Born to Rebel? The Owner Birth Order and R&D Investments in Chinese Family Firms

ABSTRACT

Family background has a significant impact on family firms' strategies, such as innovation investments. Going beyond prior studies that exclusively focus on how family governance and management factors determine R&D investment decisions, this study investigates a family science factor: family firm owner's birth order, defined as the relative rank of the owner in terms of the age hierarchy among siblings in the family. Joining the family-niche model of birth order and socioemotional wealth perspective, we propose that later-born family firm owners tend to be risk-takers and invest more in R&D projects compared with their earlier-born counterparts. We further examine how the two other powerful decision-makers within family firms (i.e., chairperson of the board and CEO) enable or constrain the owner's birth order-R&D investment relationship. We contend that the positive birth order impact on R&D investments is weaker when a family member is the chairperson of the board, while such a relationship is stronger in the presence of owner–CEO duality. We confirm our hypotheses using a sample of 605 firm-year observations from Chinese listed family firms between 2006 and 2014. This study demonstrates the important impact of family science factors on innovation heterogeneities, which is understudied in the family firm innovation literature.

Practitioner Points:

- As a result of birth order, family firm owners experience family relationships in dissimilar ways and develop different dispositions and tendencies that will have an impact on how they make decisions in adulthood, including innovation investments.
- First-born owners in family firms are more conservative about R&D investments, while later-born owners are more likely to be active innovators.
- In family firms, family owners, family board members and family executives shape the firm's innovation investments. When later-born owners are also the CEOs of the company, they can exercise more freedom to authorize R&D projects to enhance investment in innovation. In contrast, when a family member is the chairperson of the board, it will constrain later-born owners to invest in innovation projects.

Keywords

Birth order, family firms, R&D investment, innovation, corporate governance

Introduction

Research and development (R&D) investments have been recognized as an essential means of developing technological capabilities, and creating and sustaining competitive advantage in contemporary firms (De Massis et al., 2013; McDermott & O'Connor, 2002). Family firms are not an exception (Calabrò et al., 2019; De Massis et al., 2013), and 77% of family business leaders in the Global Family Business Survey 2019 cite innovation capabilities as essential to sustaining their business.

Despite the importance of family firms' R&D investments, prior studies have exclusively focussed on family governance and management factors (Calabrò et al., 2019) and found that family firms tend to be risk-averse and underinvest in R&D to preserve the socioemotional wealth (SEW) (e.g., Brinkerink & Bammens, 2018; Chen & Hsu, 2009; De Schmid et al., 2014; Massis et al., 2013; Matzler et al., 2015). SEW is defined as the "non-financial aspects of the firm that meet the family's affective needs" (Gomez-Mejia et al., 2007: 106). Regardless of this important research, there is limited discussion on how family science factors influence family firms' R&D investments. More importantly, the distinct nature of family firms arises from the 'family' (Gomez-Mejia et al., 2011; Soleimanof et al., 2018), and the current lack of examination of familial science factors downplays the family impact on family firms' innovation decisions.

To address the gap, this study investigates how family owner's birth order, the "relative rank of a child in terms of the age hierarchy among siblings in the family" (Steelman, 1985: 354), determines family firms' responses to R&D investments and how family management factors enable or constrain such a relationship. The family owner ultimately owns and plays an important role in firms' strategic decisions (Gomez-Mejia et al., 2011). Studies in family science of management phenomena suggest that birth order is an influential factor capturing

individual's risk-taking preferences to predict individual behaviours (e.g., participation in risky sports or financial investments) and organizational decisions (e.g., succession) (e.g., Campbell et al., 2019; Gilliam & Chatterjee, 2011; Sulloway & Zweigenhaft, 2010).

In this article, we join the family-niche model of birth order from the family science literature (Beer & Horn, 2000; Steelman, 1985; Sulloway, 1995) and the SEW perspective to conceptualize family firm decisions to invest in R&D projects. A key finding from the family-niche model of birth order is that siblings are biologically driven to compete for parental investment or to fulfill "family niches" (Sulloway, 1995, 1999, 2001). As a result of birth order, individuals develop different tendencies of risk-taking behaviours (e.g., Bertoni & Brunello, 2016; Gilliam & Chatterjee, 2011; Sulloway & Zweigenhaft, 2010). We argue that earlier-born children tend to be more conforming, conventional, and protective, which makes them family protectors and conservative decision-makers. In this context, R&D is perceived as a threat to SEW. In contrast, later-born siblings tend to have less parental involvement, which makes them less concerned with SEW and more focused on differentiating themselves through engaging in risk-taking activities for currying parental favour.

We also expect that family firm owners alone cannot fully execute strategic decisions (De Massis et al., 2014), but may be enabled or constrained by another two powerful decision-makers in the firm: (1) the board member; and (2) CEO. The family firm owner may sense a high level of concern about SEW from other family members on the board (Matzler et al., 2015), especially when a family member is the chairperson. On the other hand, family firm owners could also enjoy superior managerial discretion in decision-making when they are also the CEO of the firm (Baliga et al., 1996; Kim et al., 2008). We then expect that a family member as chairperson of the board weakens the positive impact of birth order on R&D investments while the owner–CEO duality strengthens such a relationship.

We tested our hypotheses in the context of 155 unique Chinese family firms from 2006 to 2014. As family firm innovation studies are largely conducted in developed countries, it is of great importance to examine what drives family firms' innovation investments in the context of weak institutional environments such as China (Webb et al., 2019). Compared with their counterparts in Western countries, family firms in China are relatively young, being legally recognized by the National People's Congress only in 1999. This means that the majority of these firms remain under the control of their founding generation and have not experienced succession as yet (Jiang et al., 2020; Li et al., 2015). Furthermore, most Chinese family owners were born before the One-child Policy implemented in 1980[1] (Greenhalgh, 2005) and, therefore, have siblings. Such a natural context enables us to directly explore the effect of family owners' birth order in the owner's generation without potential disturbance or complexity from multiple generations.

Our study makes three primary contributions. First, by integrating the family-niche model of birth order with family firm innovation research, we contribute to the debate around family innovation behaviours by shifting the focus from traditional family governance and management factors to a family science factor, namely family firm owners' birth order. This highlights the relevance and significance of family science factors in understanding innovation heterogeneities among family firms (Dyer, 2003; Jaskiewicz et al., 2017; Soleimanof et al., 2018), responding to the recent call for drawing theories related to family science in predicting the innovation behaviour of family firms (Calabrò et al., 2019). Second, we go beyond current family innovation literature that has treated the characteristics of owners from family board members and family executives in influencing innovation investments separately (e.g., Arzubiaga et al., 2018; Duran et al., 2016; Gomez-Mejia et al., 2014). In our study, we provide a more comprehensive understanding of how three powerful roles (i.e., owner, CEO and board

member) interact to jointly influence innovation investments in family firms. Finally, our examination of family firm innovation in transition economies (i.e., China) advances family innovation studies which have generally focussed on firms from developed countries (e.g., Munari et al., 2010; Schmid et al., 2014).

Theory and Hypotheses Development

Socioemotional Wealth Perspective and R&D Investments in Family Firms

The SEW perspective offers a theoretically grounded explanation of behaviours observed in family firms such as succession (Minichilli et al., 2014), risk-taking (Gomez-Mejia et al., 2007), diversification (Gomez-Mejia et al., 2010), and corporate social responsibility (CSR) (Berrone et al., 2010).[2] SEW holds that family firms strive to preserve and enhance the family's SEW, including nonfinancial aspects or "affective endowments," apart from economic considerations (Berrone et al., 2012; Gomez-Mejia et al., 2007; Gomez-Mejia et al., 2011). For family firms, "a key criterion, or at least one that has a greater priority, is whether their socioemotional endowment will be preserved" (Gomez-Mejia et al., 2007: 11). Clearly, SEW captures the essence of family firms in which SEW gains or losses are a critical frame of reference for decision making (Berrone et al., 2012).

Under the SEW perspective, most of the current literature suggests that family firms are generally conservative in R&D investments (Chrisman & Patel, 2012; Duran et al., 2016; Muñoz-Bullón & Sanchez-Bueno, 2011).[3] Considering the importance of preserving SEW, family members' altruism (i.e., the tendency to undertake actions that help family heirs) and wealth-control orientation will evoke risk-aversion and underinvestment in R&D (Duran et al., 2016; Schulze et al., 2003). This is consistent with the findings of Wiseman and Gomez-Mejia (1998), who suggest that family firms will be more risk-averse when they feel that they may lose a great deal of wealth through potentially 'risky' R&D.

In contrast, some scholars have reported that family firms actually embrace risky decisions due to their long-term perspective and natural alignment of interests between owners and managers, thereby mitigating principal-agent problems (Ashwin et al., 2015). Other scholars have explored various contingencies. For example, Chrisman and Patel (2012) found that family firms tend to engage more in R&D investments than nonfamily firms when the gap between aspirations and performance is negative. Gomez-Mejia et al. (2014) concluded that increasing institutional ownership weakens the negative relationship between family ownership and R&D investments because the presence of institutional owners renders family firms more sensitive to the necessity of gains from R&D and negative effects of underinvestment. Other studies also reported that resources slack (Liu et al., 2017), governance structure (Chen & Hsu, 2009; Duran et al., 2016; Sciascia et al., 2015), and generations stages (Duran et al., 2016; Kraiczy et al., 2015; Schmid et al., 2014) influence family firms' view of R&D in line with SEW.

Despite the abundance of fruitful findings, research to date has primarily discussed family governance and family management factors and ignored family science factors that shape individuals' risk-taking preferences and are closely associated with firms' innovation strategy. This study utilises the family-niche model of birth order underpinned by a SEW perspective to particularly examine how family owner's birth order affects views of SEW, which in turn determines family firms' R&D investments.

The Family-niche Model of Birth Order

The family-niche model of birth order has the strongest momentum in evolutionary psychology (Beer & Horn, 2000; Sulloway, 1995). Darwin (1968) natural selection theory provides the theoretical foundations for the family-niche model of birth order by suggesting that human beings adapt to their environment over time. During the adaptation process, especially in a family, *sibling–sibling conflicts* (or sibling rivalry) are one of the basic factors in the

evolutionary process (Darwin, 1968; Hamilton, 1964; Trivers, 1974). That is, siblings are biologically driven to compete for maximizing parental investments. In doing so, children must strategize for safeguarding access to parental resources and stake out a unique "family niche" to increase survival success (Dunn & Plomin, 1990; Hamilton, 1964; Sulloway, 1995; Trivers, 1974).

