Received: 1 May 2025 | Revised: 13 August 2025 | Accepted: 20 August 2025

DOI: 10.1111/irfi.70039

ORIGINAL ARTICLE

INTERNATIONAL REVIEW OF FINANCE WILEY

State ownership and green innovation in family firms

Ying Tang[1,2] | Tingting Yang[1] | Jinyu Chen[3,4] | Zhiyong Li[1,2,5]

[1]School of Finance, Southwestern University of Finance and Economics, Chengdu, China

[2]Engineering Research Center of Intelligent Finance and Laboratory of Philosophy and Social Sciences at SWUFE, Ministry of Education, Chengdu, China

[3]School of Business, Central South University, Changsha, China

[4]Institute of Metal Resources Strategy, Central South University, Changsha, China

[5]Fintech Innovation Center and Collaborative Innovation Center of Financial Security, Southwestern University of Finance and Economics, Chengdu, China

Correspondence
Zhiyong Li, School of Finance, Southwestern University of Finance and Economics, China.
Email: liz@swufe.edu.cn

Funding information
National Natural Science Foundation of China, Grant/Award Numbers: 72474229, 72471196; National Social Science Fund of China, Grant/Award Number: 24CJY122; Major Projects of the National Social Science Foundation of China, Grant/Award Number: 22&ZD161

Abstract

This paper delves into the influence of state ownership on green innovation in family firms using a sample of Chinese listed companies from 2008 to 2021. Our results show that state ownership significantly promotes family firms' green innovation performance. Intergenerational succession, CEO's green experience, and Confucian cultural atmosphere moderate this positive relationship significantly. Channel tests indicate that state ownership positively affects green innovation in family firms by enhancing their corporate social responsibility, facilitating their access to external resources, and improving their internal control quality. Cross-sectional analysis shows that the promoting effect of state ownership on green innovation is more prominent among family firms in non-heavily polluting industries, those with higher levels of information transparency, and those facing lower levels of market competition. These findings provide new insights into the reverse mixed-ownership reform in China and offer valuable guidance for family firms in formulating effective green innovation strategies.

KEYWORDS
corporate social responsibility, family firm, green innovation, reverse mixed-ownership reform, state ownership

1 | INTRODUCTION

Low-carbon transformation is a crucial driver in advancing the sustainable development of the global economy. As the world's largest carbon emitter, China faces a significant challenge in effectively promoting the green

transformation of its economy. Since 2012, China has introduced a series of key policies to advance low-carbon and sustainable development, actively facilitating the transformation of its energy structure, adopting low-carbon technologies, and accelerating the rapid development of green financial markets. In August 2024, the *Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development* was issued in China, marking the first systematic deployment at the central government level to accelerate a national comprehensive green transformation. In the face of climate change and environmental pressures, green innovation serves as a critical mechanism to help firms achieve low-carbon transformation and promote green and clean production (Farooq et al., 2024). Increasing research on corporate green innovation aims to explore how firms can better adopt green innovation strategies and achieve sustainable development. In China's context, state-owned capital plays a pivotal role in the national economy, making it essential to examine whether the presence of state ownership in the private sector can further propel the green transformation of the real economy.

Since 2013, China has initiated the mixed-ownership reform, which includes two specific forms: one involves encouraging state-owned enterprises (SOEs) to introduce private capital to improve governance structures and enhance their efficiency; the other involves encouraging state-owned capital to invest in private firms to promote the development of mixed ownership in the private economy. Relevant research examines the economic outcomes of introducing private equity from the perspective of SOEs and finds that mixed-ownership reform can effectively optimize capital structures, promote participation in innovation activities (Zhang et al., 2020), improve firm performance (Nguyen et al., 2021), and reduce carbon emissions (Yu et al., 2023). However, in recent years, increasing attention has been paid to the "reverse mixed-ownership reform", namely private firms introducing state-owned capital. Existing studies have shown that state-owned capital participation in private firms helps secure financing convenience (Hu et al., 2021), access equity financing at a lower cost (Yan et al., 2024), improve access to short-term debt and lower financing costs (Chen et al., 2023), facilitate digital transformation (Li et al., 2024), enhance earnings quality (Wang & Liu, 2024), and inhibit corporate leverage manipulation (Zhu et al., 2024). As such, the economic rationale for reverse mixed-ownership reform is increasingly being validated.

Family firms possess the unique characteristic of 'family', which entails a focus on long-term inheritance for both the family and the firm. Beyond economic interests, they also prioritize non-economic interests such as socio-emotional wealth, aligning closely with the principles of low-carbon development. Against the backdrop of low-carbon development, firms embrace the green development concept by striving for environmental protection and sustainable production, while also encountering various practical challenges (Rondi et al., 2021). In this context, engaging in green innovation not only supports the long-term inheritance and growth of family firms but also contributes to broader economic and social transformation. However, research on the economic outcomes of state-owned equity participation in family firms rarely examines the perspective of green innovation. Therefore, investigating whether state ownership, characterized by both capital and political connections, can significantly impact family firms' green innovation performance and enhance their sustainable development capabilities is of substantial theoretical and practical significance.

This paper examines a sample of family firms in China's A-share market to empirically explore the relationship between state ownership and the green innovation performance of family firms. Our findings reveal that state ownership enhances the green innovation efforts of Chinese family firms. Intergenerational succession, the CEO's green experience, and the Confucian cultural environment of the region where the firm operates significantly moderate this enhancement effect. Additionally, we identify three underlying mechanisms explaining this promoting effect: the corporate social responsibility performance channel, the resource acquisition channel, and the internal governance channel. These findings provide valuable insights into the drivers of family firms' green innovation strategies and the economic implications of reverse mixed-ownership reform in China within the context of low-carbon development.

This paper contributes to relevant literature mainly in three aspects: first, limited attention has so far been paid to the outcomes of reverse mixed-ownership reform from the private firms' side, especially from the perspective of family firms (e.g., Xu et al., 2023). We aim to bridge this gap by exploring the influence of state ownership in shaping the green innovation strategies of family firms. Second, prior studies have provided evidence for the motivation

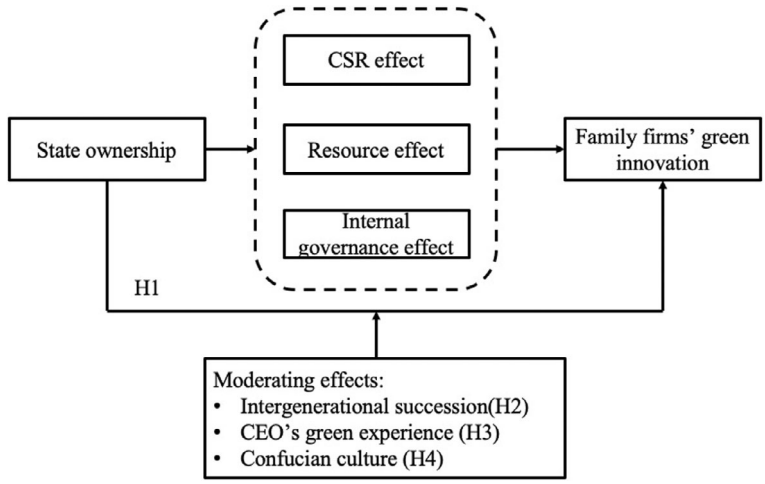

FIGURE 1 The framework of empirical analysis. *Source:* This Figure depicts the study's conceptual model.

behind green innovation practices by family firms (Bauweraerts et al., 2022; Dangelico et al., 2019; Hao et al., 2019; Wang et al., 2023; Zhao et al., 2024), but emphasize the need for context-specific analysis. This paper addresses this need by focusing on the context of reverse mixed-ownership reform in China, thereby contributing to the literature on the contextual forces driving green innovation in family firms. Lastly, this paper builds on existing research by further exploring how contextual factors—intergenerational succession, CEO's green experience, and the regional Confucian cultural atmosphere—moderate the relationship between state ownership and green innovation performance in family firms. As such, we expand the research boundaries and application contexts related to green innovation within family firms and reverse mixed-ownership reform in the Chinese context.

The rest of this paper is organized as follows: Section 2 covers the literature review and hypothesis. Section 3 details the methodology, including data and samples, variable selection, and model setting. Section 4 presents the empirical results and analysis, including baseline results, moderating effects analysis, robustness tests, and endogeneity analysis. Section 5 provides further analysis, including channel tests and cross-sectional analysis. Section 6 concludes with the conclusion and implications. Figure 1 illustrates the framework of this paper.

2 | LITERATURE REVIEW AND HYPOTHESIS

2.1 | State-owned equity and green innovation of family firms

Given the importance of innovation for the survival and long-term growth of firms, family firms' engagement in innovation activities has attracted significant academic interest but has been subject to debates (Dieleman, 2019; Duran et al., 2016; Miroshnychenko et al., 2024). Some studies provide evidence that family firms, on average, engage less in environmental protection and green practices than nonfamily firms (Miroshnychenko & De Massis, 2022). However, an increasing number of studies provide empirical evidence that family firms are motivated to adopt normative sustainable strategies, driven by socioemotional considerations (Ernst et al., 2022; Tiberius et al., 2021), and they outperform nonfamily firms in terms of innovation performance (Röd, 2016; Rondi et al., 2021; Xiang et al., 2019).

