Do Tenure and Age of Board Chair Matter for R&D Investment?

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Abstract

Purpose: This study examines whether the age and tenure of the chair of the board of directors are related to research and development (R&D) investment in China.

Design/Methodology: The study uses A-share manufacturing firms that traded on the Shanghai and Shenzhen stock exchange between 2009 and 2018. The study employs OLS regressions, controls for self-selection bias, and uses an instrumental variable to alleviate the concern of endogeneity.

Findings: The study finds that chair tenure has a negative relationship with R&D investment. We do not find a significant relationship between chair age and R&D investment.

Originality/value: The study contributes to corporate governance and strategic management literature by highlighting chair tenure as a new factor affecting R&D investments. It also adds a significant contribution to the limited literature on the chair's role in strategic decisions. Moreover, companies that are eager to strengthen corporate governance and maintain sustained innovation may reconsider the chair tenure. Given that many proposals for board governance reform explicitly stress the importance of limiting board tenure, this study contributes to policy-makers by providing evidence in support of these proposals.

Keywords: Corporate governance; board chair tenure; board chair age; China; manufacturing sector; R&D.

1. Introduction

In today's economy, firms are challenged to stay competitive and offer a continuous line of innovative products and services. Investment in research and development (R&D) has been an important component in corporate strategy as it enables introducing new products and processes, therefore enhancing firm's growth and sustainability (Guellec and de La Potterie, 2004; Kumari and Mishra, 2019). It is of interest to consider the Chinese context where 2.18% of the country's GDP is spent on R&D in 2018 (UNESCO, 2018). Relatedly, R&D expenditures in Chinese companies have been rapidly growing and China has been gradually taking the role of a 'world factory'. This is predominately due to the so-called 'Made in China 2025' initiative with the ultimate goal to be the manufacturing giant by driving the productivity, safety, and quality of goods.

While the relationship between R&D expenses and long-term growth is far from simple (Rothaermel and Hess, 2007), it is difficult for firms to develop effective R&D capabilities without effective monitoring and guidance. Accordingly, board of directors plays an important role in shaping corporate strategy especially concerning R&D investments (Westphal and Fredrickson, 2001; The China Securities Regulatory Commission, 2001; Ibrahim and Hanefah, 2016). The board of directors, especially the chair, plays an important role in ensuring that the CEO's behavior is in line with shareholders' interests, e.g., monitoring the CEO's decisions to ensure a proper investment in R&D (Dalziel et al., 2011).

Age and tenure are considered the most influential demographic attributes (Livnat et al., 2021; Standifer et al., 2013; Taylor, 1975; Zenger and Lawrence, 1989) which, therefore, likely to have a significant impact on individuals' behavior. In this vein, psychology scholars state that age and tenure reflect previous events which have implications for the present and, therefore, affect a person's decision (Ng and Feldman, 2013; Cohen, 1993). Therefore, we argue that these two chair attributes (i.e., age and tenure) are likely to have an impact on R&D investment. On one hand, older chair may have experience deterioration of physical and mental stamina, thereby may be less motivated or able to introduce a strategic change (Holmstrom, 1999). However, limited time horizons (i.e., the remaining time in life is perceived as more limited) likely lead older chairs to be more conservative in decision making, thereby exert effective monitoring to avoid reputational damage. Similarly, chair with longer board experience can carry out their overseeing responsibilities with greater skills and better contribute to company strategy (Ben-Amar et al., 2013). However, long-serving chair may lose independence over time and therefore provide less effective monitoring (Baran and Forst, 2015; Zamil et al., 2021). Hence, motivated by the aforementioned discussion, this study examines whether age and tenure of the chair affect R&D investment in China.

Furthermore, countries around the world have introduced governance guidelines urging companies to adopt term limits for their boards to reduce risks of excessive familiarity between directors and management. For instance, the UK Corporate Governance Code (2018) recommended that the directors including the chair should not remain in office for more than nine years from their first appointment to the board. Similarly, the European Commission (EC) recommended that European Union-based firms limit their directors' tenure to twelve years (European Commission, 2005). Another example can be found in Hong Kong. According to Hong

Kong Main Board Listing Rules (2019), listed companies must obtain shareholders' approval when they decide to appoint a director who has already served for nine years.

The scope of this study focuses on the chair for different reasons: First, the chair is the member who leads the board and is responsible for its overall effectiveness in directing the company (The China Securities Regulatory Commission, 2001). When CEO and chair positions are held by different persons, the chair is the formal governance leader of the firm, and thus plays a critical role in overseeing the CEO and making strategic decisions (Krause, 2017; Withers and Fitza, 2017). By acting as an essential bridge between directors and CEO (Kakabadse, Kakabadse and Knyght, 2010), the chair facilitates constructive board relations and ensures that directors receive accurate, timely and clear information, thereby playing a pivotal role in effective board governance.

Second, the role of chair is yet to be investigated sufficiently in the literature owing particularly to the fact that most studies are conducted in the US where CEO role duality is still dominant. In this regard, scholars call for more attention to be given to the role played by the chair not only in corporate governance but also in strategic decision-making (Banerjee et al., 2020; Krause, 2017; Withers and Fitza, 2017). Hence, our study responds to such calls. Third, the chair in China has strong legal power and, in many cases, he/she is the de facto top manager of the firm (Jiang and Kim, 2015). This argument is supported by Krause, Li, Ma, and Bruton (2019) which found that chairs in China exhibit a considerably larger effect on firm performance than do chairs in the US and the UK.