Because parental attention and resources are limited, siblings develop different strategies to maximize parental favour. Therefore, birth order plays a role in individual behaviours as it "causes siblings to experience family relationship in dissimilar ways and to pursue different ways of maximizing their parent's investments" (Sulloway, 1999: 190). As a result of birth order, individuals will develop different dispositions and tendencies towards their external environment. Studies have also linked birth order to individuals' personality traits (e.g., Hertwig et al., 2002; Sulloway, 1996) and risk-taking behaviours such as participation in risky sports (Sulloway & Zweigenhaft, 2010), risky adolescent behaviours (Argys et al., 2006), and financial investments (Gilliam & Chatterjee, 2011).

Given that characteristics from birth order encapsulate an individual's risk-preference, it is surprising that family business researchers have not examined such preferences in relation to investment in R&D activities. One exceptional study links birth order to leadership succession in family firms (Nicholson, 2008a, 2008b). In terms of leadership succession, scholars find that choosing the eldest son to be successor is more likely when there is a high level of SEW endowment because he/she may maximize family continuity (Barnes, 1988; Calabrò et al., 2018; Schenkel et al., 2016). In the next section, we discuss our reasoning for birth order predicting innovation investments.

Family Owner Birth Order and R&D Investments

R&D investments are assumed to be pivotal for the competitive advantage of contemporary firms. However, R&D projects are significant long-term, highly uncertain, sunk-cost investments (Chen & Hsu, 2009; Chrisman et al., 2015; Lee & O'neill, 2003) with no fixed timeline or even certainty for payoffs (Chrisman & Patel, 2012; Munari et al., 2010). For these reasons, R&D projects require a substantial level of risk tolerance from decision-makers in the organization. Such tolerance of risk may vary with birth order. We argue that earlier-born business owners are more likely to interpret R&D investments as a threat to SEW than their later-born counterparts.

Siblings, in our study, refer to brothers or sisters of the focal family owner. In comparison with owners' younger siblings, the earlier-born usually receive more family attention and care, are endowed with more familial responsibilities, and are expected to work for the continuation of the family reputation (Saad et al., 2005; Sulloway, 1996). Earlier-born children tend to initially enjoy a favoured status in the sibling hierarchy and will be more like their parents, more adherent to principles, more conservative (Paulhus et al., 1999; Saroglou & Fiasse, 2003; Sulloway, 1995) and inherently risk-averse. Gilliam and Chatterjee (2011) supported this statement by reporting that earlier-born individuals tend to demonstrate significantly less risk tolerance than later-born individuals to retain their role of family nurturers and protectors (Calabrò et al., 2018). Consequently, when deciding on R&D investments, they tend to adhere to SEW and avoid risks. The rationale behind this approach is that the nature of innovation requires substantial resource commitment, which indicates the increasing need for external financial and human resources (De Massis et al., 2014). However, family firms with strong SEW are reluctant to increase their debt level or raise money from the stock market (Mishra &

McConaughy, 1999). Also, family firms are generally hesitant to hire skillful nonfamily managers (Jess H. Chua et al., 2003) for the sake of preserving control over their firms. Moreover, innovative projects are a priori uncertain that take time to produce tangible and successful outcomes (De Massis et al., 2014; Duran et al., 2016). In this regard, family members who are heavily focused on preserving SEW will have a strong desire to minimize highly risky R&D investments that pose a threat to the continuation of family values through their firms, the preservation of family firms' social capital, and the capacity to act altruistically toward family members using firm resources (Berrone et al., 2010; Gomez-Mejia et al., 2007). Given earlier-born owners already have a privileged family position, they may feel that it would be foolhardy to invest substantially in R&D projects with the risk of losing SEW and status, especially if they lack requisite skills (Chrisman et al., 2015; McDermott & O'Connor, 2002; Sulloway, 1995).

In contrast, later-born siblings may have less established roles in the family, which drives them to compete with the established status of their elder siblings. Researchers have noted that, to garner parents' resources and attention, the later-born normally find unique ways to distinguish themselves, perhaps by challenging parental authority and supporting "radical" beliefs and business approaches (Sulloway, 1995, 1996; Zweigenhaft & Von Ammon, 2000). By differentiating themselves, later-born individuals tend to be rebellious, innovative, revolutionary and risk-taking (Healey & Ellis, 2007; Schenkel et al., 2016; Zweigenhaft & Von Ammon, 2000). For example, using a meta-analysis, Sulloway and Zweigenhaft (2010) find that later-born individuals are more likely to participate in risky sports. Bertoni and Brunello (2016) note that later-born individuals enjoy faster wage growth because of their higher propensity for risk-taking, such as changing jobs more frequently than those who are earlier-born. Following this, we expect later-born owners to tolerate higher risk and view R&D as less threatening to SEW. In summary, we propose:

Hypothesis 1: Owner's birth order is positively associated with R&D investments in family firms; that is, firms with later-born owners invest more in R&D than firms with earlier-born owners.

Although birth order has an enduring impact on the family firm owner's risk tolerance toward R&D investments, it does not mean that this birth order effect is constant. Family firm innovation literature has long documented the powerful influence of family management and governance on innovation decisions, particularly regarding the roles of CEOs or chairperson of the board (Ashwin et al., 2015; Chen & Hsu, 2009; Jiang et al., 2020; Kraiczy et al., 2015; Matzler et al., 2015). However, they primarily isolated owners from family managers and board members. R&D investments are important strategic decisions that are not only determined by the owner's willingness to innovate but also by his/her ability to innovate (Chrisman et al., 2015; De Massis et al., 2014). *Ability* is 'the discretion of family to direct, allocate, add to, or dispose of a firm's resources' (De Massis et al., 2014: 346).. In our context, although the owner's birth order can increase owners' willingness to invest in innovation, it will be contingent on the owner's ability to do that in the family firms. For this reason, we expect that R&D investment decisions will undoubtedly involve interactions among three powerful roles (i.e., owner, board member, and CEO) within which the owner is the centre of decision making (Chrisman et al., 2015; De Massis et al., 2014). In this study, we propose two important family management and governance contingencies that may enable or constrain the family firm owner's risk preferences toward R&D investments, namely the presence of a family member as the chairperson on the board and owner–CEO duality.

Constrain Risk-Taking: Family Member as the Chairperson of the Board

Boards of directors question, advise and monitor important decisions, including R&D investments within the company. When the focal owner's family member is the chairperson of the board, the family firm owner must frequently interact with that family member on the firm's strategic issues, which may have an impact on the family firm owner's preferences for decision-making (Anderson & Reeb, 2004; Arzubiaga et al., 2018; Miller et al., 2011). In family firms, family members typically demand that continuity and control of the family business remain intact, which requires family officers to be family nurturers and prioritize preserving SEW in their decision-making (König et al., 2013; Munari et al., 2010). As such, the presence of a family member in the chairperson position represents and reinforces the importance of preserving SEW. Particularly in an R&D investment context, which is high risk and objectionable, the family chairperson will be highly concerned about any risk-taking behaviour proposed by a family firm owner and thus will have a strong incentive to ensure the preservation of SEW in the decision-making process.

In addressing these demands, although the later-born tend to be R&D risk takers and believe the risk will pay off in the long-term, they will be discouraged from doing so because it potentially runs against the family firms' favoured strategy (conservation). Moreover, the family member chairperson will pressure the focal family firm owner to mitigate their risky decision making (Anderson & Reeb, 2004). Even when R&D projects are promising, given the investment's high potential for loss of SEW, the family member in the chairperson position will consistently recommend caution and question the focal owner's decisions, requiring them to put forth a substantial effort in persuading them from both economic and socio-emotional perspectives (Gomez-Mejia et al., 2007; Gomez-Mejia et al., 2014). As a result, the earlier-born

owners will display a risk-averse alignment with their family member chairperson. However, the risk-tolerant later-born owners will tend to favour the preservation of SEW, which, in turn, suppresses their risk-taking preferences and hinders investments in R&D. Therefore, we anticipate that:

Hypothesis 2: The positive relationship between the owner's birth order and R&D investments of the family firm is weakened when a family member is the chairperson of the board.

Enable Risk-Taking: Family Owner–CEO Duality

The proposed birth order effect is also contingent on whether decision-makers have enough managerial discretion to direct and allocate resources to support risk-taking strategies and buffer R&D investment shocks (Chrisman et al., 2015; De Massis et al., 2014). In the organization, power, decision-making, and authority are often centralized to the owner or the CEO. Studies of innovation and family business have documented the important role of CEOs in innovation strategies (Duran et al., 2016; Kraiczy et al., 2015).

When family firm owners are also the company CEO, their powerful position grants them greater discretion to pursue opportunities that might run counter to both economically rational investment decisions and SEW (Gomez-Mejia et al., 2001; König et al., 2013). On the one hand, later-born owners can save much effort in pursuing their risk-taking ambitions without constantly being questioned by the board when they are also the CEO (Schmid et al., 2014). In this case, they benefit from the natural alignment between owners and managers, which provides effective leadership for the firm and reduces the confusion of both internal and external stakeholders (Ashwin et al., 2015; Baliga et al., 1996). The owner-manager also has stronger incentives to monitor the management of firm assets (Block, 2012). To ensure the success of an R&D investment, later-born owners can use their increased freedom to allocate sufficient

resources to support their decisions and be highly confident of the innovation output (Zahra, 2005). For these reasons, they will have stronger preferences for authorizing R&D projects.

In contrast, when later-born owners are not CEOs, they may face excessive pressure and monitoring from the board (Duran et al., 2016; Gomez-Mejia et al., 2007), which will evoke enhanced agency costs for seeking support and restrictions on the latitude of managerial actions and decisions the owner can make. Consequently, this will hinder the tendencies to undertake substantial R&D investment. We, therefore, propose the following:

Hypothesis 3: The positive relationship between the owner's birth order and R&D investments of the family firm is strengthened when the owner is also the CEO.

