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Organization capital and green innovation: Evidence from China

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Abstract

We investigate the impact of organization capital on green innovation. Using the sample of Chinese A-share listed firms from 2008 to 2020, we find evidence that the organization capital significantly improves green innovation. And this effect is more pronounced in firms with greater environmental regulatory pressure, more media attention, less financing constraints and in non-state-owned firms. Through simultaneous equation model and mediation analysis, we find that organization capital improves corporate social responsibility via green innovation. Our results are robust to endogeneity issues, alternative variables measurement, model specifications, and estimation methods. This paper contributes to the understanding of the role of organizational resources in influencing green innovation and corporate social responsibility, and helps promote corporate green transformation and environmental practices.

KEYWORDS

corporate social responsibility, green innovation, organization capital

1 | INTRODUCTION

As environmental pollution has become a key problem restricting human sustainable development, green innovation, as a substantial means of changing polluting and inefficient production patterns, has been received increasing attention from practitioners and scholars. The literature has studied the external determinants of green innovation, such as environmental regulation, market competition and public concern (e.g., Berrone et al., 2013; Liao, 2018; Nesta et al., 2014). Recent studies have also turned to the impact of internal factors on green innovation, such as corporate governance, CEO characteristics and corporate culture (e.g., Amore & Bennedsen, 2016; Ren et al., 2021; Wang, 2019; Zhou et al., 2021). But how organization capital, one of the most important intangible assets of firms, affects green innovation, still remains unexplored.

Organization capital represents a firm's stock of knowledge, capabilities, culture, business processes, and systems that facilitates an efficient match between human skills and physical capital to enhance production efficiency (Lev et al., 2009). Examples of organization capital include Apple's innovative corporate culture, Wal-Mart's supply chain management and inventory management system, Google's project management and employee collaboration and motivation system, Procter & Gamble's brand differentiation strategy and marketing promotion. According to Atkeson and Kehoe's (2005) analysis of the US National Income and Product Accounts, organization capital accounts for more than 40% of the cash flow produced by all intangible assets. Organization capital plays an increasingly important role in the operation of enterprises, and is regarded as the key factor driving enterprises to achieve long-term success and sustainable competitive advantage (Lev et al., 2009). However, our understanding of the role(s) of organization capital in helping companies to gain a competitive advantage in the green transformation is limited and remains to be explored.

Firstly, we believe that enterprises with higher organization capital will be more sensitive to environmental risks and accordingly make more active environmental strategies. Firms with higher organization capital are associated with broader social capital, including broader and fuller knowledge exchange and access to information (Subramaniam & Youndt, 2005). As green development becomes an inevitable trend, stakeholders such as suppliers, customers, shareholders, creditors and the public have put forward more and more requirements and demands for enterprises' green transformation, such as achieving higher green performance and providing more green products. Enterprises may be more sensitive to this demand and make more active green transformation strategies to promote the social capital based on the mutual environmental interests (Chang & Chen, 2012). Existing findings also support this idea, organization capital can help firms identify the transformation risks brought by the fast-changing environment (Teece et al., 1997), and help them make forward-looking strategic decisions to gain competitive advantage, and enter or maintain a more favorable life cycle stage (Hasan & Cheung, 2018).

Secondly, organization capital provides a favorable internal environment for green innovation. According to the literature, organization capital can realize the effective interaction between human capital and assets through more efficient processes and stronger management ability, so as to produce extraordinary performance (Carlin et al., 2012). For example, organization capital has been shown to be associated with higher productivity (Atkeson & Kehoe, 2005; Lev et al., 2009), better financial performance (Eisfeldt & Papanikolaou, 2013; Leung et al., 2018), lower financing constraints and lower cash flow uncertainty (Attig & Cleary, 2014), lower costs of bank loan (Danielova et al., 2022), which provides a stable operating environment and good financial support for the implementation of green innovation. Moreover, the advanced management practices represented by organization capital may provide institutional support for green innovation (Abbas & Sağsan, 2019) and be more likely to generate a series of green management innovations such as paperless office (Bresnahan et al., 2002; Bloom et al., 2012).

Finally, innovation is a talent-intensive activity, and organization capital is believed to be contained in key talents (such as managers, R&D personnel, engineers, etc.), which will affect the enterprise's attitude toward talents. Companies with higher organization capital are associated with lower staff turnover rate (Carlin et al., 2012; Dess & Shaw, 2001; Manchester, 2010) and tend to provide higher employee incentives (Lev et al., 2009; Lustig et al., 2011), which not only keeps innovative talent in green research and development continuously, but also improves employee enthusiasm and motivation to work on long-term projects (Francis et al., 2021). Based on the above view, we believe that organization capital can promote green innovation.

In this paper, we address the important and interesting issues in the Chinese setting. The rapid development of the Chinese economy in the past few decades has come at the cost of environmental damage and excessive resource consumption (Ren et al., 2018). The Chinese government has realized the necessity of environmental protection and has issued various environmental regulatory measures to promote green development (Liu & Wang, 2017). Nowadays, green innovation has become one of the most important strategies for Chinese firms to meet compliance requirements and obtain sustainable competitive advantages. Therefore, China provides us with a good research setting where the rapid development of green transformation and its determinants can be examined. Using the data of non-financial Chinese listed firms from 2008 to 2020, we find that organization capital is positively correlated with green innovation. We further find that this promotion effect is more pronounced in firms with greater environmental regulatory pressure, more media attention, less financing constraints and non-state-owned firms. Furthermore, considering that green innovation is an important measure to promote environmental performance (Singh et al., 2020), and environmental performance is an essential component of corporate social responsibility (CSR) (Jamali & Mirshak, 2007), we further find that organization capital can improve CSR through the mediating channel of green innovation.

Our contributions are as follows. First, we enrich the research on the determinants of green innovation. Growing literature focuses on the external and internal drivers of green innovation, such as environmental regulation, public concern, corporate governance, CEO characteristics (e.g., Berrone et al., 2013a, Berrone et al., 2013b; Nesta et al., 2014; Liao, 2018). However, it is not clear how organization capital, as an important intangible resource generating long-term competitive advantage, affects green innovation. Iqbal et al. (2022) emphasize that organization capital can facilitate the utilization of environmental innovation outcomes. As the empirical evidence on the relationship between environmental innovation and firm value is mixed in the literature, Iqbal et al. (2022) investigate the moderating role of organization capital in the relationship. They argue that organization capital, as an important intangible asset, can improve the efficiency of utilizing tangible assets, which is the key factor driving firm value. Specifically, they find that organization capital can strengthen the positive relationship between environmental innovation and firm value by promoting the utilization of tangible assets resulting from environmental innovations such as new equipment, technologies, and materials. Their paper mainly focuses on the indirect impact of organization capital in utilizing environmental innovation outcomes to enhance corporate value, rather than exploring the direct impact of organization capital on environmental innovation. We try to fill this gap by studying the relationship between the two and further broaden the determinants of green innovation. By testing the heterogeneity of this relationship, we also study under what conditions organization capital is more (or less) effective.

Second, we expand the literature on the effects of organization capital. In recent years, a growing body of literature studies the impact of organization capital on major financial and operational indicators such as corporate value, productivity, stock return, cash holdings, debt cost, firm life cycle, etc. (Attig & Cleary, 2014; Eisfeldt & Papanikolaou, 2013; Hasan & Cheung, 2018). With the green development becoming an inevitable trend, how firms respond to environmental challenges, especially whether they can actively engage in green innovation, is crucial for maintaining their competitiveness in the long-term. However, the literature on how organization capital influences the response to environmental issues is still scarce and the understanding of its role is limited (e.g., Iqbal et al., 2022). Our paper explores the impact of organization capital on green innovation, contributing to a more comprehensive understanding of the role of organization capital as a source of competitive advantage in the context of green transformation and further enriching the literature on the effects of organization capital.

Third, our study adds to the research on the driving factors and transmission mechanism of CSR. The prior studies demonstrate the impact of management practices on CSR (Attig & Cleary, 2015), but the influence of organization capital and the role of green innovation are unclear. We further extend the impact of organization capital on green innovation to CSR by showing that organization capital enhances CSR through enhancing green innovation, providing an additional factor/mechanism for understanding the determinants of CSR.

Finally, by examining whether organization capital can promote green innovation of Chinese firms, we provide empirical support for the view that firms may increase investment in organizational resources and management processes to promote green innovation to obtain competitiveness in green transformation and policy makers may set some policies to encourage firms to invest more in organization capital toward this end.

