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Do corporate environmental ethics influence firms' green practice? The mediating role of green innovation and the moderating role of personal ties

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ABSTRACT

Drawing on resource-based view and social exchange theories, this study examines the relationships between corporate environmental ethics, green innovation and firm economic performance. It also explores the moderating effects of two different types of personal ties on these relationships. The analysis of a sample of 416 Chinese firms indicates that green innovation partially mediates the relationship between corporate environmental ethics and firm economic performance. Business ties amplify the positive effect of corporate environmental ethics on green innovation, whereas political ties mitigate the effect. These results contribute to the clean production literature by explaining firms' green practices from the internal organisational culture perspective and by recognising the contingent roles of social factors.

1. Introduction

Environmental deterioration and sustainable development have become global concerns (Borghesi et al., 2015; De Marchi, 2012; Peng and Lin, 2008). Following 40 years of rapid economic development, Chinese enterprises face serious environmental challenges due to their excessive resource consumption and environmental pollution (Lin et al., 2014; Li et al., 2018a,b). Traditional economic theory posits that investments in environmental management increase firms' transaction costs, creating additional burdens and negatively impacting firms' economic performance (Stefan and Paul, 2008). However, recent research has demonstrated that green innovation can improve firms' product differentiation, business performance and competitive advantage (Hojnik and Ruzzier, 2016; Huang and Li, 2017; Tang et al., 2018).

Previous studies have explored the drivers of green innovation from the perspective of institutional pressure and have identified environmental regulations (Cai and Zhou, 2014; Hojnik and Ruzzier, 2016; Zailani et al., 2015), local communities (Lee et al., 2016; Provasnek et al., 2017), consumer demand (Cai and Li, 2018; Huang et al., 2016a), interfirm and firm-university cooperation (De Marchi, 2012; Cainelli et al., 2012), technological opportunities (Cai and Li, 2018) and expected benefits (Hojnik and Ruzzier, 2016) as drivers of green innovation. In addition to these external and interfirm relationship antecedents, recent studies have demonstrated the relevance of organisational internal factors to green innovation (Xavier et al., 2017; Zhou et al., 2018). For example, the dynamic capabilities of enterprises have positive effects on the organisational adoption of green innovation in the early stage of diffusion (Zhou et al., 2018).

One critical internal factor, corporate environmental ethics (CEE), integrates environmental awareness into decision-making inside and outside an enterprise and further formalises green beliefs and ethics through the development of environmental policies (Chang, 2011). To implement green innovation, which is more complicated and uncertain than traditional innovation (Spence et al., 2011), enterprises must formulate clear environmental policies and possess matched organisational support from the

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enterprise (Dean and McMullen, 2007). Thus, CEE is likely to affect green innovation. However, few studies have conducted relevant theoretical development or empirical verification of this relationship.

In addition, according to embeddedness theory, enterprises are embedded in social networks, and firms' economic behaviours are inevitably influenced by their social connections (Granovetter, 1985). This effect is much stronger in emerging economies such as China because emerging markets generally have problems with weak market mechanisms and asymmetric information (Huang et al., 2016b; Lin et al., 2014). In such environments, organisations have traditionally relied on informal alternatives such as personal ties (guanxi in China) for access to information, contract enforcement and rights protection (Sheng et al., 2011). Park and Luo (2001) differentiated personal ties into business ties (with executives of suppliers or buyers) and political ties (with government institutions). These two types of personal ties are likely to influence firms' green innovation differently due to their different resource-bridging and adaptive capabilities (Chen and Wu, 2011). Few studies have explicitly considered the contingent roles of personal ties in the context of China (Wang et al., 2018).

To fill these research gaps, we use resource-based view (RBV) theory and social network theory to develop an integrated model to (1) investigate the direct effects of CEE on firm economic performance, (2) explore how green innovation mediates the effect of CEE on firm economic performance and (3) examine how business ties and political ties moderate the relationship between CEE and green innovation. We use survey data from 416 Chinese enterprises to test our conceptual model. The results contribute to the literature on clean production by linking green innovation to firms' internal CEE and incorporating the contingent roles of personal ties into the model.

2. Theoretical background

2.1. A resource perspective of corporate environmental ethics

The RBV theory suggests that a firm's core competence is based on access to corporate resources that may be scarce, valuable, non-substitutable or imperfectly imitable (Barney, 1991). Furthermore, variance in firms' resources leads to heterogeneous corporate activities and performance (Hitt, 2001). Resources include not only assets, capabilities, information and knowledge, but also corporate culture (Barney, 1991). As an element of organisational culture that highlights environmental management (Weaver et al., 1999a), CEE can be a critical invisible resource for enterprises seeking to achieve environmental goals (Chang, 2011; Peng and Lin, 2008). CEE consists of a firm's total ethical beliefs, values and norms related to environmental concerns (Ahmed et al., 1998). It typically consists of six components: ethic officers, codes, committees, training programmes, communication systems and a disciplinary mechanism (Weaver et al., 1999b).

Peng and Lin (2008) note that CEE is an important element of a firm's overall organisational structure. Unlike specific green actions, CEE is a mind-set that reflects a firm's basic attitudes and ethical beliefs towards the natural environment (Ahmed et al., 1998). In terms of CEE's function, Chang (2011) demonstrates that CEE formalises a firm's value of and expectation for ethical behaviour, and is a driving force for green innovation and its competitive advantages. Chen and Chang (2013) indicate that CEE is an element of corporate culture needed to attain sustainable development. Drawing on previous studies, we define CEE as an element of corporate culture that integrates environmental awareness into decision-making and formalises green beliefs and ethics through environmental policies.