Methodology

Research Setting

We chose listed family firms in China as the research setting for several reasons. First, China is now striving towards an innovation-based economy, experiencing a massive transition from "made in China" to "created in China." According to the Fourth National Economic Census conducted by the National Bureau of Statistics, privately-owned enterprises (POEs) account for 84.1% of the total number of enterprises in China, of which most of them are family-controlled (China Family Enterprise Ecology for Forty Years, 2019).[4]

Second, compared with counterparts in Western countries, family firms in transition economies such as China are relatively young. This is because nearly all means of production were owned and controlled by the Chinese State from 1949 to 1977 (Li et al., 2015). Since the economic reforms in 1978, a large number of private family firms were formed in China and finally legally recognized by the National People's Congress in 1999 (Li et al., 2015). It is important to note that most Chinese family firms are still under the control and management of

the founder's generation (PWC Global Family Business Survey 2018-China Report). This unique context enables us to directly explore the birth order effect of the owner's family within one generation rather than other complicated multigenerational cases that may create potential disturbance or complexity on the proposed birth order effect. It also minimizes the endogeneity concerns that arise from the conservatism of the family firm, according to which choosing the firstborn child as a successor and hence underinvesting in innovation is a default outcome (Calabrò et al., 2018). Additionally, such a nature context reduces another concern: first- and non-first-born siblings would have non-equal probabilities of inheriting a firm and hence ending up having different risk-preferences because of their different chances of selection into the sample of owner rather than because of their inherent risk-preferences. In short, our unique context, theoretically, minimizes some alternative explanations for our results while, practically, indicates the importance of our study in guiding Chinese family firms' decisions on the succession plan for the near future.

Third, compared to Western nations, Confucianism ideology plays an essential role in understanding the dynamics within the Chinese family businesses. Despite its importance, Confucianism still has been understudied in family business literature (Scarborough, 1998). Confucianism endorses a high level of collectivism and devotion that consider the family as much more important than any individual member (Jun & Sorenson, 2006; Scarborough, 1998; Slote & De Vos, 1998). Therefore, the desire to keep the business within the family, particularly the nuclear family, is strong among Chinese owners or entrepreneurs. In a Chinese family, children are educated to exhibit filial piety (*xiao*) throughout the life of their parents even when they become economically independent or have their own children (Jun & Sorenson, 2006). Filial piety (*xiao*) is the most important virtue in Confucianism and it means that sacrificing one's own career to serve parents' business is considered something highly desirable (Slote &

De Vos, 1998). In line with this ideology, the main inheritance mode of a Chinese family business is the owner's children inheriting their parents' business (Jun & Sorenson, 2006).

Sample and Data

We obtained the original sample of all family firms listed on the Shanghai or Shenzhen Stock Exchange of China between 2006 and 2014 from the China Stock Market and Accounting Research (CSMAR) database. Although there are variations in the definition of a family business, a general agreement is that family owners can exercise decisive power on key governance choices and strategies of the firm (Duran et al., 2016; Jess H Chua et al., 1999). Following this, we operationalized family firms as firms where the ultimate owner is a family member or a family. Some studies proposed a minimum of 5 per cent of the shares in the business (e.g., Peng & Jiang, 2010). To ensure that the family group holds a substantial portion of voting stock, we followed Chrisman and Patel (2012), Gomez-Mejia et al. (2010) and La Porta et al. (1999), and used 10% control rights share in the company as a cut-off. [5] We took 2006 as the initial sample year because, in 2006, China issued new accounting standards that required listed companies to disclose R&D investment information in their annual reports. As the Chinese State announced a change in the existing One-child Policy to a two-child policy in 2015, our sample period ends in 2014 to avoid extra policy influences on our results. As such, our sample covers the period 2006 to 2014, in which the One-child policy was is in operation. Despite this, One-child Policy is not a major issue for our proposed birth order effects as most family owners in our sample are born before the introduction of the One-child Policy in 1980 and have more than one sibling[6]. As our focus in the study is the birth order effect of the family owner, we strictly excluded firms whose family owner is from an only-child family as there are no birth order effects in these cases (Campbell et al., 2019).

To test our hypotheses, we need detailed family background information such as birth order, first-born gender, and the number of siblings. We used the full name of the ultimate family owner[7] from the CSMAR database and manually collected family information from (1) all the prospectus and annual reports of sample firms: China Securities Regulatory Commission requires public firms to disclose detailed personal information of the chairperson as well as his or her relatives who engage in the family firm management in the prospectus (Yu et al., 2019); (2) Internet: we used search engines such as *Baidu* (i.e., largest search engine in China) and *Google* to search sibling information in any public sources such as corporate official websites, specialized press articles, and books (e.g., corporate books or documentaries); and 3) social networks such as LinkedIn. To make sure the accuracy and consistency of the sibling information, we cross-checked the above different sources. Due to lack of compulsory rules of disclosing detailed family information for family firms in China, as well as the sensitive nature of the data, similar to other studies (e.g., Calabrò et al., 2018; Campbell et al., 2019), there are significant challenges in collecting sibling information for all family firms. We have conducted Heckman two-stage model to examine such concerns in the robust tests section.

We also drew data regarding institutional development from the marketization index of the National Economic Research Institute (NERI) (Fan et al., 2011). We collected firm basic information (e.g., industry, establish year, and headquarter location), accounting information (e.g., sales, assets, debt, and ROA) and corporate governance data (e.g., board information and family ownership) from the CSMAR database. After excluding heavily regulated financial firms, ST firms that faced high delisting risk, firms that issued debt exceeding asset value, cross-listed firms that faced different regulation environments, or firms with missing data, our final sample included 605 firm-year observations of 155 family listed firms between 2006 and 2014.

We took a one-year time lag between independent and control variables, and the dependent variables to mitigate endogeneity concerns.

Measures

Dependent variable. Following the widely established measures in previous studies (e.g., Chrisman & Patel, 2012; Gomez-Mejia et al., 2014; Greve, 2003; Kim et al., 2008), we measured *R&D intensity* as the percentage of R&D expenditure over total sales. This measure captures a firm's commitment to innovation, which is well suited to our framework (Gomez-Mejia et al., 2014; Lee & O'neill, 2003). It also allows us to compare R&D investments between companies in the analyses (Chen & Hsu, 2009).

Independent variable. Our independent variable is *Owner birth order.* Following Campbell et al. (2019), we adopted an ordinal measure for *Owner birth order*. It took the value of 1 for the first-born owner, 2 for a second-born, 3 for a third-born, etc. Alternatively, we also developed a birth order ratio by considering the size of the owner's family in the robust tests section (Booth & Kee, 2009).

Moderating variables. The first moderator indicates whether the chairperson is from the owner's family. According to *Company Law*, all listed companies in China must set up shareholders' meetings, board of directors, and supervisory boards (OECD, 2011). The board of directors in China have a significant impact on firms' strategic decisions and operations, such as deciding on the business plans and investments of the company, the set-up of internal management organisation, the appointment or dismissal of company managers, and evaluating and supervising the operation and performance of management to protect the interests of companies and shareholders (OECD, 2011). We developed a dummy variable, *Family member chairperson*, which equals to one if any family member except the focal owner is in the chairperson position and zero otherwise. Following Chrisman and Patel (2012), we defined

family member as a person related by blood or marriage to the owning family. The second moderating variable for testing Hypothesis 3 is the *Owner-CEO duality*. We developed an indicator variable that equals one if the family owner also serves as the CEO in the focal firm and zero otherwise (Zahra, 2005).

Control variables. Aligned with studies regarding the determinants of corporate R&D investments, we included three sets of control variables that may systematically impact family firms' R&D activities. We firstly controlled for family-level and owner-level variables in our model. We controlled for *Family size* as the number of siblings shapes parents' resources allocated to the owner, which may confound with our birth order effect (Booth & Kee, 2009; Campbell et al., 2019). We measured family size as the total count of siblings of the focal family owner. As the gender of the firstborn in the owner's family may influence parenting attention on the focal owner, we controlled for *First child gender*, coded one if the first child is male and zero for female. As mentioned above, theoretically, family conservatism would not be a major concern for our results, but it is still appropriate to eliminate such impact empirically. As there is no direct measure for family conservatism, we adopt two proxies based on available data. One is owner's *Communist Party membership*, coded one if the owner is a party member in China and zero otherwise. Communist party membership was viewed as having privileged status in China (Dickson, 2003), and owners with communist party members are expected to be more conscious of their risk-taking strategies. The second proxy is *Owner-based firm name* dummy, valued one for firms whose name include the name of the owner and zero otherwise. Literature has noted that an owner-based firm name creates a strong association between the owner and her/his firm, and such name choice acts as the signal of the firm's quality (Belenzon et al., 2017; Kashmiri & Mahajan, 2014). If the firm's reputation gets hurt, the reputation of the entire family may be tarnished (Kashmiri & Mahajan, 2014). For this reason, the owner of

owner-based name firms will be more conservative and reluctant to take risk-taking decisions that would damage such reputation. We also controlled for *Family ownership*, measured as the proportion of equity held by family members in the focal firm. Family ownership has been a long-lasting factor in influencing family firms' innovation strategies (Chrisman & Patel, 2012; L. Beck et al., 2011). The first generation's decision making generally rests with the founder who is centralized in decision making while it may change over time as succeeding generations join the family firm management (L. Beck et al., 2011; Kraiczy et al., 2014). As mentioned above, most of our sample firms represent the founder/owner generation. Even in those cases (very few) where two generations are working within the firm, the younger generation only holds managerial roles rather than ownership roles. We controlled for *Generation,* an indicator variable, which equals one if any later generation family member serves as one of the top managers except for the founder, and zero otherwise. We also included owner's education, which may affect his/her commitment to innovation investments (Daellenbach et al., 1999). *Owner education* is an ordinal variable: 1 for primary school; 2 for junior school; 3 for high school; 4 for college; 5 for bachelor's degree; 6 for master's degree; and 7 for doctoral degree.

At the firm level[8], we accounted for *Firm age* measured as the number of years since foundation (L. Beck et al., 2011). Older firms tend to be more conservative in risk-taking strategies. We controlled for *Firm size* (measured by the natural logarithm of the firm's number of employees) as it affects firms' resource endowment for R&D investments (Gomez-Mejia et al., 2014; Sciascia et al., 2015). We also accounted for *board size*, measured by the number of directors on the board (Campbell et al., 2019). Recent studies have shown that lone founder firms are more entrepreneurial and pursue superior R&D investments (Block, 2012; Miller et al., 2011). We included a dummy *Lone founder,* which equals one if the focal family firm is the lone founder firm and zero otherwise. According to Miller et al. (2007) and Miller et al. (2011),

lone founder firms refer to firms in which one of the firm's founder is active as an executive or major shareholder and no relatives of the founder are involved in the business as top managers or large shareholders.