We draw our sample from the manufacturing companies traded on the main financial markets in China (Shanghai and Shenzhen stock exchange) over 10 years ended in 2018. We

consider the manufacturing sector where R&D is usually more intense (Oh and Barker, 2018), particularly in China where the sector is considered the main body and pillar of the national economy (Zhang, 2010; Lv et al., 2019). Consistent with familiarity bias and weak monitoring argument, we find that chair tenure reduces the intensity of R&D investments. We do not find a significant relationship between chair age and R&D spending. Our findings hold when we employ a sensitivity test, an instrumental variable to control for endogeneity, and after controlling for potential sample selection bias.

Our findings offer important contributions to literature, policy-makers, and practice: To the best of our knowledge, our study is the first empirical investigation of whether and how the length of chair tenure shapes R&D spending. This, therefore, has an important contribution to corporate governance and strategic management literature by highlighting chair tenure as a new factor affecting R&D investments. Moreover, our consideration of the chair adds a valuable contribution to the limited literature on the chair's role, and responds to research calls made by prior studies (e.g., Withers and Fitza, 2017; Banerjee et al., 2020).

The paper is structured as follows. Section 2 covers the literature review and hypothesis development. Section 3 describes the methodology. Section 4 includes the discussion of the findings before section 5 concludes.

2. Literature Review and Hypotheses Development

Corporate governance regulations and academic literature highlight the important role played by board of directors in shaping corporate strategy (Westphal and Fredrickson, 2001; The China Securities Regulatory Commission, 2001; Ibrahim and Hanefah, 2016; Khatib et al., 2021; Queiri et al., 2021). In particular, prior literature agrees that R&D investment is a source of

competitive advantage for firms and critical for their growth and sustainability (Guellec and de La Potterie, 2004; Dalziel et al., 2011; Bravo and Reguera-Alvarado, 2017). However, managers often resist investing in R&D activities given the high level of uncertainty and the chance of failure, i.e., there is little assurance that R&D investment will pay-off (Kor, 2006; Guldiken and Darendeli, 2016). Even for successful R&D investments, they are recouped in the long term, leaving an adverse impact on financial performance in the short term (Sanders and Carpenter, 2003). Such potential consequences concerning R&D expenditures can negatively affect managers' personal interests and, therefore, they may be reluctant to enhance R&D investments.

Agency theorists suggest that boards of directors must monitor strategy implementation to prevent managers from acting opportunistically at the expense of shareholders (Jensen and Meckling, 1976; Alves, 2011; Kamardin and Haron, 2011; Alves, 2021; Mangala and Singla, 2021; Elsayed et al., 2022). Hence, boards may contribute to specific strategies that are linked to firm performance, such as the fostering of R&D investments. In the same vein, Wu (2008) argued that while investments in R&D benefit shareholders, CEOs tend to prune R&D spending due to its potential adverse consequences on short-term financial performance, on their compensation, and on their employment. Given such shareholders–CEO's divergent of interests, directors can align the interests of managers and shareholders by effectively monitoring R&D investments made by CEOs (Kor, 2006; Le, Walters and Kroll, 2006). Boards of directors that vigilantly perform their monitoring role should pay close attention to managerial resource allocation decisions and consequently detect R&D cuts made by top managers (Guldiken & Darendeli, 2016). They add that directors who are vigilant in their monitoring role can remind CEOs that R&D investment is useful for the long-term health of the firm, even if doing so may adversely affect short-term performance.

Moreover, based on the view of resource dependence theory, providing advice and counsel to CEOs is another way through which a board of directors can impact R&D spending (Dalziel et al., 2011; Khatib et al., 2022). Zahra and Pearce (1989) pointed out that giving advice and counsel to executives is one of the service roles of directors[1]. According to this theory, the provision of resources is a key function of directors (Pfeffer and Salancik, 1978). Resource dependence theorists argue that board members with valuable resources are in a good position to contribute to corporate strategy (Dalziel et al., 2011). Without the appropriate resources, directors may be constrained intellectually from becoming thoroughly involved in complex decisions, such as those related to R&D investments (Bravo and Reguera-Alvarado, 2017).

Although directors work as a team to monitor and advise management, the chair plays a critical role in overseeing the CEO and making strategic decisions (Robert, 2002; Kakabadse et al., 2010). In a recent review study, Banerjee et al. (2020) concluded that the chair today is expected both to guarantee general compliance with the corporate governance system and to lead effective communication with the CEO to secure a competitive strategic agenda. As a critical leadership position within the board and overall firm (Krause, 2017; Morais, Kakabadse and Kakabadse, 2018), the chair sets the agenda and tone for board meetings and discussions, and establishes board routines and procedures. When the positions of chair and CEO are separated, the chair acts as a primary communication channel between the CEO and the rest of the board (Tuggle, Sirmon, Reutzel and Bierman, 2010) and serves as an additional layer of vigilance in monitoring and as a focal source for advice to the CEO (Withers and Fitza, 2017).

[1] Johnson et al. (1996) define a "service role," such as when directors advise CEOs about managerial issues and actively initiate or formulate strategy.

In the context of China in particular, the chairs have strong legal power, are in control of strategic decision making and, in many cases, they are the de facto top managers of the firm (Jiang and Kim, 2015). Chinese firms are organized hierarchically and there is a distinct hierarchy between chairs and their team members. Such high-power distance (which is a key dimension of the Chinese culture) makes chair in the apex of the team effectively improves intra-team conflicts and power struggles (Zheng et al., 2021). Therefore, this helps the chair to standardize the decision-making process of the team and expedite intragroup cooperation (Smith et al., 2006), thereby driving an effect on innovative decision-making. Moreover, chairs usually play different roles and have more internal and external influence (Jiang et al., 2020) which, therefore, could strengthen their power in the decision-making of R&D strategy.