By cultivating CEE, enterprises formalise environmental beliefs and behaviours (Chang, 2011), and they thus indicate that they attach importance to environmentally friendly production processes and technologies. Green innovation is a core management activity that reduces waste and environmental pollution (Triguero et al., 2013) and requires innovative new or improved systems, practices, processes, and products that can reduce a firm's environmental burden (Chen et al., 2006). As indicated by previous studies (Chen, 2013), corporate environmental awareness plays a critical role in green innovation because enterprises that place a high value on and are highly concerned about the environment tend to put more attention, time, or effort into developing green innovations (Papagiannakis et al., 2014). Additionally, enterprises with strong CEE can integrate the work of different departments into environmental policies (Chang, 2011). A firm's success in solving environmental problems, promoting green innovation, and achieving sustainable benefits can be a capability that competitors cannot imitate (Porter and Van der Linde, 1995).

Some studies emphasis the intentions of green innovation. For example, Xavier et al. (2017) find that green innovation has many different connotations and is often not distinguished from eco-design, which is essentially any action intended to reduce firms' environmental impact. Some studies emphasis the objective; for example, the Organisation for Economic Co-operation and Development (OECD) (2009) defines green innovation as 'the development of products (goods and services), processes, marketing methods, organisational structure, and new or improved institutional arrangements, which, intentionally or not, contribute to a reduction of environmental impact in comparison with alternative practices'. Some studies emphasis the varieties of green innovation; for example, Chen et al. (2006) define green innovation as 'hardware or software innovation that is related to green products or processes, including the innovation in technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, or corporate environmental management', and Huang and Li (2017) define green innovation as actions related to environmental goals such as energy saving, pollution prevention, waste recycling and eco-design. We define green innovation as innovations such as new or improved systems, practices, processes and products that reduce a firm's environmental burden.

2.2. Socially embedded ties

The social network theory emphasises how personal ties help firms access and acquire scarce resources and information possessed by their partners (Peng and Luo, 2000). Studies have demonstrated that personal ties positively affect innovation (Kemper et al., 2013; Wu, 2011), marketability (Gu et al., 2008) and firm economic performance (Li et al., 2008). As China's transition economy is a mixture of planning and market-trading modes, personal ties are an inevitable element of business practices (Peng and Luo, 2000).

Scholars have classified personal ties into business ties, which are transversal connections with executives of their suppliers, buyers, and competitors, and political ties, which are vertical connections with government institutions (Sheng et al., 2011; Park and Luo, 2001). Through business ties, enterprises can acquire complementary, diverse and innovative market resources (Silva et al., 2017) and technology capital (Shi et al., 2014). Firms can also improve their commercial legitimacy (Rao et al., 2008) and trustworthiness with potential resource providers (Reinholt et al., 2011). Close business ties can also reduce opportunistic behaviour in the market, enhance trust between enterprises and function as a 'structural hole' in the process of green innovation. For political ties, although strong ties between enterprises and governments can

ease pressure from governments and the public (Faccio, 2006), which could divert attention from environmental concerns (Lin et al., 2014), heavy reliance on governments' preferential treatments could inversely reduce firms' incentives to improve innovation efficiency (Chen and Wu, 2011).

3. Hypothesis development

3.1. Mediation role of green innovation

CEE highlights managers' consciousness of their environmental responsibility (Weaver et al., 1999a) and is considered a powerful driver of green innovation. First, CEE may focus enterprises' attention on green innovation. As enterprises with positive environmental beliefs take responsibility for conserving resources and reducing waste in their production process (Liao, 2018), they are likely to further commit to implementing environmental management, including a green innovation strategy (Chen et al., 2006). CEE formalises corporate environmental value beliefs and environmental behaviour norms (Chang, 2011), enabling enterprises to integrate environmental concepts into their entire production and business activities. The decision-making in such firms is informed by green innovation.

Second, CEE may enhance the capability of green innovation because it systematically integrates and optimises various resources and is conducive to the development of green innovation. Enterprises that have environmental ethics are more willing to devote efforts to developing an eco-friendly operation (Hojnik and Ruzzier, 2016) that provides an adequate foundation and guarantee for green innovation. Moreover, CEE enables enterprises to integrate different sectors by developing formal environmental policies (Chang, 2011) and strengthening green cooperation with suppliers and competitors (Yen and Yen, 2012), effectively improving the reach of green innovation, solving environmental problems and removing obstacles to green innovation.

Third, CEE improves the efficiency of green innovation. Under the same stakeholder pressure, managers who focus more on the environment may implement green innovation strategies when subject to strong pressure. Some scholars have asserted that managers' emphasis on the environment may have a positive influence on the speed and scope of corporate management of environmental concerns (Bansal and Hunter, 2003) and on the enhancement of firms' ability to respond to environmental concerns (Papagiannakis and Lioukas, 2012), thus promoting the efficiency of green innovation.

Green innovation can lead to improved firm economic performance. Firms that replace wasteful and inefficient practices with new or improved processes, technologies, systems, and products can increase product value and gain competitive advantages (Porter and Van der Linde, 1995). Ecological modernisation theory (2000) also suggests that through green innovation, enterprises can achieve environmental and economic performance and an environmentally friendly society. Specifically, green innovations contribute to firm economic performance through increased revenue and cost reduction.

