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Does green innovation mitigate financing constraints? Evidence from China's private enterprises

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ABSTRACT

In recent years, corporate green innovation has become a hot topic in society and academia, but the relationship between green innovation and financing conditions is less frequently discussed. Based on stakeholder theory, this paper explores whether green innovation can alleviate corporate financing constraints. An empirical test using a sample of Chinese non-financial private enterprises listed in the Shanghai and Shenzhen exchange from 2012 to 2017 is established. The results of regression analyses show that green innovation, including green technology innovation and green management innovation, can significantly reduce the financing constraints of enterprises. Moreover, the interaction between corporate environmental disclosure and green innovation can have a positive effect, further improving the financing conditions of firms. These findings remain valid after endogenous and robustness testing including instrumental variables (IV), propensity score matching (PSM) and updated models. Additional research illustrates that green innovation plays a stronger role in alleviating financing constraints among heavily polluting enterprises. The above findings contribute to the literature concerning green innovation and corporate financing and provide a valuable reference for implementing green innovation, improving the financing environment and policy making.

1. Introduction

In recent years, given the continuous deterioration of the natural environment, voices speaking out for environmental protection are increasingly being heard. From the Kyoto Protocol in 1997 to the Paris Agreement in 2016, many countries have made great efforts to achieve green development (Li et al., 2018). In China, with the rapid growth of economy from Reform and Open, the issue of environment pollution has also become a focus. According to Liu et al. (2015), China astonishingly emitted approximately 2.49 gigatonnes of carbon dioxide from fossil fuel in 2013 and caused a series of negative impacts on national health and international reputation.

Fortunately, China's government has enacted many policies to control the severe situation especially in the area of industry and enterprise because they are playing a key role in the issue of pollution and emission. For example, green security, green insurance and green credit policy have been carried out to impel corporate environment protection (He et al., 2019). Based on such policies, every stakeholder involved (such as government, community and financing institutions) is encouraging and pressuring enterprises to shoulder the responsibility for sustainable economic growth (Albort-Morant et al., 2016; Song and Yu, 2018).

In this context, a large number of firms in China have implemented green innovation as a strategic activity to improve environmental performance (Kunapatarawong and Martínez-Ros, 2016; Zhang et al., 2019). Generally, green innovation with enterprises focuses on improvements and renovations undertaken to control emissions, reduce pollution and save costs (Abbas and Sağsan, 2019; Albort-Morant et al., 2016). Specifically, from the perspective of technology aspect and management processes, green innovation can be divided into green technology innovation and green management innovation (Li et al., 2018).

Similarly to other emerging markets, enterprises in China are faced with severe financing constraints and are eager for the support of capital or funds (Chava et al., 2008). As stakeholders are concerned more about the environment, corporate green innovation may play a significant role in mitigating financing constraints. On the one hand, green innovation responds to the requirements of

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stakeholders and strengthens the relationship between enterprises and stakeholders (Yu and Ramanathan, 2015). On the other hand, stakeholders will in turn increase the help and support they give to enterprises (Buysse and Verbeke, 2003), and funding is one of the most direct resources that stakeholders can provide (Cheng et al., 2014). Therefore, the first focus of this study is to determine whether green innovation can alleviate the financing constraints of enterprises.

Previous studies (Li et al., 2017; Passetti et al., 2018) have shown that corporate environmental disclosure, as a means of communication between enterprises and outside stakeholders, can reduce information asymmetry, which is important for this paper because asymmetric information is a crucial causal factor of financing constraints. In fact, green innovation and environmental disclosure represent the internal and external green practices, respectively (Passetti et al., 2018); hence, they may have the ability to facilitate each other. Consequently, this research further develops the second focus, that is, whether the combination of external activity (environmental disclosure) and internal activity (green innovation) will further improve the financing capacity.

There are obvious gaps in the current answers to the above questions; this statement can be explained as follows. For the first question, existing literature mainly examines the origin of green innovation (Chen, 2008; Kitsikopoulos et al., 2018) and its impact on financial performance (Xie et al., 2019; Zhang et al., 2019), innovation ability (Shu et al., 2016) and human resources (Kunapatarawong and Martínez-Ros, 2016). Although current research on the factors influencing financing constraints covers many levels, such as management characteristics, corporate strategy and economic policy (Beladi et al., 2018; Kuppuswamy and Villalonga, 2015; Li et al., 2011), there is a little literature focused on the relationship between green innovation and financing ability. For the second question, existing studies have mainly verified the impact of environmental disclosure on financing costs (Botosan, 1997; Dhaliwal et al., 2011; Li et al., 2017; Orens et al., 2010), while the interaction effect is less involved. Although Passetti et al. (2018) developed a mechanism by which internal and external corporate green behaviour affect organization change, they focused neither on the financing constraints nor exploit empirical research by using a large sample. Therefore, further investigations are urgently needed.

To fill the research gap and answer the above questions, this study examines the relationship between green innovation, environmental disclosure and financing constraints based on stakeholder theory. This paper employs a sample of China's privately listed companies from 2012 to 2017 to test the hypotheses since Chinese firms are typical in the area of green innovation (Li et al., 2018). In addition, we test the endogeneity and robustness via several methods and further consider the role of green innovation in heavily polluting enterprises.

The contribution of this work lies in the following three aspects. First, this study expands research in the field of green innovation by connecting green technology innovation and green management innovation to financing constraints. To the best of our knowledge, the literature discussing whether green innovation can improve the financing conditions of enterprises is limited. Second, this paper enriches the literature in the domain of corporate financing constraints. We discuss the impact of green innovation on financing constraints and provide new insights for enterprises to ease their financing constraints. Finally, this research supplements the environmental disclosure literature by exploring the interaction between green innovation and disclosure. Based on these findings, this paper provides practical guidance to enterprises and government, enabling decisions to be made more efficiently. Furthermore, we discuss how society can achieve the co-development of the environment and economy.