At the regional level, we also controlled for *Institutional development* as there is large institutional development disparities across regions in China which may influence firms' motivation to innovate and accessibility to local government's preferential policies and resources (Kafouros et al., 2015). We used the regional marketization index from NERI which have been extensively used to measure institutional development in different regions in China (e.g., Kafouros et al., 2015; Zhou et al., 2017). Finally, we included two-digit industry dummies and year dummies to control for industry-related variance and time-dependent variations.

Estimation Method

We employed feasible generalized least squares (GLS) estimation method with a first-order autoregressive AR(1) and heteroskedastic error structure to test our hypotheses (e.g., Cannella Jr et al., 2008; Souder et al., 2017; Yang et al., 2014). Due to the panel structure of our data, the main problems, including cross-sectional heteroscedasticity and within-unit serial correlation, may bias the ordinary least square (OLS) estimation (N. Beck & Katz, 1995; Neter et al., 1996). GLS estimation allows us to correct the heteroscedasticity and autocorrelated error terms (N. Beck & Katz, 1995). In doing so, we used a STATA 16 command, 'xtgls', for the analyses. Our results confirm a high degree of autocorrelation (F =27.87, p = 0.000). Because AR (1) technique requires at least two data points from each firm, we lost 16 observations from firms that only reported one-year data. For robustness check and comparison purposes, we also rerun our models using panel fixed-effects model and random-effects model in the robustness rests section. We lagged all firm-level variables in the regression.

Results

Descriptive Statistics

Table 1 presents descriptive statistics of the main variables and their correlations. The mean value of *R&D intensity* is 4%, much lower than 10.40% reported in Block (2012), based on family firms in the S&P 500, which suggests that Chinese family firms are relatively reluctant to invest in risky R&D projects. The mean value of *birth order of owner* is 1.52 and family owners are also CEOs in 37.0% of sample family firms. Only 15% of family firms are showing more than one generation involved in the management of the family firm; this result confirms that China's family firms are younger than western firms and still under the ownership of the founding generation. Regarding the correlation matrix of the main variables, the highest correlation is between *Owner birth order* and *Family size* ($r = 0.546$, $p < 0.01$). This is expected because a later birth order is possible only to the extent that family size increases (Campbell et al., 2019). We calculated the average variance inflation factor (VIFs) for each model, and the highest average VIF is 2.17, and the maximum value for any variables is 5.59, less than the common cut-off point of 10 (Cohen et al., 2003). Therefore, the problem of multicollinearity is not a major concern for this study.

/Insert Table 1 about here/

Regression Results Analysis

Table 2 presents the GLS regression results predicting R&D intensity. Hypothesis 1 proposes that family owners as later-borns are more likely to engage in higher levels of R&D investments than earlier-borns. In Model 2 of Table 2, the coefficient on *Owner birth order* is positive and significant ($\beta = 0.0048$, $p < 0.001$), confirming that under later-born owners, R&D investment intensity will increase by an average of 12% (= 0.0048/0.04) relative to the mean of *R&D intensity* in the sample. Therefore, Hypothesis 1 is well supported.

Hypothesis 2 predicts that the presence of other family member as chairperson on the board will negatively moderate the positive relationship between birth order and R&D investments. The regression coefficient on the interaction term *Owner birth order* × *Family member chairperson* is significantly negative in Model 3 (β = -0.0043, $p < 0.001$), suggesting that the presence of family member as the chairperson weakens the positive association between birth order and R&D investments, supporting Hypothesis 2. In contrast, the interaction term *Owner birth order* × *Owner-CEO duality* is positive and significant in Model 4 (β = 0.0064, $p < 0.001$), which indicates that the presence of Owner-CEO duality enhances the positive impact of birth order on R&D investment, supporting Hypothesis 3. The full model in Model 5 shows similar results and provides consistent support for Hypotheses 2 and 3.

/Insert Table 2 about here/

Effect Size Analysis

To interpret our results clearly, we calculated the adjusted predictions on the relationship between owner birth order and R&D investments. We used STATA 16 Command 'margins' and 'marginsplot' to plot the estimates in Figures 1, 2 and 3 for Hypotheses 1, 2, and 3, respectively. Note that the birth order in our sample is from 1 to 7. As **Figure 1** shows, the owner birth order is positively associated with R&D investment intensity. Specifically, holding all other variables at their means, family firms with last-born owners (birth order as 7 in our sample) invest 6.82% of total sales into R&D activities. In comparison, this number for firms with first-born owners is 3.93%. Based on the average sales in our sample (USD 531.08 million[9]), firms with last-born owners will invest USD 36.22 million in R&D, while firms with first-born owners will invest USD 20.87 million, almost USD 15.35 million less than the last-born. It clearly shows a strong economic difference in R&D investments due to the birth order difference of owners.

In **Figure 2**, it plots the moderating effect of the presence of a family member as the chairperson. As shown in **Figure 2**, when the chairperson position is taken by one of the owner's family members, the positive relationship between owner birth order and R&D investment intensity is weaker (see the flatter slope of the solid line than the dotted line in **Figure 2**), further supporting the negative moderating effect of family member chairperson in Hypothesis 2. In specific, for firms with owners as the last-borns (birth order as 7 in our sample), holding all other variables at their means, the R&D investment intensity decreases from 7.23% to 5.35% when a family member is in the chairperson position, supporting our Hypothesis 2. As **Figure 3** shows, owner birth order has a much stronger positive relationship with R&D investment intensity when the owner is also the CEO in the company (see the steeper slope of the solid line than the dotted line in **Figure 3**). More specifically, for firms with owners as the last-borns in the family, holding all other variables at their means, the R&D investment intensity significantly increases from 5.96 % to 9.53 %, strongly supporting our Hypothesis 3. It suggests that the moderating effect of owner-CEO duality is much larger than the presence of other family members as the chairperson.

/Insert Figures 1, 2 and 3 about here/

Robustness Tests

We also test the sensitivity of our results by conducting several robustness checks.

Test for alternative operationalization of family firms. The operational definition of family firms varies among the existing literature (Gomez-Mejia et al., 2011). In addition to applying 10% as the cut-off point in our main results, we alternatively adopted three other common operationalization of family firms: 1) 20% voting rights, 2) 30% voting rights, and 3) 30% voting rights with family influence (i.e., family member as CEO or chairperson in the board) (Berrone et al., 2012; Calabrò et al., 2018; Gomez-Mejia et al., 2014; Gomez-Mejia et al., 2011;

La Porta et al., 1999). As **Table 3** shows, the coefficient on *Owner birth order* is significantly positive, as predicted in Models 1, 4 and 7. The coefficients on both interactions *Owner birth order* × *Family member chairperson* (in Models 2, 5 and 8), and *Owner birth order* × *Owner-CEO duality* (in Models 3, 6 and 9) are also significant. Therefore, all results are consistent with our main results in Table 2, confirming that our hypotheses are not sensitive to the operationalization of family firms.

/Insert Table 3 about here/

Test for alternative measurements of independent variables and dependent variables. As the birth order effect is highly related to the family size (Booth & Kee, 2009), we developed a ratio measurement which was computed as the birth order divided by family size. As shown in **Table 4**, the birth order effect in Model 1 and moderating effects of family member chairperson and owner-CEO duality in Models 2-3 are consistent with our main results in Table 2, further supporting our hypotheses. In addition, as R&D investments vary significantly across different industries, we adjusted our original R&D intensity by subtracting the two-digit industry average R&D intensity by year (Kotlar et al., 2014). Then, we reran our models using the industry adjusted R&D-to-sales measure. As shown in Models 4 to 6 in Table 4, the results still hold. Furthermore, we followed prior studies (Block, 2012) and also measured our dependent variable by computing the R&D-to-assets ratio. As shown in Table 4, the significant results in Models 7 and 9 are consistent with our main findings, except for H2. It suggests that the moderation of family member as chairperson in the board is not significant when R&D investments are measured by the R&D-to-assets ratio. Although there is a difference between R&D-to-sales ratio and R&D-to-assets ratio, R&D-to-sales ratio is still the most accepted measure in the innovation studies (Chrisman & Patel, 2012; Gomez-Mejia et al., 2014; Greve, 2003; Kim et al., 2008).

/Insert Table 4 about here/

Test for alternative estimation regression models. Due to the panel data structure in the study, we also reran our models in Table 2 using panel fixed-effect[10] and random-effect estimation method. The consistent results in **Table A1** confirms that our analyses are not sensitive to different estimation models, lending strong support to our hypotheses.

Test for Sample selection bias due to missing values. As mentioned above, sample selection bias may be present among firms due to the missing value of birth order information (Heckman, 1979). We, therefore, adopted the Heckman two-stage model to account for such potential non-random sampling bias. Our first-stage probit model predicted the presence of birth order information of the family owner. We included firm size, firm age, family ownership, board size, and institutional environment in the first stage. In addition, the appropriate application of Heckman two-stage model is identifying exclusion restrictions that are correlated with the dependent variable in the first-stage regression but not with R&D intensity in the second-stage model (Certo et al., 2016). We selected one instrument: *Industry likelihood of having birth order information* within the two-digit industry[11]. We expect it may be significantly associated with the presence of birth order information while it is unlikely to relate to the focal firm's innovation investments. As shown in Panel A of **Table A2**, the correlation between *Industry likelihood of having birth order information* and *The presence of birth order information* is 0.201 ($p < 0.001$); in Panel B, the coefficients on *Industry likelihood of having birth order information* ($p < 0.001$) is significant and positive. Both results suggest the validity of our instrument. We then included the predicted inverse Mills ratio from the first-stage regression in the second stage of the model. In Models 1-3 of **Table A3**, our results still hold although controlling for sample selection bias.

Test for additional firm-level controls. Given the small sample size, we were aware of a potential over-fitting issue of the model estimation. Therefore, we only included firm size and firm age as controls at the firm level in the primary results. Besides, we also followed previous studies to include *Prior performance*, *Financial slack*, and *Cash* which all indicate resource munificence of the firm that may encourage R&D investments. Aligned with prior literature (Greve, 2003; Chrisman & Patel, 2012), we measured *Financial slack* as the ratio of current assets to current liabilities. *Cash* was measured as the ratio of cash assets to total assets (Block, 2012; Gomez-Mejia et al., 2014). *Prior performance* was measured by return on assets (ROA) achieved in the prior year (Chrisman & Patel, 2012; Yu et al., 2019). In Models 4-6 of **Table A3**, the results are still consistent with our main results. Therefore, the additional firm-level controls do not change our results.

