they set up these two indicators as the substitute variables of fairness preference, in which the degree of compensation inequity was obtained by using modeling regression to obtain the residual according to the research of Cowherd and Levine (1992). Based on the practices of Yan and Jin (2014) and Cowherd and Levine (1992), this article first obtains the numerical *DCOM* of the compensation gap between senior executives and the industry and takes it as the explained variable to investigate the degree of compensation inequity that can be explained by the human capital characteristics of senior executives such as gender, age, tenure, educational background, professional title, and so on, as well as the characteristics of the enterprise, time and industry, that is, the model residual. The absolute value is taken to represent the fairness preference intensity. However, after analysis, as the role brought by the external environment, the degree of external compensation inequity can only represent the strength of senior executives' fairness preference and cannot directly represent whether the specific preference of senior executives is jealousy or sympathy. Therefore, it is only to obtain the absolute value of the residual and does not distinguish the degree of inequity of advantages and disadvantages as Yan and Jin (2014). Based on this, Model 2 is established:

Model 2:

$$DCOM_{i,t} = \beta_0 + \beta_1 GEN_{i,t} + \beta_2 AGE_{i,t} + \beta_3 TEN_{i,t} + \beta_4 BG_{i,t} + \beta_5 PRF_{i,t} + \beta_6 LNN_{i,t} + \beta_7 ROA_{i,t} + \beta_8 YEAR + \beta_9 INDUS + \varepsilon_{i,t}$$

The role of fairness preference

In order to verify the moderating effect of fairness preference on the relationship between the compensation gap within the TMT and the corporate performance and its impact on the optimal compensation gap, we need to add the index of fairness preference *Z*, the interaction between fairness preference and the one-degree term of explanatory variable *WD*, and the interaction between the fairness preference and the squared term of *WD* into Model 1, to establish Model 3:

Model 3:

$$PER_{i,t} = \lambda_0 + \lambda_1 WD_{i,t} + \lambda_2 WD_{i,t}^2 + \lambda_3 Z_{i,t} \cdot WD_{i,t} + \lambda_4 Z_{i,t} \cdot WD_{i,t}^2 + \lambda_5 Z_{i,t} + \lambda_6 C_{i,t} + \varepsilon_{i,t}$$

According to Model 2, in the main part of the study, the degree of compensation inequity F is added to Model 3 as a substitute variable of fairness preference Z, and six groups of models including three explained variables and two explanatory variables are also obtained, which are as followings:

Model 3-1:

$$ROA_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 F_{i,t} \cdot WDl_{i,t} + \alpha_4 F_{i,t} \cdot WDlsq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Model 3-2:

$$ROA_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 F_{i,t} \cdot WDa_{i,t} + \alpha_4 F_{i,t} \cdot WDasq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Model 3-3:

$$EPS_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 F_{i,t} \cdot WDl_{i,t} + \alpha_4 F_{i,t} \cdot WDlsq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Model 3-4:

$$EPS_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 F_{i,t} \cdot WDa_{i,t} + \alpha_4 F_{i,t} \cdot WDasq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Model 3-5:

$$ROE_{i,t} = \alpha_0 + \alpha_1 WDl_{i,t} + \alpha_2 WDlsq_{i,t} + \alpha_3 F_{i,t} \cdot WDl_{i,t} + \alpha_4 F_{i,t} \cdot WDlsq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Model 3-6:

$$ROE_{i,t} = \alpha_0 + \alpha_1 WDa_{i,t} + \alpha_2 WDasq_{i,t} + \alpha_3 F_{i,t} \cdot WDa_{i,t} + \alpha_4 F_{i,t} \cdot WDasq_{i,t} + \alpha_5 F_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t}$$

Variables definition

The definition of all variables involved in this study is shown in Table 1.

In Model 1 and Model 3:

1. Explained variable *PER*: As mentioned in the model construction, corporate performance is measured by three indicators: *ROA, EPS*, and *ROE*.
2. Explanatory variable *WD*: As mentioned in the model construction, two absolute gap indicators *WDl* and *WDa* are used to measure the compensation gap within the TMT, and *WDlsq* and *WDasq* represent the squared terms of *WDl* and *WDa*, respectively, to test the inverted U-shaped relationship between *PER* and *WD*.
3. Moderating variable *Z*: As mentioned in the model construction, the fairness preference is measured by two indicators, namely, the degree of external compensation inequity *F* and educational background *BG*. Among them, the former indicator *F* is used for the subject regression, which is obtained by taking the absolute value of the residual term obtained by the regression of Model 2; the latter indicator *BG* is used for the robustness test, which is obtained by taking the average of the education background of the TMT. The educational background of each member of the team is as follows: (1) for below junior college and other educational backgrounds, (2) for junior college, (3) for undergraduate, (4) for postgraduate, and (5) for doctoral students and postdoctoral. For the executives who cannot find their educational background in all ways, then it is classified as other, numbered as 1. The larger the BG value is, the higher the overall educational level of the TMT is.
4. Control variables C: 10 control variables are selected in this study, as shown in Table 1.

In Model 2:

1. Explained variable *DCOM*: As mentioned in the model construction, it is calculated from the difference between the average compensation of the top three executives in the enterprise and the average compensation of the top three executives in the industry.
2. Explanatory variables: Nine explanatory variables are used. The first five variables gender *GEN*, age *AGE*, tenure *TEN*, educational background BG, and professional title PRF are responsible for explaining the industry compensation gap caused by the human capital characteristics of the TMT, and firm size *LNN* and return on assets *ROA* explain *DCOM* from the enterprise management level, while also controlling the industry and time. Among them, the *TEN* variable of tenure is calculated by comparing the job start date and job end date of the non-director or supervisor positions held by senior executives with the sample observation time, and for senior executives who hold several positions concurrently, we select the longest term. Industry *INDUS* dummy variable includes 16 industry categories.

Empirical test results and analysis

In this study, EXCEL and STATA software are used for research data processing and regression of the model. The results are as follows:

TABLE 1 Variable connotation.

Variables	Meaning	Definition
Models 1, 3		
PER	Corporate performance	Explained variable
ROA	Return on assets (%)	Net profit divided by average total assets
EPS	Basic earnings per share	The current period net profit attributable to common stockholders divided by the weighted average number of ordinary shares outstanding in the current period
ROE	Return on equity (%)	Net profit divided by balance of shareholders' equity
WD	Compensation gap within the TMT	Explanatory variable
WDl	Absolute index 1 (10,000)	CEO compensation minus team minimum compensation
WDlsq	Squared term 1	(CEO compensation minus team minimum compensation)^2
WDa	Absolute index 2 (10,000)	CEO compensation minus average team compensation
WDasq	Squared term 2	(CEO compensation minus average team compensation)^2
Z	Fairness preference	Moderating variable
F	The degree of external compensation inequity	Absolute value of the residual for Model 2 regression
BG	Educational background	Average education background of the TMT
C		Control variables
LNN	Firm size	Ln (number of people in the enterprise)
POT	The proportion of technical staff (%)	Number of technical staff divided by number of employees
POM	The proportion of management personnel (%)	Number of management personnel divided by number of employees
PUT	The proportion of undergraduate and above employees (%)	Number of undergraduate and above employees divided by number of employees
PSS	Proportion of state-owned shares (%)	The number of state-owned shares divided by the total number of shares
TOP10	Ownership concentration (%)	Proportion of top 10 circulating shares
BOD	Board size	Number of board members
IDP	Proportion of independent directors (%)	Number of independent directors divided by board size
DUAL	CEO duality	Dummy variable, which takes 1 when the CEO and the chairman of the board are the same person, otherwise takes 0
YEAR	Year	Dummy variable
Model 2		
DCOM	The compensation gap with the industry (10,000)	The average compensation of the top three executives minus the average compensation of the top three executives in the industry
GEN	Gender (%)	The number of male executives divided by the number of people in the TMT
AGE	Age	Average age of the TMT
TEN	Tenure	Average tenure of the TMT
BG	Educational background	Average education background of the TMT
PRF	Professional title (%)	The number of executives with professional titles divided by the number of people in the TMT
LNN	Same as Models 1, 3	—
ROA	Same as Models 1, 3	—
INDUS	Industry	Dummy variable
YEAR	Year	Dummy variable

Descriptive statistics

Table 2 lists the descriptive statistical results of the main variables of each model in this study. It can be seen that the maximum value of *WDl* is 5,900,000, the minimum value is 40,400; the maximum value of *WDa* is 3,821,820, and the minimum value is 24,500, with a difference of about 146 times and 155 times, respectively, which shows the great difference in the compensation gap within the TMT of different enterprises in China. In addition, from an annual perspective, except for the changes in the minimum values of *WDl* and *WDa* in 2019, the average values of *WDl* and *WDa* show an increasing trend year by year when their maximum and minimum values remain unchanged, indicating that the compensation gap within the TMT of China's nonfinancial enterprises is expanding year by year.

Multicollinearity test

In order to avoid the decline of the single explanatory power of model parameter estimation caused by multicollinearity, the multicollinearity test was carried out on the explanatory variable

TABLE 2 Descriptive statistics of variables.

Variables	Mean	SD	Min	Max
Models 1, 3				
ROA	4.477	5.171	−16.415	18.563
ROE	7.183	9.4	−41.142	30.157
EPS	0.384	0.481	−1.04	2.29
WDl	71.767	95.183	4.04	590
WDa	42.122	61.12	2.45	382.182
LNN	7.72	1.148	5.226	10.959
POT	20.336	16.708	0	82.19
POM	2.509	5.602	0	28.65
PUT	24.965	19.716	0	86.393
PSS	1.829	6.951	0	45.735
TOP10	41.803	20.487	1.552	87.563
BOD	8.486	1.545	5	14
IDP	37.427	5.283	33.333	57.143
DUAL	0.29	0.454	0	1
F	44.35985	59.40454	0.0154	495.9888
BG	3.221	0.525	1.833	4.333
Model 2				
DCOM	2.122	76.186	−106.706	430.516
GEN	82.994	16.512	33.333	100
AGE	47.944	3.528	39	56.25
TEN	5.103	2.21	0.977	11.538
BG	3.221	0.525	1.833	4.333
PRF	45.849	31.913	0	100
WDl				
2014	52.7	68.67	4.04	590
2015	57.67	78.93	4.04	590
2016	65.75	87.79	4.04	590
2017	72.37	91.32	4.04	590
2018	83.56	105.2	4.04	590
2019	129.1	138.5	5.84	590
2020	146.2	153.3	4.04	590
WDa				
2014	31.04	44.04	2.45	382.182
2015	34.84	52.86	2.45	382.182
2016	38.92	56.77	2.45	382.182
2017	42.47	58.71	2.45	382.182
2018	49.31	67.99	2.45	382.182
2019	70.92	87.11	2.96	382.182
2020	83.71	100.6	2.45	382.182

of the samples for Model 1, and the variance inflation factor (VIF) under the two *WD* indicators was obtained, as shown in Table 3.

First, as a comparison, the VIF of all variables in the compact Model 1 (excluding the squared term of *WD*) does not exceed 2, and the average VIF is 1.48 and 1.47, respectively, which shows that the correlation between variables in compact Model 1 is weak, so there is no need to worry about the multicollinearity

TABLE 3 Multicollinearity test.

Variables	VIF (compact)	VIF	Variables	VIF (compact)	VIF
WDl	1.27	7.97	*WDa*	1.22	8.09
WDlsq		7.55	*WDasq*		7.76
LNN	1.37	1.37	*LNN*	1.35	1.35
POT	1.78	1.78	*POT*	1.77	1.78
POM	1.25	1.25	*POM*	1.25	1.25
PUT	1.91	1.91	*PUT*	1.9	1.9
PSS	1.08	1.08	*PSS*	1.08	1.08
TOP10	1.21	1.21	*TOP10*	1.21	1.21
BOD	1.66	1.66	*BOD*	1.66	1.66
IDP	1.55	1.55	*IDP*	1.55	1.55
DUAL	1.08	1.08	*DUAL*	1.08	1.08
2015	1.66	1.66	2015	1.66	1.66
2016	1.7	1.7	2016	1.7	1.7
2017	1.72	1.72	2017	1.72	1.72
2018	1.75	1.76	2018	1.75	1.75
2019	1.41	1.42	2019	1.4	1.41
2020	1.22	1.22	2020	1.21	1.21
VIF mean	1.48	2.23	VIF mean	1.47	2.24

problems of the compact model. Second, the average values of VIF under the test of the two groups of complete Model 1 are 2.23 and 2.24, respectively, both of which do not exceed 3. Among them, the VIF of the control variables is less than 2, and the VIF of the one-degree term and the squared term of the explanatory variable *WD* is larger but does not exceed 10. Therefore, it can be considered that the correlation between the variables in Model 1 is not strong, and multicollinearity is not a serious problem.