The aforementioned discussion shows the essential role played by the chair in monitoring CEO and in shaping strategic decisions especially concerning R&D investments. Age and tenure are considered the most important demographic characteristics (Standifer et al. 2013; Taylor, 1975; Zenger and Lawrence, 1989) which, therefore, likely have a significant impact on individuals' behavior. In support of this argument, psychology scholars argue that age and tenure reflect previous events which have implications for the present and, therefore, affect a person's behavior (Ng and Feldman, 2013; Cohen, 1993). In particular, from agency theory perspective, age and tenure of chairs may affect the chairs' monitoring power, therefore they may leave an impact on chairs' strategic decisions and the way in which they deal with R&D initiatives. Additionally, based on resource dependence theory, these two attributes can be considered indicative of accumulated experience and knowledge; therefore, older chairs and chairs with longer tenure can offer different points of view on strategic issues (e.g., R&D) and deeper experience and knowledge they have acquired over the years. Hence, this study aims to explore whether chair age and chair

tenure affect R&D investment in China. Discussion on age and tenure of chair and how they may affect R&D investment is presented below.

2.1. Hypotheses development

2.1.1. Chair age and R&D

Empirical studies suggest that workers' career concerns become progressively weaker as they get older, which reduces the motivation of older workers to exert more effort (Holmstrom 1999; Xu et al., 2018). Psychological scholars in this regard (e.g., Child, 1974) argue that older directors have less physical and mental stamina needed to deal with innovative concepts and implement new strategies. In particular, Child (1974) and Talavera et al. (2018) argued that older directors tend to stick to cautious low-growth strategies, while younger directors are more eager to pursue innovative high-growth policies. In a managerial decision-making simulation, for example, Gielnik et al. (2012) reported a negative relationship between a leader's age and company growth. Consistent with this finding, Nakano and Nguyen (2011) found that firms with older boards exhibit a significantly lower variability in their operating profits, market values and stock returns, and are less likely to undertake risky investments. In the same vein, Sultana et al. (2019) reported that directors likely be associated with weaker monitoring ability, because they are less flexible to adapt to regulatory changes and they likely have less spirit compared with younger directors.

On the other hand, empirical research has shown that older individuals have more positive and stable emotions than their younger counterparts (Carstensen et al., 2011; Riediger et al., 2009). Older adults prioritize positive over negative information (Reed and Carstensen, 2012), pay greater attention to positive versus negative social cues (Kellough and Knight, 2012), and exhibit a

positivity bias in decision-making (Löckenhoff and Carstensen, 2007). Other studies reported more consultative, participative, courteous, and interpersonal leadership behaviors among older rather than younger leaders (Oshagbemi, 2004). Such behavior is reported to be more pronounced among older leaders when it comes to transformational leadership (Barbuto et al. 2007). Relatedly, theories of emotional aging hold that as people get older, they are increasingly motivated to experience positive and avoid negative feelings (Scheibe and Zacher, 2013). Socioemotional selectivity theory, for example, argues that shifting time horizons (i.e., the remaining time in life is perceived as more limited) lead older adults to be more conservative in decision making. In support of that, Sultana et al. (2019) mentioned that because older directors have lesser future career prospects, they will avoid jeopardizing such future opportunities and, as such, consciously guard their reputations by effectively monitor management and adopting actions that maintain shareholders' interests.

In the context of this study, we argue that chair age could have an impact on R&D intensity in different ways. On one hand, owing to deterioration of physical and mental stamina, older chair could have less motivation and ability to exert more effort and introduce a strategic change (Holmstrom, 1999). Also, older chair may leave a negative impact on innovation due to the lack of time available to older directors due to the accumulation of professional commitments (Gu and Zhang, 2016). On the other hand, limited time horizons (i.e., the remaining time in life is perceived as more limited) may lead older chair to be more conservative in decision making. In support of that, Sultana et al. (2019) mentioned that because older directors have lesser future career prospects, they consciously guard their reputations by effectively monitoring management and adopting actions that maintain shareholders' interests. Furthermore, older chairs are better skilled may also able to create more lasting, sounder interconnections with other firms in the same

environment than younger ones (Xu et al., 2018). Age can be considered an indicative of accumulated experience and knowledge; therefore, older chairs can offer different points of view on strategic issues (e.g., R&D) and deeper experience and knowledge they have acquired over the years.

Hence, given the above discussion concerning the potential impact of chair age on R&D investment, we are unable to make a directional prediction. Thus, we draw the following neutral hypothesis:

Hypothesis 1: There is a relationship between chair age and R&D investment.

2.1.2. Chair tenure and R&D

Prior studies have shown that directors with longer tenure have greater knowledge about the firm's business environment, leading to better expertise in discharging their monitoring responsibilities (Ben-Amar et al., 2013). Conversely, short-tenured directors may have a less complete understanding of the firm's business and history, which may diminish the effectiveness of its monitoring and advising (Pozen and Hamacher, 2015). In this regard, Beasley (1996) and Schnake et al. (2005) found that longer board service increases directors' ability to monitor managers more effectively to prevent fraud, while Sharma (2011) showed that longer-tenured directors are better at controlling managerial discretion over the use of excess cash flow. Beyond better monitoring effectiveness, longer-tenured board members are better at advising, since a longer tenure allows them to learn more about the company's operations and thereby understand its unique economic environment and financial reports (Livnat et al., 2021). For instance, directors with long tenure exchange information more frequently (Rutherford et al., 2007), and are better at

gathering and storing valuable information about the firm and can eventually share it with other independent directors (Bonini et al., 2015).