In the wave of global low-carbon development, green awareness and strategic decision-making are not only key factors for the long-term development of family firms but also affect their social reputation and brand image. Prior studies indicate that family firms have a stronger awareness of environmental protection and are thus more likely to

engage in solving social and environmental problems (Dangelico et al., 2019). Green development is inherently a long-term, continuous commitment (Ardito et al., 2019), which aligns with the strategic orientation of family businesses. Green innovation includes dual attributes of innovation and green environmental protection, which can meet the needs of enhancing firms' competitiveness and the goals of family inheritance. Some studies have found that firms that make efforts to improve the environment are more likely to be favored by consumers and investors. Driven by a desire for firm control, family social reputation, and the shared legacy between families and businesses, family firms tend to demonstrate greater social responsibility when confronting environmental issues. They adopt proactive environmental strategies to enhance their competitiveness and ensure benefits for future generations (Berrone et al., 2012; Cheng et al., 2022; Sharma & Sharma, 2011). There is evidence that family firms engage more in green innovation activities than non-family firms, which brings better firm performance (Dangelico et al., 2019; Martínez et al., 2007).

Relevant studies have provided evidence for the economic outcomes after state-owned equity enter private firms. Some studies argue that the entry of state-owned equity may reduce a family's control over the firm and lead to corruption and loss of trust, resulting in higher risk aversion (Amore & Minichilli, 2018). However, other studies suggest that state ownership in private firms can have a positive economic impact. For instance, Yu (2013) finds that state ownership is associated with political connections, and state-owned equity participation serves as a signal of political recognition, which helps enhance corporations' social reputation. Quan et al. (2018) suggest that state-owned equity facilitates access to necessary resources, particularly financial resources, and supports firms' long-term investment activities. To the best of our knowledge, there is no current literature focusing on the role of state ownership in influencing private firms' green innovation strategies.

We anticipate that state ownership will significantly influence the operational decisions of family firms, thereby affecting their green innovation activities. First, due to the political nature of state-owned equity, it implies the government's "commitment signal" (Bai et al., 2019; Yu, 2013), which not only helps family firms obtain policy and resource allocation preferences to drive innovation, but also requires them to assume more social responsibilities (Jiang et al., 2020; Quan et al., 2018). Both of these factors may encourage family firms to participate more in green innovation activities. Second, the entry of state-owned equity into family firms increases the diversity of ownership structure, which can improve corporate governance and potentially stimulate green innovation (Zhang et al., 2020). For example, Borsuk et al. (2024) find that corporations' environmental scores and carbon emissions improve when family ownership decreases. Wu et al. (2025) provide evidence for the effect of institutional investor ESG activism in fostering family firms' engagement in green innovation. Finally, after the entry of state-owned equity, family firms may face heightened expectations for social responsibility, which could be translated into increased engagement in green innovation (Jiang et al., 2020; Quan et al., 2018). As indicated by the work of Zhang et al. (2022), political connections can be a driving force of corporate green innovation by promoting entrepreneurship. As such, we propose our first hypothesis:

Hypothesis 1. State ownership promotes green innovation engagement of family firms.

2.2 | Moderating effect of intergenerational succession

Family firms face challenges related to intergenerational inheritance. However, the involvement of the second generation in management is a dynamic and unpredictable process that can lead to significant changes in corporate structure, cultural systems, and other key aspects, ultimately influencing company performance and strategic direction. According to the theory of socioemotional wealth, family firms also prioritize socioemotional wealth alongside economic benefits (Berrone et al., 2012).

Previous studies have shown that first-generation founders of family firms often have a deep emotional attachment and a strong sense of identity with the firm, viewing the inheritance of the family firm as a personal mission.

However, the second generation typically struggles to develop the same level of emotional connection, which may lead to a greater emphasis on financial performance and a reduced focus on socioemotional wealth. In China, state-owned capital carries the responsibility of macroeconomic regulation, with state-owned shareholders prioritizing national policy directives and social responsibilities, often with long-term development goals in mind. During the succession phase, the second generation may engage in short-sighted behaviors to quickly gain the trust of key shareholders and employees, potentially compromising these long-term objectives (Hillebrand, 2019). Consequently, in the early stages of their involvement, the second generation may prioritize the acquisition of corporate control, displaying a constrained approach to socioemotional wealth. This approach to intergenerational inheritance may inhibit green innovation in family firms. At the same time, the second generation's desire to achieve short-term profits may lead them to avoid high-investment, high-risk green innovations, which conflicts with the long-term, stable development goals expected by state-owned capital. Therefore, we propose the second hypothesis:

Hypothesis 2. Intergenerational succession weakens the influence of state ownership on family firms' green innovation performance.

2.3 | Moderating effect of CEO's green experience

As indicated by the Upper Echelons Theory, the cognitive abilities, values, and experiences of senior executives can significantly influence a company's strategic decision-making. As the core leader of the organization, the CEO's personal characteristics are crucial factors in shaping a firm's innovation strategies (Sariol & Abebe, 2017). Previous research has provided evidence of how CEO characteristics affect corporate green innovation activities across multiple dimensions (Quan et al., 2021; Ren et al., 2021).

Prior studies have increasingly focused on how CEOs' environmental backgrounds impact corporate green innovation behavior. CEOs with a green background are more likely to prioritize environmental and sustainability issues, integrating these concerns into the firm's strategic agenda. They are also more motivated to drive the firm's engagement in green innovation initiatives. CEOs with heightened environmental awareness can foster technological innovation within the firm (Huang et al., 2019). Such CEOs tend to be more responsive to stakeholder demands, adopting green strategies to earn stakeholder recognition and support. This environmental orientation also enhances the CEOs' confidence, reducing concerns about the uncertainty and high risks associated with green innovation (Stiglitz, 2015). Moreover, CEOs with a green background are better equipped to navigate opportunities presented by market-driven environmental policies and to assess the value of green innovation. Accordingly, we propose our third hypothesis:

Hypothesis 3. CEO's green experience strengthens the influence of state ownership on family firms' green innovation performance.

2.4 | Moderating effect of Confucian culture

Institutional theory posits that societal institutional forces shape organizational systems, with cultural belief systems, customs, and traditions exerting informal pressure on organizations and individuals (Bruton et al., 2010). Confucian culture, as a significant traditional culture in China, is grounded in the principles of "benevolence, righteousness, propriety, wisdom, and trustworthiness" and seeks to harmonize the relationship between humanity and nature while also emphasizing institutional norms. Consequently, family-owned firms that prioritize family legacy often deeply integrate Confucian culture into their management practices, linking individuals, the firm, and the broader familial and societal contexts. This approach tends to make firms focus more on long-term positioning and objectives.

Family firms inherently possess a dual nature as both profit-driven economic entities and kinship-based communities (Sison et al., 2020). State-owned equity itself bears the mission of supporting social development, and Confucian thought, which emphasizes, "benefiting the world when in power" and the idea of prioritizing righteousness over profit, encourages firms to assume social responsibilities. Under the dual influence of state ownership and Confucian culture, family firms may be more motivated to undertake social responsibilities and participate in green innovations that contribute to sustainable development (Chen et al., 2021). Therefore, we have the following hypotheses:

Hypothesis 4. A strong Confucian cultural atmosphere strengthens the influence of state ownership on family firms' green innovation performance.

3 | METHODOLOGY

3.1 | Data and sample

We use a sample of listed family firms on the Chinese A-share market from 2008 to 2021. Following prior studies (Bauweraerts et al., 2022; Calabrò et al., 2019), we adopt the following strategy to identify a family firm: (1) the ultimate controller must be a natural person or a family; (2) the natural person or family must have substantial control over the firm; (3) the natural person or family must be directly or indirectly the largest shareholder of the firm. ST and *ST companies, companies in the financial sector, and observations with missing key variables are excluded from the original sample. As such, we derive our final sample of 11,778 observations across 1596 firms. Data on family firms is obtained from the CSMAR database, state-owned equity data is sourced from the CCER database, and data on green innovation and Confucian culture measurements is sourced from the CNRDS database.

3.2 | Variables

Green innovation. In line with prior studies (Cheng et al., 2022), we measure the green innovation participation of family firms in each year by calculating the natural logarithm of the number of green inventions and green utility patent applications plus 1.

State-owned equity. We adopt a multi-dimensional matrix of measurement to capture state ownership in family firms. *State1* is a dummy variable, which equals 1 if there are state-owned shareholders among the top 10 shareholders of family firms, and 0 otherwise. *State2* is the number of state-owned shareholders among the top 10 shareholders of family firms. *State3* is the total shareholding ratio of state-owned shareholders among the top 10 shareholders of family firms. *State4* is the ratio of the shareholding of state-owned shareholders among the top 10 shareholders of family firms to that of the actual controller.

Moderating Variables. (1) Intergenerational succession (*Gene*), a dummy that equals 1 if the second-generation successor assumes a position as a director or higher, and 0 otherwise,[1] following the research by Hillebrand (2019). (2) CEO's green experience (*Gceo*), a dummy that equals 1 if the CEO has green-related study or work experience, and 0 otherwise. Following Homroy and Slechten (2019), we classify a CEO as having a green background if his biographical information contains any of the following keywords: environment, environmental protection, low-carbon, sustainability (or sustainable), ecology (or ecological), pollution, and so forth, based on the manual screening of CEOs' biographical information in CSMAR. (3) Confucian culture (*Mqjs*), a dummy that equals 1 if the number of Ming and Qing dynasty Jinshi in the city where the family firms are located exceeds the median, and 0 otherwise.