2. Theoretical basis and hypotheses

2.1. Stakeholder theory and green innovation

Stakeholder theory provides an appropriate perspective for the study of green innovation. Corporate stakeholders are groups that can influence the development of enterprises or be affected by enterprises (Freeman, 1994; Qin et al., 2019); broadly, the stakeholders of enterprises include shareholders, creditors, managers, employees, government, financial institutions and other groups (Harrison et al., 2010; Mitchell et al., 1997; Qin et al., 2019). Donaldson and Preston (1995) proposed that firms should also pay attention to stakeholders' demands and not just the maximization of shareholders' wealth. Numerous studies have confirmed that stakeholder pressure is an important factor driving enterprises to adopt environmental behaviour. For instance, Paulraj (2009) suggested that consumer demand motivates enterprises to produce green products. Kitsikopoulos et al. (2018) indicated that corporate environmental behaviour is also influenced by the government, the public and international communities. Similarly, as one of the measures of environmental behaviour, the green innovation activities of enterprises are also motivated by the attitudes of stakeholders. Consumer resistance to polluting products leads to enterprise improvement of their production process and final products to achieve green technology innovation. Environmental regulation and supervision by government and society also drive enterprises to internally improve their managerial processes to realize green management innovation (Chen, 2008; Lin et al., 2014; Ma et al., 2018). In addition, stakeholders inside firms, such as managers and employees, have also found that green innovation is a necessary condition for environmental protection and the sustainable development of enterprises. Therefore, they are also willing to implement green innovation strategies as a component of corporate social responsibility (CSR) and self-development (Song and Yu, 2018).

Correspondingly, corporations can obtain many benefits and resources through green innovation, such as a higher social reputation, bigger market share and better financial performance (Burns et al., 2016; Weng et al., 2015), and stakeholders provide these resources directly in this process. Stakeholders are the controllers of multiple types of information and resources needed for enterprise development (Burns et al., 2016), for example, feedback from consumers, policy support from governments and financing resources from investors. Previous studies have shown that maintaining a good relationship with stakeholders can help companies effectively access these resources and gain a competitive advantage (Burns et al., 2016). In the field of green innovation, numerous studies have explored the economic consequences of green innovation based on stakeholder theory. Chen et al. (2006) and Weng et al. (2015) found that green innovation can improve corporate performance and competitive advantage. Lin et al. (2014) suggested that green innovation could enhance firms' connection with the government. Aldieri et al. (2019) indicated that green innovation helps firms attract better employees. In summary, similar to CSR, all types of green innovation can effectively consolidate relationships or alleviate conflicts between enterprises and stakeholders, thus providing enterprises via a method for obtaining resources and improving financial performance (Peloza and Shang, 2011).

However, the impact of green innovation on the behaviour of investors and creditors, including potential individual shareholders, private equity funds, investment companies, bond buyers and banks, is less discussed. These groups have abundant capital resources and play a significant role in the development of enterprises. In society today, investors may regard environmental behaviour as one of the criteria for evaluating an enterprise. When

firms have strong green innovation ability, investors may choose to provide them with various financial resources. Thus, from the perspective of stakeholder theory, the financing constraints of companies could be alleviated through green innovation.

2.2. The impact of green innovation on financing constraints

As discussed above, green innovation can be divided into two types, i.e., green technology innovation and green management innovation. Following Li et al. (2018) and Ma et al. (2018), in this paper, green technology is defined as technological innovation activities concerned with resource saving and environmental protection of production process and final products, and green management is defined as managerial reform for environmental conservation within companies. Green technology innovation and green management innovation are two dimensions of green innovation.

For enterprises, the impact of green innovation on corporate financing may be achieved through a variety of stakeholders, including original and potential shareholders and bond buyers in general equity financing and debt financing. In addition, these stakeholders also include banks that provide loans and governments that provide subsidies to businesses. Therefore, combining the characteristics of green technology innovation and green management innovation, and adopting the perspective of different stakeholders, this paper discusses how green innovation alleviates financing constraints considering three perspectives.

First, for general investors (creditor and shareholder), their key concern is whether they can obtain higher future returns, and green innovation can improve the performance and value of enterprises, thus attracting more investment.

From the perspective of green technology innovation, with increasing consumer attention to environmental conservation, their demand for green products is increasing (Young et al., 2010). Green technology innovation helps firms save more material cost during the production process, create more green products and meet the needs of the market; thus, it can effectively expand their market share. As suggested by Leonidou et al. (2013), green technology innovation could improve the firms' efficiency, reputation and ability to satisfy consumers' demands, resulting in improved market performance.

Similarly, green management innovation redistributes resources within the enterprise and enables the enterprise to make and act upon more economical and less wasteful decisions, which benefits corporate performance. As proposed by Shu et al. (2016), green management innovation improves corporate management efficiency and introduces more formal and informal institutional support (i.e., policy and public support) to enterprises, thus improving the overall innovation level of firms.

Therefore, both green technology innovation and green management innovation can enhance the market competitiveness and financial performance of enterprises, and some studies have also shown that green innovation will improve the market value of corporations (Kajander et al., 2012; Ma et al., 2018; Yadav et al., 2016). Correspondingly, given green innovation's ability to promote corporate performance and value and because it embodies the concept of sustainable development, investors and analysts will attribute a high investment value and high future expectations to these firms (Flammer, 2013). Then, if these firms issue new shares or new bonds to raise funds, they could attract more potential shareholders and creditors or increased capital from existing investors. Accordingly, corporate financing constraints will be reduced through green innovation.

Second, banks also provide financial support for corporate green innovation, which can be explained from two perspectives. Before discussing this issue, the relationship and difference between the bank and ordinary debt investor (bond buyer) should be discussed. The common ground of these two roles is that they both provide debt financing, but the bond buyer considers future return as the most important concern. For banks, although they also pay attention to the corporate solvency as discussed above, this paper primarily focuses on China's political effect, i.e., green development requirements and green credit.

On the one hand, like other countries, China has a bank-centred financial system, where bank loans are the main financing methods of a majority of enterprises (Qiu and Shen, 2017), so banks are one of the most critical stakeholders in the field of corporate financing. When deciding whether to approve the loan request of a firm, a bank will perform a detailed analysis of the operation of the enterprise by reviewing the financial statements or conducting field investigations (Sufi, 2007). However, under the current requirements for green development (China regards green development as one of the highest national development priorities), the sustainable development and environmental protection enacted by enterprises in the process of production and operations have become a new concern of banks (Aizawa and Yang, 2010). Therefore, banks will treat green innovation, as the embodiment of corporate environmental behaviour (Weng et al., 2015), as an important loan reference to improve the likelihood of obtaining a loan, and then ease the financing constraints. For example, green technology innovation improves the sustainability of companies' technology practices, production process and finished products, while green management innovation improves the operational efficiency of corporations (Abbas and Sağsan, 2019). These characters provide intuitive evidence to banks that may justify an upgrade of the company's credit rating.