In contrast, directors with long tenure likely lose their independence over time owing to the potential establishment of friendships with management, which, in turn, reduces their willingness to effectively monitor or challenge management (Sultana et al., 2019; Baran and Forst, 2015; Zamil et al., 2021). Billig and Tajfil (1973) supported this notion and find that long tenure between individuals could engender favoritism bias, leading to unwarranted trust between them. Also, Hwang and Kim (2009, 139) mentioned that "when a CEO enjoys a personal tie with a director, the director's resulting concern for the CEO clouds objective monitoring and disciplining of the CEO". Moreover, Vafeas (2003) showed that directors who stay on the board longest are significantly more likely to have a fiduciary relation with the firm and are more likely to be affiliated with management. Berberich and Niu (2015) found that directors' tenure increases the probability of governance problems, such as bankruptcies, litigations, accounting restatements, or corporate scandals. Additionally, board members with long service in office likely become complacent and stop learning about the firm's operations the longer they stay on the board. Coles et al. (2015) showed evidence that longer-tenured directors may suffer from groupthink and that groupthink reduces firm value.

Therefore, consistent with the above discussion concerning chair age, we argue that chair tenure could also affect R&D investment in either ways. On one hand, chair with longer board experience can carry out their overseeing responsibilities with greater skills and better contribute to company strategy (Ben-Amar et al., 2013). In line with resource dependence theory, the knowledge acquired by chair over time in a firm is crucial to make efficient decisions and to

effectively contribute to R&D strategies (Kor and Mahoney, 2000). Similarly, Kor and Misangyi (2008) argued that such firm-specific knowledge leads to better R&D formulating and implementation.

On the other hand, from the agency theory perspective, chairs who stay in office for a longer period might lose their independence and, consequently, their ability to monitor the executive management (Hillman et al., 2011). Specifically, tenured chairs may become less effective in controlling and advising managers about identifying new growth opportunities. In addition, longer tenure of chair can result in less openness to outside information and increased commitment to a certain view of the firm, including its opportunities and challenges, and resistance to major strategic changes (Boeker, 1997). Such adherence to status quo leads to that chair could be more reluctant to change. This rigidity may have a negative impact on R&D intensity (Bravo and Reguera-Alvarado, 2017).

Based on the above competing arguments concerning the potential impact of chair tenure on R&D spending, we draw the following neutral hypothesis:

Hypothesis 2: There is a relationship between chair tenure and R&D investment.

3. Methodology

3.1. Sample

We use a sample from A-share manufacturing firms traded on Shenzhen and Shanghai stock exchange between 2009 and 2018. We consider A-shares because this type of shares is available to Chinese domestic investors and are nominated in Chinese renminbi (RMB)[2]. Prior

[2] China has other types of shares which are B, H and N-shares, but these shares are available for foreigners (B-shares) or traded outside China (H and N-shares).

studies consider this type of shares separately because they are the dominant shares traded in China and because other types of shares have different listing legislations (Chiu et al., 2020; Chen et al., 2005; Dahya et al., 2003; Haw et a., 1999). The Shanghai Stock Exchange and Shenzhen Stock Exchange are the main financial markets in China.[3] Following prior studies (e.g., Lv et al., 2019; Oh and Barker, 2018), we consider the manufacturing firms where R&D is usually more intense, as their survival and performance heavily depend on the capability to generate innovations. In particular, this sector is considered the main body and pillar of the Chinese national economy (Lv et al., 2019). The final sample is comprised of 9,997 observations across 10 years. Consistent with prior studies (e.g., Kim et al., 2015; Shailer and Wang, 2015; Chen et al., 2018), our data are retrieved from China Stock Market and Accounting Research Database (CSMAR), Economic Research database (CCER), and firm annual reports.

3.2. Empirical model

To test our hypotheses, we employ OLS regression using the following model:

$$R\&D\ intensity_{it} = a_0 + a_1 Chair\_Age + a_2 Chair\_Tenure_{it} + a_3 Control\_Variables_{it} + \epsilon_{it}$$

Following prior studies (e.g., Chen, 2013; Damak et al., 2021; Jianga et al., 2020), the R&D intensity is calculated as the ratio of R&D expenses to sales. R&D expenditures forms the initial stage for innovation activity and illustrates a firm's current innovation willingness and capability (Ebersberger and Herstad, 2011). Our independent variables are chair tenure and chair age. Chair tenure is measured as the number of years chair has been in his/her role for firm *i* in time period *t*. Chair age is measured by chronological age of chair who serves in firm *i* in time period *t.*

[3] A third stock exchange in Beijing was also recently opened (November, 2021).