We also control for a series of firm-level characteristics, including firm size, financial leverage, profitability, firm growth, cash holdings, tangible asset ratios, the number of directors, the proportion of independent directors,

TABLE 1 Variables and description.

Variables	Description
LnGI	Natural logarithm of the sum of green invention patent applications and green practical patent applications plus 1.
State1	Dummy, which equals 1 if there is state-owned shareholder in top 10 shareholders, and 0 otherwise.
State2	Number of state-owned shareholders in the top 10 shareholders
State3	The sum of the shareholding ratio of state-owned shareholders among the top 10 shareholders
State4	The ratio of shareholding of state-owned shareholders to the shareholding of the actual controller
Gene	Dummy, which equals 1 if the successor holds the position of director or above in the firm, and 0 otherwise.
Gceo	Dummy, which equals 1 if the CEO has green experience, and 0 otherwise.
Mqjs	Total number of Jinshi in Ming and Qing Dynasties in the city where the firm is located
Lnsize	Natural logarithm of the number of employees
Lev	Total assets/total liabilities
Roa	Net profit/total assets
Growth	Annual growth rate of sales
Cash	Cash and cash equivalents/total assets
Tang	Tangible assets/total assets
Bod	Total number of directors
Indr	Numbers of independent directors/total number of directors
Dual	Dummy, which equals 1 if the chairman and CEO are held by the same person, and 0 otherwise.
Age	Years of familiarization
Mf	Dummy, which equals 1 if the chairman or general manager is held by a family member, and 0 otherwise.

whether the director and CEO are the same person, the number of years since the firm became a family firm, and whether the director or the CEO is a family member. All variables are described in Table 1:

3.3 | Model

To investigate the influence of state ownership on the green innovation performance of family firms (Hypothesis 1), we estimate the following regression model:

$$LnGI_{i,t} = \alpha_0 + \alpha_1 State(j)_{i,t-1} + \alpha_i \sum Controls_{i,t-1} + Year_t + Industry_i + \varepsilon_{i,t} \quad (1)$$

where *i* specifies the firm, *t* specifies the year, and *Controls* represents the control variables. *State*(*j*) represents the state-owned equity variables. $\varepsilon_{i,t}$ is a random interference term. To avoid missing variables, we control for year and industry fixed effects. We also winsorize all continuous variables at the 1% to 99% levels in order to avoid the potential influence of outliers.

To investigate the moderating effect of intergenerational succession, CEO's green experience, and Confucian culture (Hypothesis 2–Hypothesis 4), we estimate the following model:

$$LnGI_{i,t} = \beta_0 + \beta_1 State(j)_{i,t-1} + \beta_2 State(j)_{i,t-1} \times M_t + \beta_3 M_t + \beta_i \sum Controls_{i,t-1} + Year_t + Industry_i + \varepsilon_{i,t} \quad (2)$$

where *M* represents the moderating variables, including intergenerational succession (*Gene*), CEO's green experience (*Gceo*), and Confucian culture (*Mqjs*).

4 | EMPIRICAL RESULTS AND ANALYSIS

4.1 | Descriptive statistic

The descriptive statistics of the main variables are reported in Table 2. Among them, the mean value of green innovation (*LnGI*) is 0.652, and the standard deviation is 0.955, suggesting that there is significant variation among our sample firms' green innovation engagement. The mean value of State 1 is 0.327, indicating that state-owned equity participation in listed family firms is relatively common in China. The average age of the sample family firms is 5.408, suggesting that most of the sample family firms have existed for a long time. The mean value of *Gene* is 0.248, indicating that 24.8% of the sample family firms are involved with the second generation in company management. The mean CEO green background (*Gceo*) is 0.026, suggesting that only a few CEOs in the sample firms have green experience. We also conducted a correlation analysis on the variables (results not reported here due to space constraints), which indicates there is no multicollinearity concern.

4.2 | Baseline results

The results of Model (1) are reported in Table 3. As indicated by the results in Column (1), the coefficient of *State1* is 0.069, significant at the 1% level, implying that the presence of state ownership in family firms significantly

TABLE 2 Descriptive statistics.

Variables	N	Mean	Std. error	Min	Max
LnGI	11,778	0.652	0.955	0.000	3.871
State1	10,063	0.327	0.469	0.000	1.000
State2	10,063	0.455	0.752	0.000	3.000
State3	10,063	0.012	0.032	0.000	0.213
State4	10,063	0.036	0.102	0.000	0.703
Gene	11,269	0.248	0.432	0.000	1.000
Gceo	11,167	0.026	0.158	0.000	1.000
Mqjs	10,600	0.502	0.500	0.000	1.000
Lnsize	10,063	7.370	1.026	5.176	10.210
Lev	10,063	0.345	0.180	0.044	0.816
Roa	10,063	0.057	0.058	−0.232	0.225
Growth	10,063	0.185	0.309	−0.467	1.523
Cash	10,063	0.188	0.149	0.013	0.695
Tang	10,063	0.923	0.087	0.538	0.999
Bod	10,063	8.150	1.391	5.000	12.000
Indr	10,063	0.378	0.052	0.333	0.571
Dual	10,063	0.421	0.494	0.000	1.000
Age	10,063	5.408	3.981	1.000	20.000
Mf	10,063	0.947	0.225	0.000	1.000

Note: This table reports the descriptive statistics of variables. All variables are defined in Table 1.

stimulates their green innovation performance. We can also see that the coefficients of *State2*, *State3*, and *State4* are 0.042, 0.983, and 0.261, respectively, all significant at the 1% level. This suggests that as the number of state-owned shareholders increases, the shareholding of state-owned shareholders rises, and the ownership of state-owned equity improves, family firms' engagement in green innovation significantly increases. These findings show that despite the inherent differences among family firms, state-owned equity may leverage its political advantages, facilitate access to favorable resources, and enhance governance functions within the firm, thereby creating a conducive environment for green innovation activities. Accordingly, Hypothesis 1 is supported.

4.3 | Moderating effects

4.3.1 | Intergenerational succession

In order to test the moderating role of intergenerational succession (Hypothesis 2), *Gene* is introduced into Model (2), and the results are reported in Table 4. It can be seen from the results that the coefficients of the interaction terms between state ownership and intergenerational succession are significantly negative in Columns (1)–(4). This provides supportive evidence that the impact of state ownership on family firms' engagement in green innovation is weakened if the firm is undergoing intergenerational succession. We suggest that after the second generation enters the firm, they aim to establish an image as a successor, and presenting excellent performance is often a direct way for them to gain the trust of employees and investors. As such, the pursuit of short-term performance will crowd out long-term investment in green innovation. Therefore, Hypothesis 2 is supported.

4.3.2 | CEO's green experience

In order to test whether the CEO's green experience moderates the nexus between state ownership and family firms' green innovation (Hypothesis 2), we introduce *Gceo* into Model (2). The results reported in Table 5 show that the interaction terms between state ownership and the CEO's green experience in Columns (1)–(4) are all positive and statistically significant, suggesting that CEOs with green experience enhance the promoting effect of state ownership on family firms' green innovation engagement. These results indicate that human capital, represented by CEOs with green experience, plays a prominent role in facilitating the green transformation of family firms in the context of reverse mixed-ownership reform. Therefore, Hypothesis 3 is established.

4.3.3 | Confucian culture

To examine whether Confucian culture moderates the association between state ownership and green innovation of family firms (Hypothesis 4), we introduce *Mqjs* into Model (2) for regression analysis. As indicated by the results in Table 6, the coefficients of the interaction terms between state ownership and Confucian culture in Column (1)–(4) are all positive and statistically significant, which shows that the Confucian cultural atmosphere in the region where the firm is located has an important strengthening effect on the nexus between state ownership and family firms' engagement in green innovation. Confucianism is the spiritual core of Chinese national culture, and state-owned equity has a social responsibility to ensure the stability and prosperity of the country, which complement each other and promote green innovation in family firms. Therefore, Hypothesis 4 is supported.

TABLE 3 State ownership and green innovation of family firms.

	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.069***			
	(3.586)			
State2		0.042***		
		(3.385)		
State3			0.983***	
			(3.436)	
State4				0.261***
				(2.901)
Lnsize	0.240***	0.240***	0.242***	0.243***
	(20.676)	(20.653)	(20.877)	(20.876)
Lev	0.713***	0.710***	0.705***	0.707***
	(10.763)	(10.713)	(10.643)	(10.661)
Roa	0.767***	0.766***	0.767***	0.772***
	(4.459)	(4.457)	(4.467)	(4.493)
Growth	0.094***	0.095***	0.095***	0.095***
	(3.056)	(3.069)	(3.091)	(3.079)
Cash	0.265***	0.264***	0.270***	0.268***
	(3.924)	(3.905)	(3.999)	(3.970)
Tang	0.160	0.158	0.167	0.172*
	(1.537)	(1.521)	(1.603)	(1.651)
Bod	0.016*	0.015*	0.015*	0.015*
	(1.873)	(1.818)	(1.828)	(1.843)
Indr	−0.210	−0.215	−0.189	−0.194
	(−0.981)	(−1.005)	(−0.881)	(−0.906)
Dual	0.021	0.022	0.020	0.020
	(1.209)	(1.240)	(1.137)	(1.151)
Age	0.011***	0.011***	0.012***	0.012***
	(4.174)	(4.261)	(4.648)	(4.581)
Mf	−0.021	−0.021	−0.018	−0.019
	(−0.533)	(−0.543)	(−0.469)	(−0.490)
Constant	−2.362***	−2.368***	−2.394***	−2.392***
	(−10.362)	(−10.350)	(−10.480)	(−10.480)
N	10,063	10,063	10,063	10,063
R^2	0.292	0.292	0.292	0.292
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results examining the impact of state ownership on green innovation of family firms. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 4 Moderating effect of intergenerational succession.