We organize the rest of the paper as follows. Section 2 reviews the literature and puts forward the hypothesis. Section 3 introduces the methodology, including data and sample, variables, and regression model. Section 4 shows the regression results. Section 5 provides some additional analysis. The discussion and conclusion are in Section 6.

2 | LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Green innovation is different from ordinary innovation in that it is more difficult, takes longer time and requires more investment (Jiang et al., 2022). In addition, green innovation reflects the value orientation of firms to social responsibility, rather than just to business or profit pursuit (Acemoglu et al., 2012; Zhou et al., 2021). Previous research suggests that green innovation can bring a series of positive benefits to firms, such as improving environmental performance, realizing sustainable development, improving productivity and financial performance, etc. (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Singh et al., 2020; Zhang & Zhu, 2019). Therefore, green innovation has turned into a proactive strategy for corporations to achieve a strategic head start and sustainable competitive advantage (Sellitto et al., 2020; Song & Yu, 2018).

Organization capital is a collection of culture, systems, processes, talents, management practices that have been built up over time (Lev et al., 2009). It is scarce and hard to be duplicated or replaced (Eisfeldt & Papanikolaou, 2013), which has been regarded as a key driver of corporate productivity and sustainable competitive advantages (Squicciarini & Mouel, 2012). There are two key characteristics of organization capital: it is a fundamental asset that can generate long-term competitive advantage by linking external social capital and coordinating internal management resources; and it is provided by key talents, which contains the attitude to talents (Hasan & Uddin, 2022).

First of all, organization capital is related to broader social capital, as well as better information exchange and knowledge acquisition (Subramaniam & Youndt, 2005). As environmental risk has become a major challenge restricting the sustainable development of society and the survival and development of enterprises, stakeholders such as the government, suppliers, customers, shareholders, creditors and the public have put forward higher requirements for enterprises to carry out green transformation, such as improving environmental performance and providing green products (Chang & Chen, 2012). Companies with higher organization capital may be more sensitive to these environmental risks and green demands and make more positive green transformation concerning the mutual environmental interests. Existing findings also support this idea that organization capital can help firms identify the transformation risks brought by the fast-changing environment (Teece et al., 1997), make forward-looking strategic decisions to gain competitive advantage, and enter or maintain a more favorable life cycle stage (Hasan & Cheung, 2018). Moreover, Firms can obtain more support from external social resources when carrying out green innovation (Asiaei et al., 2021) given that broader social capital has been shown to foster innovation by facilitating knowledge acquisition, exchange and creation (Nahabiet & Ghoshal, 1998).

In addition, organization capital also provides favorable conditions for green innovation from within the enterprises. Organization capital is regarded as one of the sources of extraordinary performance. Scholars find that through better management ability and process design, organization capital can realize effective interaction between human capital and assets containing intangible assets and tangible assets, thus helping firms realize more efficient resource planning, more stable business operation, higher productivity (Atkeson & Kehoe, 2005; Lev et al., 2009) and better financial performance (Eisfeldt & Papanikolaou, 2013; Leung et al., 2018). Due to better performance and development expectations, the literature also shows that organization capital is associated with lesser financial constraints, lower cash flow uncertainty (Attig & Cleary, 2014), and lower bank loan costs (Danielova et al., 2022). A more stable business operation and better financial situation will enable enterprises to pay attention to green transformation and invest in green innovation. Meanwhile, organization capital is associated with advanced management practices and higher management ability (Caroli & Van Reenen, 2001; Eisfeldt & Papanikolaou, 2013), while knowledge management practices can promote green innovation and green performance (Abbas & Sağsan, 2019), which provides support that organization capital can promote green innovation in management.

Moreover, it is noteworthy that innovation includes not only technological innovation but also management innovation (Porter & Van der Linde, 1995). Considering that organization capital is a collection of advanced management practices, in the face of environmental risks, enterprises with higher organization capital are more likely to introduce green elements into some management links such as production organization, product positioning and design, brand building, marketing, inventory and supply chain management, paperless office, staff training and other activities to realize green management innovation, which are both the main contents of organization capital (Peters & Taylor, 2017). For example, it has been demonstrated that firms with more organization capital tend to invest more in informatization and digitization (Bresnahan et al., 2002; Bloom et al., 2012; Eisfeldt & Papanikolaou, 2013), which will help to maximize efficiency and minimize waste of resources such as paper in the course of daily operations.

Finally, the talent view of organization capital holds that organization capital is contained in the key employees (such as core R&D personnel and business personnel, etc.) of a company (Boguth et al., 2022; Leung et al., 2018). Companies with higher organization capital are less likely to fire existing employees and use new employees, because existing employees are more familiar with the company's resources and procedures. Existing studies have proved that companies with higher organization capital have lower employee turnover rate (Carlin et al., 2012; Dess & Shaw, 2001; Manchester, 2010). The reduction of employees' career concerns will lead employees to focus on the development of long-term projects (Francis et al., 2021; Stein, 1989). Studies on environmental performance also show that due to the agency problem, green practices may not necessarily translate into green performance such as green patent output (Chen et al., 2018; Krüger, 2015; McWilliams et al., 2016). Compensation incentives are considered as a useful way to alleviate the agency problem and stimulate the enthusiasm of employees (Jensen & Meckling, 1976; Shleifer & Vishny, 1997). Because talent is particularly important to companies with higher organization capital, they are more inclined to offer incentive compensation to retain talent, such as providing stock options or equity shares to senior managers or key technical talents (Lev et al., 2009; Lustig et al., 2011). By coordinating and binding the interests of all parties, companies with higher organization capital are expected to have more effective green innovation outputs. Based on the above analysis, we propose the following hypothesis:

> **Hypothesis 1.** Organization capital promotes firm green innovation.

Environmental regulation and media attention always put external pressure on firms to conduct/improve environmental performance. Companies with greater environmental regulatory pressure face higher mandatory requirements for green transformation and they must improve environmental performance to meet compliance requirements through substantive green innovation (Berrone et al., 2013a, Berrone et al., 2013b; Nesta et al., 2014). Firms with higher media attention also face higher demand for improving environmental performance (Cheng & Liu, 2018). The higher demand or pressure can induce these firms to mobilize internal resources such as organization capital more effectively to meet the high expectation. Therefore, we propose the following hypotheses:

> **Hypothesis 2.** For firms with higher environmental regulation intensity, organization capital contributes more to enhancing green innovation.

> **Hypothesis 3.** For firms with higher media attention, organization capital contributes more to enhancing green innovation.

The nature of ownership will affect the company's response to external problems (Zhou et al., 2020). The difference in the pressure and motivation between state-owned enterprises (SOEs) and non-SOEs to achieve green goals may affect the level of corporate organization capital mobilization and its role in green innovation. On the one hand, one of the important tasks of Chinese SOEs is to carry out government policy (Putterman & Dong, 2000). In recent years, under the guidance of the new development concept of "Lucid waters and lush mountains are gold and silver mountains," the Chinese government has attached unprecedented importance to environmental performance (Liu & Wang, 2017). Due to their political role, SOEs may have to put more effort on green policy because environmental issues are now a top priority for national government in China. On the other hand, some studies argue that as SOEs have the advantage of the ease to access government resources and are less affected by market competition, they do not pay much attention to meeting the market demand for green products (Gong et al., 2018). Compared with SOEs, non-SOEs have greater demand for green innovation due to the dual pressure of government environmental supervision requirements and market demand for greener products (Shu et al., 2016; Yang et al., 2018). In addition, the tenure of non-SOEs leaders is relatively long, so they can consider more long-term and substantive green innovation projects, rather than focusing on accomplishments during their tenure, which often occurs in SOEs (Cheng et al., 2019). Therefore, we propose two competing hypotheses:

> **Hypothesis 4a.** Compared to SOEs, the relationship between organization capital and green innovation is more (less) positive in non-SOEs.

Numerous studies have shown that financing constraints significantly restrict firm technology innovation (Guariglia & Liu, 2014). Green technology innovation is particularly vulnerable to financing constraints due to its high cost, long cycle, and high uncertainty (Yu et al., 2021). When enterprises face more serious financing constraints, it may be more challenging to carry out green innovation, and the role of organization capital in green innovation is difficult to play. Therefore, we propose the following hypothesis:

> **Hypothesis 5.** For firms with lower financing constraints, organization capital contributes more to promoting green innovation.