Model test results and analysis

In this study, the two-way fixed effects model including individual effects and time effects under cluster robust standard errors is selected for regression.

Scatter plot analysis

Figure 1 shows the scatter plot and qfit fitting between the performance indicators of each enterprise and the compensation gap indicators within each TMT.

First, it can be seen from the six scatter plots that the sample observations are widely distributed within the range of explanatory variable *WD*, especially when *WDl* is less than 2,000,000 and *WDa* is less than 1,000,000. Second, qfit fitting shows that in the six figures, except (b1) and (b2), namely, when the corporate performance takes the *EPS* index, the fitting line does not have obvious bending, and the other four figures all show a more obvious inverted U-shaped fitting shape. Therefore, through the observation of the scatter plots, it can be preliminarily judged that there is an inverted U-shaped relationship between the compensation gap *WD* within the

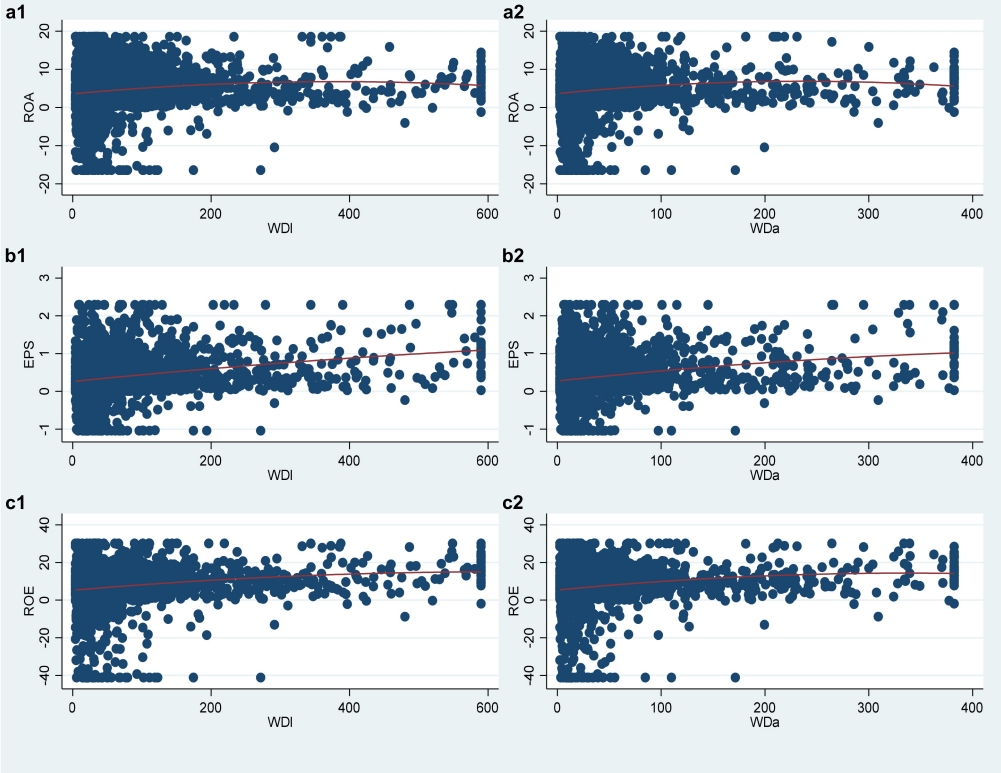

FIGURE 1
Sample scatter plot. **(a1–c2)** Represent the relationship between different variables.

TMT and the corporate performance *PER*, and most of the samples are in an upward stage of the inverted U-shaped.

Results analysis without considering fairness preference of agents

The six groups of models in Model 1 are regressed, respectively, and the results are shown in Table 4.

Inverted U-shaped relationship analysis

The purpose of Model 1 is to test whether there is an inverted U-shaped relationship between the explained variable *PER* and the explanatory variable *WD*. The key to the test is that the coefficient of the one-degree term of *WD* in the model regression is significantly positive, and the coefficient of the squared term is significantly negative.

According to Table 4, we first investigate the significance and direction of the coefficients of the one-degree term (*WDl* and *WDa*) of the explanatory variable *WD*. It can be seen that Model 1-1, Model 1-2, and Model 1-5 are significant at the level of 1%, Model 1-3, Model 1-4, and Model 1-6 are significant at the level of 5%, and the one-degree term coefficients of the six groups of models are all positive. Second, the significance and direction of the coefficients of the squared term WD^2 (*WDlsq* and *WDasq*) of *WD* are investigated. It is found that Model 1-1 and Model 1-4 are significant at the level of 5%, Model 1-3, Model 1-5, and Model 1-6 are significant at the level of 10%, Model 1-2 is not significant, and the squared term coefficients of the six groups of models are all negative. It can be considered that there is a nonlinear relationship between the compensation gap *WD* within the TMT and the corporate performance *PER*. At the same time, combined with the result that the one-degree term coefficient is positive, and the squared term coefficient is negative, it can be determined that the nonlinear relationship between the compensation gap *WD* within the TMT and the corporate performance PER is an inverted U-shape with positive first and then negative. That is, when *WD* is within the optimal compensation gap, the larger the *WD* is, the better the corporate performance PER. When the *WD* exceeds the optimal compensation gap, the larger the *WD* is, the worse the corporate performance PER. Hypothesis 1, Hypothesis 1a, and Hypothesis 1b are supported.

Marginal effects plot

In order to more intuitively show the marginal contribution of the compensation gap *WD* within the TMT to the corporate performance PER, this study draws the *WD* marginal effects plot, as shown in Figure 2:

TABLE 4 Model 1 regression results.

Variables	Model 1-1 (*ROA*)	Model 1-2 (*EPS*)	Model 1-3 (*ROE*)	Variables	Model 1-4 (*ROA*)	Model 1-5 (*EPS*)	Model 1-6 (*ROE*)
WDl	0.0137***	0.00119***	0.0233**	*WDa*	0.0233**	0.00220***	0.0420**
	(0.00512)	(0.000419)	(0.0107)		(0.00914)	(0.000723)	(0.0194)
WDlsq	−1.67e-05**	−1.17e-06	−2.64e-05*	*WDasq*	−4.38e-05**	−3.79e-06*	−7.68e-05*
	(7.72e-06)	(7.60e-07)	(1.51e-05)		(2.13e-05)	(1.96e-06)	(4.28e-05)
LNN	0.302	0.0475*	1.209	*LNN*	0.299	0.0470*	1.199
	(0.435)	(0.0265)	(1.007)		(0.434)	(0.0265)	(1.003)
POT	0.0200	0.00209*	0.0396	*POT*	0.0204	0.00210*	0.0400
	(0.0155)	(0.00116)	(0.0298)		(0.0154)	(0.00115)	(0.0296)
POM	0.0370**	0.00165	0.0504	*POM*	0.0366**	0.00161	0.0495
	(0.0184)	(0.00154)	(0.0377)		(0.0182)	(0.00153)	(0.0374)
PUT	0.0180	0.000576	0.0270	*PUT*	0.0178	0.000544	0.0266
	(0.0182)	(0.00113)	(0.0334)		(0.0182)	(0.00112)	(0.0333)
PSS	−0.0310*	−0.00181	−0.0862**	*PSS*	−0.0309*	−0.00182	−0.0863**
	(0.0176)	(0.00132)	(0.0365)		(0.0176)	(0.00132)	(0.0366)
TOP10	−0.0339***	−0.00351***	−0.0605***	*TOP10*	−0.0338***	−0.00351***	−0.0604***
	(0.00912)	(0.000801)	(0.0174)		(0.00912)	(0.000801)	(0.0174)
BOD	0.121	0.0110	0.416	*BOD*	0.117	0.0108	0.410
	(0.179)	(0.0162)	(0.368)		(0.178)	(0.0161)	(0.368)
IDP	0.0353	0.00192	0.0895	*IDP*	0.0340	0.00180	0.0871
	(0.0388)	(0.00293)	(0.0768)		(0.0390)	(0.00293)	(0.0769)
DUAL	0.342	0.0371	0.835	*DUAL*	0.314	0.0334	0.774
	(0.520)	(0.0348)	(1.106)		(0.519)	(0.0345)	(1.100)
Constant	−0.262	−0.0975	−8.763	Constant	−0.158	−0.0899	−8.578
	(4.160)	(0.298)	(8.837)		(4.167)	(0.298)	(8.836)
Individual fixed effects	Yes	Yes	Yes	Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Time fixed effects	Yes	Yes	Yes
Observation	3,093	3,093	3,093	Observation	3,093	3,093	3,093
R^2	0.024	0.041	0.023	R^2	0.025	0.042	0.024

The symbols *, **, and *** denote significance at the 10, 5, and 1% significance levels, respectively.
Robust standard errors are presented in parentheses.

It can be seen from Figure 2 that among the six groups of models, there is a phenomenon that the marginal contribution value of the compensation gap *WD* within the TMT changes from positive to negative and gradually decreases. This shows that the corporate performance, as described in the above regression results analysis, will first increase and then decline with the increase in the compensation gap within the TMT.

Results analysis considering fairness preference of agents

The absolute value of the residual obtained by the regression of Model 2 is substituted into Model 3 for regression. The results of the six groups of models are shown in Table 5:

The moderating effects plot of fairness preference of the six groups of models in Model 3 is shown in Figure 3. The horizontal coordinate is the intensity of fairness preference, and the vertical coordinate is the average marginal contribution of the compensation gap *WD* within the TMT to the corporate performance *PER*. The average marginal contribution of *WD* in the six figures all show a trend of decreasing with the increase in the intensity of fairness preference, that is, the stronger the fairness preference is, the smaller the derivative of the corporate performance PER to the compensation gap *WD* within the TMT. That confirms the preliminary results in the derivation of the Hypothesis 2 theoretical model.

Observing the regression results in Table 5, first of all, the quadratic interaction terms ($F \times WDlsq$, $F \times WDasq$) in Model 3-1, Model 3-3, Model 3-4, and Model 3-6 are all significant at the level of 1%, Model 3-2 is significant at the level of 10%, and Model 3-5 is not significant. It can be considered that fairness preference *Z* (*F*) has a significant impact on the marginal contribution of the compensation gap *WD* within the TMT. Second, in the six groups of models, the symbols of the coefficients of the quadratic interaction terms ($F \times WDlsq$, $F \times WDasq$) are all positive, which indicates that the stronger the fairness preference is, the smaller the absolute value of the marginal contribution of the compensation gap *WD* within the TMT is. In conclusion, fairness preference can moderate the relationship between the compensation gap within the TMT and corporate performance, which supports Hypothesis 2. At