We control for a number of variables that could affect R&D intensity. These variables are CEO age; CEO tenure; leverage, firm age, ROE, risk, firm size, pay growth, busy board, board meetings, role duality, board independence, and board size (e.g., Barker and Muller, 2002; Guldiken and Darendeli, 2016; Finkelstein, 1992; Kor, 2006; Chen, 2013; Hassanein et al., 2022). Older CEOs tend to be more conservative and follow lower-growth strategies (Hambrick and Mason 1984). However, Barker and Mueller (2002) argued that younger CEOs can be more risk-seeking through increasing spending on R&D because their career and financial security concerns have a longer time horizon. Longer-tenured CEOs may be less interested in pursuing strategies of innovation through higher R&D spending, preferring instead to emphasize stability (Barker and Mueller, 2002). Leverage likely to discourage firms from investing in longer-term focused R&D for the sake of increasing cash flow for debt service (Barker and Mueller, 2002; Khatib, Abdullah, Hendrawaty, and Elamer, 2021). Large firms may have greater resources to develop sustained R&D programs (Baysinger et al., 1991). In contrast, large firm size and the market power it produces may provide managers with less incentive to invest in innovations that may upset the status quo (Barker and Mueller, 2002; Hansen and Hill, 1991). We control for ROE following Bravo and Reguera-Alvarado (2017) as firms tend to reduce their R&D spending when unprofitable. On the other hand, poor profitability will spur organizations to experiment with innovative activity (e.g., Hitt et al. 1991). Van and Le (2017) found that firms invest more in R&D when they experience higher uncertainty and risky situation. Directors with several directorships may benefit R&D by providing timely information (Kor and Sundaramurthy, 2009; Azzam and Alhababsah, 2021), therefore helping firms to acquire essential resources and reducing uncertainty in R&D activities (Chen, 2014).

Concerning firm age, Chen et al. (2011) argued that the longer the firm has been listed, the more likely it is to be at the mature or declining stage of the business life cycle, suggesting reduced R&D activity. The frequency of board meetings and board independence are considered as important board characteristics that help the board of directors to effectively monitor CEO's strategic decisions (Rotrigues et al., 2020; Guldiken and Darendeli, 2016). Conversely, role duality could weaken board monitoring as both key positions are held by the same person (Guldiken and Darendeli, 2016). A large board size indicates more expertise and a wider resource pool which help in strategic decisions (Ashwin et al., 2016). Finally, pay growth is considered as an effective way to stimulate CEOs' risk-taking behavior including R&D investment (Wu and Tu, 2007). All continuous variables were winsorized at the top and bottom 1 percentile. Definition of the variables is presented in Table 1. Given that the same firm appears several times in our final sample and the residuals may be correlated across observations, we use the robust standard errors clustered by firm as per Petersen (2009).

[Table 1 near here]

4. Findings and Discussion

4.1. Descriptive statistics and collinearity test

The descriptive statistics presented in Table 2 state that the average R&D ratio to sales is 3.1 percent. Compared with other countries, previous studies show that the average R&D ratio to sales is 3.6 percent in Finland (Leiponen, 2012), 4.6 percent in Taiwan (Chen et al., 2013), and 2 percent in India (Sasidharan et al., 2015). Concerning our interest variables, the statistics show that both the average and the median of chair age is 53 years. The average of chair tenure is almost 4 years and the median is 3.25 years. The Pearson correlation matrix in Table 3 shows that R&D

intensity is negatively correlated with chair tenure at the 1 percent level. Also, R&D intensity is negatively correlated with firm size and firm age. However, it is positively correlated with risk and board size. The correlation coefficients indicate that none of the correlations are sufficiently large to pose a multicollinearity problem.

[Table 2 near here]

[Table 3 near here]

4.2. Regression results and discussion

Table 4 show the findings concerning the relationship between our variables of interest (chair age and chair tenure) and R&D intensity. The statistical outcomes show that chair tenure has a negative association with R&D intensity. Given that CEOs tend to prune R&D spending due to its potential adverse consequences on short-term financial performance, the monitoring role of the chair is crucial in this regard. Hence, our result is consistent with the agency theory proposition that long tenure in a particular firm can hamper chair independence and their ability to monitor, therefore leaves a negative impact on R&D spending. As a support to such result, it is important to mention about the cultural context in China where social connection and favor are essential in socioeconomic activities (Guan, Su, Wu, and Yang, 2016).

Another potential explanation to our result is that longer tenure of the chair in a specific firm can result in less openness to outside information and increased commitment to a certain view of the firm, including its opportunities and challenges, and resistance to major changes (Boeker, 1997). Such adherence to the status quo results in that the chair could be more reluctant to carry out strategic changes. This rigidity could leave a negative impact on R&D investment (Bravo and Reguera-Alvarado, 2017). In the same regard, Barroso et al. (2011) argued that long tenure can

reduce communication within the board and create isolated groups which will worsen the decision-making process. Moreover, Coles, Naveen, and Naveen (2015) showed evidence that longer-tenured directors may suffer from groupthink which thereby reduces firm value. This discussion is supported by evidence reported by Berberich and Niu (2015) that directors' tenure increases the probability of governance problems, such as bankruptcies, litigations, accounting restatements, or corporate scandals

Our findings do not show a significant relationship between chair age and R&D intensity. This result is consistent with prior literature that finds no significant results when analyzing the influence of directors' age on firm innovation (Bravo and Reguera-Alvarado, 2017; Faleye et al., 2017; Jia, 2016). There are no previous studies considering the impact of chair age on R&D. However, in an area outside R&D investment, Waelchli and Zeller (2013) and Goergen et al. (2016) failed to find a significant relationship between chair age and firm performance.