The existing research demonstrates the impact of management practices on CSR (Attig & Cleary, 2015), but the influence of organization capital and the role of green innovation are unclear. Considering that green innovation is a crucial means to achieve environmental performance (Singh et al., 2020), and environmental performance is a significant part of CSR (Jamali & Mirshak, 2007), we expect that organization capital will enhance CSR and green innovation could be a mediating mechanism. To test this relationship, we propose the following hypothesis:

> **Hypothesis 6.** Organization capital can enhance corporate social responsibility by promoting green innovation.

3 | METHODOLOGY

3.1 | Data and sample

We construct our dataset from several data sources. The firm green innovation information and the financial data are from Chinese Research Data Services (CNRDS) and China Stock Market & Accounting Research Database (CSMAR), respectively. Since China's Environmental Protection Administration issued a series of guidelines in 2008 to regulate the environmental management of listed companies, we select the Chinese non-financial A-share listed firms from 2008 to 2020 as a sample and obtain 21,095 firm-year observations after excluding ST firms and missing observation. We also winsorize our data at the 1% and 99% levels to deal with extreme values.

3.2 | Dependent variable: Green innovation

We follow previous research and employ the patent-based approach to measure the firm green innovation (e.g., Amore & Bennedsen, 2016). We get the green innovation information from the CNRDS and use the number of green innovations granted to measure the firm green innovation (GI) (Zhou et al., 2021). We also use two other ways to measure green innovation for robustness test. One is the amount of green patent applications (GI1), as Francis et al. (2021) argue that the number of patent applications is more closely related to the actual innovation time. The other is the number of green invention patents granted (GI2), which is considered to better reflect the green innovation capability and quality of firms (Jiang et al., 2022).

3.3 | Independent variable: Organization capital

We follow Eisfeldt and Papanikolaou (2013) and calculate the stock of organization capital by capitalizing SG&A expenditure using perpetual inventory method. According to previous literature, SG&A expenditure includes expenses related to information system development, staff training, R&D, consultant fees and brand promotion, etc., which can form and reflect the functions of organization capital. This method is widely used to calculate the organization capital (Hasan & Cheung, 2018; Leung et al., 2018; Li et al., 2018) and the formula is as follows:

$$OC_{i,t} = (1-\delta_{oc})OC_{i,t-1} + \frac{sga_{i,t}}{cpi_t} \tag{1}$$

The initial organization capital stock is calculated by the following formula:

$$OC_{i,t0} = \frac{sga_{i,t}}{g+\delta_0} \tag{2}$$

where $OC_{i,t}$ denotes organization capital of firm i at time t; δ_{oc} represents the depreciation rate of OC, which is set at 0.20 according to Eisfeldt and Papanikolaou (2014) and Peters and Taylor (2017); $sga_{i,t}$ indicates SG&A expenses of firm *i* at time *t*; cpi_t are the CPI at time *t*; *g* denotes the organization capital growth rate calculated by the average growth of firm-level SG&A expenses. To calculate the organization capital ratio, we scale organization capital by the book value of total assets.

We also use Peters and Taylor (2017)'s measure to calculate organization capital for the robustness test. It is worth noting that the above two methods are similar. The only difference is that Peters and Taylor (2017) construct organization capital using a portion of SG&A expenses rather than the deflated value of total SG&A expenses. They calculate the organization capital in the following way:

$$OC_{i,t} = (1-\delta_{oc})OC_{i,t-1} + sga_{i,t} \times \theta_0 \tag{3}$$

where θ_0 denotes the proportion of SG&A invested in organization capital. Following prior literature, we set θ_0 to 0.3 to calculate organization capital.

The initial organization capital stock is calculated by the following formula:

$$OC_{i,t0} = \frac{sga_{i,t} \times \theta_0}{g+\delta_0} \tag{4}$$

3.4 | Control variables

We refer to the prior organization capital and green innovation literature and control for a range of variables related to firm characteristics, financial indicators, and corporate governance indicators (Amore & Bennedsen, 2016; Hasan & Cheung, 2018; Jiang et al., 2022; Li, 2020; Zhou et al., 2021) in the analysis. They include firm age (AGE), size (SIZE), leverage (LEV), profitability (ROE), firm value (TOBINQ), sales growth (GROWTH), asset structure (STRUC), firm capital expenditure (CAPEX), cash flows (CFO), cash flow risk (σ(CFO)), shareholding ratio of the largest shareholder (FIRST), CEO duality (DUALITY), proportion of independent director (INDP), top management team shareholding ratio (TMT). Furthermore, we control the industry and year fixed effects to capture industry-level and time-invariant unobserved heterogeneity. The variable definition and measurement are shown in Table 1.

3.5 | Regression model

To analyze the effect of organization capital on green innovation, we employ the following regression model:

$$GI_{i,t} = \alpha_0 + \alpha_1 OC_{i,t} + \boldsymbol{\alpha}\textbf{\textit{Control}}_{i,t} + \sum Ind + \sum Year + \varepsilon_{i,t} \tag{5}$$

where GI is green innovation, OC is organization capital, and Control indicates a set of firm-level controls. We control for the industry and year fixed effects in the regression model and cluster the robust standard errors at the firm level. All variables are defined in Table 1.

TABLE 1 Variable definition and measurement.

Variable	Definition and measurement
Independent variable	
OC	Organization capital (Eisfeldt & Papanikolaou, 2013), organization capital /total assets
OCP	Organization capital (Peters & Taylor, 2017), organization capital /total assets
Dependent variable	
GI	Green innovation, the number of green patents granted
GI1	Green innovation, the number of green patent applications
GI2	Green innovation, the number of green invention patents granted
CSR	ESG score, ESG rating from Wind and Sino-Securities Index (2010–2020)
CSR1	ESG score, ESG score from Rankins ESG Ratings (2010–2019)
CSR2	ESG score, ESG score from Bloomberg (2011–2020)
Control variables	
AGE	Firm age, observation year minus year of establishment
SIZE	Firm size, ln (total assets)
LEV	Firm leverage, total liabilities/total assets
ROE	Firm profitability, earnings before interest and tax/equity
TOBINQ	Firm value, market value /total assets
GROWTH	Annual percentage change of sales
STRUC	Firm capital structure, net fixed assets/total assets
CAPEX	Firm capital expenditure, capital expenditure /total assets
FIRST	The shareholding ratio of the largest shareholder, the largest shareholder/total shares
DUALITY	If CEO and chairman of the board are the same person, the same is 1, else is 2
INDP	Proportion of independent directors, independent directors/board
TMT	Top management team shareholding ratio, TMT shares/total shares
CFO	Firm cash flows, operating cash flows/total assets
σ(CFO)	Operating cash flows volatility, standard deviation of operating cash flows over 5 years
Heterogeneity variables	
PITI	Government regulatory pressure, the Urban Pollution Source Regulatory Information Disclosure Index (PITI) provided by IPE
MEDIA	Media attention, the number of internet news from CNRDS
SOE	Dummy, One for state-owned firms; Zero for non-state-owned firms
WW	Financing constraints, the WW index from CSMAR

4 | EMPIRICAL RESULTS

4.1 | Summary statistics

Table 2 shows the summary statistics of the major variables. The table shows that the mean and standard deviation of organization capital ratio are 0.34 and 0.27 (Eisfeldt and Papanikolaou (2013)'s measure) (0.09 and 0.07 (Peters and Taylor (2017)'s measure)), respectively, indicating a large difference in the organization capital of the selected samples. The mean (standard deviation) green innovation of GI, GI1, and GI2 are 1.41, 2.39, 0.44 (4.53, 7.59 and 1.71), showing a big difference in the green innovation as well. Descriptive statistics show that the sample firms are, on average, moderately mature (AGE = 17.80), large (SIZE = 22.19), and moderately leveraged (LEV = 45%). They also have a moderate fixed-asset structure (STRUC = 22%), high growth (TOBINQ = 2.09, GROWTH = 19%), decent profitability (ROE = 6%) with some cash-flow-generating ability (CFO = 6%), and some willingness to spend money on investment (CAPEX = 6%) and low cash flow volatility (σ(CFO) = 3%). For the corporate governance, they have high shareholding ratio of the largest shareholder (FIRST = 34.06%), low CEO duality (CEO = 1.76), high proportion of independent directors (INDP = 37%), and moderate top management team shareholding ratio (TMT = 16%).

4.2 | Baseline results

Table 3 shows the baseline regression results of the impact of organization capital on green innovation. Column (1) shows that without controlling for any factors, the coefficient of organization capital is positive, indicating that organization capital improves the green innovation. Column (2) (Column 3) shows the results when industry (year) fixed effects are included while Column (4) shows regression results when both the industry and year fixed effects are controlled at the same time. Regardless, these columns indicate that organization capital has a statistically significant (p < 0.01) and positive effect on green innovation, which supports the H1. In terms of economic significance, when other variables remain unchanged, when the organization

TABLE 2 Summary statistics.