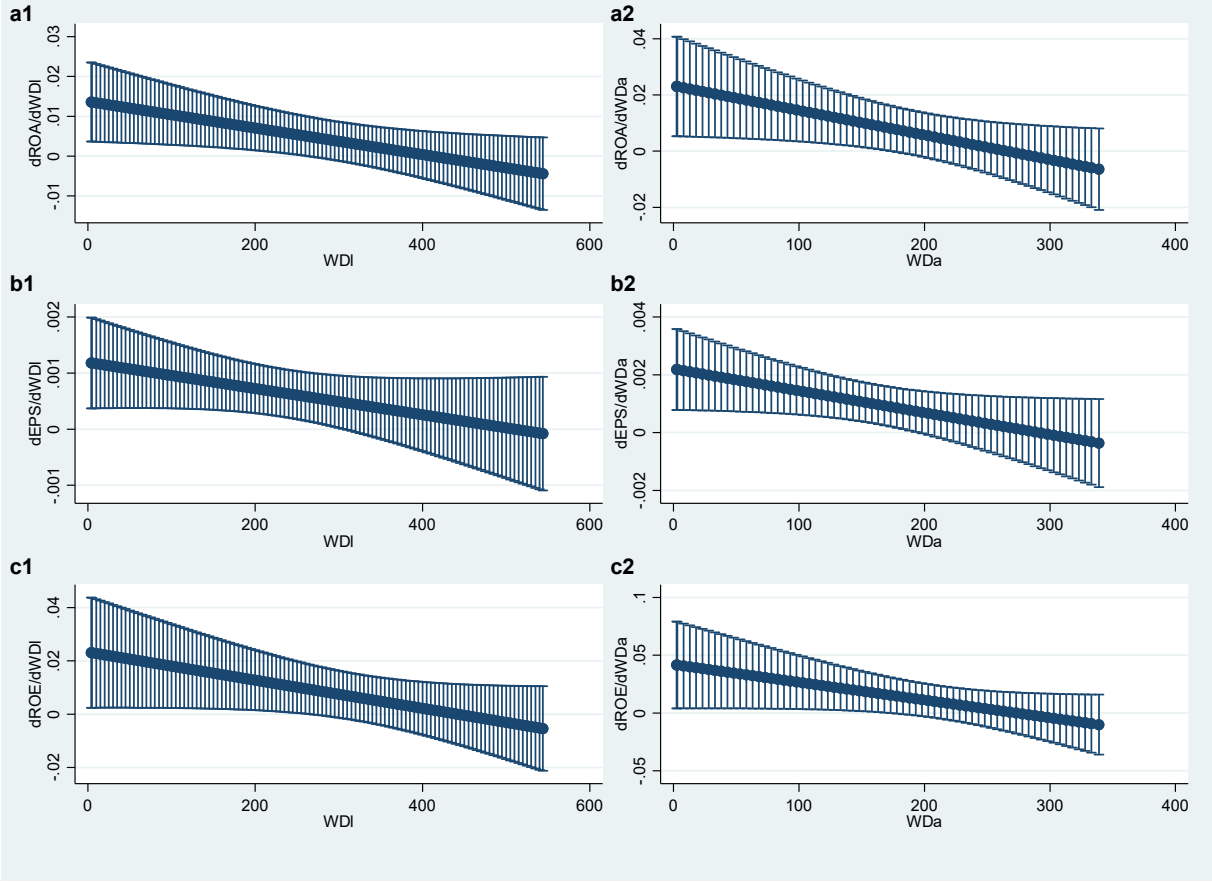

FIGURE 2
Marginal contribution of WD. **(a1–c2)** Represent the relationship between different variables.

the same time, this moderating effect shows as a weakening effect. That is, on the left side of the optimal compensation gap, fairness preference will weaken the positive relationship between the two, while on the right side of the optimal compensation gap, it will weaken the negative relationship between the two, so Hypothesis 2a is supported, but Hypothesis 2b is not supported.

Robustness tests

The robustness test of this study first reports the compact model of Model 1 to verify whether the direction and significance of the coefficients of the complete model are stable. Then, for Model 3, the index of fairness preference is replaced to compare and test the original moderating model.

Compact Model 1 regression

In order to test whether the results of Model 1 are robust, Table 6 lists six groups of compact Models in which Model 1 only contains the one-degree term of the explanatory variable. It can be seen from Table 6 that the regression coefficient of *WDI* in compact Model 1-2 is significantly positive at the level of 1%, the regression coefficients of *WDI* and *WDa* in compact Model 1-1, compact Model 1-3, and compact Model 1-5 are all significantly positive at the level of 5%, and the regression coefficients of WDa in compact Model 1-4 and compact Model 1-6 are significantly positive at the level of 10%. It indicates that when using the linear model, there is a significant positive relationship between the compensation gap within the TMT and corporate performance. The larger the compensation gap within the TMT, the higher the corporate performance. This result does not change the coefficient significance and symbolic direction of the one-degree term of the explanatory variable in Table 4, indicating that the regression results of the complete Model 1 with the one degree and squared terms of the compensation gap within the TMT listed in Table 4 are relatively robust.

Model 3 regression with replacement of moderating variable

Yan and Jin (2014) believed that the higher the education level of executives in state-owned enterprises was, the stronger the fairness preference was. This article uses this index as a

TABLE 5 Model 3 regression results.

Variables	Model 3-1 (*ROA*)	Model 3-2 (*EPS*)	Model 3-3 (*ROE*)	Variables	Model 3-4 (*ROA*)	Model 3-5 (*EPS*)	Model 3-6 (*ROE*)
WDl	0.0132***	0.00108***	0.0220**	*WDa*	0.0231***	0.00197***	0.0406**
	(0.00425)	(0.000356)	(0.00879)		(0.00787)	(0.000643)	(0.0164)
WDlsq	−2.67e-05*	−2.56e-06*	−4.79e-05*	*WDasq*	−6.67e-05**	−6.72e-06**	−0.000128*
	(1.45e-05)	(1.50e-06)	(2.88e-05)		(3.36e-05)	(3.37e-06)	(6.70e-05)
F	0.0260***	0.00152**	0.0556***	*F*	0.0239***	0.00135**	0.0511***
	(0.00765)	(0.000595)	(0.0171)		(0.00717)	(0.000559)	(0.0160)
F × *WDl*	−0.000175***	−5.82e-06	−0.000323***	*F* × *WDa*	−0.000262***	−7.24e-06	−0.000478***
	(4.08e-05)	(3.97e-06)	(8.47e-05)		(6.18e-05)	(5.92e-06)	(0.000133)
F × *WDlsq*	2.74e-07***	1.07e-08*	4.99e-07***	*F* × *WDasq*	6.32e-07***	2.14e-08	1.15e-06***
	(6.09e-08)	(6.33e-09)	(1.24e-07)		(1.49e-07)	(1.53e-08)	(3.13e-07)
LNN	0.206	0.0429*	1.019	*LNN*	0.229	0.0437*	1.058
	(0.419)	(0.0259)	(0.980)		(0.422)	(0.0260)	(0.979)
POT	0.0227	0.00222*	0.0450	*POT*	0.0223	0.00221*	0.0439
	(0.0154)	(0.00116)	(0.0297)		(0.0154)	(0.00116)	(0.0299)
POM	0.0378**	0.00153	0.0505	*POM*	0.0376**	0.00148	0.0500
	(0.0189)	(0.00156)	(0.0387)		(0.0188)	(0.00155)	(0.0385)
PUT	0.0146	0.000415	0.0203	*PUT*	0.0145	0.000412	0.0202
	(0.0180)	(0.00115)	(0.0331)		(0.0180)	(0.00114)	(0.0331)
PSS	−0.0300*	−0.00178	−0.0843**	*PSS*	−0.0304*	−0.00179	−0.0851**
	(0.0172)	(0.00133)	(0.0357)		(0.0173)	(0.00132)	(0.0360)
TOP10	−0.0323***	−0.00343***	−0.0573***	*TOP10*	−0.0324***	−0.00344***	−0.0576***
	(0.00907)	(0.000803)	(0.0172)		(0.00908)	(0.000801)	(0.0172)
BOD	0.126	0.0110	0.427	*BOD*	0.125	0.0109	0.423
	(0.181)	(0.0164)	(0.373)		(0.180)	(0.0164)	(0.373)
IDP	0.0327	0.00174	0.0840	*IDP*	0.0312	0.00168	0.0816
	(0.0386)	(0.00293)	(0.0765)		(0.0388)	(0.00293)	(0.0766)
DUAL	0.340	0.0374	0.842	*DUAL*	0.315	0.0345	0.792
	(0.511)	(0.0342)	(1.087)		(0.512)	(0.0341)	(1.082)
Constant	1.940	0.0501	−4.627	Constant	1.832	0.0474	−4.789
	(4.044)	(0.295)	(8.591)		(4.069)	(0.297)	(8.584)
Individual fixed effects	Yes	Yes	Yes	Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Time fixed effects	Yes	Yes	Yes
Observation	3,093	3,093	3,093	Observation	3,093	3,093	3,093
R^2	0.036	0.047	0.035	R^2	0.035	0.048	0.035

The symbols *, **, and *** denote significance at the 10, 5, and 1% significance levels, respectively.
Robust standard errors are presented in parentheses.

substitute variable for fairness preference of robustness tests, thus forming six groups of robustness test models of Model 3. The regression results are shown in Table 7:

It is observed that the coefficient significance of the squared terms (*WDlsq* and *WDasq*), the one-degree terms (*WDl* and *WDa*) and their interaction terms (*BG* × *WDl* and *BG* × *WDa*) of the explanatory variable in Table 7 is not significantly different from that in Table 5. However, the coefficients of quadratic interaction terms (*BG* × *WDlsq* and *BG* × *WDasq*) are not significant in the six models but are still positive. At the same time, the coefficient directions of the above four terms are consistent with those in Table 5, indicating that the moderating effect of fairness preference *Z* is to weaken the relationship between the compensation gap within the TMT and corporate performance. However, the weakening effect is significant when the degree of external compensation inequity *F* is the fairness preference index, while the weakening effect of the education background *BG* index is less significant.

Discussion

Previous studies on the influencing factors of corporate performance mainly focus on two parts: one is external factors, mainly including the degree of marketization (Dai and Guo, 2020), media attention (Bai et al., 2019), and government factors (Haider et al., 2018; Najaf and Najaf, 2021), legal factors (Trevlopoulos et al., 2021). The second is internal factors. It mainly includes organizational culture (Sari et al., 2018), capital structure (Uremadu and Onyekachi, 2018), executive

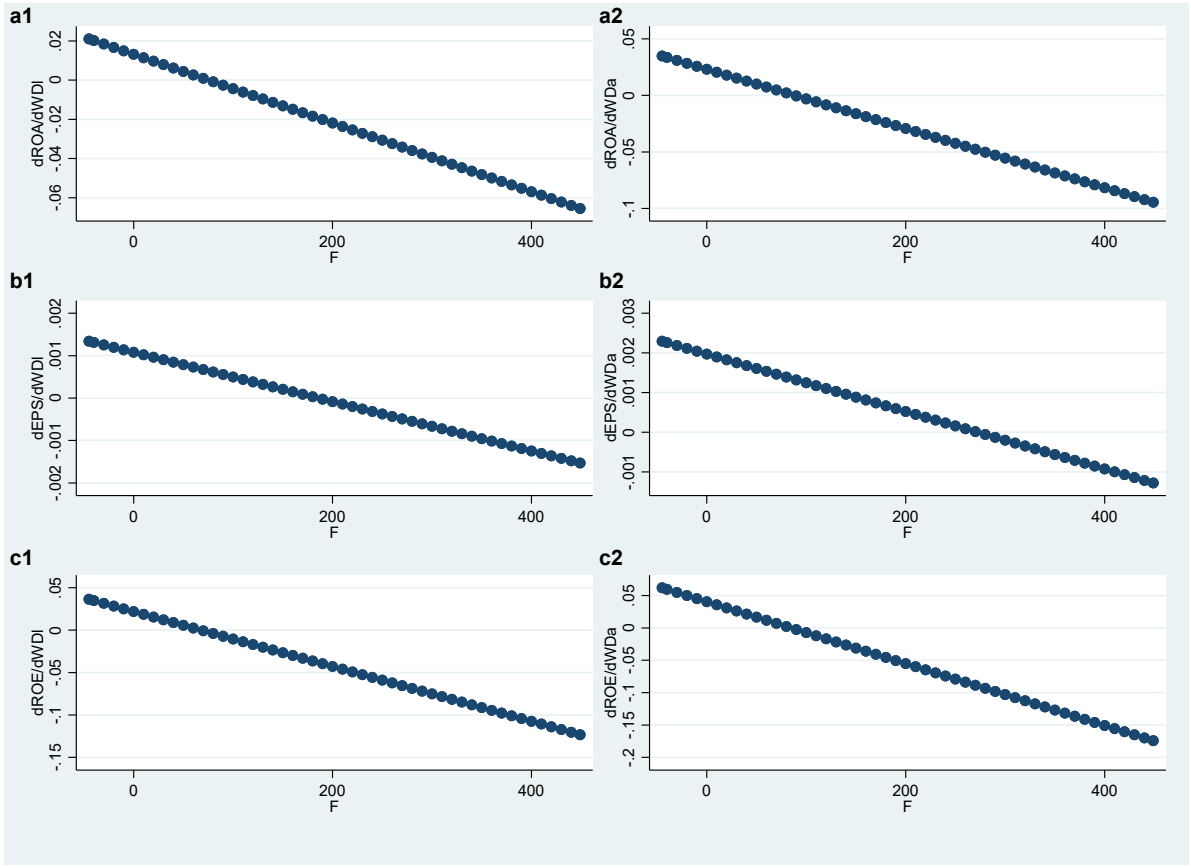

FIGURE 3
Moderating effects of fairness preference. **(a1–c2)** Represent the relationship between different variables.

characteristics (Leng and Kang, 2022), executive compensation (Rehman et al., 2021), and corporate characteristics (Richards et al., 2019; Younis and Sundarakani, 2019; Shahbaz et al., 2020). In contrast, external factors are difficult to control, while enterprises have more initiative in the improvement of internal factors. As a kind of special human capital in the enterprise, TMT has a great impact on corporate performance. As an incentive mechanism, the compensation gap within the TMT potentially affects the efforts of executives on corporate performance to a considerable extent.