Green innovation can increase revenues by creating new green products, processes, and services (Borghesi et al., 2015) that help enterprises meet the diverse needs of customers (Cai and Li, 2018; Li, 2014) and establish a green image (Chen et al., 2006). Thus, green innovation increases corporate market share and creates high economic returns (Cai and Li, 2018; Li, 2014). Therefore, green innovation may be an effective strategy for creating new business value (Cai and Zhou, 2014), and it can bring additional profits to enterprises. From the cost reduction perspective, green innovation may reduce corporate costs by saving resources (e.g. recycling waste, saving raw materials), increasing resource use (Chen et al., 2006) and reducing pollution. In addition, reduced emission levels reduce waste treatment and disposal costs. Therefore, green innovation practices may contribute to a lower pollution penalty and non-compliance costs (Li, 2014). Taking these findings together, we propose the following hypothesis.

H1. Green innovation mediates the positive impact of CEE on firm economic performance.

3.2. Moderation role of personal ties

3.2.1. Business ties

Business ties may amplify the positive effect of CEE on green innovation. First, business ties help organisations identify, acquire and deploy the external resources required for green innovation. A firm's green innovation process is a complex system that requires external and internal resources (Uyarra et al., 2016), and green innovations that are based solely on corporate internal resources are difficult to implement. Corporate executives' network of relationships with suppliers, customers and competitors may form an interested community that helps enterprises obtain access to the complementary, diverse and innovative resources held by external stakeholders (Shi et al., 2014; Silva et al., 2017). These external resources, such as knowledge and competencies, contribute to corporate growth and provide the basis for innovation strategies (Chesbrough, 2003).

Second, business ties provide enterprises with effective and reliable information that successfully transforms CEE into green innovation. In China's emerging market, regulatory mechanisms and laws are not strong (Peng and Luo, 2000). Unethical conduct increases the transaction costs of business activities (Wu, 2011). Business ties help enterprises overcome these disadvantages, adapt to market changes and develop appropriate green innovation strategies. Close business ties facilitate enterprises' access to reliable information, which may effectively reduce the costs of searching and filtering information (Wu, 2011) and alleviate the information asymmetry problem in the process of green innovation. For example, enterprises can obtain raw materials, logistics and other information from upstream partners or competitors including information related to cutting-edge technical direction, dynamic market environments and market demand/customer preferences (Wu, 2011). Business ties that provide such information enable businesses to respond quickly and flexibly to rapidly changing environments (Gu and Su, 2018; Wu, 2011), reduce environmental uncertainty (Peng and Luo, 2000) and promote the smooth transition of environmental ethics into green innovation.

Third, business ties create opportunities for innovation cooperation and improve the efficiency of green innovation. Close business ties are conducive to the development of alternative enforcement mechanisms (e.g. norms, trust, and reputation) (Wu, 2011), as they establish and enhance trust and reciprocity between enterprises and thus reduce the occurrence of opportunistic behaviour. Personal interactions create both formal and informal conduits, allowing enterprises to learn how to jointly solve problems and to receive direct feedback from partners, which may help them overcome obstacles and improve learning outcomes (Uzzi, 1997). That is, in addition to allowing formal cooperation with their partners, business ties can spawn broader cooperation opportunities for enterprises. Thus, we propose the following hypothesis.

H2. Business ties positively moderate the effect of CEE on green innovation.

3.2.2. Political ties

Unlike business ties, political ties may weaken the positive impact of CEE on green innovation. First, political ties could, to some extent, reduce enterprises' initiative and enthusiasm for pursuing green innovation. Although political ties can help garner support from governments and other institutions, heavy reliance on government resources and preferential treatment may weaken managers' incentives to promote innovation (Chen and Wu, 2011). Specifically, enterprises with strong political ties tend to use their political links to alleviate government supervision (Lin et al., 2014), circumvent environmental laws and regulations and slow the pace of environmental legislation, ultimately reducing green innovations (Russo and Fouts, 1997). As a result, high-level political ties distract enterprises from environmental concerns (Lin et al., 2014), weakening their incentives to carry out green innovations.

Second, political ties may interfere with corporate governance and reduce firms' internal capabilities. Although political connections with government can bring firms benefits, corporate activities may be subject to different levels of political interference and management suppression (Wu, 2011). This phenomenon may lead to a number of problems such as weak governance, a low level of professionalism and inefficient resource allocation (Lin et al., 2014). To obtain additional government resources, some managers even relinquish their decision-making autonomy and indulge officials' rent-seeking behaviour (Sheng et al., 2011). Notably, the problems caused by political ties may negatively affect corporate governance and hinder the improvement of organisational capacity (Wu, 2011), thus negatively impacting the development of green innovation efficiency.

Third, enterprises' excessive efforts to build and maintain political ties make corporate green innovation difficult. Enterprises embedded in political networks may have to bear high costs (Lin et al., 2014), such as funds for implementing philanthropic activities and hiring political lobbyists, to gain support from the government and its affiliates. Additionally, enterprises must provide a steady stream of investment to maintain their political ties, which consumes a substantial amount of corporate resources (Wu, 2011), leading to a negative impact on corporate investment in green innovation practices. Therefore, we propose the following.

H3. Political ties negatively moderate the impact of CEE on green innovation.