Variable	Mean	SD	Min	Max	P25	P50	P75
GI	1.41	4.53	0.00	33.00	0.00	0.00	1.00
GI1	2.39	7.59	0.00	56.00	0.00	0.00	1.00
GI2	0.44	1.71	0.00	13.00	0.00	0.00	0.00
OC	0.34	0.27	0.03	1.42	0.16	0.26	0.42
OCP	0.09	0.07	0.01	0.37	0.04	0.07	0.11
AGE	17.80	5.47	3.00	52.00	14.00	18.00	21.00
SIZE	22.19	1.26	19.78	26.06	21.31	22.02	22.90
LEV	0.45	0.20	0.06	0.90	0.29	0.45	0.60
ROE	0.06	0.06	−0.19	0.25	0.03	0.05	0.09
TOBINQ	2.09	1.35	0.88	8.73	1.26	1.65	2.40
GROWTH	0.19	0.46	−0.55	3.03	−0.02	0.11	0.27
STRUC	0.22	0.16	0.00	0.69	0.09	0.19	0.31
CAPEX	0.06	0.06	0.00	0.35	0.02	0.04	0.08
FIRST	34.06	14.78	8.48	74.30	22.46	31.87	44.04
DUALITY	1.76	0.43	1.00	2.00	2.00	2.00	2.00
INDP	0.37	0.05	0.33	0.57	0.33	0.33	0.43
TMT	0.16	0.28	0.00	1.16	0.00	0.00	0.22
CF	0.06	0.06	−0.20	0.22	0.03	0.06	0.09
σ(CFO)	0.03	0.04	0.00	0.24	0.01	0.02	0.03

capital ratio increases by 1%, the number of green innovations will increase by 1.45 (equivalent to 0.32 standard deviation).

4.3 | Robustness checks

We perform several tests to check the robustness of our findings. They include alternative samples, estimation methods and measures of variables. We also use three methods to account for endogeneity.

4.3.1 | Alternative measures of key variables

We re-estimate the model by using alternative measures of green innovation and organization capital, respectively, and find similar results. Instead of using Eisfeldt and Papanikolaou (2013)'s measure, we also use Peters and Taylor (2017)'s measure (OCP) to calculate the organization capital. For the estimation of green innovation, we use two alternative green innovation measures (GI1 and GI2). Consistent with the main finding, all the results show that the organization capital has a positive effect on green innovation, as shown in Table 4.

4.3.2 | Alternative estimation methods

Moreover, considering that the green innovation should be non-negative and some firms have no green innovation patent, in which case the OLS estimates may be biased (Zhou et al., 2021). We follow Cheng and Liu (2018) and use a Poisson regression to re-run the regression model, Column (1) and (3) of Table 5 show the results and the relationship is still positive. We also run a Tobit regression, the results are similar to the main finding, as show in Column (2) and (4) of Table 5.

4.3.3 | Sub-sample test

China has implemented the Environmental Protection Law in 2015 and our study uses the sample from 2008 to 2020, therefor our findings may be driven by the period after 2015. In addition to controlling the year fixed effect, we further divide the sample into two parts according to 2015 and re-run regression respectively. Table 6 shows that both sub-sample results are significant ($p < 0.01$). It is worth noting that the sub-sample regression coefficient after 2015 increased from 1.11 to 2.07 and the difference is statistically significant ($F = 10.36$, $p < 0.01$), which indicates the promotion effect of this legal regulation on the relationship and reinforces the main findings of this paper.

4.4 | Accounting for endogeneity

4.4.1 | Lagged independent variables and controls

We first lag the independent and control variables one period and two periods in the regression to avoid the endogeneity effect arising from reverse causality. Table 7 shows the estimation results. The coefficients of organization capital are positive and significant at the 1% level, revealing a similar result as that of the main finding.

TABLE 3 Baseline results.

Variables	(1) GI	(2) GI	(3) GI	(4) GI
OC	1.0616***	1.4449***	1.0959***	1.4506***
	(3.41)	(4.43)	(3.53)	(4.42)
AGE	−0.0288*	−0.0176	−0.0559***	−0.0288*
	(−1.94)	(−1.28)	(−3.40)	(−1.80)
SIZE	1.2987***	1.2708***	1.2173***	1.2537***
	(8.52)	(9.55)	(7.31)	(8.53)
LEV	−0.2425	−0.2508	−0.0412	−0.2786
	(−0.64)	(−0.66)	(−0.10)	(−0.72)
ROE	−18.4852***	−7.5949***	−16.3975***	−7.1267***
	(−4.96)	(−2.86)	(−4.33)	(−2.66)
TOBINQ	0.1113***	0.0748**	0.1185***	0.0978**
	(3.01)	(2.23)	(2.61)	(2.35)
GROWTH	−0.3280***	−0.3166***	−0.2677***	−0.2622***
	(−5.67)	(−5.61)	(−4.77)	(−4.72)
STRUC	−1.4996***	−0.6888	−1.2970**	−0.5920
	(−2.93)	(−1.42)	(−2.56)	(−1.21)
CAPEX	1.8075*	0.7984	1.8303**	0.7229
	(1.95)	(1.02)	(1.97)	(0.91)
FIRST	−0.0070	−0.0059	−0.0056	−0.0057
	(−1.13)	(−1.14)	(−0.90)	(−1.10)
DUALITY	−0.1960	−0.1377	−0.1730	−0.1330
	(−1.29)	(−1.01)	(−1.14)	(−0.96)
INDP	0.3380	0.6334	0.0542	0.4916
	(0.27)	(0.55)	(0.04)	(0.43)
TMT	0.9526***	0.2594	0.5679**	0.1599
	(4.64)	(1.25)	(2.51)	(0.73)
CF	18.2240***	7.8000***	16.1173***	6.9799**
	(4.62)	(2.75)	(4.12)	(2.47)
σ(CFO)	−1.4302	0.6117	−1.6512	0.2586
	(−1.26)	(0.57)	(−1.47)	(0.24)
Constant	−26.7782***	−27.6728***	−25.0057***	−27.1461***
	(−8.25)	(−9.69)	(−7.14)	(−8.70)
Observations	21,095	21,095	21,095	21,095
R-squared	0.101	0.211	0.117	0.217
Year FE	NO	NO	YES	YES
Industry FE	NO	YES	NO	YES

Note: Robust *t*-statistics in parentheses $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

4.4.2 | Two-stage least squares (2SLS) regression

We refer to previous studies (Hasan & Cheung, 2018) and use the industry-level organization capital as an instrumental variable (IV) to conduct a 2SLS regression to further reduce the endogeneity problem arising from other sources. Firms in fast-changing industries tend to invest less organization capital for fear of obsolescence risk (Carlin et al., 2012), so the firm-level organization capital in the same industry may be similar and closely related to the industry-level organization capital, but it is unlikely that the organization capital of individual firm can affect the industry-level organization capital. Thus, industry average organization capital can be used as an effective IV to solve the endogeneity problem between the organization capital and the green innovation. Table 8 shows the 2SLS regression results. The F-statistic of the instrument coefficient is much bigger than 10, indicating that this is not a weak IV. The coefficients of organization capital are still statistically positive, providing strong support to H1.

TABLE 4 Alternative measures of key variables.