The study focused on investigating the relationship between the compensation gap within the TMT and corporate performance through the moderating influence of fairness preference. Existing studies on the relationship between TMT and corporate performance have drawn inconsistent conclusions. Sun et al. (2020) found through empirical tests that the internal vertical compensation gap between CEOs and non-CEOs was positively correlated with corporate performance, the relationship between the internal horizontal pay gap within non-CEOs and corporate performance was inverse-U-shaped, and the degree of marketization strengthened the incentive effect of the vertical and horizontal pay gap. Li and Wang (2022) argued that when the CEO also served as the chairman of the board of directors, acting as the "single line liaison" between the board of directors and the enterprise, the compensation of the CEO was much higher than that of non-CEO executives and the CEO-TMT internal compensation gap was negatively correlated with the corporate performance. The increase in the compensation gap of the executive team can motivate executives to make innovative decisions and improve innovation performance (Hou, 2018). Mountouri (2019) explored the effect of the within-board compensation gap on the performance of the organization, the results suggested that the firm performance was affected positively by the compensation gap when measured as the Return on Assets, the Return on Equity, or Tobin's Q.

The findings of the study model are consistent with the literature (Chen and Zhang, 2010; Huang, 2012; Chen et al., 2019; Fu et al., 2022). All these studies have proved the inverted U-shaped relationship between the compensation gap within the TMT and corporate performance. That is, there is a significant positive correlation between the optimal

TABLE 6 Compact Model 1 containing only the one-degree term of WD.

Variables	Compact Model 1-1 (*ROA*)	Compact Model 1-2 (*EPS*)	Compact Model 1-3 (*ROE*)	Variables	Compact Model 1-4 (*ROA*)	Compact Model 1-5 (*EPS*)	Compact Model 1-6 (*ROE*)
WDl	0.00527**	0.000599***	0.00993**	*WDa*	0.00834*	0.000913**	0.0158*
	(0.00261)	(0.000220)	(0.00494)		(0.00426)	(0.000354)	(0.00812)
LNN	0.327	0.0492*	1.249	*LNN*	0.325	0.0492*	1.244
	(0.432)	(0.0264)	(1.005)		(0.432)	(0.0265)	(1.004)
POT	0.0218	0.00221*	0.0423	*POT*	0.0220	0.00224**	0.0427
	(0.0155)	(0.00114)	(0.0294)		(0.0154)	(0.00114)	(0.0293)
POM	0.0378**	0.00171	0.0516	*POM*	0.0377**	0.00170	0.0514
	(0.0182)	(0.00153)	(0.0375)		(0.0181)	(0.00152)	(0.0373)
PUT	0.0190	0.000646	0.0286	*PUT*	0.0188	0.000634	0.0284
	(0.0182)	(0.00112)	(0.0332)		(0.0181)	(0.00112)	(0.0331)
PSS	−0.0300*	−0.00174	−0.0847**	*PSS*	−0.0302*	−0.00176	−0.0850**
	(0.0176)	(0.00133)	(0.0365)		(0.0176)	(0.00133)	(0.0365)
TOP10	−0.0338***	−0.00351***	−0.0604***	*TOP10*	−0.0338***	−0.00351***	−0.0604***
	(0.00913)	(0.000802)	(0.0174)		(0.00913)	(0.000804)	(0.0174)
BOD	0.114	0.0105	0.405	*BOD*	0.111	0.0104	0.400
	(0.178)	(0.0161)	(0.366)		(0.177)	(0.0160)	(0.365)
IDP	0.0349	0.00190	0.0889	*IDP*	0.0337	0.00178	0.0866
	(0.0388)	(0.00292)	(0.0767)		(0.0388)	(0.00292)	(0.0768)
DUAL	0.401	0.0413	0.930	*DUAL*	0.389	0.0400	0.906
	(0.522)	(0.0351)	(1.107)		(0.521)	(0.0350)	(1.105)
Constant	−0.144	−0.0892	−8.575	Constant	−0.0359	−0.0794	−8.364
	(4.150)	(0.298)	(8.823)		(4.147)	(0.297)	(8.814)
Individual fixed effects	Yes	Yes	Yes	Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Time fixed effects	Yes	Yes	Yes
Observation	3,093	3,093	3,093	Observation	3,093	3,093	3,093
R^2	0.022	0.040	0.022	R^2	0.022	0.040	0.022

The symbols *, **, and *** denote significance at the 10, 5, and 1% significance levels, respectively.
Robust standard errors are presented in parentheses.

compensation gap. The larger the compensation gap, the better the corporate performance will be. This is consistent with the claims of tournament theory. But when the optimal compensation gap is exceeded, there is a significant negative correlation. The larger the compensation gap, the worse the corporate performance will be. This is in line with the inferences of equity theory. Different from previous studies, we further explore the role of fairness preference on the relationship between the compensation gap within the TMT and corporate performance based on social preference theory and conclude that fairness preference will weaken the correlation between the two.

The theoretical model analysis of this study believes that there is an optimal value of compensation gap in the traditional tournament model, and the tournament model based on the fairness preference of agents does not change this conclusion. The existence of the optimal value of the compensation gap indicates that the compensation gap is not the larger the better. In the empirical test part, through the regression method of two-way fixed effects, it is verified that there is a more significant inverted U-shaped relationship between the compensation gap within the TMT and corporate performance. The first hypothesis that there is an inverted U-shaped relationship between the TMT compensation gap and corporate performance is confirmed. That is, within the optimal value of the compensation gap, there is a significant positive correlation between them. The larger the compensation gap, the higher the corporate performance. When the optimal value is exceeded, there is a significant negative correlation between them. The larger the compensation gap, the lower the corporate performance.

In the theoretical model analysis part of the study, it is found that the existence and enhancement of fairness preference will reduce the marginal contribution of the compensation gap to corporate performance, that is, the incentive effect of the tournament will be reduced. Further analysis of the empirical regression results shows that the moderating effect of fairness preference on the relationship between the compensation gap within the TMT and corporate performance is as follows:

Within the optimal compensation gap, fairness preference will weaken the positive relationship between the compensation

TABLE 7 Robust test Model 3 with replacement of moderating variable.

Variables	Model 3-7 (*ROA*)	Model 3-8 (*EPS*)	Model 3-9 (*ROE*)	Variables	Model 3-10 (*ROA*)	Model 3-11 (*EPS*)	Model 3-12 (*ROE*)
WDl	0.0119***	0.00111***	0.0203**	*WDa*	0.0204***	0.00207***	0.0368**
	(0.00387)	(0.000317)	(0.00817)		(0.00704)	(0.000565)	(0.0151)
WDlsq	−1.51e-05*	−1.36e-06*	−2.30e-05	*WDasq*	−4.28e-05**	−4.88e-06**	−7.45e-05*
	(7.80e-06)	(8.10e-07)	(1.51e-05)		(2.06e-05)	(2.06e-06)	(4.14e-05)
BG	0.0659	−0.0498	−0.173	*BG*	0.0587	−0.0559	−0.216
	(0.525)	(0.0446)	(1.084)		(0.531)	(0.0451)	(1.100)
BG × *WDl*	−0.0157***	−0.000772	−0.0178	*BG* × *WDa*	−0.0248**	−0.00144	−0.0289
	(0.00601)	(0.000529)	(0.0125)		(0.0111)	(0.000965)	(0.0233)
BG × *WDlsq*	1.94e-05	1.53e-06	1.71e-05	*BG* × *WDasq*	5.38e-05	5.87e-06	5.72e-05
	(1.33e-05)	(1.36e-06)	(2.64e-05)		(3.52e-05)	(3.79e-06)	(7.23e-05)
LNN	0.322	0.0504*	1.250	*LNN*	0.319	0.0492*	1.240
	(0.436)	(0.0266)	(1.020)		(0.436)	(0.0267)	(1.016)
POT	0.0198	0.00203*	0.0389	*POT*	0.0198	0.00203*	0.0389
	(0.0151)	(0.00115)	(0.0296)		(0.0151)	(0.00114)	(0.0293)
POM	0.0359**	0.00163	0.0489	*POM*	0.0352*	0.00158	0.0478
	(0.0180)	(0.00152)	(0.0371)		(0.0179)	(0.00150)	(0.0369)
PUT	0.0188	0.000753	0.0288	*PUT*	0.0189	0.000749	0.0286
	(0.0179)	(0.00112)	(0.0327)		(0.0179)	(0.00111)	(0.0327)
PSS	−0.0321*	−0.00177	−0.0872**	*PSS*	−0.0316*	−0.00175	−0.0867**
	(0.0175)	(0.00132)	(0.0363)		(0.0175)	(0.00132)	(0.0363)
TOP10	−0.0335***	−0.00348***	−0.0599***	*TOP10*	−0.0332***	−0.00346***	−0.0595***
	(0.00911)	(0.000801)	(0.0173)		(0.00914)	(0.000800)	(0.0173)
BOD	0.131	0.0118	0.429	*BOD*	0.132	0.0119	0.430
	(0.178)	(0.0162)	(0.368)		(0.177)	(0.0161)	(0.367)
IDP	0.0341	0.00188	0.0878	*IDP*	0.0321	0.00172	0.0846
	(0.0383)	(0.00293)	(0.0764)		(0.0384)	(0.00292)	(0.0764)
DUAL	0.319	0.0345	0.808	*DUAL*	0.295	0.0296	0.749
	(0.513)	(0.0346)	(1.101)		(0.512)	(0.0344)	(1.094)
Constant	0.517	−0.0460	−7.526	Constant	0.608	−0.0257	−7.280
	(4.162)	(0.301)	(8.909)		(4.166)	(0.300)	(8.875)
Individual fixed effects	Yes	Yes	Yes	Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Time fixed effects	Yes	Yes	Yes
Observation	3,093	3,093	3,093	Observation	3,093	3,093	3,093
R^2	0.029	0.043	0.024	R^2	0.028	0.044	0.024

The symbols *, **, and *** denote significance at the 10, 5, and 1% significance levels, respectively.
Robust standard errors are presented in parentheses.

gap within the TMT and corporate performance. When it exceeds the optimal compensation gap, fairness preference will also weaken the negative relationship between the compensation gap within the TMT and the corporate performance. The second hypothesis that fairness preference moderates the correlation between the TMT compensation gap and corporate performance is supported, but the result goes in the opposite direction of Hypothesis 2b. When the optimal compensation gap is exceeded, fairness preference will not strengthen the negative relationship between them. On the contrary, fairness preference will weaken the relationship between them. This indicates that due to the attention of top management members to the fairness of compensation distribution results, the sensitivity of corporate performance to the compensation gap within the TMT is weakened.

Conclusion

In this article, the fairness preference theory in behavior theory is introduced to the traditional tournament model, and a tournament model based on the fairness preference of agents is constructed, which is more in line with reality. Through the derivation and analysis of the theoretical model, and combined with the multivariate regression analysis of the panel data of 3,093 observations of 733 nonfinancial listed companies in Shanghai and Shenzhen stock markets from 2014

to 2020, this article discusses and tests the relationship between the compensation gap within the TMT and the corporate performance, and the moderating effect of fairness preference on the relationship between them.