Another aspect of banks' financial support for green innovation is a new loan model known as green credit. China's green credit policy was jointly formulated by three central government departments in 2007: the State Environmental Protection Administration (SEPA), the China Banking Regulatory Commission (CBRC) and the People's Bank of China (PBC) (Aizawa and Yang, 2010). It is issued only to eco-friendly enterprises for their R&D and production of sustainable products or services; compared with ordinary loans, green credit focuses more on green development ability than the current profitability of enterprises (Liu et al., 2019; Zhang et al., 2011). Consequently, green innovation can provide firms with the opportunity to apply for green credit loans, thereby improving the financing level of enterprises. For instance, under the guidance of China's green credit policy, a large number of enterprises with a strong capacity for environmental conservation and green innovation have obtained more loans (Liu et al., 2019).

Finally, green innovation can help enterprises obtain financial support from the government. In many emerging markets such as China, the government is the main promoter and party responsible for environmental conservation. Studies have shown that the green innovation activities of enterprises (both green technology innovation and green management innovation) originate from government requirements and encouragement (Chen, 2008). Therefore, corporate environmental behaviour coincides with the will of the government.

In China, when firms achieve success in the field of green innovation, the government will reward them through various administrative subsidies and methods (Zhao and Chen, 2019), the cash holdings of enterprises will be increased, and the financing constraints will to a certain extent be eased. For example, in 2019, the National Development and Reform Commission (NDRC) and Ministry of Science and Technology (MST) of China jointly published the Suggestion of Building a Market-oriented Green Technology Innovation System. In this document, the governments of China have promised to popularize and subsidize green innovation enterprises by buying their green innovation outcomes.

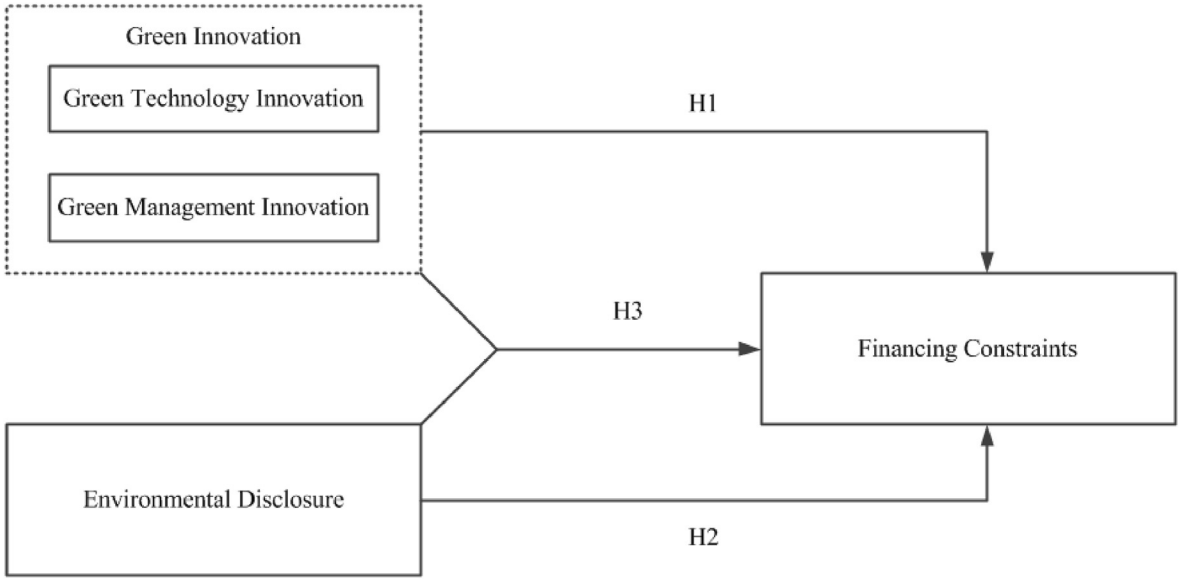

Fig. 1. Research framework.

In addition to direct financial subsidies, the government also plays an indirect role. Environmental behaviour is a reflection of CSR. It has been argued that CSR can strengthen the links with the government and reduce the difficulty of external financing (Borghesi et al., 2014; Khwaja and Mian, 2005). This view is also reflected in the field of green innovation. For instance, in China, there is a strong relationship between the government and commercial banks (Hou et al., 2018). Through the government's role, green innovation can also improve the relationship between firms and banks and thereby increase the credit offered.

Therefore, the following hypothesis is proposed:

H1. Green innovation can alleviate the financing constraints of enterprises.

Considering the above discussion regarding green technology and management innovation, we posit that both aspects of green innovation have positive effects and hence propose the following dimensional hypotheses:

H1a. Green technology innovation can alleviate the financing constraints of enterprises.

H1b. Green management innovation can alleviate the financing constraints of enterprises.

2.3. The role of environmental disclosure

While exploring the role of green innovation, there is another type of behaviour that deserves focus: corporate environmental disclosure. At present, most countries do not require mandatory environmental information disclosure from enterprises, which means that green innovation and environmental disclosure may not appear in the same firm at the same time (Li et al., 2017). This paper also finds that many listed companies in China have high green innovation ability or green performance but that these are not reflected in their social responsibility reports. Environmental disclosure can help stakeholders learn more about the participation of enterprises in green activities (Guenther et al., 2016). Therefore, it can be inferred that when accompanied by environmental disclosure, corporate green innovation may further reduce the financing constraints of corporations. To prove this statement, this paper examines the interactive effects of green innovation and environmental disclosure on corporate financing constraints as a component of the positive impact of environmental behaviour.

The existing literature mainly expounds the positive effect of environmental disclosure on enterprise financing from two perspectives: information asymmetry and the signal effect. To a large extent, the financing constraints of enterprises are created by information asymmetry. The dilemma of adverse selection is common because investors cannot be fully informed about the enterprise information (Botosan, 1997). As a means for enterprises to communicate with external stakeholders, information disclosure can effectively alleviate the problem of information asymmetry and reduce the financing difficulty (Glosten and Milgrom, 1985). Corporate environmental information disclosure plays a similar role, as proven by many empirical studies. For example, Dhaliwal et al. (2011) and Orens et al. (2010) both illustrate that non-financial disclosure (including environmental disclosure) can effectively reduce the cost of equity and debt financing because investors find a higher investment value of such enterprises.