Based on the above analysis, we construct the theoretical model presented in Fig. 1:

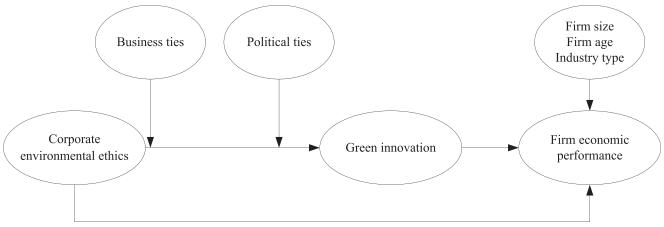


Fig. 1. Conceptual model.

4. Methods

4.1. Questionnaire design

The survey questionnaire was structured into five sections: enterprise characteristics (e.g. industry sector, year founded, number of employees), CEE, green innovation, personal ties and firm economic performance. To ensure reliability and validity, we based our questionnaire on mature scales that fit our research context. The survey questionnaire was initially in English, and we translated it into Chinese using the back-translation technique. Six managers and scholars examined and modified the survey items to make them clearer. We then conducted a pre-investigation with mid- or top-level decision-makers, graduate students and professors who specialise in environmental management. The questionnaire was revised based on their feedback.

We used the scale developed by Henriques and Sadorsky (1999), which included four items, to measure CEE.

Previous studies have measured green innovation by number of patents (Li et al., 2017; Ioppolo et al., 2019), ISO14001 (Li et al. (2018a,b); Lin et al., 2014) or survey items (Chang, 2011; De Marchi, 2012; Cai and Li, 2018). Following Chang (2011), De Marchi (2012) and Cai and Li (2018), we used survey items to collect data on green innovation and other constructs in our conceptual model.

To measure personal ties, we adapted five items to measure business ties and four items to capture political ties from Sheng et al. (2011) and Peng and Luo (2000).

To measure firm economic performance, we adapted three items from Li et al. (2018a,b). The respondents compared their firms' economic performance with their competitors' profitability, total sales of goods and services, and market share in the past three years.

Firm age, firm size and industry type were included as control variables. These three variables have been shown to affect green innovation and firm economic performance (Liao, 2016). Firm size was assessed using staff numbers (Dibrell et al., 2011; Liao, 2016), and five firm sizes were defined. Firm age was assessed as the years since the company was founded (Liao, 2016), and four categories were used. Different industry sectors have different pollution potential, so we defined two industry types: pollution-intensive sectors and non-pollution-intensive sectors. All of the measurements for the key constructs used a 7-point Likert scale, as summarised in Table 1.

4.2. Data collection

From January 2018 to September 2018, we collected data from four provinces or cities in China: Shanghai, Shaanxi, Guangdong and Tianjin. They respectively represented the industrial centres of Changjiang River Delta, western China, Zhujiang River Delta, and Bohai Rim region, and were representative of different degrees of development within China's market economy.

A random sample of 784 enterprises was selected covering different industries, including the pharmaceutical and medical, chemical and petrochemical, and service industries. For each enterprise, we identified a key informant, who was generally the president, vice president, green manager or CEO, who was knowledgeable about the green innovation practices of the firm. We contacted these managers through emails or telephone calls before mailing them the questionnaire. Each questionnaire included a brief introduction highlighting the purpose of the study and ensuring the participants of confidentiality. The respondents were also informed that they could obtain the final results if they returned a completed questionnaire. Follow-up calls and mailings were made 2 weeks after the initial mailing to improve the effective response rate. To protect the respondents' confidentiality, the finished questionnaires were sent directly to the researchers.

Of the 480 questionnaires received, 416 were complete and acceptable, giving a response rate of 53.1%. The descriptive statistics of the participating firms and respondents are given in Table 2. A *t*-test was carried out on the characteristics of the respondent and non-respondent firms. The results showed no significant

Table 1
Measures of constructs.

Construct	Description	Factor loadings	AVE	CR	Cronbach's alpha
Corporate environmental ethics	1.Firm has specific policies for environmental protection	0.863	0.780	0.934	0.933
	2.Firm has a budget for environmental protection	0.914			
	3.Firm integrates environmental programme, strategy, or objectives to marketing campaigns	0.887			
	4.Firm integrates environmental programme, strategy, or objectives to its culture	0.868			
Green innovation	Manufacturing process of the company		0.680	0.914	0.912
	1.Reduces consumption, e.g., fuel, gas, oil, and petrol	0.818			
	2.Reuses and recycles materials	0.777			
	3.Develops clean technologies that promote energy efficiency and pollution prevention.	0.905			
	4.Reduces emissions of harmful substances and hazardous wastes.	0.793			
	5.Reduces use of raw materials	0.825			
Business ties	Firm has good connections with managers of		0.615	0.887	0.882
	1.Suppliers	0.849			
	2.Customers	0.870			
	3.Competitors	0.852			
	4.Marketing-based corporative enterprises	0.744			
	5.Technological corporative enterprises	0.565			
Political ties	1.Firm maintains close personal ties with government officials	0.874	0.731	0.916	0.916
	2.Firm establishes close ties with regulatory authorities such as commerce and industry bureaus.	0.906			
	3.Firm's ties with local officials is satisfactory	0.863			
	4.Firm allocates a great deal of resources to build ties with government officials	0.772			
Firm economic performance	Firm performs better compared with competitors over the past year on		0.661	0.854	0.854
	1.Profitability	0.808			
	2.Total sales of goods and services	0.806			
	3.Market share	0.825			

differences. Furthermore, we conducted t-tests to evaluate the differences between the early responses (216) and later responses (200). No significant differences were observed, suggesting that the data were relatively free from non-response bias.