It is worth mentioning that board independence, board meetings, pay growth, risk, and (firm size) show a significant and a positive (a negative) relationship with R&D intensity. These findings support arguments presented in prior studies. Board independence and the frequency of board meetings are essential board attributes highlighted by corporate governance code across the globe. More independent directors and frequent meetings could help the board of directors to effectively monitor the CEO's decisions (Rotrigues et al., 2020; Guldiken and Darendeli, 2016). Wu and Tu (2007) argued that pay growth is considered an effective way to encourage CEOs' risk-taking behavior including R&D investments. Moreover, the positive relationship between risk and R&D is consistent with the notion that risk may encourage investment in growth options and find that firms tend to invest more in R&D when they face risky situation (Van and Le, 2017). Although firm size could have a different impact on R&D investments, our result is consistent with the

argument that the market power of large firms may provide managers will less incentive to invest in innovations that may change the status quo (Barker and Mueller, 2002).[4]

[Table 4 near here]

4.3. Robustness tests

In order to strengthen our findings, two sensitivity tests have been run. First, following prior studies (e.g., Coles et al., 2006; Kor, 2006), we use the R&D spending to total assets (R&D/TA) as another common proxy for R&D intensity. The independent and control variables are the same as run in the primary analysis. Second, we split age and tenure based on median and create two dummy variables named as 'Old chair' and 'Tenured chair', where they take value of one if chair age (tenure) is above median, and zero otherwise. Table 5 shows the impact of chair tenure on R&D intensity, using this new proxy, while Table 6 shows the regression using the new measures of our independent variables. The findings of both regressions are significant and positive, therefore provide a confirmation to the main findings.

[Table 5 near here]

[Table 6 near here]

4.4. Endogeneity test

The issue of endogeneity is a common concern in accounting and finance research (Larcker and Rusticus, 2010). A common approach to address such an issue is using instrumental variables in a two-stage least squares model (2SLS) (Larcker and Rusticus, 2010). Following Chen et al. (2019), we implement this approach with industry average tenure serving as the instrument (Table

[4] The insignificant impact of other control variables on R&D intensity is also consistent with prior studies (e.g., Barker and Mueller, 2002; Oh and Barker, 2018; Chen, 2014).

7). Industry average tenure is calculated as the mean tenure of firms in the same industry. This is a reasonable instrument because it is correlated with chair tenure at the firm-level, but is not likely to determine a firm's R&D intensity. In the first stage, we run a regression of chair tenure on industry chair tenure and all the control variables. In the second stage, we use the predicted chair tenure (Chair Tenure_Predict) derived from the first-stage regression to examine its effect on R&D intensity. Our findings are quantitatively consistent with the main regression presented in Table 4. However, this approach requires valid exclusion restrictions (instruments) and, in many settings, compelling instruments are not available (Larcker and Rusticus, 2010; Lennox, Francis, and Wang, 2012). To the best of our knowledge, the relevant literature has not identified a valid instrument for chair age. The lack of a valid instrument restricts our ability to conduct reliable instrumental variable regression concerning this variable[5] (see study limitation in the Conclusion).

[Table 7 near here]

4.5. Test for sample selection bias

Not all the firms undertake R&D. They can self-select into R&D either due to the prevailing market structure or expected net gains from R&D (Sasidharan and Kathuria, 2011). Therefore, employing an OLS regression to estimate the R&D intensity of only those firms undertaking R&D likely lead to self-selection bias (Sasidharan and Kathuria, 2011). Following prior studies (e.g., Chuang and Lin, 1999), we employ the two-stage regression procedure suggested by Heckman (1979) to investigate whether our main results hold after controlling for potential sample-selection bias. In the first stage, we model firms' decision to use R&D (Table 8, Panel A). Consistent with

[5] Also, the endogeneity problem raises a concern that a significant relationship between variables could be biased. Our main regression shows that chair age has no significant impact on R&D, thereby reduce such a concern.

Lai, Lin and Lin (2015), we predict that the decision to use R&D is essentially a function of the following factors: (i) firm size, (ii) firm leverage, (iii) firm age, and (iv) industry[6]. Thus, in the first stage, we construct a probit model to estimate the probability of a firm doing R&D. In the second stage, we include the Inverse Mills Ratio (IMR) obtained from the first stage as an additional explanatory variable to correct for the selection bias. The findings of this estimation (Table 8, Panel B) are consistent with our main outcomes, indicating that the selection bias is non-existent in our analysis.

[Table 8 near here]

5. Conclusion

The objective of this study is to examine the impact of chair tenure and chair age on R&D intensity using a sample comprised of A-share manufacturing firms traded on Shanghai and Shenzhen stock exchange between 2009 and 2018. This study focuses on the Chinese market where chairs have strong legal power and are in control of strategic decision making. We find that chair tenure negatively affects R&D intensity. Consistent with agency theory, this result suggests that when chairs spend a long time in their positions, they may lose their independence and monitoring power because they establish a close relationship with the CEO, leaving an adverse impact on R&D spending. Also, long-tenured chairs may exhibit greater rigidity and a more significant commitment to existing principles and precedents, thereby more reluctant to make a strategic change. Moreover, we do not find a significant relationship between chair age and R&D intensity.

[6] We do not consider industry variable because our sample is from one sector only: the manufacturing sector.

Our study offers a valuable contribution to the literature, regulators and practice. This study implies a step forward in the R&D and strategy literature, and also in the literature on corporate governance and firm strategy. Specifically, our findings contribute to the literature by highlighting chair tenure as a new factor affecting R&D investment decision. In the same regard, our study encourages new research on other chair demographic attributes (e.g., chairs religion, education, nationality) or also demographic similarities between chair and other key corporate governance players. Future research can also consider whether chair tenure and age affect other business outcomes outside of R&D area (e.g., executive pay, cost of capital, audit fees, and disclosure level).

Our study has implications for policy-makers and practice. The potential impact of directors' tenure is one of the topics that obtained much debate by policy-makers, and a consensus is yet to be reached. Our results contribute to the merits of this debate. In this regard, regulators (in China, in particular) could take this issue seriously into consideration for future governance reform. In other words, as policy-makers have recently started looking into the tenure of directors in office, our findings support the calls for limiting directors' tenure. Specifically, policy makers may impose or recommend a limit on directors tenure (and chair tenure in particular) when they develop the board tenure framework. Moreover, our findings have significant implications for companies in the selection process of the chair. In particular, firms that are eager to maintain sustained innovation may re-consider the tenure of the chairs during the process of their appointment (or re-appointment). Our findings concerning chair age may also alleviate the stakeholders' concern over the negative stereotypes of aging.