	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.097***			
	(4.184)			
State1*Gene	−0.092**			
	(−2.285)			
State2		0.054***		
		(3.445)		
State2*Gene		−0.046*		
		(−1.843)		
State3			0.839**	
			(2.416)	
State3*Gene			−1.099*	
			(−1.907)	
State4				0.257**
				(2.307)
State4*Gene				−0.389**
				(−2.129)
Gene	−0.044*	−0.053**	−0.061***	−0.061***
	(−1.799)	(−2.281)	(−2.873)	(−2.867)
Controls	Yes	Yes	Yes	Yes
Constant	−2.142***	−2.138***	−2.154***	−2.156***
	(−8.855)	(−8.847)	(−8.927)	(−8.947)
N	9594	9594	9594	9594
R^2	0.291	0.290	0.290	0.290
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the moderating role of intergenerational succession on the relationship between state ownership and family firms' green innovation. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.4 | Robustness tests

4.4.1 | Parallel trend assumption

First, we conduct a parallel trend test to verify the validity of our baseline staggered DID identification assumption. Specifically, we replace *State1* in the baseline regression with six indicator variables: *pre_3*, *pre_2*, *pre_1*, *post_1*, *post_2*, *post_3*, where *pre_j* (*post_j*) equals 1 for observations j years before (after) the entry of state equity. The results in Figure 2 show that the coefficients of *pre_3*, *pre_2*, and *pre_1* are close to zero and statistically insignificant. This indicates that there was no significant difference in green innovation activities between the treated and control firms before the entry of state equity, which supports the parallel trend assumption that underlines the DID design. In contrast, the coefficients of *post_1*, *post_2*, and *post_3* are positive and statistically significant This suggests that family firms' green innovation activities increase in the years following the entry of state equity, with the magnitude increasing by year.

TABLE 5 Moderating effect of CEO's green experience.

	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.060***			
	(3.030)			
State1*Gceo	0.332**			
	(2.485)			
State2		0.030**		
		(2.320)		
State2*Gceo		0.238***		
		(3.140)		
State3			0.443	
			(1.545)	
State3*Gceo			3.727**	
			(2.399)	
State4				0.098
				(1.082)
State4*Gceo				1.142**
				(2.387)
Gceo	0.031	0.016	0.098	0.105
	(0.359)	(0.201)	(1.294)	(1.415)
Controls	Yes	Yes	Yes	Yes
Constant	−2.374***	−2.371***	−2.394***	−2.394***
	(−10.035)	(−10.007)	(−10.136)	(−10.145)
N	9357	9357	9357	9357
R^2	0.287	0.287	0.286	0.286
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the moderating role of CEO's green experience on the relationship between state ownership and family firms' green innovation. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.4.2 | Alternative measures of green innovation

In our baseline analysis, green innovation is measured by the logarithm of the sum of green invention and practical patent applications. To ensure the reliability of our results, we adopt two alternative measures of green innovation for robustness checks. First, we use the natural logarithm of the sum of green patent authorizations (*LnGIget*) to better reflect the quality of family firms' green innovation. Then, we re-estimate our baseline model. As shown in the results in Column (1)–(4) of Table 7, our baseline conclusion remains robust. Second, recent studies suggest that the log-like transformation may lead to biased results (Chen & Roth, 2024; Cohn et al., 2022). Therefore, we adopt a Negative Binomial regression approach using the number of green patent applications (*GIcount*) to alleviate this concern (Liu et al., 2025). As can be seen from the results in Column (5)–(8) of Table 7, the positive impact of state ownership on green innovation of family firms still holds.

TABLE 6 Moderating effect of Confucian culture.

	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.036			
	(1.277)			
State1*Mqjs	0.091**			
	(2.373)			
State2		0.016		
		(0.879)		
State2*Mqjs		0.061**		
		(2.438)		
State3			0.621	
			(1.465)	
State3*Mqjs			1.053*	
			(1.728)	
State4				0.118
				(0.896)
State4*Mqjs				0.465**
				(2.361)
Mqjs	−0.071***	−0.069***	−0.054***	−0.056***
	(−3.371)	(−3.348)	(−2.773)	(−2.907)
Controls	Yes	Yes	Yes	Yes
Constant	−2.047***	−2.047***	−2.101***	−2.101***
	(−8.619)	(−8.608)	(−8.833)	(−8.847)
N	9055	9055	9055	9055
R^2	0.296	0.296	0.295	0.295
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the moderating role of Confucian culture on the relationship between state ownership and family firms' green innovation. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.4.3 | Alternative identification of family firms

Considering that there are different standards for identifying family firms, we re-screen the sample based on the family's shareholding, excluding firms where the actual controller and their family, as the largest shareholder, hold less than 15% of the shares. Using this new sample, we re-estimate Model (1). As indicated by the results in Table 8, the coefficients of state ownership variables remain positive and statistically significant, consistent with the baseline results.

4.4.4 | Controlling for industry-year fixed effect

We include industry and year fixed effects in our baseline analysis, in order to capture potential omitted variables at the industry and time levels. However, time-varying industry dynamics may still exist. Therefore, we further control

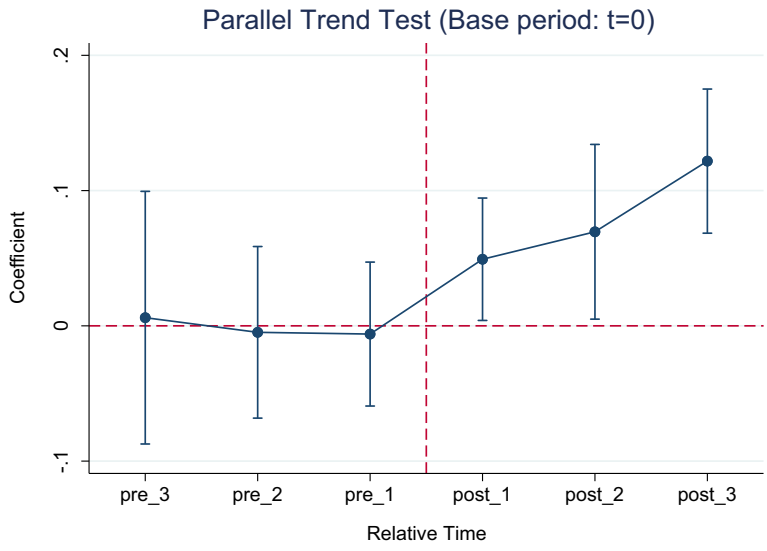

FIGURE 2 Parallel trend test. *Source:* This Figure depicts the results of the parallel trend test of our baseline model.

TABLE 7 Alternative measures of green innovation.

	(1) LnGIget	(2) LnGIget	(3) LnGIget	(4) LnGIget	(5) GIcount	(6) GIcount	(7) GIcount	(8) GIcount
State1	0.076***				1.103**			
	(4.508)				(2.422)			
State2		0.046***				1.066**		
		(4.331)				(2.574)		
State3			1.071***				4.573***	
			(4.247)				(2.764)	
State4				0.286***				1.446**
				(3.587)				(2.131)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.225***	−2.232***	−2.260***	−2.258***	0.006***	0.006***	0.006***	0.006***
	(−11.950)	(−11.919)	(−12.125)	(−12.124)	(−9.073)	(−9.075)	(−9.134)	(−9.113)
N	10,063	10,063	10,063	10,063	10,063	10,063	10,063	10,063
R^2/ Pseudo R^2	0.292	0.291	0.291	0.291	0.0700	0.0701	0.0701	0.0700
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the regression results of robustness checks adopting alternative measures of green innovation. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

for industry*year fixed effect to mitigate confounding influences arising from industry dynamics, to ensure the reliability of our findings. The results are reported in Table 9. We can see that our baseline conclusions remain robust after considering industry dynamics.

TABLE 8 Changing identification of family firms.

	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.070***			
	(3.561)			
State2		0.040***		
		(3.134)		
State3			0.642**	
			(2.062)	
State4				0.196*
				(1.845)
Controls	Yes	Yes	Yes	Yes
Constant	−2.370***	−2.376***	−2.394***	−2.394***
	(−10.220)	(−10.214)	(−10.328)	(−10.333)
N	9633	9633	9633	9633
R^2	0.288	0.288	0.288	0.288
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of robustness checks adopting alternative identification of family firms. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 9 Controlling for industry-year fixed effect.