Another function of corporate environmental disclosure is the signal effect. Due to the concerns of various social groups regarding environmental deterioration, the green behaviour of companies is generally praised. Managers express the concept of environmental protection through environmental disclosure, which attracts investors' attention. In this case, investors consider the enterprises to be indicating the future development direction, so they will invest more funds in such firms (Li et al., 2017). Kock et al. (2012) directly examined the relationship between environmental disclosure and financing and found that corporate financing constraints are eased by disclosing more information, and this action has a positive impact on the long-term development of enterprises.

Therefore, consistent with some previous studies, this paper offers the following hypothesis:

H2. Environmental disclosure can alleviate the financing constraints of enterprises.

Based on hypothesis 2, this paper continues to explore the interaction between green innovation and environmental disclosure. Considering that both of these embody corporate environmental behaviour, they should show a synergistic effect; that is,

Table 1
Summary statistics.

Panel A: Summary

Variable	Obs	Mean	Std. Dev.	Min	p 25	p 75	Max
SA	7785	−3.339	0.229	−3.958	−3.438	−3.178	−2.937
GTI	7785	0.606	0.489	0	0	1	1
GMI	7785	0.395	0.489	0	0	1	1
Dis_C	7785	0.179	0.384	0	0	0	1
Dis_Q	7785	1.469	7.320	0	0	0	85
Top	7785	32.689	14.001	8	21.797	41.933	70.774
Maghold	7785	23.063	24.574	0	1.008	38.200	93.513
Expend	7785	5.498	4.761	0.120	1.970	7.525	22.524
Growth	7785	23.750	40.934	−43.204	3.160	32.237	255.889
Cash	7785	20.341	13.759	2.712	10.360	26.656	66.837
Size	7785	21.744	1.016	19.941	20.986	22.327	24.938
PPE	7785	32.998	15.612	2.899	21.335	43.723	71.139
CF	7785	4.398	6.596	−14.721	0.574	8.346	23.003
NDTS	7785	19.947	13.266	2.699	10.854	24.773	68.667
Lev	7785	35.597	18.468	4.561	20.528	48.871	81.094
ROA	7785	5.384	5.187	−10.826	2.177	8.109	22.102

Panel B: Group differences

Variable	***GTI* = 1**			***GTI* = 0**			**Difference**
	Obs	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**	
SA	4717	−3.368	0.222	3068	−3.295	0.233	−0.073***
GMI	4717	0.423	0.494	3068	0.353	0.478	0.070***
Dis_C	4717	0.217	0.412	3068	0.121	0.326	0.097***
Dis_Q	4717	1.988	8.321	3068	0.672	5.336	1.316***
Top	4717	31.897	14.014	3068	33.905	13.896	−2.008***
Maghold	4717	22.983	23.880	3068	23.185	25.608	−0.202
Expend	4717	5.144	4.543	3068	6.042	5.031	−0.898***
Growth	4717	25.248	41.891	3068	21.448	39.313	3.800***
Cash	4717	19.316	12.905	3068	21.915	14.842	−2.599***
Size	4717	21.952	1.029	3068	21.424	0.907	0.528***
PPE	4717	31.749	15.174	3068	34.918	16.076	−3.169***
CF	4717	3.979	6.470	3068	5.042	6.736	−1.063***
NDTS	4717	19.462	12.392	3068	20.691	14.478	−1.228***
Lev	4717	38.166	18.273	3068	31.648	18.067	6.518***
ROA	4717	5.166	5.027	3068	5.720	5.407	−0.554***
Variable	***GMI* = 1**			***GMI* = 0**			**Difference**
	Obs	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**	
SA	3078	−3.379	0.222	4707	−3.313	0.230	−0.066***
GTI	3078	0.648	0.478	4707	0.578	0.494	0.070***
Dis_C	3078	0.224	0.417	4707	0.150	0.357	0.074***
Dis_Q	3078	2.919	10.702	4707	0.521	3.387	2.398***
Top	3078	32.634	13.988	4707	32.724	14.011	−0.090
Maghold	3078	20.577	22.940	4707	24.688	25.458	−4.111***
Expend	3078	5.357	4.620	4707	5.590	4.850	−0.233**
Growth	3078	22.334	39.499	4707	24.676	41.824	−2.342**
Cash	3078	18.001	11.925	4707	21.870	14.637	−3.869***
Size	3078	21.908	0.983	4707	21.636	1.023	0.272***
PPE	3078	34.522	15.305	4707	32.001	15.731	2.521***
CF	3078	4.691	6.472	4707	4.207	6.670	0.485***
NDTS	3078	18.258	11.834	4707	21.051	14.016	−2.793***
Lev	3078	37.233	17.779	4707	34.527	18.830	2.706***
ROA	3078	5.205	5.167	4707	5.501	5.196	−0.296**
Variable	***Dis_C* = 1**			***Dis_C* = 0**			**Difference**
	Obs	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**	
SA	1395	−3.522	0.264	6390	−3.299	0.200	−0.223***
GTI	1395	0.735	0.442	6390	0.578	0.494	0.157***
GMI	1395	0.494	0.500	6390	0.374	0.484	0.120***
Dis_Q	1395	8.200	15.620	6390	0.000	0.000	8.200***
Top	1395	31.886	14.817	6390	32.864	13.811	−0.978**
Maghold	1395	14.354	21.139	6390	24.964	24.861	−10.611***
Expend	1395	5.252	4.375	6390	5.552	4.840	−0.299**
Growth	1395	19.535	39.214	6390	24.671	41.246	−5.135***
Cash	1395	17.970	11.358	6390	20.858	14.178	−2.888***
Size	1395	22.491	1.094	6390	21.581	0.921	0.910***
PPE	1395	36.447	16.325	6390	32.245	15.350	4.203***
CF	1395	5.585	6.571	6390	4.139	6.574	1.446***
NDTS	1395	17.845	12.267	6390	20.405	13.432	−2.560***
Lev	1395	42.616	18.366	6390	34.065	18.134	8.551***
ROA	1395	5.729	5.399	6390	5.309	5.137	0.420***

Note: **$p < 0.05$, ***$p < 0.01$.

Table 2
Correlation coefficient of major variables.

	SA	GTI	GMI	Dis_C	Dis_Q
SA	1				
GTI	−0.156***	1			
GMI	−0.141***	0.070***	1		
Dis_C	−0.373***	0.123***	0.094***	1	
Dis_Q	−0.264***	0.088***	0.160***	0.430***	1

Note: ***$p < 0.01$ (two-tailed).

Table 3
Regression results of green innovation and financing constraints.