This study is conducted in China where social ties and favor are essential in socioeconomic activities and where culture is characterized by high-power distance. This limits the generalizability of our findings to other developed countries where corporate governance system

is robust and where businesses are conducted on arm's length basis. Extending this research to other settings may be useful for advising on tenure policy decisions within different corporate governance environments. This study focuses on manufacturing sector only, so future research may include other sectors to further enhance the findings' generalizability. Moreover, our research uses R&D intensity as an input of innovation. Future studies may consider patents or new products as real outputs of innovation. As the Covid-19 pandemic has significantly affected businesses, future studies may examine whether our results hold during and after the pandemic. Finally, regardless of our effort to address the endogeneity problem, we caution against assuming that this issue has been fully resolved by the method used.

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Table 1: Variable definition

Variables	Definition	Reference
R&D intensity	Research and development expenditures scaled by the total sales for firm *i* in year *t*.	Chen, 2013; Damak et al., 2021.
Chair Tenure	The number of years chair has been in his/her role for firm *i* in time period *t*.	Withers and Fitza, 2017.
Chair age	Chronological age of chair for firm *i* in year *t*.	Waelchli and Zeller, 2013
CEO Tenure	The number of years CEO has been in his/her role for firm *i* in time period *t*.	Barker and Mueller, 2002.
CEO age	Chronological age of CEO for firm *i* in year *t*.	Barker and Mueller, 2002
Firm Age	The natural logarithm of the number of years since the listed of the firm.	Chen et al., 2011.
SIZE	The natural logarithm of total assets for firm *i* in year *t*.	Baysinger et al., 1991; Barker and Mueller, 2002.
LEV	The total debt for firm *i* in year *t* scaled by the total equity.	Barker and Mueller, 2002.
ROE	Net operating income divided by total equity for firm *i* in time period *t*.	Bravo and Reguera-Alvarado, 2017.
Risk	Beta coefficient of firm's stock for firm *i* in year *t*.	Van and Le, 2017.
Busy Board	Dummy variable that takes the value of one if at least 50% of the shareholder representatives hold three or more directorships, and zero otherwise.	Kor and Sundaramurthy, 2009.
Pay Growth	The average salary growth rate of executive team for firm *i* in year *t*.	Wu and Tu, 2007
Board Independence	The proportion of independent directors, measured as the number of independent directors to the total number of directors in the boardroom of firm *i* in year *t*.	Rotrigues et al., 2020; Guldiken and Darendeli, 2016
Board meetings	The annual meeting number of board for firm *i* in year *t*.	Rotrigues et al., 2020.
Role Duality	Dummy variable that takes the value of one if both chair and CEO are served by one person, and zero otherwise.	Guldiken and Darendeli, 2016
Board Size	Number of board directors for firm *i* in year *t*..	Ashwin et al., 2016.

Table 2: Descriptive statistics

Variables	Mean	SD	Min	Median	Max
Dependent variable					
R&D intensity	0.031	0.11	0.00	0.036	0.47
Independent variable					
Chair Age	53	6.94	36	53	72
Chair Tenure	3.90	2.88	0.83	3.25	15
Control variables					
CEO Age	49	6.16	34	49	66
CEO Tenure	3.57	2.98	0.83	2.67	13
Size (log)	22.2	1.4	13.8	21.9	29
Leverage	0.50	0.21	0.07	0.49	1
ROE	0.07	0.08	-0.13	0.06	0.23
Firm Age (log)	2.55	0.47	1.09	2.64	3.22
Risk	1.10	0.49	-2.86	1.09	14
Pay Growth	0.37	1	-0.75	0.10	6.94
Busy Board	0.15	0.36	0	0	1
Board Meetings	8	0.40	3	9	23
Board Independence	0.36	0.038	0.22	0.40	0.67
Board Size	9	1.85	6	6	17
Role Duality	0.19	0.30	0	0	1

Table 3: Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. R&D intensity	1															
2. Chair Age	-0.011	1														
3. Chair Tenure	-0.028***	0.30***	1													
4. CEO Age	-0.002	0.25***	0.12***	1												
5. CEO Tenure	-0.009	0.15***	0.39***	0.23***	1											
6. Size	-0.087***	0.17***	0.12***	0.15***	0.05***	1										
7. Leverage	-0.037	-0.05***	-0.13***	-0.004	-0.12***	0.23***	1									
8. ROE	-0.004	0.05***	0.03***	0.011	0.020	0.09***	-0.15***	1								
9. Firm Age	-0.022**	0.039***	0.010	0.09***	0.010	0.23***	0.22***	-0.10***	1							
10. Risk	0.016*	0.026***	0.025**	0.029***	-0.004	0.056***	0.014	-0.06***	0.04***	1						
11. Pay Growth	-0.002	0.051***	0.143***	0.048***	0.036***	0.16***	-0.03***	0.10***	0.11***	0.06***	1					
12. Busy Board	0.009	0.015	0.016*	0.036***	0.013	0.10***	0.001	0.023**	0.094***	-0.021**	0.049***	1				
13. Board Meetings	-0.008	-0.05***	0.002	-0.026*	-0.04***	0.19***	0.16***	-0.04***	0.10***	0.019*	0.08***	0.04***	1			
14. Board Size	0.024**	0.011	-0.07***	0.040***	-0.05***	0.23***	0.15***	-0.03***	0.15***	0.011	0.013	0.043***	0.042***	1		
15. Board Independence	0.010	0.007	-0.035***	-0.014	-0.019	-0.04***	-0.003	-0.008	-0.013	-0.05***	-0.08***	0.095	0.041***	0.051***	1	
16. Role Duality	-0.001	-0.002	-0.013	-0.007	-0.013	-0.011	-0.03***	0.009	-0.01	-0.013	-0.05***	-0.02*	-0.001	0.015*	0.086***	1