Variables	(1) LnGI	(2) LnGI	(3) LnGI	(4) LnGI
State1	0.071**			
	(2.579)			
State2		0.042*		
		(1.882)		
State3			1.011*	
			(1.975)	
State4				0.275*
				(1.873)
Constant	−1.673***	−1.662***	−1.698***	−1.700***
	(−4.682)	(−4.639)	(−4.731)	(−4.723)
N	9917	9917	9917	9917
R^2	0.312	0.312	0.312	0.312
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry*year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of robustness checks controlling for industry-year fixed effects. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.5 | Endogeneity

4.5.1 | PSM-DID analysis

Our research may face challenges suggesting that family firms with better performance are more likely to attract state-owned equity participation, and there may be systematic differences between family firms with state ownership and those without. Therefore, we conduct a PSM-DID analysis to mitigate the reverse causality problem and sample selection bias. First, we construct the treatment group and the control group based on whether state ownership exists in the family firms. Then, firm-level and family-level characteristics are selected as covariates, including firm size, leverage, profitability, and years as a family-owned firm. Second, we conduct a difference-in-difference analysis using the entry of state-owned capital into family firms as a shock. A dummy variable (*Treat*) is created, which equals 1 for family firms with state ownership and 0 for those without. Another dummy variable (*After*) is generated, which equals 1 for the year when state-owned equity enters family firms and subsequent years, and 0 otherwise. We estimate the following model:

$$LnGI_{i,t} = \gamma_0 + \gamma_1 Treat \times After_{i,t} + \gamma_2 Treat_{i,t} + \gamma_i \sum Controls_{i,t-1} + Year_t + Industry_i + \varepsilon_{i,t} \quad (3)$$

Further, we employ four types of matching methods to mitigate differences between the two groups: 1:1 nearest neighbor matching, 1:2 nearest neighbor matching, radius matching, and kernel matching. Among them, radius matching results in minimal sample loss, yielding 7949 valid samples in the control group and 3847 valid samples in the treatment group. The standardized deviation (% bias) of covariates between the two groups is less than 5%. Subsequently, we re-run Model (3) using the samples matched under radius matching. As indicated by the results in Table 10, the coefficient of the interaction term (*Treat*After*) is positive and significant at the 1% level. Thus, our baseline conclusion remains robust.

4.5.2 | Stacked DID analysis

Our baseline analysis adopts a staggered DID approach to investigate the impact of state ownership entry on family firms' green innovation. However, recent studies (Baker et al., 2022; Borusyak et al., 2024) point out that this approach may lead to biased estimation of the average treatment effect between groups or over time, due to the fact that early-treated firms remain in the sample and are compared to later-treated and untreated firms. Therefore, we follow Cengiz et al. (2019) and adopt the stacked DID approach to alleviate this concern. First, we construct event-specific datasets. Firms that become treated (with the entry of state equity) in the same year belong to the same cohort, and so do firms that have not been treated. For each treated cohort (i.e., based on the first entry year of state equity), we create a dataset that includes treatment firms and a group of control firms that have not received state equity participation during the sample period, and retain the data over the [−3, +3] treatment window. And then, we stack all datasets together and estimate the following stacked regression model:

$$LnGI_{i,t,c} = \delta_0 + \delta_1 STATE_{i,t-1,c} + \delta_i \sum Controls_{i,t-1,c} + Cohort * Year_{t,c} + Industry_{i,c} + \varepsilon_{i,t,c} \quad (4)$$

where *i*, *t*, and *c* specify firm, year, and treatment cohort, respectively. $STATE_{i,t-1,c}$ is a dummy indicating whether firm *i* in cohort *c* has been treated in event year $t-1$. *Controls* are control variables defined in Table 1. *Industry* and *Cohort*Year* are industry and cohort-year fixed effects, respectively.

Table 11 reports the results of stacked DID analysis. As can be seen from the results, the coefficient of *STATE* is 0.097, significant at the 5% level, in line with our baseline results. This indicates that our baseline results are not affected by the potential bias due to heterogeneous treatment effects.

TABLE 10 PSM-DID analysis.

	LnGI
Treat*After	0.061***
	(3.047)
Treat	0.017
	(0.715)
Controls	Yes
Constant	−2.380***
	(−10.363)
N	10,062
R^2	0.292
Industry	Yes
Year	Yes

Note: This table reports the regression results of PSM-DID analysis. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5 | FURTHER ANALYSIS

5.1 | Channel tests

5.1.1 | Corporate social responsibility channel

Even though there exists debate on corporate social responsibility in family firms due to the possibility that family firms may undertake strategic activities (Stock et al., 2024), we expect that when state-owned capital enters family firms, it often leads to an enhanced sense of corporate social responsibility (CSR) in response to climate change. Dong et al. (2022) indicate that state-owned enterprises in China are motivated to invest resources in CER-related activities to meet the expectations of their ultimate controller (the government). For family firms, undertaking social responsibility not only bolsters the firm's social reputation but also helps shape the image of a responsible firm, thereby increasing stakeholder trust (Maaloul et al., 2023). According to Socioemotional Wealth (SEW) theory, both financial gains and non-economic factors play an important role in shaping family firms, especially the desire for the survival and long-term development of the firm, with an emphasis on passing it down through generations. Entrepreneurial family firms, which represent the culmination of the family's efforts, typically develop strategies with long-term interests in mind (Madden et al., 2020). These firms place great importance on the recognition and support of family members, thus valuing the firm's reputation and its image among stakeholders. As environmental issues gain greater significance among stakeholders, firms are increasingly inclined to assume social responsibility and mitigate potential conflicts through proactive green product innovation (Aiello et al., 2021). Therefore, we suggest that the involvement of state ownership can incentivize family firms to more actively fulfill their corporate social responsibilities, thereby enhancing their level of green innovation.

Accordingly, we use corporate social responsibility (CSR) scores provided by Hexun.com to measure the CSR performance of family firms. A higher CSR score indicates better CSR performance. To test the CSR channel, we regress CSR performance on state ownership, with the results reported in Table 12. We observe that the coefficients of the four state ownership variables are all significantly positive, indicating that state ownership significantly improves the CSR performance of family firms. Furthermore, the greater the number of state-owned shareholders, the higher the shareholding of state-owned equity, and the more ownership of state-owned equity, the better the CSR performance of family firms, which subsequently promotes their green innovation.

TABLE 11 Stacked DID analysis.

Variables	(1) LnGI
STATE	0.097**
	(2.251)
Controls	Yes
Constant	−0.849**
	(−2.506)
N	30,930
R^2	0.247
Industry	Yes
Cohort*year	Yes

Note: This table reports the regression results of stacked DID analysis. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 12 Channel test: Corporate social responsibility.

	(1) CER	(2) CER	(3) CER	(4) CER
State1	1.228***			
	(5.056)			
State2		0.922***		
		(5.653)		
State3			18.585***	
			(4.825)	
State4				6.039***
				(4.734)
Controls	Yes	Yes	Yes	Yes
Constant	−12.231***	−12.296***	−12.690***	−12.733***
	(−3.450)	(−3.466)	(−3.560)	(−3.566)
N	8178	8178	8178	8178
R^2	0.264	0.265	0.265	0.265
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the mediating role of corporate social responsibility. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5.1.2 | Resource acquisition channel

Introducing state-owned capital is a direct channel for private firms to establish relationships with the government, imbued with inherent political attributes. Potential political endorsements and implicit guarantees associated with state-owned capital can enable private firms to secure additional resources, primarily in the form of credit support, tax reductions, and increased government subsidies (Bai et al., 2019; Hu et al., 2021; Lin & Bo, 2012). These

resources can provide firms with sustainable competitive advantages, and firms with greater resource access are better positioned to pursue green innovation (Calza et al., 2016). Additionally, state-owned capital can help family firms better comprehend government policies and gain advantageous information (Chan et al., 2012). Taken together, the entry of state-owned equity strengthens the political connections of family firms, which can significantly alleviate their disadvantages in resource acquisition and thereby promote their engagement in green innovation activities.

To investigate whether the above resource acquisition channel exists, we regress financial constraints and government subsidies on state-owned equity variables. Specifically, financial constraints (*FC*) are measured by the FC index proposed by Hadlock and Pierce (2010), and government subsidies (*Gsub*) are measured by the annual subsidies received by firms. The results are shown in Table 13. From Columns (1)–(4), we can observe that the coefficients of state ownership variables are negative and statistically significant, supporting the effect of state ownership in alleviating the financing constraints of family firms. From Columns (5)–(8), we can see that state ownership variables are significantly positive, indicating that state ownership is helpful in facilitating family firms in obtaining government subsidies. As such, these results provide supportive evidence for the resource acquisition channel we proposed to understand the nexus between state ownership and family firms' green innovation engagement.

5.1.3 | Internal governance channel

The high concentration of control in family firms may place family controllers in a dominant, "one-man" position, leading to nepotism driven by kinship ties. This may weaken the development and effectiveness of their internal control system and result in a lack of balance in the internal governance structure of family firms. Prior research has found that the entry of state-owned capital into private firms helps improve their corporate governance, mitigates the agency problems between major and minority shareholders, and encourages firms to focus more on long-term strategic planning (Lu & Shi, 2012; Yu, 2013). Du and Cao (2023) also provide evidence that non-family shareholder governance promotes the implementation of green innovation strategies in family firms. Therefore, we suggest that state ownership can improve the internal governance quality in family firms, thereby promoting their green innovation engagement.