Variables	(1) GI1	(2) GI2	(3) GI	(4) GI1	(5) GI2
OC	0.5895***	2.9141***	-	-	-
	(4.15)	(4.95)	-	-	-
OCP	-	-	5.4862***	2.1973***	10.9794***
	-	-	(4.34)	(4.01)	(4.85)
AGE	−0.0082	−0.0428*	−0.0277*	−0.0077	−0.0406
	(−1.53)	(−1.72)	(−1.73)	(−1.45)	(−1.64)
SIZE	0.4669***	2.2310***	1.2483***	0.4645***	2.2200***
	(8.37)	(8.85)	(8.52)	(8.37)	(8.84)
LEV	−0.2490*	−0.3654	−0.2707	−0.2448*	−0.3481
	(−1.79)	(−0.58)	(−0.70)	(−1.76)	(−0.56)
ROE	−3.0852***	−11.1818**	−7.2185***	−3.1347***	−11.3821**
	(−3.01)	(−2.47)	(−2.69)	(−3.04)	(−2.51)
TOBINQ	0.0436***	0.2484***	0.1019**	0.0456***	0.2571***
	(2.76)	(3.34)	(2.44)	(2.88)	(3.45)
GROWTH	−0.0893***	−0.3554***	−0.2654***	−0.0910***	−0.3625***
	(−4.59)	(−3.89)	(−4.77)	(−4.67)	(−3.95)
STRUC	−0.4978***	−1.8560**	−0.5930	−0.4989***	−1.8589**
	(−2.70)	(−2.27)	(−1.21)	(−2.71)	(−2.27)
CAPEX	0.2447	1.8878	0.6893	0.2278	1.8162
	(0.94)	(1.36)	(0.86)	(0.87)	(1.31)
FIRST	−0.0018	−0.0122	−0.0057	−0.0018	−0.0123
	(−0.94)	(−1.42)	(−1.10)	(−0.94)	(−1.42)
DUALITY	−0.0431	−0.2148	−0.1332	−0.0431	−0.2151
	(−0.85)	(−0.94)	(−0.96)	(−0.85)	(−0.94)
INDP	0.1398	−0.2325	0.4980	0.1424	−0.2196
	(0.33)	(−0.13)	(0.43)	(0.33)	(−0.12)
TMT	0.0782	0.2361	0.1380	0.0691	0.1918
	(0.82)	(0.66)	(0.63)	(0.73)	(0.54)
CF	2.6980**	14.0912***	7.0123**	2.7270**	14.1769***
	(2.51)	(3.07)	(2.48)	(2.53)	(3.09)
σ(CFO)	0.0772	−1.6805	0.4203	0.1477	−1.3497
	(0.21)	(−1.01)	(0.39)	(0.40)	(−0.82)
Constant	−9.9855***	−47.9341***	−27.0574***	−9.9426***	−47.7471***
	(−8.38)	(−8.96)	(−8.70)	(−8.38)	(−8.95)
Observations	21,095	21,095	21,095	21,095	21,095
R-squared	0.172	0.223	0.217	0.172	0.223
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES

Note: Robust *t*-statistics in parentheses ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

4.4.3 | Entropy balancing estimates

We follow the previous research (e.g., Hasan, 2022) and adopt the entropy balancing method to alleviate the covariate imbalance problem. Hainmueller (2012) proposes the entropy balancing method, which can simultaneously control the multi-dimensional covariate balance of the samples of the treatment group and the control group, so as to maximize the accurate matching between the two groups of samples. We divide the sample into two groups according to median organization capital and perform the entropy balancing estimates. Table 9 shows the regression results are similar to our main findings.

TABLE 5 Alternative estimation methods.

Variables	(1) Poisson GI	(2) Tobit GI	(3) Poisson GI	(4) Tobit GI
OC	0.7880***	1.4506***	-	-
	(8.61)	(10.49)	-	-
OCP	-	-	3.1261***	5.4862***
	-	-	(8.86)	(10.29)
AGE	−0.0272***	−0.0288***	−0.0271***	−0.0277***
	(−6.36)	(−4.24)	(−6.33)	(−4.08)
SIZE	0.6202***	1.2537***	0.6193***	1.2483***
	(34.56)	(22.37)	(34.54)	(22.34)
LEV	−0.0454	−0.2786	−0.0509	−0.2707
	(−0.32)	(−1.56)	(−0.36)	(−1.52)
ROE	−1.2987	−7.1267***	−1.2969	−7.2185***
	(−1.34)	(−4.88)	(−1.34)	(−4.94)
TOBINQ	−0.0608***	0.0978***	−0.0614***	0.1019***
	(−3.09)	(4.25)	(−3.11)	(4.43)
GROWTH	−0.2518***	−0.2622***	−0.2509***	−0.2654***
	(−4.82)	(−5.58)	(−4.81)	(−5.64)
STRUC	−0.0854	−0.5920**	−0.0769	−0.5930**
	(−0.49)	(−2.51)	(−0.44)	(−2.51)
CAPEX	1.0503***	0.7229	1.0605***	0.6893
	(3.25)	(1.56)	(3.28)	(1.49)
FIRST	−0.0011	−0.0057**	−0.0011	−0.0057**
	(−0.80)	(−2.54)	(−0.80)	(−2.54)
DUALITY	0.0020	−0.1330*	0.0030	−0.1332*
	(0.05)	(−1.94)	(0.07)	(−1.94)
INDP	−0.1496	0.4916	−0.1419	0.4980
	(−0.46)	(0.85)	(−0.43)	(0.86)
TMT	0.2085***	0.1599	0.1991**	0.1380
	(2.63)	(1.47)	(2.52)	(1.27)
CF	2.0168*	6.9799***	1.9539*	7.0123***
	(1.80)	(4.36)	(1.75)	(4.38)
σ(CFO)	−1.6381**	0.2586	−1.5993**	0.4203
	(−2.04)	(0.41)	(−2.00)	(0.68)
Constant	−16.5492***	−27.1461***	−16.5490***	−27.0574***
	(−27.37)	(−22.56)	(−27.39)	(−22.55)
Observations	21,095	21,095	21,095	21,095
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES

Note: Robust *t*-statistics in parentheses ***p < 0.01; **p < 0.05; *p < 0.1.

4.5 | Heterogeneous/cross sectional analysis

4.5.1 | Heterogeneous effects by different external forces

We test the impact of external pressure (environmental regulatory pressure and media attention) on the relationship between organization capital and green innovation. First, we use the Urban Pollution Source Regulatory Information Disclosure Index (PITI) provided by the Institute of Public and Environmental Affairs (IPE) to measure the government environmental regulatory pressure, which has been widely adopted by Chinese scholars in research related to government environmental regulation (e.g., Pan & Fan, 2021). The higher the PITI score, the stronger the government's environmental regulatory

TABLE 6 Sub-sample test.

Variables	(1) 2008–2015 GI	(2) 2016–2020 GI	(3) 2008–2015 GI	(4) 2016–2020 GI
OC	1.1070***	2.0696***	-	-
	(7.44)	(7.97)	-	-
OCP	-	-	4.2514***	7.8378***
	-	-	(7.32)	(7.83)
AGE	−0.0306***	−0.0286**	−0.0298***	−0.0271**
	(−4.03)	(−2.48)	(−3.92)	(−2.35)
SIZE	1.0251***	1.5606***	1.0216***	1.5530***
	(14.95)	(17.02)	(14.95)	(17.00)
LEV	−0.6123***	0.0389	−0.6106***	0.0547
	(−2.89)	(0.12)	(−2.89)	(0.17)
ROE	−4.4993***	−9.1801***	−4.5339***	−9.3171***
	(−2.79)	(−3.52)	(−2.81)	(−3.57)
TOBINQ	0.0856***	0.0655	0.0880***	0.0715*
	(3.29)	(1.60)	(3.38)	(1.75)
GROWTH	−0.1664***	−0.4177***	−0.1675***	−0.4234***
	(−3.65)	(−4.29)	(−3.67)	(−4.35)
STRUC	−0.4518*	−0.9802**	−0.4528*	−0.9780**
	(−1.79)	(−2.09)	(−1.80)	(−2.08)
CAPEX	−0.1698	2.6173**	−0.1834	2.5524**
	(−0.39)	(2.41)	(−0.43)	(2.35)
FIRST	−0.0074***	−0.0007	−0.0074***	−0.0006
	(−3.14)	(−0.16)	(−3.16)	(−0.14)
DUALITY	−0.1634**	−0.1075	−0.1641**	−0.1062
	(−2.09)	(−0.91)	(−2.10)	(−0.90)
INDP	−0.0849	1.4276	−0.0761	1.4272
	(−0.13)	(1.45)	(−0.11)	(1.45)
TMT	0.1532	0.1670	0.1391	0.1332
	(1.18)	(0.92)	(1.07)	(0.74)
CF	4.0422**	9.1989***	3.9999**	9.2885***
	(2.23)	(3.30)	(2.20)	(3.32)
σ(CFO)	0.4891	−0.2756	0.6138	−0.0771
	(0.92)	(−0.19)	(1.15)	(−0.05)
Constant	−21.4151***	−35.0045***	−21.3648***	−34.8612***
	(−14.61)	(−16.96)	(−14.61)	(−16.93)
Observations	12,151	8944	12,151	8944
R-squared	0.200	0.233	0.200	0.233
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
F-Test for difference (*p*-value)	10.36 (0.0013)		9.61 (0.0019)	

Note: Robust *t*-statistics in parentheses ***p < 0.01; **p < 0.05; *p < 0.1.

pressure. Second, given that more and more people are turning to the internet to look up relevant information (Cheng & Liu, 2018), in our case, we refer to Luo et al. (2019) and employ firm-level internet news report from CNRDS to measure the media attention. To test the impact of above external forces on the relation between organization capital and green innovation empirically, we divide the samples into two groups according to whether the above variables are greater than the median of the sample.