The main conclusions are as follows: (1) There is an inverted U-shaped relationship between the TMT compensation gap and corporate performance. Within the optimal compensation gap, there is a significant positive correlation. The larger the compensation gap, the better the corporate performance will be. When the optimal compensation gap is exceeded, there is a significant negative correlation. The larger the compensation gap, the worse the corporate performance will be. (2) Fairness preference will weaken the correlation between the TMT compensation gap and corporate performance. Within the optimal compensation gap, the fairness preference will weaken the positive relationship between them, and when it exceeds the optimal compensation gap, the fairness preference will also weaken the negative relationship between them.

Combining the subject regression and robustness tests of this study, the measurement effects of the two empirical indicators of fairness preference are not the same. On the one hand, in terms of the moderating effect on the relationship between the compensation gap within the TMT and corporate performance, the degree of external compensation inequity is consistent with the effect direction of educational background. That ensures the robustness of the effect direction of fairness preference. On the other hand, compared with the degree of external compensation inequity, the moderating effect of educational background on the correlation between them is less significant. This shows that compared with the degree of external compensation inequity, the education background index is not an excellent substitute variable of fairness preference.

Implications

Managerial implications and policy suggestions

The design of compensation gap should include consideration of fairness preference of senior executives

The intensity of senior executives' fairness preference affects the incentive effect of the compensation gap. The existence and enhancement of fairness preference will reduce the marginal contribution of the compensation gap to corporate performance. Fairness preference weakens the relationship between the compensation gap within the TMT and the corporate performance, this shows that due to the attention of senior executives to fairness, the tournament system can not fully play its original effectiveness. The effect of the compensation gap within the TMT on corporate performance is lower than that without fairness preference, and fairness preference will accelerate the emergence of the negative effect of the compensation gap. Therefore, when setting the compensation gap within the TMT, the enterprise should actively identify the strength of senior executives' fairness preference, judge the strong degree of reaction of each top management member to the compensation inequality, and incorporate this into the consideration of setting the compensation difference and the compensation variation range within the same compensation level.

Be wary of the negative effect of the excessive compensation gap within the top management team

Based on the sample data, it is found that about 2% of the samples whose amount of the compensation gap within the TMT is too large, which has had a negative impact on their performance. Therefore, we recommend that these enterprises take measures to narrow the compensation gap between the ranks of their TMTs, in order to reduce the negative impact of the excessive compensation gap on corporate performance.

Research limitations and prospects

First, fairness preference belongs to individual characteristics, which are heterogeneous and easily affected by the environment. The measurement of fairness preference is often seen in various experiments. The fairness preference in this study uses two indicators: the degree of external compensation inequity and educational background in the relevant literature. The former reflects the impact of the external environment, and the latter reflects individual heterogeneity. However, both indicators can only represent the intensity of preference, not the specific jealousy or sympathy of team members. In the future, indicators that can fully reflect fairness preference should be actively developed, or the combination mode of fairness preference indicators in experiments and large sample empirical regression should be actively explored.

Second, this study uses the unbalanced panel data of nonfinancial enterprises in the past 7 years for overall regression. Since the industry sample size of some non-manufacturing in the total sample is too small, the group regression by industry is not carried out. However, the compensation gap in each industry is different, and their respective optimal compensation gaps are likely to be different. For further study, we can increase the time span to expand the sample size to explore the differences between industries. In addition, the increase in time span is also helpful to explore the changes and impacts of fairness preference.

Data availability statement

The original contributions presented in this study are included in the article, further inquiries can be directed to the corresponding author.

Author contributions

XW and XY contributed to the conception and design of the study. XC and XY organized the database and performed the statistical analysis. XW and HZ performed original draft preparation, writing—review and editing. All authors contributed to the manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Self-interest or altruism: Entrepreneurs' military experience and the motivation of corporate philanthropic donations

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This study aims to explore the motivation of corporate philanthropic donations through investigating the impact of entrepreneurs' military experience. Based on the data from the 12th Chinese privately owned enterprises survey, this study finds that entrepreneurs' military experience has a positive impact on corporate philanthropic donations and the result keeps consistent after a series of robustness tests. Further, corporate financing constraints do not significantly influence the relationship between entrepreneurs' military experience and corporate philanthropic donations, while return on equity (ROE) strengthens the relationship. Therefore, entrepreneurs with military experience still donate even if their firms suffer from financial constraints. When firms achieve higher ROE, they will donate more. The findings suggest that the donations of firms with military entrepreneurs are more likely to be altruistic, enriching the understanding of the motivation of corporate philanthropic donations.

KEYWORDS

military experience, philanthropic donations, privately owned enterprises, entrepreneurs, altruism

Introduction

Corporate philanthropy has remarkably kept its momentum as a growing phenomenon of global importance. It is widespread among large multinational corporations as well as small and medium-sized firms (Gautier and Pache, 2015). For example, 2021 Forbes China releases the top 100 corporations donating a total of CNY 24.51 billion, with a significant increase of 37% over the previous year. Also, the topics related to philanthropic donations attract increasing attention from scholars (Gu et al., 2019). However, research in this field remains controversial and rife with conceptual and empirical debates. Some scholars argue that philanthropic donations require abundant investments in the short run that cost the resources (Brammer and Millington, 2008) and distract managerial attention (Lev et al., 2010). So why would firms still be so "generous"? As some scholars argue, corporate

philanthropic donations can generate a range of positive values. Corporate philanthropic donations help firms increase brand awareness (Lev et al., 2010), build social reputations (Muller and Kräussl, 2011), establish corporate legitimacy with key regulators (Sánchez, 2000) and achieve competitive advantages (Gautier and Pache, 2015). In 2003, chief executive officers (CEOs) of well-known corporations, such as Accenture, McDonald's Corporation, and Deutsche Bank AG, acknowledged at the World Economic Forum (WEF) that social philanthropy issues are crucial elements of businesses, and it is economically and ethically critical to positively respond to these issues (Bruch and Walter, 2005).

Considering the added-values generated by philanthropic donations, a stream of studies focus on philanthropic donation motivations. According to previous studies, there are two different motivations of corporate philanthropic donations, self-interest, and altruism (Liket and Simaens, 2013). The Financial Accounting Standards Board (FASB) defines corporate philanthropy as the voluntary and unconditional transfer of cash or other assets from a firm to the public. In its essence, corporate donation behaviors should be driven by a strong altruistic motivation (Sánchez, 2000; Henderson and Malani, 2009; Su and He, 2010; Lähdesmäki and Takala, 2012). It aims to benefit the public (Su and He, 2010) without expecting anything in return (Campbell et al., 1999). However, with the increasingly fierce market competition, corporate philanthropic donations are no longer motivated by pure altruism and self-interest motivation is coming to the fore. For example, Sanlu Group donated more than CNY 10 million for the Sichuan earthquake accident in 2008, which was widely praised by the public. But in the same year, it was widely criticized for the "melamine incident" and went bankrupt. Why do the "good deed" that actively fulfills social responsibility and the "evil deed" that ignores the law and violates integrity co-exist in the same firm? Evidently, many corporate philanthropic donations are consciously self-interested and designed to attain strategic benefits. Relevant research also indicates that, in addition to altruistic motivation, the self-interest motivations of corporate philanthropic donations specifically include profit maximization motivation (Lev et al., 2010; Muller and Kräussl, 2011), political motivation (Ma and Parish, 2006; Su et al., 2020), strategic motivation (Mescon and Tilson, 1987; Gan, 2006) and managerial opportunistic motivation (Davis, 1973; Brown et al., 2006; Masulis and Reza, 2015).

Although the previous literature helps us understand corporate philanthropic donation motivations from multiple perspectives, what we expect from corporate philanthropic donations is more of an altruistic action of service to society. According to the previous studies, altruistic motivation stems primarily from individual empathy, that is, the emotional perception generated by personal experiences (Batson et al., 1991). Philanthropic behaviors based on empathy are altruistic in nature. As far as we know, few existing studies investigate the relationship between entrepreneurs' personal experiences and corporate philanthropic donations as a means of unravelling the motivation of philanthropic donations. As the upper echelons theory asserts, executives' characteristics or experiences significantly influence firm-level decisions and behaviors. Especially, entrepreneurs of privately owned enterprises (POEs), as the primary decision-makers and executors of POEs, have much more freedom to put their own psychological perceptions on firm-level behaviors, such as corporate philanthropic donations. Accordingly, the previous studies find that the personal experience of executives like military experience (Luo et al., 2017) may make a strong and significant impact on firm-level decisions and behaviors (Malmendier et al., 2011). Through investigating the link between personal experience of entrepreneurs and corporate philanthropic donations, we may better understand the motivation of corporate philanthropic donations: self-interest or altruism.

Specifically, this study aims to further explore the relationship between the military experience of entrepreneurs of POEs and corporate philanthropic donations in the Chinese context. China has a large number of veterans who quit the military and come into firms or public institutions to start a new career (Xie and Hao, 2017). Among the top 500 Chinese corporations, there are about 200 presidents and vice-presidents with military backgrounds. Military experience has created a number of well-known entrepreneurs with distinctive personalities, such as Liu Chuanzhi (former chairman of Lenovo), Zhang Ruimin (founder of the Haier Group), Ren Zhengfei (former CEO of Huawei), and Wang Shi (founder of Wanke). Liu Chuanzhi directly states, "I am shaped by the military". In his opinion, corporate management should be bound by "iron discipline", like the military, and should be firmly implemented once the discipline is set down. Wang Shi joined the military at the age of 17. He admits, "military life is of great value to my success". From a psychological perspective, military experience emphasizes integrity, loyalty, and dedication (Luo et al., 2017). Thus, entrepreneurs with a military imprint demonstrate a concern for society and the public interest (Zhang et al., 2022) and have a high sense of ethics and social responsibility (Chen et al., 2021). They are not blindly following orders and have an opinionated manner (Benmelech and Frydman, 2015). The values imprinted by entrepreneurs' military experience have a long-term influence on their cognition and behaviors.

The above context provides the over-arching rationality for our study. We suppose a positive relationship between the military experience of entrepreneurs of POEs and corporate philanthropic donations, as military entrepreneurs have learned honesty, integrity, and "doing the right thing" from their military experience (Luo et al., 2017). That is, POEs may hold the altruistic motivation of philanthropic donations when their entrepreneurs have military experience. Further, the altruistic motivation suggests that the donations may not be influenced by the resource conditions. That is, entrepreneurs with military experience may still donate even if their firms suffer from financial constraints. When firms achieve higher return on equity (ROE), they will donate more. Therefore, this study introduces the other two moderating variables of financing constraints reflecting resource

conditions and ROE reflecting financial performance to further examine the altruistic motivation related to military experience. To examine the hypotheses, we draw upon the data from the 12th Chinese privately owned enterprises survey. The contributions of this study are as follows.

First, this study contributes to the stream of literature regarding the motivation of corporate philanthropic donations by investigating the impact of entrepreneurs' military experience on corporate philanthropic donations. There are very few studies investigating the link between entrepreneurs' military experience and corporate philanthropic donations, except for Luo et al. (2017). Their study argues that corporate philanthropic donations are usually employed as strategic tools to achieve business or political benefits; and thereby, firms run by military top executives make significantly fewer donations than those led by non-military executives, as military top executives usually have a high level of altruistic tendency and do not relay donations to obtain strategic benefits.

Different from Luo et al. (2017) using listed firms as the research sample, this study selects POEs and studies the donation motivation of entrepreneurs of POEs with military experience. Luo et al. (2017) find that firms run by military top executives donate less. However, we suppose that POEs founded by entrepreneurs with military experience may donate more. The contradictory conclusions may be well explained by the differences of corporate governance and decision mechanism between listed firms and POEs. Distinct from listed firms in which decisions are influenced and negotiated by a multi-party of stakeholders, the decisions of POEs are only made by entrepreneurs themselves (Long and Yang, 2016). As a result, in listed firms, donations may be likely to be employed by some stakeholders or executives as a strategic tactic to attain short-term benefits (Luo et al., 2017); therefore, military top executives may try to reduce these donations. However, in POEs, donations are not strategically used by military entrepreneurs to improve their bottom line. That is, they may altruistically donate due to their military experience. Accordingly, in nature, our conclusions are not contradictory with Luo et al. (2017), as both of them assume that executives with military experience are likely to be driven by altruistic motivation. Therefore, this study complements well to Luo et al. (2017) and further deepens our understanding on the motivation of corporate philanthropic donations.