To examine the internal governance channel, we use the DiBo Internal Control Index to assess the internal governance quality of family firms. Given that family ties may result in weaker supervision and less stringent operational oversight, the management hierarchy sub-index (*Neik*) is used as the measure. We then regress internal governance quality on state-owned equity variables, with results reported in Table 14. The coefficients of *State1* and *State2* are 4.884 and 3.151, respectively, both statistically significant. This suggests that state ownership contributes to improving the internal control quality of family firms, and as the number of state-owned shareholders increases, the enhancing effect on internal control quality becomes more significant, thereby fostering higher levels of green innovation.

5.1.4 | Alternative explanation

Alternative explanations may arise for the influence of state-owned capital on family firms' green innovation performance. First is the risk-taking channel. It can be argued that family firms may increase their risk-taking capacity after the entry of state-owned capital, and thus their engagement in green innovation may be affected. Firms with higher levels of risk-taking capacity are likely to exhibit greater enthusiasm for innovation (García-Granero et al., 2015). Second is the managerial overconfidence channel. Considering that green innovation involves high-risk investment, state-owned equity may influence management's behavior by increasing their overconfidence. As such, managers

TABLE 13 Channel test: Resource acquisition.

	(1) FC	(2) FC	(3) FC	(4) FC	(5) Gsub	(6) Gsub	(7) Gsub	(8) Gsub
State1	−0.026***				0.849			
	(−7.242)				(1.622)			
State2		−0.018***				0.568*		
		(−7.858)				(1.649)		
State3			−0.211***				27.852***	
			(−4.494)				(2.823)	
State4				−0.045***				10.438***
				(−3.059)				(3.210)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.393***	1.395***	1.400***	1.399***	−63.243***	−63.156***	−63.861***	−63.990***
	(31.090)	(31.123)	(31.088)	(31.148)	(−9.389)	(−9.375)	(−9.437)	(−9.450)
N	9774	9774	9774	9774	7557	7557	7557	7557
R^2	0.622	0.623	0.621	0.620	0.259	0.259	0.260	0.261
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the mediating role of resource acquisition. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 14 Channel test: Internal governance.

	(1) Neik	(2) Neik	(3) Neik	(4) Neik
State1	4.884**			
	(2.316)			
State2		3.151**		
		(2.186)		
State3			22.267	
			(0.750)	
State4				6.442
				(0.668)
Controls	Yes	Yes	Yes	Yes
Constant	231.341***	230.868***	229.989***	230.007***
	(8.598)	(8.560)	(8.549)	(8.550)
N	7271	7271	7271	7271
R^2	0.134	0.134	0.133	0.133
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the mediating role of internal governance. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 15 Risk taking and managerial overconfidence.

	(1) Risk	(2) Risk	(3) Risk	(4) Risk	(5) OC	(6) OC	(7) OC	(8) OC
State1	−0.001				−0.001			
	(−1.062)				(−0.342)			
State2		−0.000				0.000		
		(−0.984)				(0.107)		
State3			−0.002				0.020	
			(−0.217)				(0.458)	
State4				0.000				0.001
				(0.016)				(0.107)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.107***	0.107***	0.107***	0.107***	0.572***	0.572***	0.571***	0.571***
	(10.078)	(10.084)	(10.083)	(10.076)	(11.525)	(11.521)	(11.501)	(11.511)
N	9571	9571	9571	9571	9058	9058	9058	9058
R^2	0.141	0.141	0.141	0.141	0.351	0.351	0.351	0.351
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the regression results of the mediating role of corporate social responsibility. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

may overestimate the probability of success in risky investments, driven by their self-assessment of abilities and favorable external conditions.

To further validate the robustness of our findings, we explore two alternative explanations. Specifically, following John et al. (2008), we measure risk-taking (*Risk*) using the three-year rolling standard deviation of ROA, adjusted for industry-level and year-level means. Additionally, we construct a comprehensive variable to measure managerial overconfidence (*OC*), incorporating data on manager gender, age, educational background, and the duality of CEO and chairman roles. We then regress risk-taking and managerial overconfidence on state-owned equity variables. As indicated by the results in Table 15, the coefficients of the state ownership variables are insignificant. Consequently, these two potential explanations are ruled out, providing further support for the channels identified in our study.

5.2 | Cross-sectional analysis

Given that firms with different characteristics may exhibit substantial variation in their green innovation strategies, the impact of state ownership on the green innovation performance of family firms may vary among firms. Therefore, we conduct a heterogeneity analysis to deepen our understanding of the contextual factors that moderate the association between state ownership and the green innovation performance of family firms.

5.2.1 | Heavily polluting firms and non-heavily polluting firms

Compared to non-heavily polluting firms (NPF), heavily polluting firms (HPF) face greater challenges and a more stringent financing environment. Some studies have found that HPFs in China suffer from reductions in bank loans following the introduction of environmental regulations (Liu et al., 2019). However, more research suggests that HPFs are motivated to enhance their green innovation performance under China's green financing policy, green industrial policy, and dual carbon policy (Chang et al., 2024; Hong et al., 2024; Lin & Pan, 2024; Zhu & Tan, 2022). Accordingly, we expect that the impact of state ownership may differ significantly between NPFs and HPFs, and therefore, a heterogeneity analysis is conducted to explore this distinction.

The sample of family firms is divided into two groups: non-heavily polluting industries and heavily polluting industries.[2] We then run subsample regression on Model (1). As indicated by the results in Table 16, the promoting effect of state ownership is only significant within the sample of NPFs. This suggests that, given HPFs are driven toward green innovation by stringent environmental regulations in the Chinese context of low-carbon development, state ownership has a more profound impact on family firms' green innovation within NPFs.

5.2.2 | Information transparency

Information transparency is a critical factor in corporate financing, playing a key role in alleviating constraints on green innovation investment (Lin et al., 2013). We expect that for family firms with higher information transparency, state-owned equity exerts a more significant effect. We use the information disclosure quality ratings by the Shenzhen and Shanghai Stock Exchanges as the measure, which classify information disclosure quality into four categories: excellent, good, pass, and fail. Specifically, a score of 0 is assigned to "fail," and a score of 1 is assigned otherwise. We then conduct subsample regression analysis based on Model (1). As indicated by the results in

TABLE 16 Heavily polluting and non-heavily polluting firms.

	(1) NPF	(2) HPF	(3) NPF	(4) HPF	(5) NPF	(6) HPF	(7) NPF	(8) HPF
	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI
State1	0.093***	0.005						
	(3.879)	(0.162)						
State2			0.059***	0.002				
			(3.737)	(0.120)				
State3					1.152***	0.534		
					(3.153)	(1.251)		
State4							0.289**	0.190
							(2.531)	(1.363)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.620***	−1.353***	−2.634***	−1.352***	−2.665***	−1.358***	−2.659***	−1.369***
	(−9.427)	(−4.441)	(−9.440)	(−4.439)	(−9.567)	(−4.443)	(−9.556)	(−4.464)
N	7175	2888	7175	2888	7175	2888	7175	2888
R^2	0.295	0.219	0.295	0.219	0.295	0.219	0.294	0.219
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the sub-group regression results between heavily polluting and non-heavily polluting firms. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 17 Information transparency.

	(1) Low	(2) High	(3) Low	(4) High	(5) Low	(6) High	(7) Low	(8) High
	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI
State1	−0.175	0.044**						
	(−0.746)	(2.153)						
State2			−0.021	0.030**				
			(−0.140)	(2.267)				
State3					3.342	0.746**		
					(0.872)	(2.390)		
State4							0.906	0.168*
							(0.807)	(1.738)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.765*	−2.019***	−2.742*	−2.027***	−3.181**	−2.043***	−3.151**	−2.038***
	(−1.888)	(−8.398)	(−1.844)	(−8.405)	(−2.073)	(−8.475)	(−2.036)	(−8.467)
N	138	8583	138	8583	138	8583	138	8583
R^2	0.647	0.290	0.644	0.290	0.648	0.290	0.647	0.290
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the sub-group regression results between high and low information transparency firms. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 17, the promoting effect of state ownership is significant only among family firms with high information transparency, in line with our expectation.

5.2.3 | Market competition

Market competition is a critical factor influencing corporate green innovation, yet the literature presents mixed findings. Evidence suggests that market competition can drive green innovation, while excessive competition may hinder it, potentially leading to a non-linear relationship between the two (Aghion et al., 2005; Lambertini et al., 2017). It can be inferred that lower levels of market competition enable firms to secure more resources and funds through market share, where stable competition helps mitigate costs and reduce risks associated with green innovation (Beneito et al., 2017). Consequently, we anticipate that the influence of state ownership on green innovation may vary for family firms facing different levels of market competition.

We use HHI as a proxy for the level of market competition, with a higher HHI indicating less competition. The sample is divided into two groups based on the median HHI score: low competition and high competition. We then conduct subsample regression analysis based on Model (1). As shown in Table 18, the promoting effect of state ownership is significant only in the low competition group. This implies that in markets with lower competition, state-owned equity—along with its inherent resource and policy advantages—can more effectively foster green innovation within family firms.

TABLE 18 Market competition.