TABLE 7 Lag the independent and control variable.

Variables	(1) T + 1 GI	(2) T + 2 GI	(3) T + 1 GI	(4) T + 2 GI
OC	1.6666***	1.6547***	-	-
	(4.32)	(4.01)	-	-
OCP	-	-	6.3480***	6.3648***
	-	-	(4.26)	(3.97)
AGE	−0.0303*	−0.0333*	−0.0291	−0.0321
	(−1.66)	(−1.67)	(−1.59)	(−1.61)
SIZE	1.3888***	1.4907***	1.3838***	1.4863***
	(8.24)	(8.11)	(8.24)	(8.11)
LEV	−0.4578	−0.3471	−0.4529	−0.3454
	(−1.02)	(−0.70)	(−1.01)	(−0.70)
ROE	−4.4020	−3.7846	−4.4712	−3.8257
	(−1.39)	(−1.03)	(−1.41)	(−1.04)
TOBINQ	0.1131**	0.1806***	0.1170**	0.1837***
	(2.17)	(3.05)	(2.24)	(3.10)
GROWTH	−0.1605**	−0.1633**	−0.1632**	−0.1652**
	(−2.27)	(−2.37)	(−2.30)	(−2.40)
STRUC	−0.4248	−0.5277	−0.4251	−0.5267
	(−0.76)	(−0.86)	(−0.76)	(−0.86)
CAPEX	1.0266	1.0402	0.9956	1.0164
	(1.06)	(0.96)	(1.02)	(0.94)
FIRST	−0.0062	−0.0080	−0.0062	−0.0080
	(−1.04)	(−1.23)	(−1.05)	(−1.23)
DUALITY	−0.2575	−0.3356*	−0.2582	−0.3369*
	(−1.59)	(−1.86)	(−1.59)	(−1.87)
INDP	0.4953	0.5821	0.5011	0.5908
	(0.38)	(0.41)	(0.39)	(0.42)
TMT	0.1666	0.2090	0.1436	0.1879
	(0.66)	(0.75)	(0.57)	(0.68)
CF	4.9209	5.4207	4.8943	5.3466
	(1.46)	(1.39)	(1.45)	(1.37)
σ(CFO)	0.2341	−0.7999	0.4128	−0.6391
	(0.18)	(−0.61)	(0.31)	(−0.49)
Constant	−29.7576***	−31.7502***	−29.6782***	−31.6856***
	(−8.36)	(−8.22)	(−8.36)	(−8.21)
Observations	16,733	14,306	16,733	14,306
R-squared	0.232	0.234	0.232	0.234
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES

Note: Robust *t*-statistics in parentheses ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Table 10 shows the heterogeneous results under different environmental regulatory pressure and media attention. We find that the coefficients of the high external forces group (high environmental regulatory pressure group and high media attention group) and the low external forces group are both significant ($p < 0.01$), but the coefficients of the high external forces group are significantly greater than the low external forces group (the *p*-value of *F*-test <0.05), indicating that there is a significant difference. This means that environmental regulatory pressure and media attention will improve the role of organization capital in promoting green innovation, which supports H2 and H3.

TABLE 8 Two stage least square (2SLS) estimation results.

Variables	(1) GI	(2) GI
OC	2.9767**	-
	(2.11)	-
OCP	-	11.8152**
	-	(2.11)
AGE	−0.0335**	−0.0316*
	(−2.00)	(−1.91)
SIZE	1.3027***	1.2960***
	(8.28)	(8.33)
LEV	−0.4707	−0.4722
	(−1.14)	(−1.15)
ROE	−4.8454	−4.8229
	(−1.43)	(−1.41)
TOBINQ	0.0356	0.0386
	(0.54)	(0.58)
GROWTH	−0.1745*	−0.1729*
	(−1.79)	(−1.76)
STRUC	−0.4702	−0.4607
	(−0.94)	(−0.92)
CAPEX	1.3365	1.3235
	(1.39)	(1.38)
FIRST	−0.0060	−0.0060
	(−1.15)	(−1.16)
DUALITY	−0.1369	−0.1376
	(−0.99)	(−0.99)
INDP	0.4850	0.4982
	(0.42)	(0.43)
TMT	0.2296	0.1892
	(1.04)	(0.87)
CF	4.0925	3.8835
	(1.07)	(0.99)
σ(CFO)	−0.7624	−0.5129
	(−0.55)	(−0.39)
Constant	−28.4597***	−28.3955***
	(−8.24)	(−8.28)
Observations	21,095	21,095
R-squared	0.212	0.211
Year FE	YES	YES
Industry FE	YES	YES
First-stage F statistic	99.66	101.46
Kleibergen-Paaprk LM statistic (*p*-value)	28.94 (0.0000)	26.24 (0.0000)

Note: Robust *t*-statistics in parentheses $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

4.5.2 | Heterogeneous effects by ownership nature

Table 11 shows that the regression coefficients of the non-SOEs are larger than the SOEs, and the *F*-test shows a significant difference ($p < 0.01$). This means that the organization capital of non-SOEs has a stronger role in promoting green innovation, supporting H4a.

TABLE 9 Entropy balancing estimates.

Variables	(1) GI	(2) GI
OC	1.1761***	-
	(4.05)	-
OCP	-	4.5086***
	-	(3.98)
AGE	−0.0250	−0.0238
	(−1.52)	(−1.46)
SIZE	1.1708***	1.1734***
	(8.21)	(8.27)
LEV	−0.0569	−0.0214
	(−0.17)	(−0.07)
ROE	−1.6711	−1.8783
	(−0.53)	(−0.61)
TOBINQ	0.0727*	0.0807**
	(1.88)	(2.09)
GROWTH	−0.1281*	−0.1275*
	(−1.86)	(−1.87)
STRUC	−0.4494	−0.4709
	(−0.94)	(−1.01)
CAPEX	0.3054	0.4695
	(0.39)	(0.60)
FIRST	−0.0048	−0.0043
	(−1.03)	(−0.92)
DUALITY	−0.1713	−0.1639
	(−1.33)	(−1.28)
INDP	−0.1825	−0.3722
	(−0.19)	(−0.41)
TMT	0.1250	0.1268
	(0.69)	(0.70)
CF	1.0992	1.1987
	(0.32)	(0.36)
σ(CFO)	−0.2402	−0.0489
	(−0.27)	(−0.06)
Constant	−24.2774***	−24.2862***
	(−8.06)	(−8.10)
Observations	21,095	21,095
R-squared	0.224	0.224
Year FE	YES	YES
Industry FE	YES	YES

Note: Robust *t*-statistics in parentheses $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

4.5.3 | Heterogeneous effects by financing constraints

We refer to the method of Whited and Wu (2006) and use WW index to measure the financing constraints. The larger the WW index, the greater the degree of financing constraints. We divide the sample into two groups based on the WW index median. Table 12 shows that the coefficients of both groups are significant ($p < 0.01$), but the

TABLE 10 Heterogeneous effects by different external forces.