We conducted several procedures to mitigate the potential dangers of common method variance (CMV). First, we surveyed top managers knowledgeable about their green innovation management. We expected these individuals to have accurate and reliable information (Narayanan et al., 2011). Second, we examined the potential CMV based on Harman's single-factor test, using all of the independent and dependent variables. As expected, the un-rotated test resulted in five diverse factors, and the highest score was 21.76%. Thus, no single factor could account for the majority of the variance. These results suggested there was no serious threat of CMV.

Table 2
Demographic profile of sampled firm and respondents.

Type of industry	Frequency	percentage (%)
Food, beverage, alcohol, and cigars	42	10.1
Textile, apparel, and luxury	38	9.1
Pharmaceutical and medical	50	12.0
Chemicals and petrochemicals	37	8.9
Electrical machinery and equipment	21	5.0
Transportation and transportation infrastructure	27	6.5
Computer and communications equipment	48	11.5
Software and technology services	73	17.5
Trade and retail	51	12.3
Others	29	7.0
Type of ownership	Frequency	percentage (%)
State-owned firms	46	11.1%
Private firm	308	74.0%
Others	29	14.9%
Gender of respondents	Frequency	percentage (%)
Female	132	31.7
Male	284	68.3
Age of respondents	Frequency	percentage (%)
Under 25	87	20.9
25–40 years	251	60.3
Over 40 years	78	18.8
Tenure of respondents	Frequency	percentage (%)
<4 years	17	4.1
4–6 years	69	16.6
6–8 years	220	52.9
8–10 years	95	22.8
Over 10 years	15	3.6

4.3. Reliability and validity

First, to examine the factor structure of the measurement items, we used explorative factor analysis (EFA). The results extracted five factors corresponding to each variable. The five-factor solution for the 21 items explained 78.0% of the total variance. Cronbach's a-values were used to analyse the reliability of the scales. In addition, the composite reliability (CR) was calculated based on the confirmatory factor analysis (CFA) factor loadings. Then, we calculated the average variance extracted (AVE) values to ascertain scale convergent validity. As shown in Table 1, the CR for each construct was at least 0.854, and AVE was at least 0.615. The Cronbach's a-value was at least 0.854, indicating that the theoretical constructs possessed sufficient reliability and convergent validity. Furthermore, we conducted goodness-of-fit tests of five different models by synthesising the five latent variables. As shown in Table 3, the CFA of each model and the five-factor model neatly fit the data ($X^2 = 365.375$, df = 179, $X^2/df = 2.041$, SRMR = 0.035, GFI = 0.921, NFI = 0.942, IFI = 0.969, RMSEA = 0.050,CFI = 0.969, TLI = 0.964), whereas the other models did not fulfil the basic fitness requirements, suggesting that all of the variables were distinct and therefore appropriate for inclusion in the analyses. Table 4 presents the variables' Pearson correlations, means and standard deviations (SDs).

5. Analysis and results

5.1. Test of mediation effect

To test the mediation effect, we used hierarchical regression using SPSS22.0 software and bootstrapping technique using AMOS22.0 software.

Table 3
Results of confirmatory factor analysis.

Models	X2/df	SRMR	GFI	NFI	IFI	TLI	CFI	RMSEA
Five-factor model	2.041	0.035	0.921	0.942	0.969	0.964	0.969	0.050
Four-factor model	8.087	0.097	0.678	0.764	0.787	0.754	0.786	0.131
Three-factor model	9.962	0.106	0.637	0.704	0.726	0.689	0.725	0.147
Two-factor model	16.045	0.159	0.356	0.518	0.534	0.478	0.533	0.190
One-factor model	22.133	0.203	0.443	0.332	0.342	0.267	0.340	0.226

Note: Five-factor model: CEE, green innovation, business ties, political ties, firm economic performance.
Four-factor model: combing CEE and green innovation on the five-factor model.
Three-factor model: combing CEE, green innovation, and firm economic performance on the five-factor model.
Two-factor model: combing business ties and political ties on the three-factor model.
One-factor model: combing CEE, business ties, political ties, green innovation, and firm economic performance on the five-factor model.

Table 4
Means, SDs, and Pearson correlations.

Variables	Mean	S.D.	Correlations							
			Age	Size	Industry	Corporate environmental ethics	Green innovation	Business ties	Political ties	Firm economic performance
Age	2.040	0.932	1							
Size	2.220	1.074	0.095	1						
Industry	0.410	0.493	0.079*	0.086	1					
Corporate environmental ethics	3.266	1.376	0.061	0.038	−0.005	1				
Green innovation	4.161	1.709	0.018	0.017	0.015	0.448**	1			
Business ties	3.754	1.085	0.070	0.040	0.005	0.124*	−0.076	1		
Political ties	3.668	1.205	−0.032	−0.013	0.139***	0.151**	0.039	0.123*	1	
Firm economic performance	4.753	1.466	0.016	0.008	0.147**	0.381**	0.453**	−0.047	0.068	1

Note: *p < 0.05; **p < 0.01; ***p < 0.001.

Hypothesis 1 posited a mediating effect of green innovation on the relationships between CEE and firm economic performance. We examined the mediating effect using four steps as recommended by Baron and Kenny (1986).

First, the independent variable (CEE) must be significantly related to the dependent variables (firm economic performance). Model 6 (Table 5) showed that CEE was significantly and positively associated with firm economic performance ($\beta = 0.383$, $P < 0.001$).