Discussion

Birth order, which encapsulates an individual's risk-preferences in the family domain, substantially impacts family firms' R&D investments. Drawing on the family-niche model of birth order and socioemotional wealth perspective, we found evidence that family owners born later are more actively investing in R&D projects. We also conjectured that this positive relationship is constrained when there is a family member as the chairperson of the board. In contrast, when there is an owner-CEO duality in family firms, the positive birth order effect is enhanced.

Theoretical Implications

This study makes the three primary contributions to family firm innovation literature. First, we introduce birth order as a pivotal but primarily ignored family science factor to shed light on the debate over family firm innovation. Although prior studies have provided a wealth of insights to understand family firm innovation behaviours, the dominant research has largely focused on

how family ownership or family management affect R&D investments (Calabrò et al., 2019; Chrisman et al., 2015; De Massis et al., 2013). Our results suggest that ignoring family science factors (i.e., birth order of owner) would downplay the important individual differences which account for significant variances in family firms' R&D investments. Building on the family-niche model of birth order, we theorize that birth order reflects how siblings compete within a family, which in turn shapes the siblings' risk-taking tendencies in adulthood. Specifically, we suggest that earlier-born owners are more conservative about R&D investments, while later-born owners are more likely to be active innovators. This is of great importance to providing a nascent explanation for heterogeneities arising from the family background.

On the other hand, by adding birth order into family business research, we diverge from prior literature by shifting the conversation from traditional organizational factors to family-specific factors in understanding the variances of R&D investments (Dyer, 2003; Jaskiewicz et al., 2017). Although it is well accepted that family firms differ from non-family firms in that they simultaneously operate under business and familial principles (Gomez-Mejia et al., 2007; Jess H Chua et al., 1999), there is a dearth of research incorporating the family side of the story. As noted, "if organizational scholars do not account for the family as a variable in their research, they will be incapable of accounting for the behaviour of a significant population of organizations they purport to understand" (Dyer, 2003: 404). In the current study, our conceptualization of birth order effects highlights the importance of factors from the family science field in studying family innovation behaviours. This also responds to calls for leveraging family science theories to understand family firms' behaviours in specific (Calabrò et al., 2019; Soleimanof et al., 2018) and management phenomena in general (Jaskiewicz et al., 2017).

Second, our modelling of owner, chairperson, CEO together in the article provides a more comprehensive picture of how these three crucial roles in family firms jointly shape firms' innovation investments. While scholars have separately noted the critical impact of family board member and family CEO/executives on innovation decisions (e.g., Bendig et al., 2020; Duran et al., 2016; Jiang et al., 2020; Matzler et al., 2015), limited studies are integrating the role of the family owner, family board member and family manager on innovation. Our results suggest that later-born owners tend to invest more in R&D, and such a relationship is constrained when there is a family member as the chairperson; it is enhanced when the owner is also a CEO in the family firm. By examining the three powerful roles together, we elaborate on how the 'pulling' roles (i.e., family chairperson) and the 'pushing' roles (i.e., CEO) interact with family owner roles, which ultimately influence family firms' innovation decisions. Moreover, such weakening and strengthening moderations also respond to De Massis et al. (2014)'s call for jointly considering family firms' willingness (i.e., birth order) and ability (i.e., family member as the chairperson of the board and owner-CEO duality) when investigating behaviour heterogeneities among family firms (e.g., innovation investments).

Furthermore, we are also aware that our study shares similar findings with Campbell et al. (2019) that early-born CEOs will take fewer risks than later-born CEOs. However, not every CEO is the owner, as well as not every owner in family firms is the CEO. Our focus on owner's birth order and its interaction with owner-CEO duality advances their work by illustrating CEO's birth order impact is not only direct but could also be indirect by serving as a significant boundary in the relationship between owner's birth order and innovation investments. Specifically, we find that the owner's birth order impact is stronger when the owner is also a CEO. Such finding highlights the importance to consider the two roles in the study jointly.

Finally, our findings also advance family innovation literature, since it is generally undertaken in Western countries (Munari et al., 2010; Schmid et al., 2014; Sciascia et al., 2015) rather than in transition economies such as China. As noted, family firms comprise the majority of publicly traded firms in the world and at least two-thirds of all businesses around the world (Campbell et al., 2019). In Western countries, family firms usually have a long history. In contrast, in transition economies like China, family firms have been formed relatively recently. However, rapid formation and increasing development make them of great importance to the nation's innovation competitiveness, as well as to the global economy (Jiang et al., 2020). Our results on the groups of family firms in transition economies add nascent evidence to previous settings, extending our understanding of family firms' innovation behaviours.

Managerial Implications

Along with the theoretical contributions, we also offer practical insights into how R&D investments are made by family firms' executives. Top decision-makers in family firms not only focus on maintaining a strong and competitive business but as members of the family, they also need to guarantee the longevity of the company by avoiding unnecessary risks and enabling successors to benefit from the achievements obtained by the previous generations.

The findings presented in this study inform owners, practitioners, and advisors about the role that family ownership has toward innovation behaviours, especially in developing economies. More specifically, our study empirically assesses how the birth order of the owner, as an important family science factor, determines R&D decisions heterogeneities among family businesses. As a result of birth order, individuals experience family relationships in dissimilar ways and develop different dispositions and tendencies that will have an enduring and persistent impact on how they make decisions in adulthood, including the tendency of risk-taking behaviours. Our results confirm that first-born owners are more conservative about R&D

investments, while later-born owners are more likely to be active innovators. Furthermore, we also suggest the roles of two other influential decision-makers within the company to better identify the impact that altogether family owner, family board member, and family executives have on shaping a firm's innovation investments. When later-born owners are also the CEOs of the company, they can exercise more freedom to authorize R&D projects without constantly being questioned by the board. In contrast, when later-born owners are not CEOs, they may face excessive pressure and monitoring from the board, which will eventually prevent the company from adequately investing in innovation projects. This awareness will guide family business' executives and consultants toward more effective managerial decisions on R&D investments.

Limitations and Future Research

As with all research, our study suffers from several limitations, which offer opportunities for future research. First, owing to data availability, we were not able to gain detailed information on siblings in family firms. Authors of future studies could extend our research by investigating different sibling rivalry contingencies, such as sibling age gaps and the death of siblings. An example of a promising study in this field could be analysing potential linkages between birth order, the 'Fredo effect' among family members and innovation decisions (Kidwell et al., 2012). Second, birth order can be viewed as both a biological and psychological factor (Shulman & Mosak, 1977). That is, biological birth order changes when siblings are born or die, but psychological birth order most substantially influences individual personality. Our data restricted our test of biological birth order, while future researchers could deepen and expand our findings by considering psychological birth order. Furthermore, we did not have data on owner's religiosity or location of child-rearing. Therefore, despite the inclusion of two control variables in the model, we could not fully capture the level of conservatism of the family firms. Future researchers might validate the birth order impact by controlling for more individual-level

factors that constrain or enable R&D investments. Third, as our focus is family firms, we decided to study owner's birth order which has been understudied in the past. However, due to data limitations, we could not utilise the CEO's birth order information and compare the owner birth order impact with the CEO birth order impact. We encourage researchers in future studies to compare these two important decision-makers' birth orders and investigate their independent and collective impacts on family firms' innovation decisions. Fourth, our arguments in this study may also vary depending on whether R&D investments are exploitative or exploratory (Patel & Chrisman, 2014). We focused on the overall R&D investments, so our research could be expanded to observe how birth order influences different types of R&D investment, depending on available data. Finally, studying birth order effects in family firms in China has some limitations. On the one hand, it prevented us from examining family firms that have survived for several generations. We believe future research can extend our study to other country contexts such as Italy, Australia, and United States and further investigate the complexities arising from having different generations of owners. For example, in the presence of various generations, the birth order effect may be different between owners who inherited their business from a previous generation and non-inherited owners. It will be promising to test whether our birth order effect still holds in the presence of multiple generations. Moreover, gender is a significant factor in considering the influence of birth order. However, because women are extremely underrepresented in our sample, we failed to explore the gender impacts on R&D investments. Future studies can compare our results against different country contexts where female leadership is a more common practice in family firms.

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Table 1. Descriptive statistics and correlations

Variables	*N*	*Mean*	*Std.*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. R&D intensity	621	0.04	0.05	1															
2. Owner birth order	621	1.52	0.89	-0.026	1														
3. Owner-CEO duality	621	0.37	0.48	0.217	-0.049	1													
4. Family members chairperson	621	0.09	0.29	-0.058	0.115	-0.22	1												
5. Family size	621	2.82	1.05	-0.127	0.546	-0.109	0.14	1											
6. Family ownership	621	0.41	0.14	-0.004	-0.123	0.168	-0.047	-0.049	1										
7. Generation	621	0.15	0.36	-0.137	0.159	-0.168	0.134	0.081	-0.063	1									
8. Communist party membership	621	0.33	0.47	-0.19	0.242	-0.234	0.06	0.135	-0.058	0.034	1								
9. Owner education	621	5.05	1.23	0.134	-0.131	0.114	0.0	-0.267	0.078	-0.022	-0.158	1							
10. First child gender	621	0.84	0.36	-0.102	-0.437	-0.057	-0.001	-0.193	0.048	-0.108	-0.008	0.065	1						
11. Owner-based firm name	621	0.1	0.3	-0.082	0.082	-0.094	0.131	0.018	-0.008	0.291	0.076	-0.015	0.015	1					
12. Firm age	621	10.83	4.91	-0.092	0.04	-0.088	0.158	-0.028	-0.272	0.16	0.056	0.06	-0.012	0.049	1				
13. Firm size[a]	621	7.55	1.08	-0.179	0.246	-0.214	0.009	0.2	-0.01	0.113	0.123	-0.007	-0.022	0.09	-0.025	1			
14. Board size	621	8.56	1.5	-0.051	-0.018	-0.152	0.011	0.064	-0.062	0.162	0.154	-0.075	-0.02	0.191	0.056	0.184	1		
15. Lone founder	621	0.31	0.46	-0.037	0.182	-0.102	-0.045	0.007	-0.214	0.161	0.111	-0.043	-0.171	-0.067	0.242	0.010	0.113	1	
16. Institutional environment	621	7.6	1.39	0.144	0.047	0.149	-0.002	-0.044	0.111	-0.034	-0.045	-0.116	-0.092	0.022	-0.017	-0.058	-0.105	-0.124	1

Note: Correlations greater than |0.081| are significant at $p < .05$. [a] Natural logarithm