	(1) High	(2) Low	(3) High	(4) Low	(5) High	(6) Low	(7) High	(8) Low
	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI	LnGI
State1	0.035	0.098***						
	(1.292)	(3.585)						
State2			0.012	0.073***				
			(0.713)	(3.958)				
State3					0.426	1.673***		
					(1.163)	(3.658)		
State4							0.108	0.452***
							(0.923)	(3.204)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−2.357***	−2.646***	−2.360***	−2.671***	−2.368***	−2.715***	−2.370***	−2.713***
	(−8.040)	(−8.463)	(−8.032)	(−8.500)	(−8.078)	(−8.636)	(−8.085)	(−8.633)
N	5071	4992	5071	4992	5071	4992	5071	4992
R^2	0.229	0.354	0.229	0.355	0.229	0.355	0.229	0.354
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the sub-group regression results between high and low market competition firms. All variables are defined in Table 1. Values in parentheses are t statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

6 | CONCLUSION AND IMPLICATION

This study uses a sample of entrepreneurial family firms in the Chinese A-share market during 2008–2021, empirically assessing the impact of state ownership on green innovation and identifying boundary conditions.

We have the following findings: First, the presence of state-owned equity significantly enhances the green innovation performance of family firms. Specifically, more state-owned shareholders among the top 10 shareholders, greater shareholdings of state-owned equity, and increased state ownership are associated with enhanced green innovation performance of family firms. These findings remain robust after a series of robustness checks and addressing endogeneity concerns. Second, the promoting effect of state ownership is more significant when the firm's CEO has green experience and when the firm is located in a region with a strong Confucian influence. However, this positive effect diminishes when the firm undergoes intergenerational succession. Third, channel tests reveal that state-owned equity positively affects the green innovation of family firms via three underlying channels: enhancing their CER performance, improving their access to financial resources, and promoting their internal governance quality. Finally, cross-sectional analyses show that the promoting effect of state ownership on family firms' green innovation performance is more significant among NHF, firms with higher information transparency, and those facing lower levels of market competition.

Our findings provide implications for both family firms and policymakers. First, the positive role of state ownership in promoting the sustainable transformation and development of the private economy in the Chinese context should be highlighted. Our results show that state ownership in family firms helps acquire more essential financial resources, bolster their CER performance, and improve their internal governance quality. These benefits collectively support their increased green innovation efforts and strengthen long-term competitiveness. Therefore, family firms are encouraged to prioritize the introduction of state-owned capital. Second, family firms should tailor their green innovation strategies to their specific internal and external contexts. In particular, positive factors can be leveraged to enhance green innovation, such as the CEO's green experience and regional Confucian culture. Meanwhile, attention must be given to potential drawbacks, such as the possible negative impacts of second-generation involvement during periods of intergenerational succession. Third, policymakers are encouraged to recognize and harness the crucial role of state-owned equity in driving low-carbon economic transformation and development. Accordingly, the positive effects of reverse mixed ownership reform have been validated, and it can be further improved to maximize the benefits of state-owned equity in promoting sustainable growth within family firms.

ACKNOWLEDGMENTS

The authors gratefully acknowledge financial support from National Social Science Fund of China (24CJY122), National Natural Science Foundation of China (72474229; 72471196) and the Major Projects of the National Social Science Foundation of China (22&ZD161).

ORCID

Zhiyong Li https://orcid.org/0000-0001-9307-8453

ENDNOTES

[1] This data is sourced from basic information on family firms (CSMAR) and successor information (CNRDS), and is manually compiled through Baidu searches.

[2] For more details at: http://www.csrc.gov.cn/csrc/c100103/c1452025/content.shtml.

REFERENCES

Aghion, P., Bloom, N., Blundell, R., Griffith, R., & Howitt, P. (2005). Competition and innovation: An inverted-U relationship. *The Quarterly Journal of Economics*, *120*(2), 701–728.

Aiello, F., Cardamone, P., Mannarino, L., & Pupo, V. (2021). Green patenting and corporate social responsibility: Does family involvement in business matter? *Corporate Social Responsibility and Environmental Management*, *28*(4), 1386–1396.

Amore, M. D., & Minichilli, A. (2018). Local political uncertainty, family control, and investment behavior. *Journal of Financial and Quantitative Analysis*, *53*(4), 1781–1804.

Ardito, L., Messeni Petruzzelli, A., Pascucci, F., & Peruffo, E. (2019). Inter-firm R&D collaborations and green innovation value: The role of family firms' involvement and the moderating effects of proximity dimensions. *Business Strategy and the Environment*, *28*(1), 185–197.

Bai, Y., Song, S., Jiao, J., & Yang, R. (2019). The impacts of government R&D subsidies on green innovation: Evidence from Chinese energy-intensive firms. *Journal of Cleaner Production*, *233*, 819–829.

Baker, A. C., Larcker, D. F., & Wang, C. C. (2022). How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics*, *144*(2), 370–395.

Bauweraerts, J., Arzubiaga, U., & Diaz-Moriana, V. (2022). Going greener, performing better? The case of private family firms. *Research in International Business and Finance*, *63*, 101784.

Beneito, P., Rochina-Barrachina, M. E., & Sanchis, A. (2017). Competition and innovation with selective exit: An inverted-U shape relationship? *Oxford Economic Papers*, *69*(4), 1032–1053.

Berrone, P., Cruz, C., & Gomez-Mejia, L. R. (2012). Socioemotional wealth in family firms: Theoretical dimensions, assessment approaches, and agenda for future research. *Family Business Review*, *25*(3), 258–279.

Borsuk, M., Eugster, N., Klein, P. O., & Kowalewski, O. (2024). Family firms and carbon emissions. *Journal of Corporate Finance*, *89*, 102672.

Borusyak, K., Jaravel, X., & Spiess, J. (2024). Revisiting event-study designs: Robust and efficient estimation. *Review of Economic Studies*, *91*(6), 3253–3285.

Bruton, G. D., Ahlstrom, D., & Li, H. L. (2010). Institutional theory and entrepreneurship: Where are we now and where do we need to move in the future? *Entrepreneurship Theory and Practice*, *34*(3), 421–440.

Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., De Massis, A., & Kraus, S. (2019). Innovation in family firms: A systematic literature review and guidance for future research. *International Journal of Management Reviews*, *21*(3), 317–355.

Calza, F., Profumo, G., & Tutore, I. (2016). Corporate ownership and environmental proactivity. *Business Strategy and the Environment*, *25*(6), 369–389.

Cengiz, D., Dube, A., Lindner, A., & Zipperer, B. (2019). The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics*, *134*(3), 1405–1454.

Chan, K. S., Dang, V. Q., & Yan, I. K. (2012). Chinese firms' political connection, ownership, and financing constraints. *Economics Letters*, *115*(2), 164–167.

Chang, K., Luo, D., Dong, Y., & Xiong, C. (2024). The impact of green finance policy on green innovation performance: Evidence from Chinese heavily polluting enterprises. *Journal of Environmental Management*, *352*, 119961.

Chen, J., & Roth, J. (2024). Logs with zeros? Some problems and solutions. *The Quarterly Journal of Economics*, *139*(2), 891–936.

Chen, L., Gao, F., Guo, T., & Huang, X. (2023). Mixed ownership reform and the short-term debt for long-term investment of non-state-owned enterprises: Evidence from China. *International Review of Financial Analysis*, *90*, 102861.

Chen, M., Xiao, J. Z., & Zhao, Y. (2021). Confucianism, successor choice, and firm performance in family firms: Evidence from China. *Journal of Corporate Finance*, *69*, 102023.

Cheng, C., Li, S., Liu, S., & Zhang, S. (2022). Origin matters: The institution imprint effect and green innovation in family businesses. *Finance Research Letters*, *50*, 103324.

Cohn, J. B., Liu, Z., & Wardlaw, M. I. (2022). Count (and count-like) data in finance. *Journal of Financial Economics*, *146*(2), 529–551.

Dangelico, R. M., Nastasi, A., & Pisa, S. (2019). A comparison of family and nonfamily small firms in their approach to green innovation: A study of Italian companies in the agri-food industry. *Business Strategy and the Environment*, *28*(7), 1434–1448.

Dieleman, M. (2019). Reaping what you sow: The family firm innovation trajectory. *Journal of Family Business Strategy*, *10*(4), 100248.

Dong, W., Dong, X., & Lv, X. (2022). How does ownership structure affect corporate environmental responsibility? Evidence from the manufacturing sector in China. *Energy Economics*, *112*, 106112.

Du, S., & Cao, J. (2023). Non-family shareholder governance and green innovation of family firms: A socio-emotional wealth theory perspective. *International Review of Financial Analysis*, *90*, 102857.

Duran, P., Kammerlander, N., Van Essen, M., & Zellweger, T. (2016). Doing more with less: Innovation input and output in family firms. *Academy of Management Journal*, *59*(4), 1224–1264.

Ernst, R. A., Gerken, M., Hack, A., & Hülsbeck, M. (2022). Family firms as agents of sustainable development: A normative perspective. *Technological Forecasting and Social Change*, *174*, 121135.

Farooq, U., Thavorn, J., & Tabash, M. I. (2024). Exploring the impact of environmental regulations and green innovation on corporate investment and cash management: Evidence from Asian economies. *China Finance Review International*. https://doi.org/10.1108/cfri-06-2024-0337

García-Granero, A., Llopis, Ó., Fernández-Mesa, A., & Alegre, J. (2015). Unraveling the link between managerial risk-taking and innovation: The mediating role of a risk-taking climate. *Journal of Business Research*, *68*(5), 1094–1104.