	(1)	(2)	(3)	(4)
	SA	SA	SA	SA
GTI	−0.075***	−0.023***		
	(-8.55)	(-3.43)		
GMI			−0.062***	−0.026***
			(-6.40)	(-3.34)
Top		0.003***		0.003***
		(9.15)		(9.27)
Maghold		0.002***		0.002***
		(13.74)		(13.44)
Expend		0.006***		0.006***
		(9.50)		(9.52)
Growth		−0.000		−0.000
		(-0.27)		(-0.49)
Cash		0.002***		0.002***
		(7.47)		(7.27)
Size		−0.068***		−0.070***
		(-9.64)		(-9.95)
PPE		−0.000		−0.000
		(-1.53)		(-1.21)
CF		−0.004***		−0.004***
		(-7.48)		(-7.03)
NDTS		−0.001***		−0.001***
		(-3.98)		(-4.28)
Lev		−0.001***		−0.001***
		(-4.39)		(-4.59)
ROA		0.001		0.001
		(1.52)		(1.49)
Constant	−3.320***	−2.029***	−3.343***	−1.994***
	(-484.30)	(-12.79)	(-550.22)	(-12.68)
IND	NO	YES	NO	YES
YEAR	NO	YES	NO	YES
N	5728	5728	5728	5728
R^2	0.031	0.416	0.021	0.417
Adj. R^2	0.031	0.413	0.020	0.413
F	73.148***	60.260***	40.911***	61.730***

Note: t statistics in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

when enterprises both carry out green innovation and disclose relevant information, financing constraints will be further reduced. With similar reasoning, this argument can also be explained from the perspective of stakeholders.

For ordinary investors, the combination of green innovation and environmental disclosure generates a value premium, thus helping enterprises attract more investment. As reported by Passetti et al. (2018), when firms carry out both internal environmental reform and external information disclosure, the green concept will be more integrated within the company, and the degree of greenness attributed to the enterprise will accordingly be higher. Thus, through environmental disclosure, enterprises can communicate with outside stakeholders and solve the problem of information asymmetry to obtain more suggestions for improvement, update the technology and process of green technology innovation and green management innovation (Delmas and Burbano, 2011; Laughlin, 1991) and promote the performance and investment value of enterprises. Similarly, green innovation also improves the quality of environmental disclosure, so a better signal effect and corporate social image are created. Therefore, investors will be more optimistic about such firms and increase their investment in them, which will further reduce the financing difficulty of enterprises.

For the government and banks, environmental disclosure reduces their search costs and helps them more accurately determine which companies need support. As proactive environmental disclosure mitigates the information asymmetry between enterprises and stakeholders, the government can issue subsidies more accurately, and banks can judge the environmental capacity of enterprises more conveniently (Aerts et al., 2008). In this context, environmental disclosure and green innovation complement each other and enhance the advantages of both; enterprises can receive more government support, and this behaviour is more in line with the loan requirements of banks. In addition, unlike the government, which cares about only enterprises needing capital support rather than about returns, commercial banks also need to consider the solvency of enterprises when making loans, similar to ordinary investors (Sufi, 2007). As mentioned above, green innovation, combined with environmental disclosure can improve the financial performance and market value of enterprises. Therefore, banks will be more willing to lend to such enterprises. In conclusion, corporate financing constraints will be further eased.

According to the above analysis, the following hypothesis is proposed in this paper:

H3. Green innovation and environmental disclosure have a positive interaction effect, further reducing the financing constraints of enterprises.

Similarly, this paper advances the following two dimensional hypotheses:

H3a. Green technology innovation and environmental disclosure have a positive interaction effect, further reducing the financing constraints of enterprises.

H3b. Green management innovation and environmental disclosure have a positive interaction effect, further reducing the financing constraints of enterprises.

The framework of this research is illustrated in Fig. 1.

3. Methodology

3.1. Data

This study takes Chinese private companies listed in the Shanghai Stock Exchange and Shenzhen Stock Exchange as a sample but excludes financial and insurance companies and enterprises with missing data. In China, state-owned enterprises (SOEs) can receive large amounts of fund support from the government and are faced with little financing constraints; hence, this research examines only private enterprises. In addition, enterprises began to attach importance to green innovation after the Construction of Ecological Civilization was proposed in 2012, and the Environmental Protection Law of China was amended starting in the same year. Therefore, the sample period in this research is 2012–2017. Finally, a total of 1832 enterprises and 7785 company-year observations were collected (5728 when lagged one year in the regression). All continuous variables are winsorized at the upper and lower 1% levels to mitigate the impact of extreme values. To avoid endogeneity effects, the independent variables are lagged one period in the regression. Green innovation data are acquired manually from the National Intellectual Property Administration (NIPA) of the People's Republic of China

Table 4
Regression results for interaction effects.

	(1)	(2)	(3)	(4)	(5)	(6)
	SA	SA	SA	SA	SA	SA
Dis_C	−0.080***		−0.047***		−0.045***	
	(-7.09)		(-3.05)		(-3.28)	
Dis_Q		−0.004***		−0.001**		−0.000
		(-6.31)		(-2.28)		(-0.30)
GTI × *Dis_C*			−0.047**			
			(-2.34)			
GTI × *Dis_Q*				−0.004***		
				(-3.77)		
GMI × *Dis_C*					−0.074***	
					(-3.58)	
GMI × *Dis_Q*						−0.004***
						(-3.14)
GTI			−0.012*	−0.014**		
			(-1.86)	(-2.11)		
GMI					−0.007	−0.010
					(-0.99)	(-1.41)
Top	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(8.86)	(9.48)	(8.86)	(9.47)	(9.14)	(9.63)
Maghold	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(13.18)	(13.21)	(13.30)	(13.29)	(13.13)	(13.06)
Expend	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***
	(9.20)	(9.22)	(9.14)	(9.14)	(9.22)	(9.27)
Growth	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(-1.03)	(-0.69)	(-0.90)	(-0.54)	(-1.09)	(-0.77)
Cash	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(7.52)	(7.60)	(7.56)	(7.79)	(7.51)	(7.58)
Size	−0.058***	−0.064***	−0.056***	−0.063***	−0.058***	−0.065***
	(-8.13)	(-9.11)	(-7.78)	(-8.90)	(-8.37)	(-9.37)
PPE	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(-0.87)	(-1.38)	(-1.20)	(-1.55)	(-0.87)	(-1.34)
CF	−0.004***	−0.004***	−0.004***	−0.004***	−0.003***	−0.004***
	(-6.96)	(-7.38)	(-7.09)	(-7.44)	(-6.79)	(-7.22)
NDTS	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(-3.73)	(-4.04)	(-3.73)	(-4.11)	(-3.97)	(-4.23)
Lev	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(-4.75)	(-4.49)	(-4.50)	(-4.35)	(-4.77)	(-4.52)
ROA	0.002**	0.001*	0.002**	0.001	0.002*	0.001
	(2.09)	(1.68)	(1.99)	(1.58)	(1.91)	(1.53)
Constant	−2.242***	−2.142***	−2.282***	−2.159***	−2.235***	−2.114***
	(-14.12)	(-13.72)	(-14.33)	(-13.77)	(-14.35)	(-13.69)
IND	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES
N	5728	5728	5728	5728	5728	5728
R^2	0.432	0.443	0.436	0.448	0.439	0.447
Adj. R^2	0.429	0.440	0.433	0.445	0.436	0.444
F	65.397***	63.252***	64.147***	62.713***	63.843***	63.344***