Table 2. FGLS regression predicting R&D investments

	Model 1	Model 2	Model 3	Model 4	Model 5
Family size	-0.0028***	-0.0043***	-0.0038***	-0.0034***	-0.0036***
	(0.0004)	(0.0006)	(0.0005)	(0.0004)	(0.0004)
First child gender	-0.0172***	-0.0127***	-0.0116***	-0.0098***	-0.0094***
	(0.0010)	(0.0014)	(0.0014)	(0.0014)	(0.0015)
Communist party membership	-0.0071***	-0.0090***	-0.0091***	-0.0079***	-0.0092***
	(0.0009)	(0.0008)	(0.0008)	(0.0008)	(0.0009)
Owner-based firm name	-0.0134***	-0.0120***	-0.0097***	-0.0136***	-0.0143***
	(0.0013)	(0.0012)	(0.0012)	(0.0020)	(0.0021)
Family ownership	-0.0089***	-0.0062**	-0.0081***	-0.0038*	0.0005
	(0.0023)	(0.0024)	(0.0024)	(0.0022)	(0.0023)
Generation	-0.0049***	-0.0057***	-0.0075***	-0.0042***	-0.0038***
	(0.0010)	(0.0012)	(0.0013)	(0.0013)	(0.0013)
Owner education	0.0051***	0.0049***	0.0051***	0.0048***	0.0055***
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Firm age	-0.0010***	-0.0009***	-0.0008***	-0.0009***	-0.0009***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm size	-0.0046***	-0.0049***	-0.0058***	-0.0058***	-0.0051***
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Board size	0.0011***	0.0011***	0.0011***	0.0015***	0.0016***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Lone founder	-0.0007	-0.0027***	-0.0019**	-0.0011	-0.0011
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Institutional environment	0.0007**	0.0004	0.0006**	0.0006***	0.0009***
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Owner-CEO duality	0.0049***	0.0044***	0.0038***	-0.0045***	-0.0012
	(0.0005)	(0.0006)	(0.0006)	(0.0011)	(0.0012)
Family members chairperson	0.0043***	0.0043***	0.0116***	0.0055***	0.0088***
	(0.0014)	(0.0015)	(0.0020)	(0.0013)	(0.0020)
Owner birth order		0.0048***	0.0057***	0.0026***	0.0055***
		(0.0008)	(0.0008)	(0.0008)	(0.0009)
Owner birth order × Family member chairperson			-0.0043***		-0.0026***
			(0.0007)		(0.0008)
Owner birth order × Owner-CEO duality				0.0064***	0.0035***
				(0.0007)	(0.0008)
Observations	605	605	605	605	605
The number of firms	155	155	155	155	155
Chi-square	1.2e+06***	5.8e+03***	7.2e+03***	1.1e+07***	4.2e+11***

Note: This table presents results using time–series feasible generalized least square (FGLS) model. Year, industry dummies and constant are included in all specifications. Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Table 3. Robust tests: alternative operationalization of family firms

	20% Family ownership			30% Family ownership			30% Family ownership and family influence		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Family size	-0.0044***	-0.0041***	-0.0031***	-0.0037***	-0.0032***	-0.0031***	-0.0049***	-0.0049***	-0.0047***
	(0.0006)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0005)	(0.0007)	(0.0007)	(0.0007)
First child gender	-0.0120***	-0.0083***	-0.0093***	-0.0077***	-0.0082***	-0.0076***	-0.0070***	-0.0063***	-0.0051**
	(0.0015)	(0.0016)	(0.0017)	(0.0021)	(0.0020)	(0.0024)	(0.0017)	(0.0015)	(0.0023)
Communist party membership	-0.0090***	-0.0106***	-0.0092***	-0.0066***	-0.0108***	-0.0071***	-0.0036***	-0.0061***	-0.0045***
	(0.0009)	(0.0009)	(0.0009)	(0.0011)	(0.0010)	(0.0009)	(0.0011)	(0.0010)	(0.0013)
Owner-based firm name	-0.0121***	-0.0115***	-0.0135***	-0.0191***	-0.0158***	-0.0171***	-0.0178***	-0.0183***	-0.0171***
	(0.0013)	(0.0013)	(0.0019)	(0.0021)	(0.0017)	(0.0020)	(0.0020)	(0.0021)	(0.0017)
Family ownership	-0.0088***	-0.0099***	-0.0040	-0.0177***	-0.0136***	-0.0161***	-0.0199***	-0.0208***	-0.0171***
	(0.0024)	(0.0022)	(0.0025)	(0.0033)	(0.0033)	(0.0028)	(0.0033)	(0.0031)	(0.0034)
Generation	-0.0049***	-0.0065***	-0.0036**	-0.0040**	-0.0051***	-0.0013	-0.0012	-0.0026*	0.0001
	(0.0013)	(0.0013)	(0.0014)	(0.0019)	(0.0017)	(0.0017)	(0.0016)	(0.0015)	(0.0017)
Owner education	0.0050***	0.0054***	0.0045***	0.0011**	0.0007	0.0002	0.0016***	0.0010**	0.0004
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)
Firm age	-0.0010***	-0.0010***	-0.0009***	-0.0010***	-0.0009***	-0.0011***	-0.0012***	-0.0011***	-0.0012***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm size	-0.0044***	-0.0045***	-0.0050***	-0.0061***	-0.0064***	-0.0058***	-0.0056***	-0.0061***	-0.0055***
	(0.0004)	(0.0005)	(0.0003)	(0.0004)	(0.0005)	(0.0003)	(0.0004)	(0.0003)	(0.0004)
Board size	0.0011***	0.0014***	0.0012***	0.0003	0.0003	0.0001	0.0003	0.0004*	0.0003
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Lone founder	-0.0025**	-0.0020**	-0.0013	0.0056***	0.0071***	0.0042***	0.0055***	0.0045***	0.0036***
	(0.0010)	(0.0010)	(0.0010)	(0.0013)	(0.0012)	(0.0013)	(0.0013)	(0.0012)	(0.0013)
Institutional environment	0.0001	0.0009***	0.0002	0.0012***	0.0022***	0.0011***	0.0010***	0.0015***	0.0008**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Owner-CEO duality	0.0049***	0.0049***	-0.0032***	0.0025***	0.0025***	-0.0064***	0.0033***	0.0033***	-0.0060***
	(0.0006)	(0.0006)	(0.0011)	(0.0008)	(0.0008)	(0.0018)	(0.0009)	(0.0007)	(0.0021)
Family members chairperson	0.0042***	0.0114***	0.0047***	0.0052***	0.0168***	0.0072***	0.0062***	0.0108***	0.0067***
	(0.0015)	(0.0021)	(0.0013)	(0.0017)	(0.0026)	(0.0016)	(0.0016)	(0.0027)	(0.0016)
Owner birth order	0.0049***	0.0074***	0.0026***	0.0022**	0.0039***	0.0001	0.0023**	0.0047***	0.0015
	(0.0009)	(0.0008)	(0.0009)	(0.0010)	(0.0010)	(0.0012)	(0.0011)	(0.0011)	(0.0012)
Owner birth order × Family member chairperson		-0.0046***			-0.0054***			-0.0025**	
		(0.0006)			(0.0010)			(0.0011)	
Owner birth order × Owner-CEO duality			0.0057***			0.0070***			0.0068***
			(0.0007)			(0.0014)			(0.0016)
Observations	577	577	577	441	441	441	419	419	419
The number of firms	152	152	152	123	123	123	117	117	117
Chi-square	1.4e+05***	7.7e+09***	8.6e+05***	3.9e+03***	4.0e+03***	2.9e+04***	4.8e+03***	1.1e+04***	6.6e+04***

Note: This table presents results using time–series feasible generalized least square (FGLS) model. Year, industry dummies and constant are included in all specifications. Standard errors in parentheses.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Table 4. Robust tests: Alternative measures for dependent variable and independent variable

	IV: Birth order ratio			DV: Industry-adjusted R&D-to-sales ratio			DV: R&D-to-assets ratio		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Family size	-0.0008**	-0.0004	-0.0010**	-0.0020***	-0.0019***	-0.0010**	-0.0010***	-0.0009***	-0.0010***
	(0.0004)	(0.0003)	(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0003)	(0.0003)	(0.0003)
First child gender	-0.0103***	-0.0096***	-0.0062***	-0.0098***	-0.0082***	-0.0085***	-0.0075***	-0.0082***	-0.0078***
	(0.0014)	(0.0012)	(0.0016)	(0.0010)	(0.0009)	(0.0012)	(0.0008)	(0.0008)	(0.0009)
Communist party membership	-0.0102***	-0.0107***	-0.0083***	-0.0082***	-0.0090***	-0.0078***	-0.0033***	-0.0034***	-0.0034***
	(0.0008)	(0.0007)	(0.0009)	(0.0008)	(0.0007)	(0.0007)	(0.0004)	(0.0004)	(0.0004)
Owner-based firm name	-0.0127***	-0.0109***	-0.0124***	-0.0114***	-0.0092***	-0.0123***	-0.0045***	-0.0032***	-0.0039***
	(0.0016)	(0.0018)	(0.0017)	(0.0011)	(0.0009)	(0.0013)	(0.0004)	(0.0005)	(0.0004)
Family ownership	-0.0076***	-0.0091***	-0.0005	-0.0050***	-0.0062***	-0.0062***	0.0022*	0.0026**	0.0035***
	(0.0021)	(0.0024)	(0.0022)	(0.0018)	(0.0017)	(0.0024)	(0.0013)	(0.0011)	(0.0013)
Generation	-0.0052***	-0.0056***	-0.0035***	-0.0005	-0.0014	0.0010	0.0001	-0.0008	-0.0007
	(0.0012)	(0.0013)	(0.0012)	(0.0011)	(0.0010)	(0.0011)	(0.0004)	(0.0006)	(0.0005)
Owner education	0.0052***	0.0057***	0.0047***	0.0057***	0.0052***	0.0038***	0.0023***	0.0024***	0.0021***
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Firm age	-0.0009***	-0.0009***	-0.0007***	-0.0007***	-0.0006***	-0.0007***	-0.0004***	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
Firm size	-0.0053***	-0.0057***	-0.0047***	-0.0051***	-0.0050***	-0.0049***	0.0004***	0.0001	0.0001
	(0.0004)	(0.0004)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0001)	(0.0002)	(0.0002)
Board size	0.0012***	0.0015***	0.0013***	0.0020***	0.0016***	0.0014***	0.0001	0.0001*	0.0002***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Lone founder	-0.0026***	-0.0027***	-0.0015*	-0.0013*	-0.0006	-0.0001	0.0004*	0.0005	0.0006
	(0.0008)	(0.0008)	(0.0008)	(0.0007)	(0.0006)	(0.0009)	(0.0002)	(0.0004)	(0.0005)
Institutional environment	0.0004	0.0004	0.0005	0.0005**	-0.0002	0.0001	0.0011***	0.0012***	0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0001)	(0.0001)	(0.0001)
Owner-CEO duality	0.0040***	0.0035***	-0.0169***	0.0019***	0.0030***	-0.0048***	-0.0012***	-0.0011***	-0.0027***
	(0.0006)	(0.0006)	(0.0018)	(0.0006)	(0.0005)	(0.0013)	(0.0002)	(0.0003)	(0.0008)
Family members chairperson	0.0042***	0.0144***	0.0057***	-0.0013	0.0075***	0.0022*	0.0010***	0.0026**	0.0017***
	(0.0015)	(0.0025)	(0.0007)	(0.0016)	(0.0027)	(0.0013)	(0.0003)	(0.0011)	(0.0004)
Owner birth order	0.0198***	0.0226***	0.0054**	0.0043***	0.0054***	0.0015*	0.0035***	0.0037***	0.0027***
	(0.0022)	(0.0023)	(0.0026)	(0.0007)	(0.0006)	(0.0008)	(0.0005)	(0.0005)	(0.0005)
Owner birth order × Family member chairperson		-0.0207***			-0.0032***			-0.0009	
		(0.0039)			(0.0008)			(0.0008)	
Owner birth order × Owner-CEO duality			0.0405***			0.0054***			0.0014**
			(0.0042)			(0.0009)			(0.0007)
Observations	605	605	605	605	605	605	605	605	605
The number of firms	155	155	155	155	155	155	155	155	155
Chi-square	8.2e+03***	6.3e+03***	1.1e+04***	4.8e+03***	5.8e+04***	8.7e+03***	8.3e+05***	1.2e+05***	1.6e+05***