Second, this study enriches the literature on entrepreneurs' personal experiences in influencing business decisions. Based on the upper echelons theory and imprint theory, the military culture of discipline, sacrifice, and responsibility (Williams et al., 2000) makes military entrepreneurs have a greater sense of responsibility and normative awareness, which drives them to make more philanthropic donations.

Third, this study expands the literature related to the factors that influence corporate philanthropic donations. While existing studies focus on the impact of military experience on corporate performance (Özlen, 2014; Li and Rainville, 2021; Lin et al., 2021), investment decisions (Benmelech and Frydman, 2015), and financial misconduct (Koch-Bayram and Wernicke, 2018), less attention is paid to the attitudes of military entrepreneurs toward corporate social responsibility, especially toward corporate philanthropy. Additionally, philanthropy in China has not been widely documented and explored, especially in the private sector (Su and He, 2010). Most of the existing studies use the listed firms as the research sample (Adams and Hardwick, 1998; Lev et al., 2010; Luo et al., 2017), with insufficient attention paid to POEs. We consider POEs as the research subjects to investigate their philanthropic donations, thereby enriching our understanding of POEs' philanthropic donation behaviors.

Literature review and hypotheses development

The impact of military experience

The imprint theory argues that individuals who go through an "environmentally sensitive period" develop characteristics that match the external environment. As stated by the previous studies, sensitive periods are characterized by a brief duration but have a significant impact on the individual (Han et al., 2022). These characteristics will persist in individuals despite subsequent environmental changes (Marquis and Tilcsik, 2013) and have a lasting impact on individuals and their careers (Zhang et al., 2022). In particular, the ideology of an organization's founder, formed early in life through the imprint process, can fundamentally shape the firm (Marquis and Qiao, 2018). The military, as an organization that has a strong formative impact on individual values and behavioral patterns, provides an organizational environment for the formation of the military imprint. Military service generally occurs during a person's youth, which is a sensitive period for the formation of individual values and cognition. The experience during this period can have a profound impact on the individual to form the military imprint. For example, Lowell McAdam, CEO of Verizon, recalls his military service by saying, "what you learn in the service stays with you for the rest of your life" (Zhang et al., 2022).

The existing studies focus more on the shaping of individual characteristics by military experience. Some scholars argue, military service hones one's mind, and veterans typically exhibit strong psychological qualities (Elder, 1986). Military personnel are adept at making better decisions under pressure and in the face of crisis (Benmelech and Frydman, 2015). The military also develops some frequently mentioned leadership qualities, including self-discipline, resourcefulness, loyalty (Wansink et al., 2008) and a collective sense of compliance with rules (Zhang et al., 2022). However, the previous studies also indicate that military experience can lead to aggression and overconfidence (Malmendier et al., 2011), which is associated with an increase in risk-taking behaviors (Lin et al., 2021).

Further, according to the upper echelons theory (Hambrick and Mason, 1984), entrepreneurs' military experience also has an

impact on corporate behaviors. Existing studies explore the impact of executives' military experience on corporate pollution and environmental innovation (Zhang et al., 2022), environmental disclosure (Chen et al., 2021), corporate performance (Özlen, 2014; Lin et al., 2021), tax avoidance behaviors (Law and Mills, 2017), illegal activities (Daboub et al., 1995), and financial disclosure (Bamber et al., 2010). In particular, the relationship between executives' military experience and corporate performance is a prevailing topic of scholarly attention, but research findings are controversial (Jin, 2019). For example, some scholars argue that executives' military service experience has a significant positive impact on corporate performance (Özlen, 2014). Such firms are less likely to engage in fraudulent activities and exhibit better corporate performance during industry downturns (Benmelech and Frydman, 2015). In contrast, some scholars find that the performance of firms with military executives is inferior to firms with non-military executives (Li and Rainville, 2021; Lin et al., 2021).

The motivations of corporate philanthropic donations

The motivations of corporate philanthropic donations have become a prevailing research topic. First, based on the view of profit maximization, the function of a firm is economic and the executives' decisions are controlled by the desire to maximize profits (Davis, 1973). Thus, corporate philanthropic donations exhibit economic motivation (Lev et al., 2010; Muller and Kräussl, 2011). Likewise, the strategic view argues that philanthropy should be an integral part of a firm rather than an *ad hoc* activity in response to passing fads (Mescon and Tilson, 1987). Firms believe in the idea of "doing well by doing good". Philanthropy not only fulfils humanitarian needs (Cha and Rew, 2018), but also generates positive moral capital (Godfrey, 2005), preserves corporate reputation, and ultimately improves corporate competitiveness (Long and Yang, 2016). Second, managerial opportunism provides another explanation for the motivation of corporate philanthropic donations. As contended by the agency theory, executives pursue not only financial satisfaction but also social status (Davis, 1973). Executives use corporate funds to support their philanthropic preferences and enhance their personal reputation (Masulis and Reza, 2015). They donate more when participation in philanthropic donations is perceived as an additional benefit (Brown et al., 2006). Third, some studies define corporate philanthropy as political tactics from the perspective of the government-business nexus. It is argued that firms engage in philanthropic activities in order to build political connections (Su et al., 2020), obtain political favors and benefits, thereby enhancing political status (Ma and Parish, 2006). For example, the majority of banks in China are state-owned or state-dominated, which allows local governments to play a significant role in allocating bank loans (Long and Yang, 2016). Corporate philanthropy is an important means to build connections with the government to obtain loans. Fourth, in contrast with the above motivations of self-interest, altruistic motivation favorers believe that corporate donations are driven by managers' sense of social responsibility (Campbell et al., 1999; Sánchez, 2000). It aims to benefit the public (Su and He, 2010) without expecting anything in return (Campbell et al., 1999). From this point of view, corporate managers will support philanthropy even if these actions have little or no impact on corporate profits (Long and Yang, 2016).

In terms of the motivations of philanthropic donations, some scholars identify the factors influencing corporate philanthropic donations, such as leverage (Adams and Hardwick, 1998; Zhang et al., 2009), firm size (Brammer and Millington, 2006; Zhang et al., 2009), corporate finance (Seifer et al., 2003), ownership structure (Zhang et al., 2009), governance mechanism (Bartkus et al., 2002), institutional pressure (Husted and Allen, 2006), and corporate value and reputation (Muller and Kräussl, 2011). Except for firm-level influencing factors, there is also a correlation between executives' individual characteristics and corporate philanthropy (Cha and Rew, 2018). As stated by the previous studies, firms with executives who experienced traumatic events such as famine in their childhood (Han et al., 2022), and executives with a higher level of education (Wei et al., 2018), with foreign study or work experience (Su et al., 2020), or from provinces with strong humanistic and collectivist orientations (Gu et al., 2019) are more likely to engage in higher level of philanthropic donations.

Hypotheses development

Philanthropic donations are the action of firms after they fulfill financial, legal and ethical responsibilities (Carroll, 1991). As discretionary activities, philanthropic donations are directly influenced by entrepreneurs' military experience. Relying on the imprint theory, the shaping impact of military experience on entrepreneurs is manifested in two main ways. First, the military provides an ideal macro environment where entrepreneurs' military imprint can form (Jackson et al., 2012). Military service generally occurs during a person's youth, a sensitive period in which personal values and perceptions are formed. During this period, individuals are highly vulnerable to environmental impacts (Marquis and Tilcsik, 2013) and tend to align themselves with new environment (Tilcsik, 2014). The military is viewed as an organization that services the people and the country. To maintain loyalty, the military provides intensive training for military personnel to learn norms and values. Under military's daily training and education, soldiers' original identity and habits are broken and a value system that emphasizes compliance with rules and service to the long-term welfare of society is instilled (Zhang et al., 2022). Second, interpersonal factors constitute the micro-environment in which imprint is institutionalized. The exemplary role from leaders provides the guidance for individuals to develop right values. The military establishes an incentive system to reward

those who fulfill the expectations of military culture (Jackson et al., 2012). Moreover, the military also publicizes deeds of combat heroes who are not afraid of sacrifice and dedication. Heroic actions are regarded as ideal behaviors in reality and become the object of advocacy and learning, providing concrete action guidelines to military personnel. All these processes result in military personnel being instilled with values such as dedication and enhance their sense of mission and responsibility.

As reviewed above, the military often adheres to a stricter moral code (Luo et al., 2017). Thus, military entrepreneurs exhibit character traits of willingness to contribute and take responsibility with a stronger motivation to donate. Military entrepreneurs learn loyalty, responsibility, fraternity, and integrity from their military experience (Williams et al., 2000). Especially through a series of systematic training programs, military personnel are instilled with the concept of "serving first and then self" (Akerlof and Kranton, 2005). Therefore, military entrepreneurs demonstrate a concern for society and the public interest (Zhang et al., 2022) and have a high sense of ethics and social responsibility (Chen et al., 2021). As Xie and Hao (2017) argue, the strong sense of responsibility of military executives brings with a positive impact on public welfare. Although some scholars argue that imprint fades under the impact of new perceptions (Marquis and Qiao, 2018), it can be reactivated and evoked. The situation in which philanthropic donations occur can be a condition that evokes the military imprint. The more urgent the social needs, the more they can evoke the entrepreneurs' sense of responsibility and dedication formed during their military period. For example, they usually respond philanthropically when disasters occur (Muller and Kräussl, 2011).

Additionally, the military experience leaves entrepreneurs with a collective management imprint of adherence to norms, which leads them to behave in ways that serve the long-term welfare of society (Zhang et al., 2022). Therefore, they are more likely to make philanthropic donation decisions. As contended by the social norm theory, people voluntarily defend social norms even when their economic interests are not directly influenced by norm violations (Yin et al., 2021). Given that China is an ethically oriented society, corporate philanthropic donations in China are consistent with the requirements of social norms. Firms with military entrepreneurs are more likely to adhere to such social norms. As some scholars argue, the military culture emphasizes compliance with rules (Law and Mills, 2017). Military entrepreneurs are more likely to adhere to norms (Xie and Hao, 2017; Koch-Bayram and Wernicke, 2018) and focus on social goals (Ullah et al., 2021). In military entrepreneurs' consciousness, corporate philanthropy is a necessary practice to adhere to social norms (Luo et al., 2017). As the "helmsman" of firms, they are more willing to promote corporate involvement in philanthropic activities. According to the above analysis, we propose the following hypothesis:

> *H1*: Entrepreneurs' military experience has a positive impact on corporate philanthropic donations.

Both financing constraints and ROE are important indicators of a firm's financial condition. However, there are differences between them. On the one hand, the corporate financing constraints are antecedent to business operations and reflect the firm's ability to access potential credit resources (Zhang, 2022). ROE is the result of a firm's business operations and refers to a firm's financial performance, that is, operating performance (Zhang, 2022). It is independent of investors and stock markets and reflects the firm's own profitability (Jin et al., 2020). On the other hand, the financing constraints are the representation of the firm's resource availability at the market level; the larger the value, the stronger the resource constraints. ROE is the representation of the operating capability at the firm level; the higher the value, the stronger the operating capability and the higher freedom of operation. Further, to support the assumption that POEs with military entrepreneurs are more likely to be altruistic, we suppose that the donations may not be influenced by the resource conditions. That is, entrepreneurs with military experience may still donate even with a high level of financial constraints. However, when firms achieve higher ROE, they will donate more.