Note: t statistics in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

(http://www.pss-system.gov.cn/) and the Certification and Accreditation Administration (CAA) of the People's Republic of China (http://www.cnca.gov.cn/). Other corporate data are collected from the CSMAR database (China Stock Market and Accounting Research). The statistical software used in this work is Stata 15.

3.2. Definition of variables

The dependent variable in this work is the financing constraints of firms. Based on previous literature, this research uses the SA index (*SA*) to measure corporate financing constraints (Hadlock and Pierce, 2010; Kuppuswamy and Villalonga, 2015). The calculation formula of the SA index is $(-0.737* Size) + (0.043* Size^2) - (0.040*Lage)$, where *Size* is the log of total assets and *Lage* is the number of years the enterprise has been listed. The higher the SA index, the more serious are the financing constraints. In the robustness test, the cash-cash flow sensitivity is used to replace the measure of financing constraints.

The main independent variable in this paper is green innovation. Based on Li et al. (2018), green technology innovation (*GTI*) is measured by whether the enterprise has green patents, and green management innovation (*GMI*) is measured by whether the enterprise has obtained environmental management system certification (ISO14001 or GB/T24001 certification). Both *GTI* and *GMI* are dummy variables, and each is equal to 1 when the enterprise has the corresponding green innovation.[1]

Another independent variable is environmental disclosure. With reference to Hu and Loh (2018), the following two variables are used in this research. *Dis_C* is a dummy variable that captures the choice of environmental disclosure. If the enterprise disclosed environmental information, it is equal to 1; otherwise, it is 0. *Dis_Q* represents the quality of environmental disclosure. The higher the

[1] As illustrated above, the *GTI* data were manually collected from the NIPA website, and the *GMI* data were manually collected from the CAA website.

Table 5
Results of endogeneity tests.

Panel A: Regression results of instrumental variables				
	(1)	(2)	(3)	(4)
	First stage: Probit model		Second stage: OLS model	
	GTI	*GMI*	*SA*	*SA*
IVGTI	2.423***			
	(5.78)			
IVGMI		2.492***		
		(13.21)		
GTI			−0.221***	
			(-20.30)	
GMI				−0.072***
				(-2.69)
Top	−0.003***	−0.001	0.003***	0.003***
	(-2.61)	(-0.60)	(14.53)	(17.78)
Maghold	0.002***	−0.002***	0.002***	0.002***
	(3.87)	(-3.66)	(20.81)	(19.64)
Expend	−0.004	−0.006	0.006***	0.006***
	(-1.22)	(-1.63)	(11.35)	(13.44)
Growth	0.000	−0.001*	0.000	−0.000
	(0.67)	(-1.85)	(0.08)	(-0.98)
Cash	−0.001	−0.006***	0.002***	0.002***
	(-0.74)	(-4.45)	(8.93)	(9.39)
Size	0.368***	0.110***	−0.048***	−0.068***
	(18.06)	(5.71)	(-14.47)	(-22.74)
PPE	−0.012***	0.000	−0.001***	−0.000*
	(-9.38)	(0.14)	(-6.13)	(-1.95)
CF	−0.007**	0.009***	−0.004***	−0.004***
	(-2.55)	(3.40)	(-10.23)	(-8.72)
NDTS	−0.002	−0.007***	−0.001***	−0.002***
	(-1.56)	(-5.07)	(-6.87)	(-7.49)
Lev	0.005***	−0.002*	−0.001***	−0.001***
	(4.66)	(-1.72)	(-4.75)	(-7.91)
ROA	−0.013***	−0.009**	0.000	0.001**
	(-3.45)	(-2.40)	(0.77)	(1.98)
Constant	−8.460***	−3.228***	−2.346***	−2.014***
	(-16.92)	(-7.18)	(-31.69)	(-30.48)
IND	YES	YES	YES	YES
YEAR	YES	YES	YES	YES
N	7785	7785	7785	7785
Pseudo R^2	0.121	–	0.082	–
Chi^2	1258.73***	4253.26***	856.45***	3828.63***

Panel B: Results of PSM (outcome variable is lagged *SA*)

Treatment variable	Sample	Treated	Controls	Difference	Std. Dev.	t-value
GTI	Unmatched	−3.395	−3.320	−0.075	0.005	−13.62***
	ATT	−3.395	−3.372	−0.023	0.009	−2.44**
GMI	Unmatched	−3.404	−3.340	−0.064	0.005	−11.51***
	ATT	−3.404	−3.368	−0.367	0.008	−4.57***

Note: z statistics are in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

value, the better is the quality of the corporate environmental disclosure. The measurement of *Dis_Q* is performed according to Clarkson et al. (2008), but some terms are omitted because most Chinese firms do not disclose them. Finally, this paper evaluates *Dis_Q* from three aspects: environmental governance, descriptive environmental behaviour and environmental indicators. The specific measurement of *Dis_Q* is shown in Appendix B.

In addition, according to the available research, this work also establishes several control variables as follows (Kuppuswamy and Villalonga, 2015; Li et al., 2008, 2017). Ownership concentration (*Top*) and management stock ownership (*Maghold*) represent the shareholdings of the largest shareholder and company executives, respectively. Capital expenditure (*Expend*) indicates the proportion of investment expenditure to total assets. Enterprise growth (*Growth*) is the growth rate of business income. Cash hold (*Cash*) represents the proportion of cash held by enterprises to total assets. Enterprise scale (*Size*) equals the natural logarithm of total assets. Asset tangibility (*PPE*) is the proportion of tangible assets to total assets. Cash flow (*CF*) indicates the proportion of net cash flow to total assets. Non-debt tax shield (*NDTS*) is the non-debt tax shields of companies divided by total assets. Asset-liability Ratio (*Lev*) is the leverage rate of enterprises. Financial Performance (*ROA*) is the rate of return on total assets. Moreover, two dummy variables, *IND* and *YEAR*, are also established to control the industrial and annual fixed effects.