Variables	(1) PITI > median GI	(2) PITI < median GI	(3) PITI > median GI	(4) PITI < median GI	(5) Media > median GI	(6) Media < median GI	(7) Media > median GI	(8) Media < median GI
OC	1.7787***	1.1099***	-	-	1.9530***	0.3647***	-	-
	(7.01)	(6.40)	-	-	(8.81)	(3.29)	-	-
OCP	-	-	6.7561***	4.1621***	-	-	7.2428***	1.4740***
	-	-	(6.92)	(6.21)	-	-	(8.55)	(3.45)
AGE	−0.0171	−0.0418***	−0.0159	−0.0410***	−0.0280***	−0.0313***	−0.0267**	−0.0311***
	(−1.53)	(−4.23)	(−1.42)	(−4.15)	(−2.66)	(−3.70)	(−2.53)	(−3.67)
SIZE	1.4508***	1.0837***	1.4448***	1.0786***	1.5503***	0.5386***	1.5436***	0.5383***
	(15.61)	(13.08)	(15.59)	(13.07)	(19.01)	(9.45)	(18.96)	(9.47)
LEV	−0.4735	−0.1901	−0.4656	−0.1827	−0.9650***	0.6078***	−0.9448***	0.6072***
	(−1.59)	(−0.75)	(−1.56)	(−0.73)	(−3.12)	(3.32)	(−3.06)	(3.32)
ROE	−3.2529	−6.7514***	−3.3254	−6.8252***	−6.7722***	−5.8261***	−6.9290***	−5.8285***
	(−1.35)	(−2.68)	(−1.38)	(−2.71)	(−2.99)	(−3.53)	(−3.05)	(−3.54)
TOBINQ	0.1109***	0.0605*	0.1144***	0.0646**	0.1245***	0.0049	0.1302***	0.0054
	(2.69)	(1.94)	(2.77)	(2.07)	(3.58)	(0.19)	(3.75)	(0.22)
GROWTH	−0.2390***	−0.2214***	−0.2433***	−0.2238***	−0.3014***	−0.1765***	−0.3064***	−0.1763***
	(−2.74)	(−3.25)	(−2.79)	(−3.28)	(−4.05)	(−3.17)	(−4.11)	(−3.16)
STRUC	0.6434	−0.9370***	0.6455	−0.9329***	−0.7342*	−0.2689	−0.7318*	−0.2696
	(1.30)	(−3.09)	(1.30)	(−3.08)	(−1.80)	(−1.10)	(−1.79)	(−1.10)
CAPEX	2.6973***	0.0458	2.6511**	0.0205	1.3055*	−0.1214	1.2558	−0.1210
	(2.62)	(0.08)	(2.57)	(0.04)	(1.68)	(−0.31)	(1.61)	(−0.31)
FIRST	−0.0028	−0.0088***	−0.0027	−0.0088***	−0.0073*	−0.0039*	−0.0073*	−0.0039*
	(−0.69)	(−2.91)	(−0.68)	(−2.90)	(−1.95)	(−1.80)	(−1.95)	(−1.80)
DUALITY	−0.2388**	−0.2440**	−0.2390**	−0.2455**	−0.1899	0.0183	−0.1907	0.0183
	(−2.09)	(−2.20)	(−2.09)	(−2.22)	(−1.61)	(0.29)	(−1.61)	(0.29)
INDP	−1.8428**	1.9425**	−1.8582**	1.9505**	1.3287	−0.6222	1.3497	−0.6208
	(−1.98)	(2.14)	(−1.99)	(2.15)	(1.44)	(−1.05)	(1.46)	(−1.05)
TMT	0.1438	0.1238	0.1173	0.1052	0.3880**	−0.1542	0.3593*	−0.1585
	(0.80)	(0.73)	(0.66)	(0.62)	(2.02)	(−1.46)	(1.87)	(−1.51)
CF	2.6020	7.1558***	2.5976	7.1847***	6.0511**	6.3222***	6.1462**	6.3038***
	(0.97)	(2.65)	(0.97)	(2.67)	(2.38)	(3.49)	(2.41)	(3.48)
σ(CFO)	−0.4490	0.9105	−0.2547	1.0412	0.5054	−0.0601	0.7247	−0.0335
	(−0.28)	(1.25)	(−0.16)	(1.43)	(0.47)	(−0.09)	(0.67)	(−0.05)

TABLE 10 (Continued)

Variables	(1) PITI > median GI	(2) PITI < median GI	(3) PITI > median GI	(4) PITI < median GI	(5) Media > median GI	(6) Media < median GI	(7) Media > median GI	(8) Media < median GI
Constant	−31.2971***	−23.4447***	−31.2157***	−23.3482***	−35.5138***	−11.4139***	−35.4021***	−11.4193***
	(−15.88)	(−12.65)	(−15.87)	(−12.64)	(−18.84)	(−9.46)	(−18.81)	(−9.49)
Observations	8593	7858	8593	7858	10,549	10,524	10,549	10,524
R-squared	0.264	0.190	0.264	0.190	0.265	0.146	0.265	0.147
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
F-test for difference (*p*-value)	4.73 (0.0296)		4.80 (0.0258)		32.71 (0.0000)		36.99 (0.0000)	

Note: Robust *t*-statistics in parentheses ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

coefficients of low financing constraint group are significantly larger than the high financing constraints group (the *p*-value of *F*-test <0.01), indicating that lower financing constraints will increase the promoting effect of organization capital on green innovation, which supports H5.

5 | ADDITIONAL ANALYSIS

In this part, we test whether and how organization capital can further promote corporate social responsibility (CSR). To test the mediating role of green innovation in promoting CSR, we refer to previous research (Cheung, 2016) and use the following simultaneous equations model:

$$CSR_{i,t} = \beta_0 + \beta_1 OC_{i,t} + \beta_2 GI_{i,t} + \boldsymbol{\beta Control_{i,t}} + \sum Ind + \sum Year + \vartheta_{i,t} \quad (6)$$

$$GI_{i,t} = \alpha_0 + \alpha_1 OC_{i,t} + \boldsymbol{\alpha Control_{i,t}} + \sum Ind + \sum Year + \varepsilon_{i,t} \quad (7)$$

where CSR is ESG score obtained from Wind and Sino-Securities Index, Rankins ESG Ratings and Bloomberg database, respectively, and the latter two are used for robustness test. In this simultaneous-equations model, the direct and indirect effects from organization capital on CSR are captured by β_1 and $\alpha_1\beta_2$ (via GI), respectively. We estimate the above two equations simultaneously and use the bootstraps method to test the indirect effects (Cheung, 2016).

The simultaneous equations model results are shown in Table 13. Column (1) of Table 13 shows that the coefficients of GI and OC on CSR are 0.0078 (p < 0.01) and 0.3567 (p < 0.01). Column (2) shows that the coefficient of OC on GI is 1.5766 (p < 0.01). The bootstrap method results show that the indirect effect of OC on CSR is 0.0122 (via GI), and the 95% confidence interval of indirect effect does not include 0, indicating that the indirect effect is significantly larger than 0. In short, organization capital can promote CSR by promoting green innovation, which strongly supports H6. We use the alternative measures of CSR to re-run the model, the results still remain robust as shown in Columns (3)–(6).

6 | DISCUSSION AND CONCLUSION

Our study explores the role of organization capital as a source of sustainable competitive advantage in promoting green innovation and green competitiveness. By promoting the exchange of information and knowledge and coordinating resources efficiently, organization capital not only makes firms more sensitive to the green demands of stakeholders but also provides better internal conditions for green innovation, such as more efficient management, more stable operations, better financial conditions, and more energetic talents. Moreover, as a collection of advanced management practices, firms with higher organization capital may be more likely to engage in a series of green process and management innovations. Using the Chinese A-share listed firms from 2008 to 2020 as a sample, we find that the

TABLE 11 Heterogeneous effects by ownership nature.

Variables	(1) NOSOE GI	(2) SOE GI	(3) NOSOE GI	(4) SOE GI
OC	1.6885***	0.6960***	-	-
	(8.20)	(3.79)	-	-
OCP	-	-	6.3813***	2.5660***
	-	-	(8.20)	(3.59)
AGE	−0.0215***	−0.0444***	−0.0205***	−0.0437***
	(−2.86)	(−3.21)	(−2.72)	(−3.17)
SIZE	1.0391***	1.4573***	1.0319***	1.4540***
	(13.17)	(17.51)	(13.14)	(17.51)
LEV	0.9651***	−1.7995***	0.9786***	−1.7984***
	(4.86)	(−5.50)	(4.93)	(−5.50)
ROE	−4.6825***	−10.0634***	−4.7104***	−10.1623***
	(−2.75)	(−3.93)	(−2.77)	(−3.96)
TOBINQ	0.0383	0.2025***	0.0430	0.2051***
	(1.43)	(4.60)	(1.61)	(4.65)
GROWTH	−0.2346***	−0.3154***	−0.2379***	−0.3178***
	(−4.03)	(−3.88)	(−4.09)	(−3.91)
STRUC	−0.9340***	0.1495	−0.9290***	0.1447
	(−3.00)	(0.41)	(−2.98)	(0.39)
CAPEX	1.0904**	0.1207	1.0661**	0.0964
	(2.05)	(0.14)	(2.01)	(0.11)
FIRST	0.0018	−0.0155***	0.0016	−0.0155***
	(0.62)	(−4.20)	(0.57)	(−4.19)
DUALITY	−0.0720	−0.3704**	−0.0737	−0.3710**
	(−0.95)	(−2.36)	(−0.98)	(−2.36)
INDP	0.5314	0.4338	0.5236	0.4480
	(0.79)	(0.42)	(0.78)	(0.43)
TMT	0.2646**	−0.5965	0.2468**	−0.6252
	(2.24)	(−0.59)	(2.10)	(−0.62)
CF	5.3739***	8.3739***	5.3420***	8.4450***
	(2.92)	(2.87)	(2.90)	(2.89)
σ(CFO)	0.1714	−0.3694	0.3814	−0.2964
	(0.19)	(−0.39)	(0.44)	(−0.32)
Constant	−22.9626***	−30.3071***	−22.8335***	−30.2475***
	(−13.19)	(−17.71)	(−13.17)	(−17.71)
Observations	12,120	8975	12,120	8975
R-squared	0.182	0.288	0.182	0.288
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
F-test for difference (*p*-value)	12.95 (0.0003)		13.02 (0.0003)	

Note: Robust *t*-statistics in parentheses $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

organization capital significantly improves the green innovation. And this promotion effect is more pronounced in firms with greater environmental regulatory pressure, more media attention, less financing constraints and non-state-owned firms. We extend the influence of organization capital on green innovation to CSR, and find that organization capital enhances CSR by promoting green innovation. Our findings are robust to endogeneity issues, alternative variables measurement, samples, and estimation methods.