In real capital markets, the cost of external equity can be much higher than the cost of internal financing due to problems such as information asymmetry (Love, 2003), exposing firms to financing constraints. However, for POEs, military entrepreneurs may not reduce their donations even in the presence of financing constraints. Specifically, the military emphasizes responsibility, dedication, and self-sacrifice to do the "right thing" (Xie and Hao, 2017). Thus, entrepreneurs with military experience place social interests ahead of personal interests (Zhang et al., 2022). Fritzsche and Oz (2007) note that, when decision-makers have multiple conflicting values, they tend to choose the most important value, and then choose those actions that are consistent with the values. Accordingly, if there is a conflict between alleviating corporate financing constraints and making philanthropic donations, military entrepreneurs are more willing to choose the latter. Furthermore, military training develops entrepreneurs' ability to fight in complex environments (Lin et al., 2021). They have a sense of absolute authority (Chen et al., 2021) and demonstrate strong psychological qualities (Elder, 1986). Military entrepreneurs are brave enough to face challenges and show risk-taking tendencies in their decision-making (Wansink et al., 2008; Malmendier et al., 2011). Thus, when financing constraints impose resource limitations, we expect entrepreneurs are not easily reducing philanthropic donations because they have the confidence and ability to ensure the normal operation of their firm. Hence, we propose the second hypothesis as follows:

> *H2*: Entrepreneurs with military experience will not donate less when facing a high level of financing constraints.

ROE is an important indicator of financial performance (Zhang, 2022), reflecting the condition of business operations and influencing the donation ability of firms with military entrepreneurs. Corporate social responsibility emphasizes the importance of financial performance. The relationship between financial performance and social responsibility is considered to be "generally positive" (Julian and Ofori-Dankwa, 2013). When financial performance is better, firms increase their involvement in autonomous activities (Surroca et al., 2010), leading to military entrepreneurs' philanthropic donation decision-making more freely. That is, a higher ROE can financially support military entrepreneurs to firmly express their views and proposals in the philanthropic decision-making process. As McGuire et al. (1988), Brammer et al. (2009), and Zhang et al. (2018) state, firms with better financial performance are more able to engage in philanthropic donations. In addition, entrepreneurs often have multiple roles and need to manage their corresponding responsibilities carefully (Werbel and Carter, 2002). Military entrepreneurs are not only active participants in philanthropic donations, but also business operators. They need to be loyal to the firm's value system, and accountable for its operations (Benmelech and Frydman, 2015), allocating resources for various business decisions by weighing and addressing multiple business demands in a fair and rational manner (Orlitzky et al., 2003). The higher the ROE is, the more discretion military entrepreneurs have, and the less difficulty there will be for them to allocate funds for philanthropic activities. Thus, we propose the following hypothesis:

> *H3*: ROE strengthens the positive impact of entrepreneurs' military experience on corporate philanthropic donations.

Research design

Sample and data

This study utilizes a dataset of the 12th Chinese privately owned enterprises survey (2016) which is conducted by four institutions: The United Front Work Department of CPC Central Committee, All-China Federation of Industry and Commerce, State Administration for Industry and Commerce of the People's Republic of China, and China Society of Private Economy at Chinese Academy of Social Sciences. This survey conducts a nationwide multistage-stratified random sampling of POEs at 0.055% (Long and Yang, 2016), covering POEs of all sizes and industries in 31 provinces and containing the basic, financial, and operational information. After dropping the samples with missing or outlier values, we use 3,767 sample firms to examine the hypotheses.

Model specification and variable definition

The basic model specification is set as follows.

$$\text{Donation}_{i,t} = \beta_0 + \beta_1 \text{Military}_i + \sum \text{controls} + \varepsilon_{i,t} \quad (1)$$

where $\text{Donation}_{i,t}$ is the dependent variable, representing philanthropic donations of firm i in year t. Following Su et al. (2020), we measure it by the natural logarithm of one plus the total donation expenditure in year t. Military_i is the independent variable. Considering the process of imprint formation, if entrepreneurs hold the officer rank during their military service, a stronger military imprint would be formed to them than ordinary soldiers (Zhang et al., 2022). Therefore, we set a dummy variable according to Guo et al. (2020), code it as 1 if the entrepreneurs have military officer experience and 0 if not. $\sum$controls are a set of variables at firm-level, individual-level and industry-level. *Financial redundancy (Fin)* is measured by the ratio of own funds to loans in liquidity. For *listing status (Listing)*, if a firm is listed, it is coded as 1, and if not, as 0. *Firm size (Size)* is measured by the natural logarithm of operating incomes. *Firm age (Age)* is measured by the years since a firm was established. For *gender*, we code males as 0 and females as 1. For *education (Edu)*, the higher the numeric value, the higher entrepreneurs' education level. For *political identity (Pol)*, if entrepreneurs are the members of the People's Congress or Chinese People's Political Consultative Conference, it is coded as 1 and 0 if not. For *overseas work experience (Exp)*, if entrepreneurs have overseas work experience, it is coded as 1 and 0 if not. Furthermore, the model includes industry dummy variable. Table 1 reports the descriptive statistics of the variables used in this study. Table 2 reports the correlations for all variables.

Empirical analysis

Baseline model regression results

Table 3 reports the regression coefficient, standard error, and *p* value of all independent and control variables. In Model 1, only control variables are added to verify their impact on corporate philanthropic donations. Furthermore, entrepreneurs' military experience is added in Model 2 to prove its relationship with corporate philanthropic donations. The estimated coefficient of military experience is 0.150 and is significant at the 10% level. It suggests that entrepreneurs' military experience has a significantly positive impact on corporate philanthropic donations, thereby supporting H1.

Robustness tests

To ensure the reliability of the baseline estimated results, a series of robustness tests are conducted. The results are reported in Table 4. First, we expand the research subjects by coding 1 if

TABLE 1 Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Donation	5,265	1.039	1.390	0	7.721
Military	7,845	0.036	0.186	0	1
Fin	5,719	0.035	0.169	0	1
Listing	7,203	0.023	0.149	0	1
Size	6,664	6.272	2.752	−3.507	15.611
Age	7,500	8.830	6.732	0	42
Gender	7,802	0.202	0.402	0	1
Edu	7,697	2.868	1.101	1	6
Pol	7,845	0.266	0.442	0	1
Exp	7,845	0.145	0.352	0	1

TABLE 2 Correlation matrix.

	Donation	Military	Fin	Listing	Size	Age	Gender	Edu	Pol	Exp
Donation	1									
Military	0.073***	1								
Fin	−0.028*	0.022	1							
Listing	0.176***	0.029**	−0.017	1						
Size	0.594***	0.087***	−0.029**	0.191***	1					
Age	0.351***	0.076***	−0.039***	0.092***	0.457***	1				
Gender	−0.129***	−0.020*	−0.030**	−0.032***	−0.160***	−0.085***	1			
Edu	0.259***	0.113***	−0.028**	0.119***	0.356***	0.126***	−0.004	1		
Pol	0.405***	0.087***	−0.016	0.078***	0.450***	0.359***	−0.115***	0.187***	1	
Exp	0.052***	−0.019*	0.015	0.018	0.019	0.031***	−0.004	0.020*	0.026**	1

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

TABLE 3 Baseline model regression.

Items	Donation					
	Model 1			Model 2		
	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value
Military				0.150*	0.085	0.078
Fin	−0.025	0.096	0.795	−0.031	0.097	0.749
Listing	0.562***	0.120	0.000	0.563***	0.120	0.000
Size	0.209***	0.008	0.000	0.209***	0.008	0.000
Age	0.017***	0.003	0.000	0.017***	0.003	0.000
Gender	−0.069	0.044	0.113	−0.070	0.044	0.109
Edu	0.054***	0.017	0.001	0.052***	0.017	0.002
Pol	0.409***	0.043	0.000	0.408***	0.043	0.000
Exp	0.074	0.058	0.201	0.075	0.057	0.190
Constant	−0.815***	0.084	0.000	−0.814***	0.084	0.000
Industry Dummy		Control			Control	
R^2		0.380			0.380	
F-value		104.184			99.845	
N		3,767			3,767	

* and *** denote significance at the 10% and 1% levels, respectively.

entrepreneurs or his/her family numbers have military officer experience and 0 if not. Second, we use different measures of military experience (military 2) by coding 1 if entrepreneurs have military officer or soldier experience and 0 if not. Third, we code 1 if entrepreneurs or his/her family members have military officer or soldier experience and 0 if not. Similarly, we obtain results

TABLE 4 Robustness tests.

Items	Donation											
	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value
Military	0.135**	0.058	0.020							0.250*	0.143	0.081
Military 2				0.135*	0.074	0.067	0.114**	0.053	0.031			
Fin	−0.033	0.096	0.729	−0.031	0.097	0.747	−0.035	0.097	0.720	0.360**	0.175	0.039
Listing	0.565***	0.120	0.000	0.565***	0.120	0.000	0.565***	0.120	0.000	0.265	0.196	0.177
Size	0.209***	0.008	0.000	0.209***	0.008	0.000	0.209***	0.008	0.000	0.426***	0.016	0.000
Age	0.017***	0.003	0.000	0.017***	0.003	0.000	0.017***	0.003	0.000	0.035***	0.005	0.000
Gender	−0.071	0.044	0.102	−0.068	0.044	0.118	−0.070	0.044	0.109	−0.157*	0.084	0.062
Edu	0.051***	0.017	0.003	0.052***	0.017	0.002	0.051***	0.017	0.003	0.078**	0.031	0.011
Pol	0.404***	0.043	0.000	0.408***	0.043	0.000	0.405***	0.043	0.000	0.680***	0.073	0.000
Exp	0.075	0.057	0.190	0.075	0.057	0.190	0.075	0.057	0.191	0.138	0.104	0.184
Constant	−0.814***	0.084	0.000	−0.817***	0.084	0.000	−0.817***	0.084	0.000	−3.350***	0.173	0.000
Industry dummy	Control			Control			Control			Control		
R^2	0.381			0.380			0.381			0.174		
F-value	100.008			99.863			99.954					
N	3,767			3,767			3,767			3,767		

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

consistent with the baseline estimates. Finally, corporate philanthropic donations do not have any negative value and belong to the "truncated data". Thus, we adopt the Tobit regression analysis method as a robust test, and the results remain consistent with the ordinary least squares (OLS) estimated results.

To deal with possible endogeneity issues, we use two-stage instrumental variable method for estimation. Following the idea of constructing grouped means as instrumental variable proposed by Fisman and Svensson (2007), we select the proportion of entrepreneurs' experience of military officer and soldier in the industry as an instrumental variable. Table 5 reports the instrumental variable estimated results. As shown in Model 3, the instrumental variable has a strong relationship with the explanatory variable. Meanwhile, the results of Model 4 show that the regression coefficient of entrepreneurs' military experience is 5.494 and significant at the 10% significance level, which is consistent with the above findings.

The moderating effect tests

We further examine the moderating effects of financing constraints (FC) and ROE on the relationship between entrepreneurs' military experience and corporate philanthropic donations. When firms are unable to obtain financing through formal channels, that is, facing serious financing constraints, firms can only choose private or informal financing with high interest costs. Therefore, we measure financing constraints by using the proportion of private borrowing to all borrowing, and the estimated results are shown in Model 6 of Table 6. The estimated results show that the coefficient of the interaction term of entrepreneurs' military experience and financing constraints is positive but insignificant. It suggests that financing constraints do not influence the positive relationship between entrepreneurs' military experience and corporate philanthropic donations, and H2 is supported.

Referring to Ichsani and Suhardi (2015), ROE is measured by the ratio of net profits to net assets and the estimated results are shown in Model 6 of Table 6. The coefficient of the interaction term of entrepreneurs' military experience and ROE is significantly positive ($\beta = 2.033$, $p < 0.05$), so H3 is supported. It suggests that corporate ROE enhances the positive relationship between entrepreneurs' military experience and corporate philanthropic donations, which means firms with military entrepreneurs will donate more when performance is superior. To provide further support for the moderating effect of ROE, we plot the moderating relationship in Figure 1. When ROE is higher, the impact of entrepreneurs' military experience on corporate philanthropic donations is stronger.

We argue that philanthropic donations of firms with military entrepreneurs may be driven by multiple motivations, and altruism has been revealed. It is logical in a shareholder-centered environment (Moir and Taffler, 2004). This finding is consistent with the view of Frey and Meier (2004). They find that in the extended version of altruism, individuals have pro-social preferences who are not only concerned with their own utility but also with the utility of others. On the one hand, philanthropic donations cannot be explained by relying on a strict self-interest axiom (Frey and Meier, 2004). Our study finds that, financing constraints do not influence the positive relationship between entrepreneurs' military experience and corporate philanthropic donations, and when the ROE is high, firms with military entrepreneurs will donate more. This suggests that corporate philanthropy is a form of gratuitous donations and does

TABLE 5 Instrumental variable analysis.