Note: This table presents results using time–series feasible generalized least square (FGLS) model. Year, industry dummies and constant are included in all specifications. Standard errors in parentheses. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

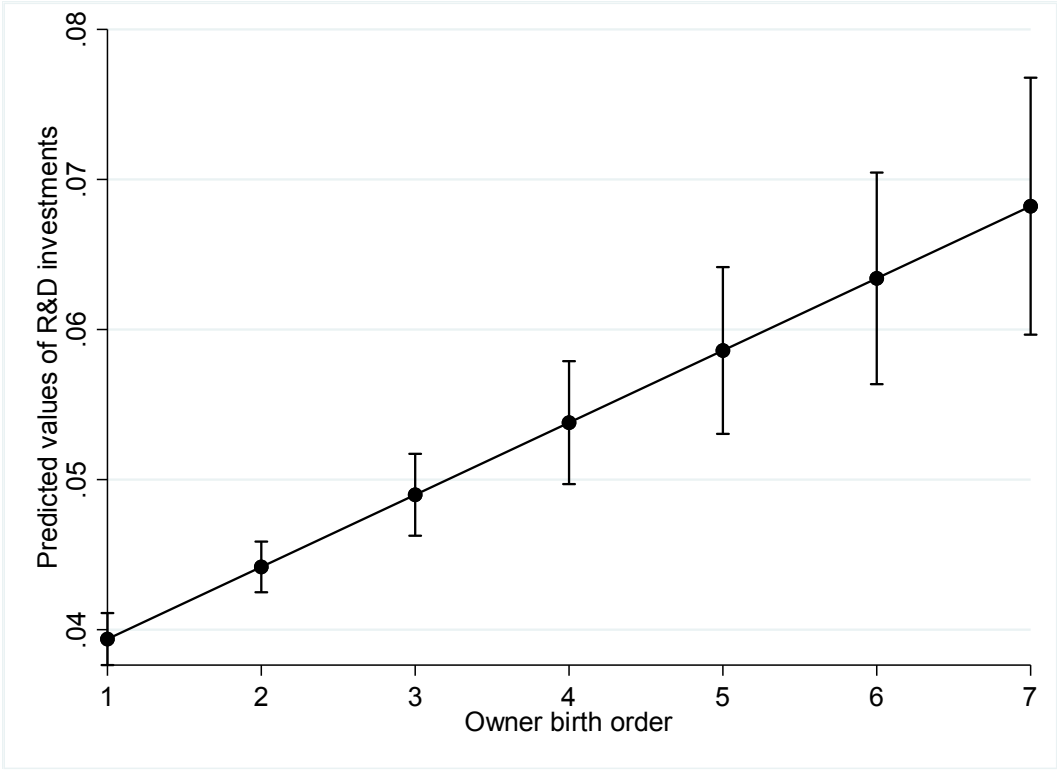

Figure 1. The main effect of owner birth order (95% confidence interval)

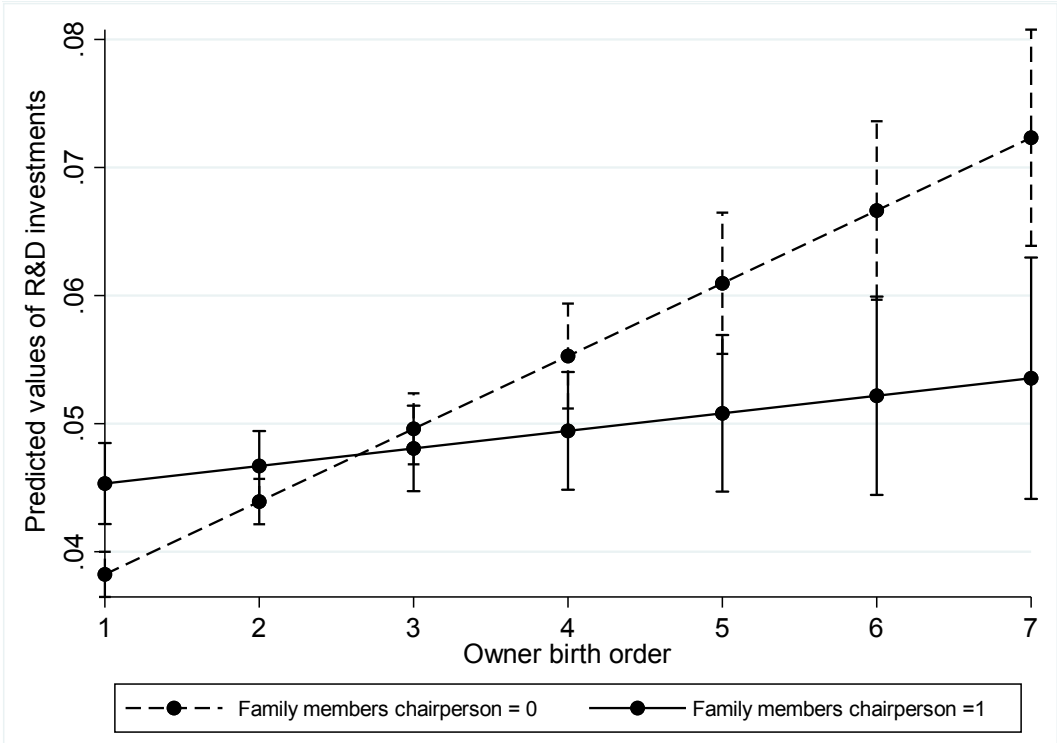

Figure 2. The moderation effect of family members chairperson (95% confidence interval)

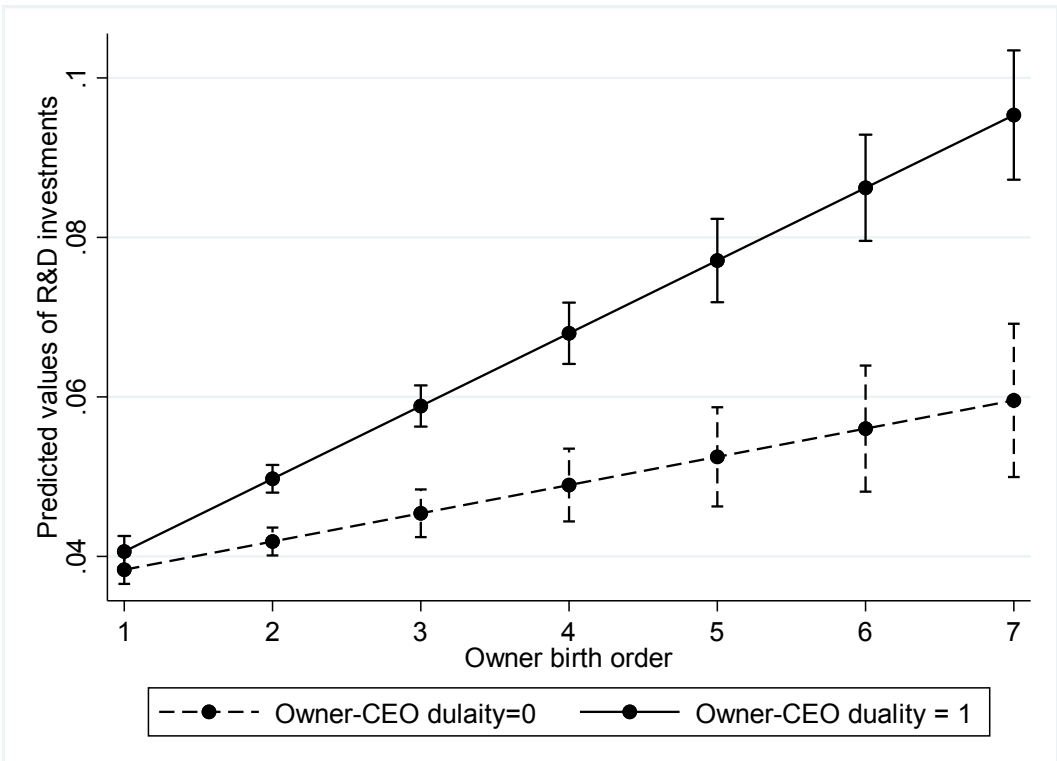

Figure 3. The moderation effect of Owner-CEO duality (95% confidence interval)