TABLE 12 Heterogeneous effects by financing constraints.

Variables	(1) WW > median GI	(2) WW < median GI	(3) WW > median GI	(4) WW < median GI
OC	0.3541***	1.9555***	-	-
	(3.40)	(7.18)	-	-
OCP	-	-	1.4340***	7.3271***
	-	-	(3.46)	(7.07)
AGE	−0.0447***	−0.0336***	−0.0444***	−0.0327***
	(−7.80)	(−2.82)	(−7.74)	(−2.75)
SIZE	0.2860***	1.9315***	0.2846***	1.9288***
	(6.74)	(19.24)	(6.73)	(19.22)
LEV	0.4342***	−1.2854***	0.4360***	−1.2959***
	(2.94)	(−3.04)	(2.96)	(−3.07)
ROE	−1.9937**	−7.8574***	−1.9875**	−7.9702***
	(−2.10)	(−2.74)	(−2.09)	(−2.78)
TOBINQ	−0.0264*	0.0028	−0.0262*	0.0025
	(−1.71)	(0.05)	(−1.70)	(0.04)
GROWTH	−0.0737	−0.0006	−0.0735	−0.0020
	(−1.32)	(−0.01)	(−1.32)	(−0.03)
STRUC	−0.3127*	−1.0952**	−0.3132*	−1.0928**
	(−1.67)	(−2.33)	(−1.68)	(−2.32)
CAPEX	0.3371	0.9468	0.3402	0.9116
	(1.00)	(1.11)	(1.01)	(1.07)
FIRST	−0.0060***	−0.0061	−0.0060***	−0.0061
	(−3.12)	(−1.57)	(−3.13)	(−1.56)
DUALITY	−0.0600	−0.2294	−0.0602	−0.2302*
	(−1.01)	(−1.64)	(−1.02)	(−1.65)
INDP	0.1840	−0.0816	0.1865	−0.0672
	(0.34)	(−0.08)	(0.35)	(−0.06)
TMT	0.1072	0.0448	0.1028	0.0208
	(0.88)	(0.20)	(0.85)	(0.10)
CF	2.3665**	8.3208**	2.3444**	8.3634**
	(2.14)	(2.27)	(2.12)	(2.28)
σ(CFO)	−0.7151*	−1.6893	−0.6845*	−1.6466
	(−1.78)	(−0.94)	(−1.71)	(−0.92)
Constant	−5.7236***	−42.6987***	−5.7101***	−42.6386***
	(−6.27)	(−19.64)	(−6.27)	(−19.62)
Observations	9560	9560	9560	9560
R-squared	0.112	0.268	0.112	0.268
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
F-test for difference (*p*-value)	30.15 (0.0000)		27.84 (0.0000)	

Note: Robust *t*-statistics in parentheses ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Our evidence sheds light for the research on the role of organization capital, the influencing factors of corporate green innovation and CSR. And we provide empirical support for the view that firms may increase investment in organizational resources and management processes to promote green innovation and obtain competitiveness in green transformation and policy makers may set some policies to

TABLE 13 Additional analysis.

Variables	(1) CSR	(2) GI	(3) CSR1	(4) GI	(5) CSR2	(6) GI
GI	0.0078***		0.1588***		0.1156***	
	(4.61)		(6.26)		(9.20)	
OC	0.3567***	1.5766***	6.0079***	1.6298***	2.4576***	1.8910***
	(10.42)	(10.65)	(8.53)	(4.05)	(7.72)	(6.35)
AGE	0.0051***	−0.0259***	−0.0924***	−0.0100	0.0673***	−0.0573***
	(3.35)	(−3.92)	(−2.83)	(−0.53)	(4.51)	(−4.10)
SIZE	0.3740***	1.3457***	4.3326***	1.9948***	2.0571***	1.9516***
	(42.94)	(36.90)	(25.95)	(21.88)	(24.51)	(25.91)
LEV	−0.5801***	−0.2989	−3.6228***	−2.4338***	−2.5066***	−1.6568***
	(−11.69)	(−1.39)	(−3.19)	(−3.74)	(−4.67)	(−3.29)
ROE	0.2131	−8.9321***	−35.5985***	−8.6100*	−16.8112***	−12.5082***
	(0.53)	(−5.08)	(−4.51)	(−1.90)	(−4.31)	(−3.42)
TOBINQ	0.0295***	0.1166***	0.4526***	0.0613	−0.1039	0.0633
	(4.31)	(3.92)	(2.72)	(0.64)	(−1.45)	(0.94)
GROWTH	−0.1193***	−0.2743***	0.4356	−0.4871**	−0.3432*	−0.4697***
	(−7.09)	(−3.76)	(1.02)	(−1.99)	(−1.94)	(−2.84)
STRUC	0.0992	−0.8527***	−0.3905	−1.1101	0.8774	−1.5268**
	(1.50)	(−2.97)	(−0.29)	(−1.46)	(1.35)	(−2.51)
CAPEX	−0.1608	1.3106**	4.9479*	2.3303	−0.2726	0.4548
	(−1.27)	(2.38)	(1.76)	(1.44)	(−0.22)	(0.39)
FIRST	0.0011**	−0.0052**	0.0398***	−0.0087	0.0161***	−0.0079*
	(2.19)	(−2.32)	(3.94)	(−1.50)	(3.36)	(−1.76)
DUALITY	0.0713***	−0.1271*	1.6022***	−0.6280***	0.5852***	−0.4392***
	(4.07)	(−1.67)	(4.08)	(−2.79)	(3.25)	(−2.60)
INDP	0.0413	0.4249	−7.1784***	2.2647	−0.2166	0.3867
	(0.31)	(0.73)	(−2.74)	(1.51)	(−0.17)	(0.33)
TMT	−0.0632**	0.2184*	3.0683***	0.6135	−0.3597	0.3734
	(−2.10)	(1.67)	(3.58)	(1.25)	(−1.00)	(1.11)
CF	1.3198***	8.9803***	36.3695***	8.6046	19.9053***	12.4100***
	(2.91)	(4.57)	(3.98)	(1.64)	(4.44)	(2.95)
σ(CFO)	−2.7736***	−0.3361	−11.5224**	−3.8826	−11.5585***	0.6834
	(−13.20)	(−0.37)	(−2.27)	(−1.34)	(−5.25)	(0.33)
Constant	−2.3847***	−29.2332***	−70.6648***	−41.9054***	−31.3703***	−41.2785***
	(−10.80)	(−31.31)	(−16.23)	(−17.32)	(−15.02)	(−21.74)
Observations	18,785	18,785	4822	4822	7293	7293
R-squared	0.245	0.221	0.413	0.349	0.322	0.299
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES

Bootstrap method of column (1)

Variable	Indirect effect	Std. error	*Z*-value	*p*-Value	95% Conf. Interval	
GI	0.0122	0.0029	4.23	0.000	0.0068	0.0184

Note: Robust *t*-statistics in parentheses ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

encourage firms to invest more in organization capital toward this end. Our research limitations mainly lie in the fact that the green innovation indicators we used are based on the number of patents, which can only reflect green innovation at the technological level, and may not reflect green management innovation or process innovation. In addition, given that low-carbon transformation is the latest trend in green development, further research can be conducted on how organization capital affects a company's low-carbon transformation and how it can be used to maintain competitiveness during the process.

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