The description and specification of all variables are listed in Appendix A.

3.3. Summary statistics

The summary statistics of the variables are shown in Table 1. Panel A shows the summary situation for all variables. The mean value of *GTI* is 0.606, while the mean value of *GMI* is 0.395,

Table 6
Regression results of cash-cash flow sensitivity.

	(1)	(2)	(3)
	ΔCash	ΔCash	ΔCash
CF	0.083***	0.136***	0.114***
	(4.10)	(4.76)	(4.63)
GTI × *CF*		−0.093***	
		(-2.75)	
GMI × *CF*			−0.084**
			(-2.50)
GTI		0.045	
		(0.16)	
GMI			0.411
			(1.63)
Top	−0.047***	−0.048***	−0.047***
	(-6.46)	(-6.53)	(-6.46)
Maghold	0.003	0.003	0.003
	(0.63)	(0.68)	(0.56)
Expend	−0.217***	−0.217***	−0.217***
	(-8.61)	(-8.60)	(-8.59)
Growth	0.015***	0.015***	0.016***
	(5.75)	(5.75)	(5.81)
Cash	0.383***	0.382***	0.382***
	(28.12)	(28.16)	(28.02)
Size	−0.185	−0.146	−0.184
	(-1.45)	(-1.10)	(-1.43)
PPE	0.065***	0.064***	0.066***
	(8.33)	(8.10)	(8.42)
NDTS	−0.059***	−0.060***	−0.060***
	(-5.75)	(-5.86)	(-5.77)
Lev	0.131***	0.132***	0.131***
	(16.99)	(17.09)	(16.90)
ROA	0.310***	0.308***	0.312***
	(11.30)	(11.23)	(11.34)
Constant	−10.784***	−11.583***	−10.977***
	(-3.69)	(-3.89)	(-3.75)
IND	YES	YES	YES
YEAR	YES	YES	YES
N	7785	7785	7785
R^2	0.269	0.270	0.269
Adj. R^2	0.266	0.267	0.266
F	59.874***	56.659***	56.599***

Note: t statistics are in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

Table 7
Regression results of median regression.

	(1)	(3)
	SA	SA
GTI	−0.024***	
	(-4.28)	
GMI		−0.024***
		(-3.82)
Top	0.002***	0.002***
	(7.66)	(7.46)
Maghold	0.001***	0.001***
	(7.49)	(7.27)
Expend	0.004***	0.004***
	(6.78)	(7.34)
Growth	0.000	0.000
	(1.57)	(0.99)
Cash	0.002***	0.002***
	(8.24)	(8.38)
Size	−0.098***	−0.100***
	(-15.71)	(-16.03)
PPE	0.000	0.000
	(-1.57)	(-1.32)
CF	−0.004***	−0.004***
	(-9.42)	(-8.48)
NDTS	−0.001***	−0.002***
	(-5.41)	(-5.50)
Lev	0.000*	−0.001**
	(-1.8)	(-2.28)
ROA	0.002***	0.002***
	(3.23)	(3.12)
Constant	−1.333***	−1.289***
	(-9.62)	(-9.36)
IND	YES	YES
YEAR	YES	YES
N	5728	5728
R^2	0.385	0.385

Note: t statistics are in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

indicating a broad participation scope of green technology innovation. Moreover, the average value of *Dis_C* is 0.179, which means that fewer than 18% of private enterprises in China disclose environmental information. In Panel B, this paper compares the difference between *GTI*, *GMI* and *Dis_C*. As illustrated, the SA values are lower when *GTI*, *GMI* and *Dis_C* are equal to 1, meaning that green innovation and environmental disclosure may reduce financing constraints. These results validate H1 and H2 to a certain extent.

4. Empirical results

4.1. Correlation analysis

The correlation coefficients of the independent variables and dependent variables are shown in Table 2. According to the table, there is a significant negative correlation between financing constraints and green innovation and environmental disclosure, which preliminarily confirms hypotheses H1 and H2. Simultaneously, the correlation coefficients of all variables except the dependent variable are less than 0.6, indicating that there is no serious multi-collinearity among variables (Lee, 2006). In the following regression, the VIF values of each variable are also calculated, and the results are all less than 10, further confirming this statement.

4.2. Regression results

The regression results of hypothesis H1 are illustrated in Table 3. As previously mentioned, all independent variables are lagged by one year to avoid endogeneity. In this table, whether control variables are added or not, the coefficients of two variables of green innovation (*GTI* and *GMI*) are significantly negative at the 1% level ($p < 0.01$), indicating that green innovation can reduce the financing constraints of enterprises. Thus, principal hypothesis H1 and dimensional hypotheses H1a and H1b are supported.

The regression results of the interaction effects of environmental disclosure are shown in Table 4. In this table, the coefficient of environmental disclosure is the focus of hypothesis H2, while the terms capturing the intersection of green innovation and environmental disclosure are the key to hypothesis H3. In results (1) and (2), the coefficients of the two environmental disclosure variables (*Dis_C* and *Dis_Q*) are both negative and significant at the 1% level ($p < 0.01$), indicating that environmental disclosure mitigates corporate financing constraints, and H2 is supported. This result is also in line with the conclusions of previous studies (Kock et al., 2012). Simultaneously, all coefficients of the four intersection terms are significantly negative, and except for the significance of the coefficients of *GTI* and *Dis_C*, which is 5% ($p < 0.05$), all other terms are significant at the 1% level ($p < 0.01$); therefore, principal hypothesis H3 and dimensional hypotheses H3a and H3b are confirmed.