Note: *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively

Table 4: Regression of the relationship between chair age, chair tenure and R&D intensity

Variables	Expected sign	Coeff.	*t*-value
Chair Age	+/-	0.004	1.13
Chair Tenure	+/-	-0.012	-2.02**
CEO Age	+/-	0.0002	0.71
CEO Tenure	+/-	-0.007	-1.57
Size	+/-	-0.015	-6.49***
Leverage	-	0.011	1.17
ROE	+/-	0.018	0.94
Firm Age	-	0.002	0.45
Risk	+/-	0.006	3.12***
Pay Growth	+	0.003	2.49***
Busy Board	+/-	0.002	0.56
Board Independence	+	0.010	1.81*
Role Duality	-	-0.540	-0.69
Board Size	+	0.003	0.80
Board Meeting	+	0.016	1.70*
Constant		0.31	7.28***
adj. R^2		0.085	
N		9,997	

Note: *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively. All tabulated t-statistics are based on robust standard errors that are clustered at the firm level.

Table 5: Regression of the relationship between chair age, chair tenure and R&D intensity (using alternative proxy for R&D)

Variables	Expected sign	Coeff.	*t*-value
Chair Age	+/-	0.019	1.25
Chair Tenure	+/-	-0.018	-2.31**
CEO Age	+/-	0.001	1.12
CEO Tenure	+/-	-0.005	-1.51
Leverage	-	0.019	1.13
ROE	+/-	0.010	0.59
Firm Age	-	0.021	0.64
Risk	+/-	0.009	3.58***
Pay Growth	+	0.006	2.61***
Busy Board	+/-	0.003	0.52
Board Independence	+	0.023	1.76*
Role Duality	-	-0.590	-0.60
Board Size	+	0.005	0.65
Board Meeting	+	0.017	1.76*
Constant		0.24	4.13***
adj. R^2		0.102	
N		9,997	

Note: *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively. All tabulated t-statistics are based on robust standard errors that are clustered at the firm level.

Table 6: Regression of the relationship between chair age, chair tenure and R&D intensity (using alternative proxies for chair age and chair tenure)

Variables	Expected sign	Coeff.	*t*-value
Old Chair	+/-	0.033	1.05
Tenured Chair	+/-	-0.017	-1.83**
CEO Age	+/-	0.001	0.63
CEO Tenure	+/-	-0.009	-1.55
Leverage	-	0.24	1.16
ROE	+/-	0.019	0.89
Firm Age	-	0.002	0.40
Risk	+/-	0.007	2.99***
Pay Growth	+	0.006	2.73***
Busy Board	+/-	0.011	0.81
Board Independence	+	0.019	1.73*
Role Duality	-	-0.590	-0.67
Board Size	+	0.005	0.72
Board Meeting	+	0.023	1.74*
Constant		0.28	6.12***
adj. R^2		0.103	
N		9,997	

Note: *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively. All tabulated t-statistics are based on robust standard errors that are clustered at the firm level.

Table 7: Regression of the relationship between chair age, chair tenure and R&D intensity using 2SLS

	1st Stage		2nd Stage	
Variables	Coeff.	*t*-value	Coeff.	*t*-value
Chair Tenure_Predict	0.012	1.76*		
Chair Tenure			-0.017	-1.98**
Chair Age			0.009	0.88
Control variables	Included		Included	
Partial R^2			0.052	

Note: *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively. Control variables are included in both stages but not presented for brevity. All tabulated t-statistics are based on robust standard errors that are clustered at the firm level.

Table 8: chair tenure, chair age and R&D intensity: Controlling for self-selection bias using Heckman's estimation

Panel A: Determinants of R&D choice using a probit model as follows:

$$R\&D\_DUM_{it} = \alpha_0 + \alpha_1 Levrage_{it} + \alpha_2 Firm\ Age_{\ it} + \alpha_3 Size_{it} + e_{it}$$

R&D_DUM equals to 1 if a firm is involved in R&D and 0 otherwise.

	Constant	Leverage	Age	Size	Pseudo R^2
Coeff	-2.92***	0.0063	0.148	-0.077***	0.22
SE	(-0.026)	(0.108)	(0.127)	(-0.010)	

Panel B: Regression model

Variables	Coeff.	*t*-value
Chair Age	0.004	1.12
Chair Tenure	-0.013	-2.01**
CEO Age	0.0002	0.70
CEO Tenure	-0.007	-1.59
Size	-0.016	-6.44***
Leverage	0.011	1.16
ROE	0.018	0.90
Firm Age	0.002	0.46
Risk	0.007	3.19***
Pay Growth	0.003	2.52***
Busy Board	0.002	0.55
Board Independence	0.011	1.82*
Role Duality	-0.54	-0.69
Board Size	0.003	0.81
Board Meeting	0.015	1.73*
IMR	0.056	0.92
Constant	0.33	7.10***
adj. R^2	0.08	

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels (two-tailed), respectively. All tabulated t-statistics are based on robust standard errors that are clustered at the firm level.