Hadlock, C. J., & Pierce, J. R. (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies*, *23*(5), 1909–1940.

Hao, Y., Fan, C., Long, Y., & Pan, J. (2019). The role of returnee executives in improving green innovation performance of Chinese manufacturing enterprises: Implications for sustainable development strategy. *Business Strategy and the Environment*, *28*(5), 804–818.

Hillebrand, S. (2019). Innovation in family firms–a generational perspective. *Journal of Family Business Management*, *9*(2), 126–148.

Homroy, S., & Slechten, A. (2019). Do board expertise and networked boards affect environmental performance? *Journal of Business Ethics*, *158*(1), 269–292.

Hong, Y., Jiang, X., Xu, H., & Yu, C. (2024). The impacts of China's dual carbon policy on green innovation: Evidence from Chinese heavy-polluting enterprises. *Journal of Environmental Management*, *350*, 119620.

Hu, D., Qiu, L., She, M., & Wang, Y. (2021). Sustaining the sustainable development: How do firms turn government green subsidies into financial performance through green innovation? *Business Strategy and the Environment*, *30*(5), 2271–2292.

Huang, Q., Chen, X., Zhou, M., Zhang, X., & Duan, L. (2019). How does CEO's environmental awareness affect technological innovation? *International Journal of Environmental Research and Public Health*, *16*(2), 261.

Jiang, W., Wang, A. X., Zhou, K. Z., & Zhang, C. (2020). Stakeholder relationship capability and firm innovation: A contingent analysis. *Journal of Business Ethics*, *167*, 111–125.

John, K., Litov, L., & Yeung, B. (2008). Corporate governance and risk-taking. *The Journal of Finance*, *63*(4), 1679–1728.

Lambertini, L., Poyago-Theotoky, J., & Tampieri, A. (2017). Cournot competition and "green" innovation: An inverted-U relationship. *Energy Economics*, *68*, 116–123.

Li, W., Li, X., Peng, L., & Ning, C. (2024). Silent actions: Digital transformation in private enterprises with state equity participation. *Finance Research Letters*, *65*, 105492.

Lin, B., & Pan, T. (2024). The impact of green credit on green transformation of heavily polluting enterprises: Reverse forcing or forward pushing? *Energy Policy*, *184*, 113901.

Lin, C., Ma, Y., Malatesta, P., & Xuan, Y. (2013). Corporate ownership structure and the choice between bank debt and public debt. *Journal of Financial Economics*, *109*(2), 517–534.

Lin, H. C. M., & Bo, H. (2012). State-ownership and financial constraints on investment of Chinese-listed firms: New evidence. *The European Journal of Finance*, *18*(6), 497–513.

Liu, X., Wang, E., & Cai, D. (2019). Green credit policy, property rights and debt financing: Quasi-natural experimental evidence from China. *Finance Research Letters*, *29*, 129–135.

Liu, Y., Huang, H., Mbanyele, W., Wei, Z., & Li, X. (2025). How does green industrial policy affect corporate green innovation? Evidence from the green factory identification in China. *Energy Economics*, *141*, 108047.

Lu, Y., & Shi, X. (2012). Corporate governance reform and state ownership: Evidence from China. *Asia-Pacific Journal of Financial Studies*, *41*(6), 665–685.

Maaloul, A., Zéghal, D., Ben Amar, W., & Mansour, S. (2023). The effect of environmental, social, and governance (ESG) performance and disclosure on cost of debt: The mediating effect of corporate reputation. *Corporate Reputation Review*, *26*(1), 1–18.

Madden, L., McMillan, A., & Harris, O. (2020). Drivers of selectivity in family firms: Understanding the impact of age and ownership on CSR. *Journal of Family Business Strategy*, *11*(2), 100335.

Martínez, J. I., Stöhr, B. S., & Quiroga, B. F. (2007). Family ownership and firm performance: Evidence from public companies in Chile. *Family Business Review*, *20*(2), 83–94.

Miroshnychenko, I., & De Massis, A. (2022). Sustainability practices of family and nonfamily firms: A worldwide study. *Technological Forecasting and Social Change*, *174*, 121079.

Miroshnychenko, I., Miller, D., De Massis, A., & Le Breton-Miller, I. (2024). Are family firms green? *Small Business Economics*, *64*(2), 1–306.

Nguyen, B., Do, H., & Le, C. (2021). How much state ownership do hybrid firms need for better performance? *Small Business Economics*, *59*, 1–27.

Quan, X., Ke, Y., Qian, Y., & Zhang, Y. (2021). CEO foreign experience and green innovation: Evidence from China. *Journal of Business Ethics*, *182*, 535–557.

Quan, Y., Wu, H., Li, S., & Ying, S. X. (2018). Firm sustainable development and stakeholder engagement: The role of government support. *Business Strategy and the Environment*, *27*(8), 1145–1158.

Ren, S., Wang, Y., Hu, Y., & Yan, J. (2021). CEO hometown identity and firm green innovation. *Business Strategy and the Environment*, *30*(2), 756–774.

Röd, I. (2016). Disentangling the family firm's innovation process: A systematic review. *Journal of Family Business Strategy*, *7*(3), 185–201.

Rondi, E., De Massis, A., & Kraus, S. (2021). Servitization through open service innovation in family firms: Exploring the ability-willingness paradox. *Journal of Business Research*, *135*, 436–444.

Sariol, A. M., & Abebe, M. A. (2017). The influence of CEO power on explorative and exploitative organizational innovation. *Journal of Business Research*, *73*, 38–45.

Sharma, P., & Sharma, S. (2011). Drivers of proactive environmental strategy in family firms. *Business Ethics Quarterly*, *21*(2), 309–334.

Sison, A. J. G., Ferrero, I., & Redín, D. M. (2020). Some virtue ethics implications from Aristotelian and Confucian perspectives on family and business. *Journal of Business Ethics*, *165*(2), 241–254.

Stiglitz, J. E. (2015). Leaders and followers: Perspectives on the Nordic model and the economics of innovation. *Journal of Public Economics*, *127*, 3–16.

Stock, C., Pütz, L., Schell, S., & Werner, A. (2024). Corporate social responsibility in family firms: Status and future directions of a research field. *Journal of Business Ethics*, *190*(1), 199–259.

Tiberius, V., Stiller, L., & Dabić, M. (2021). Sustainability beyond economic prosperity: Social microfoundations of dynamic capabilities in family businesses. *Technological Forecasting and Social Change*, *173*, 121093.

Wang, A., Si, L., & Hu, S. (2023). Can the penalty mechanism of mandatory environmental regulations promote green innovation? Evidence from China's enterprise data. *Energy Economics*, *125*, 106856.

Wang, L., & Liu, S. (2024). Reverse mixed-ownership reform and earnings quality of Chinese private enterprises: From the perspective of state-owned capital participation. *Applied Economics Letters*, 1–11.

Wu, B., Chen, F., Li, L., Xu, L., Liu, Z., & Wu, Y. (2025). Institutional investor ESG activism and exploratory green innovation: Unpacking the heterogeneous responses of family firms across intergenerational contexts. *The British Accounting Review*, *57*(4), 101324.

Xiang, D., Chen, J., Tripe, D., & Zhang, N. (2019). Family firms, sustainable innovation and financing cost: Evidence from Chinese hi-tech small and medium-sized enterprises. *Technological Forecasting and Social Change*, *144*, 499–511.

Xu, J., Zhang, H., & Wu, W. (2023). One novel mixed ownership reform and green innovation in private firms: Evidence from China. *Emerging Markets Review*, *57*, 101076.

Yan, L., Nie, Z., & Deng, Y. (2024). Can reverse mixed-ownership reform reduce the cost of equity financing of private enterprises? *Emerging Markets Finance and Trade*, *60*(8), 1716–1731.

Yu, L., Liu, Y., Niu, Y., & Xiao, Z. (2023). Greener together: The impact of China's mixed-ownership reform on firm carbon emissions. *Energy Policy*, *180*, 113689.

Yu, M. (2013). State ownership and firm performance: Empirical evidence from Chinese listed companies. *China Journal of Accounting Research*, *6*(2), 75–87.

Zhang, C., Zhou, B., & Tian, X. (2022). Political connections and green innovation: The role of a corporate entrepreneurship strategy in state-owned enterprises. *Journal of Business Research*, *146*, 375–384.

Zhang, X., Yu, M., & Chen, G. (2020). Does mixed-ownership reform improve SOEs' innovation? Evidence from state ownership. *China Economic Review*, *61*, 101450.

Zhao, Z., Zhao, Y., Lv, X., Li, X., Zheng, L., Fan, S., & Zuo, S. (2024). Environmental regulation and green innovation: Does state ownership matter? *Energy Economics*, *136*, 107762.

Zhu, R., Xin, X., & Tan, K. (2024). Reverse mixed ownership reform: Does state-owned capital injection inhibit corporate leverage manipulation? *Finance Research Letters*, *59*, 104764.

Zhu, Z., & Tan, Y. (2022). Can green industrial policy promote green innovation in heavily polluting enterprises? Evidence from China. *Economic Analysis and Policy*, *74*, 59–75.

How to cite this article: Tang, Y., Yang, T., Chen, J., & Li, Z. (2025). State ownership and green innovation in family firms. *International Review of Finance*, *25*(3), e70039. https://doi.org/10.1111/irfi.70039