Second, the independent variable (CEE) must be significantly related to the mediator (green innovation). Model 2 (Table 5) showed that CEE positively affected green innovation ($\beta = 0.448$, $P < 0.001$).

Third, the mediator (green innovation) must be significantly related to the dependent variable (firm economic performance). Model 7 (Table 5) showed that green innovation was significantly and positively associated with firm economic performance ($\beta = 0.451$, $P < 0.001$).

Fourth, when adding the mediator (green innovation) to the first step, the previously significant effect of the independent variable (CEE) on the dependent variable (firm economic performance) should be either reduced or insignificant. In Model 8 (Table 5), when green innovation was added, CEE was still positively affected firm economic performance ($\beta = 0.226$, $P < 0.001$), but the correlation coefficient decreased from $\beta = 0.383$ ($P < 0.001$) to $\beta = 0.226$ ($P < 0.001$). In line with Baron and Kenny (1986), we concluded that green innovation partially mediated the relationship between CEE and firm economic performance, providing support for Hypothesis 1. These results suggested that CEE can improve firm economic performance by increasing green innovation.

To further confirm Hypothesis 1, we used bias-corrected bootstrapping to test the significance of the mediation effect using AMOS. This method not only evaluated the Beta coefficient of the indirect effects but also demonstrated the statistical significance of the coefficients with bootstrapped bias-corrected confidence intervals (BC-CIs) using 1000 duplicate samples. The mediation effect occurred when the BC-CIs of the indirect parameters did not contain zero. Our analysis results are displayed in Table 6. The estimation of the 95% BC-CI interval of the direct effect of CEE on firm economic performance excluded zero [0.205, 0.481], indicating that CEE was positively related to firm economic performance. The estimation of the 95% BC-CI interval of the direct effect of CEE on green innovation excluded zero [0.385, 0.619], indicating that CEE was positively associated with green innovation. The estimation of the 95% BC-CI interval of the direct effect of green innovation on firm economic performance excludes zero [0.175, 0.501], which suggests that green innovation is positively related to firm economic performance. The estimation of the 95% BC-CI interval of the indirect effect of CEE on firm economic performance via green innovation excluded zero [0.088, 0.288], indicating that the effect of CEE on firm economic performance was significantly and partly mediated by green innovation. Thus, Hypothesis 1 was further supported.

5.2. Test of moderation effect

To test the moderation effect and thus eliminate possible multicollinearity, we mean-centred the main variables before examining the interactive effects. The variance inflation factor scores of the variables were all below 10.0, indicating multicollinearity was not a serious problem. The regression results are reported in Table 5.

Hypothesis 2 posited that business ties positively moderate the effect of CEE on green innovation. Model 3 (Table 5) showed that the interaction term 'CEE x business ties' was positively related to green innovation ($\beta = 0.205$, $p < 0.001$), indicating that business ties positively moderate the effect of CEE on green innovation. Thus, H2 was supported.

Hypothesis 3 predicted that political ties negatively moderate the relationship between CEE and green innovation. Model 4 (Table 5) showed that the interaction term 'CEE x political ties' was

Table 5
Hierarchical regression results.

	Green innovation				Firm economic performance			
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Demographics								
Age	0.016	−0.011	−0.005	−0.015	0.005	−0.017	−0.002	−0.014
	(0.091)	(0.082)	(0.079)	(0.081)	(0.077)	(0.071)	(0.069)	(0.067)
Size	0.014	0.000	−0.002	−0.005	−0.005	−0.018	−0.012	−0.018
	(0.079)	(0.071)	(0.068)	(0.070)	(0.067)	(0.062)	(0.060)	(0.058)
Industry	0.012	0.018	0.011	0.027	0.147**	0.152**	0.142**	0.146**
	(0.172)	(0.154)	(0.149)	(0.155)	(0.146)	(0.135)	(0.130)	(0.127)
Main effect								
CEE		0.448***	0.402***	0.461***		0.383***		0.226***
		(0.055)	(0.056)	(0.055)		(0.048)		(0.051)
Green innovation							0.451***	0.350***
							(0.037)	(0.041)
Business ties			−0.109*					
			(0.068)					
Political ties				−0.041				
				(0.064)				
Interaction Effect								
CEE x Business ties			0.205***					
			(0.048)					
CEE x Political ties				−0.113*				
				(0.043)				
R^2	0.001	0.201	0.256	0.215	0.022	0.168	0.225	0.266
ΔR^2	−0.007	0.193	0.245	0.203	0.015	0.160	0.27	0.257
F-value	0.096	25.825***	23.493***	18.616***	3.044*	20.731***	27.793***	29.656***

Note: *p < 0.05; **p < 0.01; ***p < 0.001, Standard errors in parentheses.

Table 6
Bootstrapping for mediation analyses.