Items	Model 3			Model 4		
	Military			Donation		
	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value
Military				5.494*	2.821	0.052
Fin	0.038*	0.022	0.088	−0.234	0.183	0.201
Listing	−0.005	0.030	0.868	0.565**	0.240	0.019
Size	0.002	0.001	0.167	0.194***	0.014	0.000
Age	0.002***	0.001	0.007	0.007	0.006	0.248
Gender	0.005	0.008	0.510	−0.103*	0.060	0.087
Edu	0.017***	0.003	0.000	−0.035	0.054	0.519
Pol	0.011	0.009	0.260	0.374***	0.081	0.000
Exp	−0.012	0.010	0.256	0.148*	0.084	0.078
Constant	−0.072***	0.014	0.000	−0.587***	0.140	0.000
IV	0.007***	0.003	0.009			
F-value		8.580				
Prob > *F*		0.000				
N		3,850			3,850	

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

TABLE 6 The moderating effect tests.

	Donation					
	Model 5			Model 6		
	Regression coefficient	S. E.	*p*-value	Regression coefficient	S. E.	*p*-value
Military	0.280*	0.151	0.064	7.426**	3.012	0.014
FC	−0.005	0.004	0.190	−0.004	0.004	0.299
ROE	0.001	0.000	0.260	0.073**	0.031	0.017
Military × FC				0.026	0.045	0.558
Military × ROE				2.033**	0.857	0.018
Fin	0.039	0.176	0.826	0.045	0.176	0.799
Listing	0.251	0.206	0.224	0.253	0.206	0.219
Size	0.263***	0.017	0.000	0.262***	0.017	0.000
Age	0.014**	0.006	0.015	0.014**	0.006	0.012
Gender	−0.083	0.099	0.399	−0.084	0.098	0.395
Edu	0.020	0.033	0.545	0.019	0.033	0.572
Pol	0.338***	0.077	0.000	0.343***	0.077	0.000
Exp	0.011	0.117	0.925	0.011	0.117	0.925
Constant	−0.953***	0.132	0.000	−1.212***	0.170	0.000
R^2		0.315			0.318	
F-Value		53.109			45.526	
N		1,283			1,283	

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

not expect these expenditures to improve business operations (Lys et al., 2015). Coupled with the role of military experience in shaping the character traits and behavioral styles of entrepreneurs, we have reason to believe that there is an altruistic motivation for corporate philanthropic donations due to entrepreneurs' military experience. In nature, this is consistent with the findings of Luo et al. (2017). On the other hand, corporate philanthropic donations may be based on the idea of altruism (Campbell et al., 1999), but this is not a prerequisite for the existence of corporate philanthropy. Our findings cannot exclude the existence of other motivations. As the previous research reveals, executives with military experience consider the sustainability of business development and demonstrate a long-term

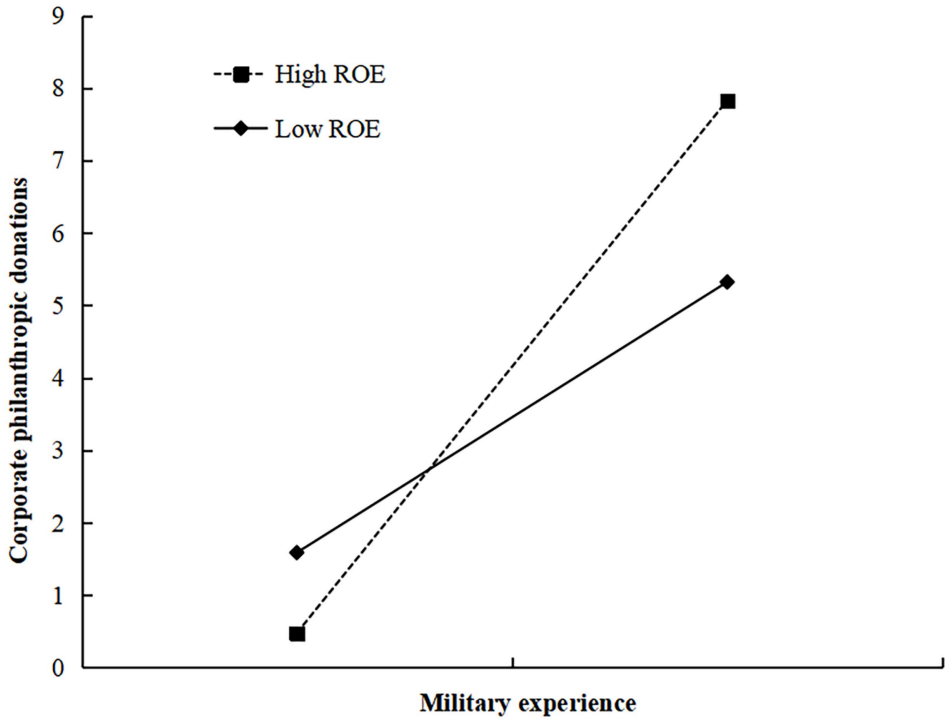

FIGURE 1
The moderating effect of ROE.

perspective in operations (Zhang et al., 2022). Therefore, corporate philanthropy may be strategic (Lähdesmäki and Takala, 2012). It is designed to fit the firm's overall mission, goals or targets (Moir and Taffler, 2004) to achieve the aim of "doing good always leads to doing better" (Sen and Bhattacharya, 2001). In this sense, it is likely to see multiple philanthropic donation motivations may co-exist within a firm, while the firm may choose one as a priority.

Conclusion and discussion

Conclusion

In the study, employing imprint theory as a framework, we focus on military entrepreneurs to investigate the potential impact of entrepreneurs' military experience on corporate philanthropic donations, and explore philanthropic donation motivation. It is worth noting that POEs provide an interesting and important context for studying the impact of entrepreneurs' experiences on corporate philanthropic donations. As POEs are the backbone of philanthropy (Ma and Parish, 2006). Their philanthropic behaviors are largely aligned with the entrepreneurs' wishes (Long and Yang, 2016), with a more individualistic character and more diverse motivations (Lähdesmäki and Takala, 2012). However, existing relevant research does not pay enough attention to POEs. This study focuses on POEs, which helps to better assess the donation behaviors of POEs in China.

The findings suggest that entrepreneurs' military experience has a significantly positive impact on corporate philanthropic donations and the result keeps consistent after a series of robustness tests. Entrepreneurs' military experience influences corporate philanthropic preferences that is confirmed. The military culture of discipline, sacrifice, and responsibility (Williams et al., 2000) imprints military entrepreneurs with a strong sense of dedication, responsibility, and normative awareness. After they have accumulated wealth by entering the business sector, military imprint drives them to make more philanthropic donations when in social need. Sociological and psychological research suggests that executives with different experiences may exhibit different patterns when making corporate decisions. Our study extends this finding from the philanthropic donation dimension.

In addition, entrepreneurs should also consider the corporate conditions when making philanthropic donation decisions. By exploring the impacts of corporate financing constraints and ROE on the relationship between entrepreneurs' military experience and corporate philanthropic donations, we find that corporate financing constraints do not influence the positive relationship between entrepreneurs' military experience and corporate philanthropic donations, and firms with military entrepreneurs will donate more when ROE is higher. Identifying motivations is a particularly difficult task (Lähdesmäki and Takala, 2012). Nevertheless, in terms of the results of this study, we suggest that altruism is a motivation for firms with military entrepreneurs to engage in philanthropy. As the previous research reveals, some

executives emphasize that philanthropy is a moral responsibility of the firm rather than potential benefits (Moir and Taffler, 2004).

Practical implications

This study explores the impact of entrepreneurs' military experience on corporate philanthropic donations, providing helpful managerial implications. First, given the increasing public attention to corporate social responsibility, corporate philanthropic donations have become an important way to fulfil social responsibility (Davis, 1973). Entrepreneurs with military experience are conducive to promoting philanthropic donations. Meanwhile, military personnel have unique leadership skills influenced by the military culture (Wong et al., 2003). Therefore, firms should encourage executives with military experience to participate in corporate governance and appropriately participate in philanthropic activities. Second, as the upper echelons theory indicates, military executives apply military values and norms into firm strategic decisions (Zhang et al., 2022), which may have an impact on business operations. Before executives are appointed, firms should conduct in-depth investigations into the candidate's background and make prudent job appointment. Finally, our findings suggest that firms actively participate in philanthropic donations when they are financially healthy. To better assume social responsibility, firms need to optimize their business conditions as many as possible. For example, they should strive to adapt to the market environment, continuously stimulate development vitality and creativity, and actively improve management efficiency. Meanwhile, for the relevant departments, they should combine military and local resources to support the veterans' employment, and provide assistance to veterans in starting their own businesses, so society can obtain more philanthropic donations from firms.

Limitations and suggestions for future research

This study should be viewed in the light of several limitations, which also provide suggestions for future research. First, we focus on POEs. Although POEs have accounted for the majority of Chinese firms, the conclusions may vary across different types of firms. Thus, our findings should be extended to other types of firms with caution. Second, the impact of entrepreneurs' military experience on corporate philanthropic donations is complex. Although we examine the moderating factors at the corporate level, research about the moderating effects of entrepreneurs' individual characteristics is not conducted in detail. Subsequent studies can further explore the impacts of entrepreneurs' age and education on the relationship between entrepreneurs' military experience and corporate philanthropic donations, which may inspire interesting findings and provide more evidence regarding the arguments presented in this study. Finally, although this study finds that altruistic donations are advocated by military entrepreneurs, organizational interests remain an important factor when it comes to actual business operations. Our findings cannot exclude the existence of other motivations. Future studies could present a more comprehensive picture of corporate philanthropic donation motivations. In addition, we limit philanthropic donations to cash donations. But in reality, firms engage in a wide variety of philanthropic activities, such as volunteer initiatives, community service and educational or cultural projects (Bruch and Walter, 2005). A wide range of philanthropic activities could be incorporated into the research framework by subsequent studies.

Data availability statement

The data sets analysed in this study are not publicly available and registration must be completed to access them at https://cpes.zkey.cc/DataExplore/. The "12th Chinese privately owned enterprises survey (2016)" conducted by four institutions: The United Front Work Department of CPC Central Committee, All-China Federation of Industry and Commerce, State Administration for Industry and Commerce of the People's Republic of China, and the China Society of Private Economy at Chinese Academy of Social Sciences.

Author contributions

HC is responsible for research framework design, data analysis, and manuscript writing. HW is responsible for data compilation and manuscript writing. HL participates in research framework design and is responsible for manuscript revision. All authors contribute to the paper and approve the submitted version.

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Conflict of interest

The authors declare that the research is conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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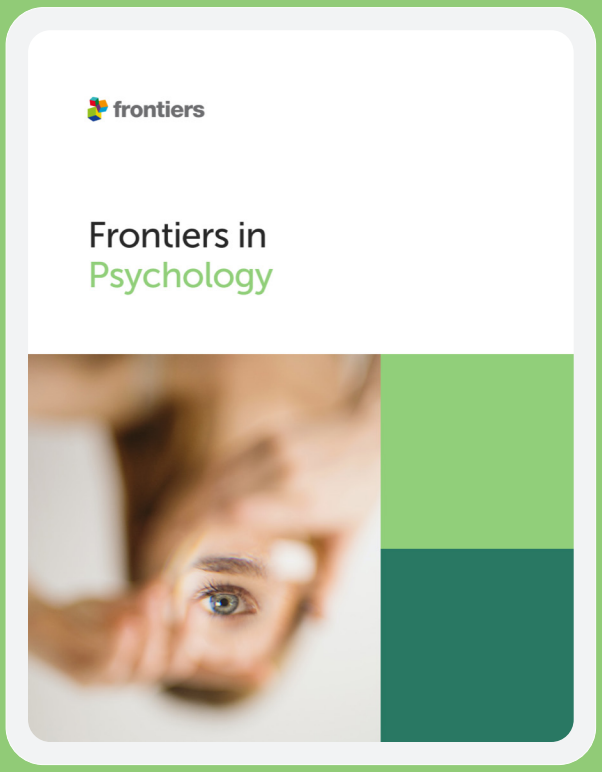

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