APPENDIX A

Table A1. Robust tests: Alternative regression models

	Panel fixed-effect model			Panel Random-effect model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Family size	-0.0084*	-0.0085*	-0.0100	-0.0043	-0.0043	-0.0045
	(0.0051)	(0.0050)	(0.0064)	(0.0031)	(0.0031)	(0.0031)
First child gender				-0.0085	-0.0089	-0.0044
				(0.0118)	(0.0118)	(0.0116)
Communist Party membership				-0.0145***	-0.0144***	-0.0153***
				(0.0045)	(0.0045)	(0.0046)
Owner-based firm name				-0.0102	-0.0091	-0.0082
				(0.0062)	(0.0063)	(0.0065)
Family ownership	-0.0025	-0.0024	0.0018	-0.0046	-0.0040	-0.0025
	(0.0099)	(0.0099)	(0.0100)	(0.0084)	(0.0084)	(0.0085)
Generation	-0.0037	-0.0031	-0.0040	-0.0041	-0.0037	-0.0031
	(0.0037)	(0.0036)	(0.0037)	(0.0029)	(0.0029)	(0.0030)
Owner education	-0.0021	-0.0021	-0.0029	0.0022	0.0022	0.0007
	(0.0031)	(0.0031)	(0.0040)	(0.0020)	(0.0020)	(0.0022)
Firm age	0.0041***	0.0041***	0.0040***	-0.0011***	-0.0011**	-0.0010**
	(0.0007)	(0.0007)	(0.0007)	(0.0004)	(0.0004)	(0.0004)
Firm size	-0.0017	-0.0015	-0.0015	-0.0035*	-0.0034*	-0.0038*
	(0.0030)	(0.0030)	(0.0029)	(0.0020)	(0.0020)	(0.0020)
Board size	0.0010	0.0010	0.0008	0.0013	0.0013	0.0014
	(0.0012)	(0.0012)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Lone founder	-0.0056	-0.0056	-0.0057	-0.0038	-0.0036	-0.0034
	(0.0041)	(0.0040)	(0.0040)	(0.0042)	(0.0042)	(0.0042)
Institutional environment	-0.0059*	-0.0061**	-0.0052*	-0.0010	-0.0010	-0.0007
	(0.0030)	(0.0030)	(0.0029)	(0.0018)	(0.0018)	(0.0017)
Owner-CEO duality	-0.0101*	-0.0102*	-0.0340**	-0.0069	-0.0069	-0.0225**
	(0.0055)	(0.0055)	(0.0151)	(0.0050)	(0.0050)	(0.0102)
Family members chairperson	0.0023	0.0091***	0.0021	0.0020	0.0084***	0.0023
	(0.0030)	(0.0030)	(0.0030)	(0.0025)	(0.0027)	(0.0024)
Owner birth order	0.0064***	0.0064***	0.0065***	0.0061***	0.0064***	0.0032
	(0.0012)	(0.0012)	(0.0011)	(0.0023)	(0.0023)	(0.0028)
Owner birth order × Family members chairperson		-0.0040***			-0.0037***	
		(0.0012)			(0.0011)	
Owner birth order × Owner-CEO duality			0.0194*			0.0121**
			(0.0109)			(0.0060)
Observations	621	621	621	621	621	621
The number of firms	171	171	171	171	171	171
R square (between)	0.0146	0.0150	0.0035	0.4372	0.4377	0.4380

R square (within)	0.1590	0.1614	0.1740	0.1501	0.1523	0.1624

Note: blanks in Model 1, 2, and 3 are because the variables are time invariant and cannot be estimated in panel fixed-effects model. Year, industry dummies and constant are included in all specifications. Robust standard errors in parentheses. The * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Table A2. Heckman First stage regression results

Panel A: Descriptive statistics and correlations in the first stage

Variables	1	2	3	4	5	6	7
1. The presence of birth order information	1						
2. Firm age	-0.067	1					
3. Firm size[a]	0.115	-0.113	1				
4. Family ownership	0.076	-0.235	0.122	1			
5. Board size	0.015	-0.039	0.198	-0.106	1		
6. Institutional environment	0.026	-0.026	0.09	0.189	-0.057	1	
7. Industry likelihood of having birth order information	0.201	-0.032	0.098	0.066	0.056	0.042	1

Note: Correlations greater than |0.026| are significant at $p < .05$. [a] Natural logarithm

Panel B: Heckman first stage regression results

	Model 1 (DV: The presence of birth order information)
Firm age	-0.0131
	(0.0082)
Firm size	0.1266***
	(0.0343)
Family ownership	0.3999*
	(0.2209)
Board size	-0.0108
	(0.0234)
Institutional environment	0.0071
	(0.0265)
Industry likelihood of having birth order information	3.6459***
	(0.5268)
Constant	-2.4951***
	(0.6504)
Observations	8850
Log Likelihood	-4.1e+03
Wald Chi-square	105.4678***

Table A3. Robust tests: Heckman models and additional firm-level controls

	Heckman second-stage model			Additional firm-level controls		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Family size	-0.0031***	-0.0027***	-0.0023***	-0.0042***	-0.0044***	-0.0032***
	(0.0005)	(0.0004)	(0.0004)	(0.0007)	(0.0007)	(0.0007)
First child gender	-0.0111***	-0.0114***	-0.0100***	-0.0054***	-0.0062***	-0.0058***
	(0.0013)	(0.0013)	(0.0014)	(0.0019)	(0.0018)	(0.0019)
Communist party membership	-0.0089***	-0.0096***	-0.0086***	-0.0041***	-0.0059***	-0.0049***
	(0.0008)	(0.0007)	(0.0008)	(0.0012)	(0.0012)	(0.0012)
Owner-based firm name	-0.0135***	-0.0108***	-0.0133***	-0.0111***	-0.0088***	-0.0080***
	(0.0011)	(0.0012)	(0.0016)	(0.0020)	(0.0019)	(0.0019)
Family ownership	0.0001	-0.0005	0.0024	-0.0169***	-0.0146***	-0.0081**
	(0.0024)	(0.0025)	(0.0021)	(0.0036)	(0.0034)	(0.0038)
Generation	-0.0066***	-0.0085***	-0.0068***	-0.0051***	-0.0049***	-0.0046***
	(0.0012)	(0.0012)	(0.0014)	(0.0013)	(0.0013)	(0.0013)
Owner education	0.0051***	0.0055***	0.0046***	0.0029***	0.0020***	0.0019***
	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0005)
Firm age	-0.0012***	-0.0011***	-0.0011***	-0.0008***	-0.0008***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm size	-0.0022***	-0.0031***	-0.0032***	-0.0025***	-0.0024***	-0.0032***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0006)
Board size	0.0010***	0.0010***	0.0011***	0.0012***	0.0012***	0.0006**
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Lone founder	-0.0030***	-0.0020**	0.0003	-0.0034***	-0.0020*	-0.0011
	(0.0009)	(0.0008)	(0.0007)	(0.0011)	(0.0011)	(0.0011)
Institutional environment	0.0006*	0.0007**	0.0009***	0.0014***	0.0015***	0.0017***
	(0.0003)	(0.0003)	(0.0002)	(0.0004)	(0.0004)	(0.0004)
Inverse Mills Ratio	0.0225***	0.0216***	0.0215***			
	(0.0023)	(0.0023)	(0.0026)			
Prior performance				0.0059*	0.0072**	0.0072**
				(0.0035)	(0.0032)	(0.0032)
Financial slack				0.0002*	0.0002*	0.0001
				(0.0001)	(0.0001)	(0.0001)
Cash				0.0367***	0.0362***	0.0330***
				(0.0027)	(0.0027)	(0.0028)
Owner-CEO duality	0.0046***	0.0042***	-0.0036***	0.0014	0.0014	-0.0091***
	(0.0006)	(0.0005)	(0.0012)	(0.0009)	(0.0009)	(0.0016)
Family members chairperson	0.0033**	0.0110***	0.0045***	0.0040**	0.0121***	0.0042**
	(0.0015)	(0.0023)	(0.0013)	(0.0017)	(0.0028)	(0.0017)
Owner birth order	0.0044***	0.0050***	0.0012	0.0032***	0.0055***	0.0010
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)	(0.0010)
Owner birth order × Family members chairperson		-0.0042***			-0.0043***	

		(0.0008)			(0.0011)	
Owner birth order × Owner-CEO duality			0.0061***			0.0080***
			(0.0007)			(0.0012)
Observations	605	605	605	605	605	605
The number of firms	155	155	155	155	155	155
Chi-square	7.0e+03***	9.3e+03***	4.7e+04***	2.5e+03***	4.2e+03***	8.1e+03***

Note: Robust standard errors in parentheses. Year, industry dummies and constant are included in all specifications. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

[1] Detailed explanations could be seen in the Methodology section.

[2] See detailed reviews from Gomez-Mejia et al. (2011) and Berrone, Cruz, and Gomez-Mejia (2012).

[3] For a comprehensive review, see De Massis et al. (2013) and Calabrò et al. (2019).

[4] China privately operated economy research association family business research group. 2019. Report on China Family Business Ecology for 40 Years. Beijing: China Industrial and Commercial United Press. (In Chinese)

[5] For sensitivity test, we also used 20% and 30% as a cutoff point. The details will be discussed in the Robust Tests section.

[6] Although the age of the ultimate owner is not available, the average age of owners is 44.4 both in 2006 and in 2016 according to the nation-wide survey of Chinese POEs conducted by the privately owned enterprises research project team in China (over 80% of POEs in China are family controlled).

[7] The ultimate family owner in our study is defined as the owner who has the determining voting rights in the company. In most cases, there are only one ultimate owner in the company. If there is more than one ultimate owner (the maximum count is 2 in our sample and only accounts for 4.35%), we restricted our focus to the dominant owner, who has dominant share in the company. In order to test the sensitivity to such treatment, we re-ran our models adding the number of owners in the family firms as control variables; these results are consistent with the main results. As a concern of overfitting of the variable, we didn't include the variable in the main results. The results are available upon request.

[8] Due to the sample size of the study, we are aware of potential overfitting issues in our models. Therefore, we only control for firm age and firm size as basic firm-level controls. However, we also notice the importance of other firm-level controls. Therefore, we examine other firm-level controls and test the consistency of our results in the Robust Tests section.

[9] Exchange rate is 1 RMB = 0.15 US dollars, based on 28 Jan 2021.

[10] It should be noted that as some control variables are invariant across years, the coefficients on these variables cannot be estimated in the panel fixed-effect models.

[11] This measure includes the focal firm. The results are still consistent when we excluded the focal firm. Results are available on request.