Path	Bootstrapping Estimated Value and Confidence Interval			Pass or Not
	Direct Effect	Indirect Effect	Total Effect	
CEE-Green innovation	0.517 [0.385–0.619]	–	–	Pass
Green innovation- Firm economic performance	0.345 [0.175–0.501]	–	–	Pass
CEE-Firm economic performance	0.342 [0.205–0.481]	0.178 [0.088–0.288]	0.521 [0.414–0.609]	Pass

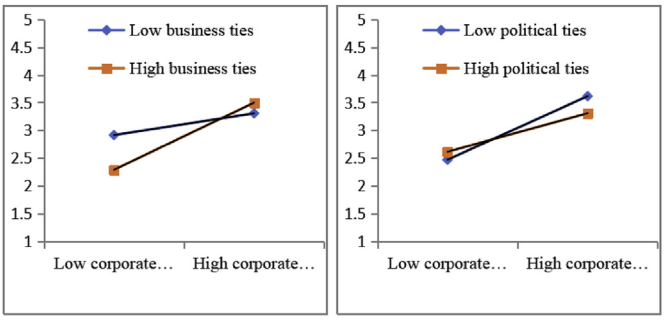
Note: Bootstrapping sample = 1000.

significantly and negatively related to green innovation ($\beta = -0.113$, $p < 0.05$), indicating that political ties negatively moderate the effect of CEE on green innovation, Thus, H3 was supported.

Furthermore, based on the suggestion of Aiken and West (1991), we plotted two figures to illustrate the moderation effects of business ties and political ties. By adding or subtracting a standard deviation of the average value, we obtained high and low values for business ties and political ties. Then, we regressed CEE on green innovation at high and low levels of business ties and political ties. As Fig. 2(A) shows, when business ties were high, the relationship between CEE and green innovation was positive and significant, whereas when business ties were low, the relationship between CEE and green innovation was insignificant and flat, suggesting that the positive relationship between CEE and green innovation becomes stronger when the level of business ties increase. Therefore, Hypothesis 2 was confirmed.

In contrast, when political ties were low, the relationship between CEE and green innovation was positive and significant, whereas when political ties were high, the relationship between CEE and green innovation was insignificant and flat (Fig. 2(B)), indicating that the positive relationship between CEE and green innovation became weaker when the level of political ties increased. Hence, Hypothesis 3 was supported.

We further classified the samples into pollution-intensive sectors and non-pollution-intensive sectors and conducted the mediating test and moderating test separately for each group. There were two differences between the two samples. First, in



(A) (B)

Fig. 2. The interaction impact of CEE and personal ties on r
(A) The interaction impact of CEE and business ties on green innovation: the positive relationship between CEE and green innovation becomes stronger when the level of business ties increase.
(B) The interaction impact of CEE and political ties on green innovation: the positive relationship between CEE and green innovation becomes weaker when the level of political ties increase.

pollution-intensive sectors, green innovation only partially mediated the effect of CEE on firm economic performance, which was the same result as in the overall model, whereas in non-pollution-intensive sectors, the green innovation had a fully mediating effect. Second, in non-pollution-intensive sectors, political ties had a significant negative moderating effect on the relationship between

CEE and green innovation, whereas in pollution-intensive sectors, the moderating effect was not significant.

6. Conclusion and discussion

This study tests a theoretical model linking CEE to firm economic performance through green innovation in the Chinese context. Drawing from the resource-based view and social network theories, we examine how CEE improves firm economic performance by promoting green innovation and then test the moderating effects of different types of personal ties on this relationship. The results indicate that green innovation mediates the relationship between CEE and firm economic performance. Furthermore, business ties positively moderate the impact of CEE impact on green innovation, whereas political ties negatively moderate the relationship.

6.1. Theoretical implication

This study makes several contributions to the literature. First, by using RBV, this study provides a theoretical framework for examining the positive relationship between CEE and firm performance. For instance, Chang (2011) proves that manufacturing companies' environmental ethics can positively affect their competitive advantage. Kumar et al. (2019) find that CEE has positive effects on firms' environmental performance and competitive advantage. Han et al. (2019) verify that higher CEE is likely to improve performance. As RBV holds that corporate resources include not only assets, capabilities, information and knowledge, but also valuable corporate culture (Barney, 1991), it explains why CEE, including managers' concern for the environment, is an important organisational internal cultural resource. As an organisational culture resource (Weaver et al., 1999a), CEE may integrate environmental awareness into strategic decision-making and inform firms' environmental practices and environmental policy. Our study's RBV perspective both confirms and explains these positive associations.

Second, this study extends the clean production literature by successfully linking CEE, green innovation and firm economic performance together. Previous studies have separately confirmed the positive effect of CEE on green innovation (e.g. Chen and Chang, 2013), the positive impact of corporate environmental consciousness (e.g. managerial environmental concern) on green innovation (e.g. Hojnik and Ruzzier, 2016), the positive effect of green product and process innovation on firm performance (e.g. Tang et al., 2018; Xie et al., 2019) and the positive effect of green patenting on firm performance (e.g. Zhang et al., 2019a). However, whether CEE can be transferred to firm economic performance via green innovation is unclear. A central finding of our study is that green innovation is the intermediary mechanism in the process through which CEE improves firm economic performance. Using data collected from 416 Chinese enterprises, our study demonstrates that green innovation partially mediates the relationship between CEE and firm economic performance. This enriches the clean production literature by explaining firms' green innovative efforts from an internal organisational ethics perspective.

Third, this research enriches social network theory by showing the moderating effects of different types of personal ties on the relationship between CEE and green innovation. Firms' economic behaviours are inevitably influenced by their social connections, and these effects are very prominent in emerging economies such as China (Huang et al., 2016b; Lin et al., 2014). The effects of personal ties on business transactions are complex. Studies in different contexts have concluded that the effects of political ties on product innovation can be negative (e.g. Lin et al., 2014), positive (e.g. Zhang et al., 2019b), inverted U-shaped (e.g. Wu, 2011) or have no effect (e.g. Parinaz et al., 2019). For business ties, Zhang et al. (2019b) and Wu (2011) confirm that business ties improve product innovation performance. However, these studies examine direct effects; whether business ties and political ties moderate the effectiveness of CEE on green innovation remains unclear. This study reveals that in emerging markets the moderating effects vary according to the type of personal ties. Business ties enhance the positive effect of CEE on green innovation, whereas political ties weaken corporate incentives to implement green innovation. Our findings bring social perspectives into the clean production context and shed new light on this issue by identifying business ties and political ties as a mechanism that moderates CEE effect on green innovation. We find that building ties with a government and its affiliates consumes resources that could be used for green innovation, weakening the enthusiasm and ability of a firm to implement green innovation. Thus, political capital may harm the implementation of firms' green innovation.

6.2. Managerial implications

Our findings have the following implications for managers. First, the results reveal that CEE can significantly promote green innovation and firm economic performance. Thus, enterprises should focus on the importance of environmental culture and invest resources into developing and cultivating CEE. Enterprises may promote green innovation by giving full play to the internal mechanisms of enterprises' environmental ethics. As the core of an enterprise, top managers play a vital role in protecting environmental responsibility. When facing increasing environmental pressure, top managers should adopt a pro-environment paradigm and promote environmental ethics in their enterprises. For example, managers should formalise environmental protection beliefs and environmental behaviour codes (Chang, 2011), enabling enterprises to develop environmental management in their production technology and business activities. Additionally, managers should carry out training and practical activities that are consistent with CEE, develop a series of environmental policies or integrate environmental policies into departments' everyday business activities. By integrating environmental concerns into management practices, enterprises may promote green innovation and thus achieve higher economic performance.

Second, our results demonstrate that green innovation mediates the relationship between CEE and firm economic performance. Thus, managers should treat green innovation as a passive strategic behaviour for improving firm economic performance (Burgos-Jiménez et al., 2013). Executives should understand that green innovation does not degrade corporate profits, but can help enterprises to achieve higher firm economic performance. In that sense, managers must recognise the importance of green innovation in their business strategy and adopt an open attitude toward green innovation activities. Managers should develop strategies to encourage their enterprises to adopt green innovation practices. For example, green innovation can be incorporated into corporate innovation strategies; knowledge of the components of green innovation should be developed; and practical activities that reduce pollution, save energy, and increase waste reusing and recycling should be stimulated. Additionally, when resources permit, enterprises should invest in green infrastructure and provide a supportive environment for the development of green products or process innovations. Additionally, our results show that in pollution-intensive sectors, green innovation partially mediates the relationship between CEE and firm economic performance, which is the same as in the overall model, whereas in non-pollution-intensive sectors, it fully mediates the relationship. This indicates that in non-pollution-intensive sectors, the pressure to

reduce pollution is not that pressing. Firms' CEE can be fully achieved and transferred to firms' economic performance via green innovation. In contrast, in pollution-intensive sectors, green innovation alone is not sufficient. Firms may also need to build governance support, advanced pollution control technology and so on to fulfil their CEE.

Third, enterprises should focus on the construction of external personal ties to achieve greater returns for their green innovation. Our findings provide good and bad news about the different effects of personal ties on green innovation and firm economic performance. As business ties and political ties have opposite effects, managers should treat the two types of personal ties differently. Business ties promote CEE's transformation efficiency, so managers should strengthen their business ties with suppliers, competitors, and customers as such ties can provide active support to enterprises with environmental ethics. Managers should cultivate and maintain high-quality business ties to create favourable conditions for green innovation and firm economic performance improvement. However, the negative effects of political ties suggest that enterprises should not rely on government agencies and officials when implementing green practices. Investing in political ties does not help a firm to improve its economic performance through green innovation. Particularly in emerging economies, enterprises should be cautious about relationships with government institutions (Lin et al., 2014). Additionally, in non-pollution-intensive sectors, political ties have a significant negative moderating effect on the relationship between CEE and green innovation, whereas in pollution-intensive sectors, the moderating effect is not significant. This difference indicates that in the non-pollution-intensive sectors, relationships with government officials may be harmful to CEE's promotion of green innovation. However, pollution-intensive sectors have stronger motivations for green innovation. Political ties may assist them in getting scarce innovation resources or favourable policies that may offset some of the negative effects. Therefore, relative to pollution-intensive sectors, firms in non-pollution-intensive sectors should be more cautious in cultivating political links.

6.3. Limitations and future research

Our study has several limitations. First, the data are only collected from China. Further efforts should test whether the results apply to other countries or other fields with different institutional contexts. Second, as the data are cross-sectional, we do not analyse any dynamic changes in CEE, green innovation or firm economic performance. Further research could verify the model with longitudinal data when conditions permit. In addition, our measures of firm economic performance are based on a subjective and relative measure rather than on objective data or accounting-based indicators, as reliable objective measurements of firm economic performance are not widely available in China. Furthermore, some of the enterprises in our sample are not listed companies. Finally, this study measures business ties and political ties by asking corporate executives about the relationships between their companies and external entities. Although this type of measurement is widely used in the literature (Peng and Luo, 2000), it does not evaluate the specific characteristics of the strength, mode and value of the personal ties. Further research can explore these issues more deeply.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Ying Guo: Conceptualization, Writing - original draft, Methodology, Data curation. **Lifang Wang:** Software, Validation, Resources, Supervision, Funding acquisition. **Qian Yang:** Formal analysis, Visualization, Investigation, Writing - review & editing, Funding acquisition.

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