Table 8
Regression results for the sample of manufacturing enterprises.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SA	SA	SA	SA	SA	SA	SA	SA
GP	−0.024***				−0.012		−0.014*	
	(-3.17)				(-1.60)		(-1.82)	
GM		−0.026***				−0.004		−0.007
		(-2.82)				(-0.51)		(-0.88)
Dis_C			−0.086***		−0.051***	−0.043***		
			(-6.68)		(-3.05)	(-2.73)		
Dis_Q				−0.004***			−0.001**	−0.000
				(-6.00)			(-2.02)	(-0.12)
Dis_C								
GP × *Dis_C*					−0.050**			
					(-2.15)			
GM × *Dis_C*						−0.085***		
						(-3.63)		
GP × *Dis_Q*							−0.004***	
							(-3.55)	
GM × *Dis_Q*								−0.005***
								(-3.06)
Constant	−1.856***	−1.821***	−2.093***	−1.970***	−2.136***	−2.085***	−1.987***	−1.944***
	(-10.55)	(-10.39)	(-11.89)	(-11.40)	(-12.13)	(-12.14)	(-11.44)	(-11.35)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES
N	4516	4516	4516	4516	4516	4516	4516	4516
R^2	0.412	0.413	0.431	0.443	0.435	0.440	0.449	0.448
Adj. R^2	0.410	0.411	0.429	0.441	0.433	0.438	0.447	0.446
F	81.713***	83.533***	87.893***	87.015***	81.337***	82.546***	82.105***	82.254***

Note: t statistics are in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

4.3. Robustness tests

4.3.1. Endogeneity issue

In reality, enterprises engaging in green innovation activities face a high failure risk and need to invest many resources, such as employees and cash, in innovation projects; hence, the lower the financing constraints, the more likely enterprises are to engage in green activities. Thus, there may be an endogeneity problem of reciprocal causation or a reverse causal relationship in this study. This research uses instrumental variables (IV) to solve this problem. The choice of instrumental variables is the proportion of enterprises with green innovation in the industry in that year. The symbols of instrumental variables are *IVGTI* and *IVGMI*, respectively.

The regression results for the instrumental variables are shown in Table 5, Panel A. Results (1) and (2) are the results of the first-stage regression (probit model). As these results illustrate, the coefficients of two instrumental variables are significant at the 1% level ($p < 0.01$), proving that the instrumental variables are effective and the weak instrumental variable effect is very low. In the second stage, i.e., results (3) and (4), the coefficients of green innovation (*GTI* and *GMI*) are still significantly negative at the 1% level ($p < 0.01$), meaning that the endogeneity problem of reciprocal causation does not change the findings of this research.

In addition, this research employs propensity score matching (PSM) to solve the endogeneity problem of sample selection bias. The results are shown in Table 5, Panel B. The treatment variables are *GTI* and *GMI*, the outcome variable is lagged *SA*, and the covariates is all control variables suggested in section 3.2. After matching, the *SA* values of the treated groups are still significantly lower than the control groups, meaning that the selection bias does not change the above results.

4.3.2. Other robustness tests

Three additional methods are used to test the robustness. First, this paper employs cash-cash flow sensitivity to measure corporate financing constraints, as shown in Table 6. The dependent variable of this method is the change in cash holdings of enterprises (*ΔCash*). The higher the positive impact of cash flow (*CF*) is on the cash holdings change (*ΔCash*), the greater are the financing constraints (Almeida et al., 2004). The result (1) shows that financing constraints are widespread in firms, as the coefficient of *CF* is significantly positive. However, in results (2) and (3), the coefficients of the intersections of green innovation and *CF* are significantly negative, proving that green innovation has the ability to reduce cash-cash flow sensitivity and financing constraints; thus, the test is robust.

Second, this paper exploits the median regression to avoid the effect of extreme values, and the results are shown in Table 7. In this table, both coefficients of *GTI* and *GMI* are still significantly negative correlated with *SA*, meaning that the findings are not affected by extreme values and the original results are robust.

Finally, this research selects manufacturing enterprises as a new sample for testing, and the regression results are shown in Table 8. *Controls* represent the assemblage of control variables. As listed in the table, the direction and significance of all coefficients have not changed greatly, indicating that the findings of this study are robust.

4.4. Additional research: heavily polluting enterprises

This paper further explores whether green innovation within heavily polluting enterprises is more conducive to alleviating financing constraints. In general, stakeholders pay more attention to the improvement measures of enterprises for sustainable development. Heavily polluting enterprises have greater space for improvement and thus can better satisfy the demands of stakeholders. Therefore, this study argues that green innovation by

Table 9
Regression results of the interaction of heavily polluting enterprises.

	(1)	(2)
	SA	SA
HP × *GTI*	−0.030**	
	(-2.13)	
HP × *GMI*		−0.047***
		(-3.27)
GTI	−0.011	
	(-0.93)	
GMI		−0.001
		(-0.10)
HP	−0.024*	−0.020*
	(-1.74)	(-1.74)
Top	0.003***	0.003***
	(9.09)	(9.25)
Maghold	0.002***	0.002***
	(13.87)	(13.51)
Expend	0.007***	0.007***
	(9.68)	(9.78)
Growth	−0.000	−0.000
	(-0.30)	(-0.52)
Cash	0.002***	0.002***
	(7.45)	(7.25)
Size	−0.066***	−0.067***
	(-9.15)	(-9.54)
PPE	−0.000	−0.000
	(-1.16)	(-0.63)
CF	−0.004***	−0.004***
	(-7.55)	(-6.95)
NDTS	−0.001***	−0.001***
	(-3.84)	(-4.21)
Lev	−0.001***	−0.001***
	(-4.72)	(-4.99)
ROA	0.001	0.001
	(1.33)	(1.35)
Constant	−2.102***	−2.072***
	(-13.20)	(-13.13)
N	5728	5728
R^2	0.423	0.425
Adj. R^2	0.419	0.421
F	57.925***	59.363***

Note: t statistics in parentheses (corrected for heteroskedasticity and firm-level clustering).
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ (two-tailed).

heavily polluting enterprises can better reduce their financing constraints.

The regression results are shown in Table 9. *HP* in the table is a dummy variable, and if the enterprise is a heavily polluting enterprise, it is 1; otherwise, it is 0. The intersection terms of *HP* and the green innovation variables (*GTI* and *GMI*) are both significantly negative. Therefore, it can be judged that the green innovation of heavy polluters can better reduce financing constraints.

5. Discussion

First, green innovation, including green technology innovation and green management innovation, can mitigate corporate financing constraints. These results can be attributed to the key stakeholders' capital support. Green technology innovation achieves the aims of green products and a green production process, green management innovation reduces the resource cost and enhances corporate efficiency, and both increase corporate environmental performance and organizational performance. Therefore, general investors should increase their investment since green innovation has the ability to improve corporate value and future return, and banks will grant more loans because green innovation fulfils the demands of green development proposals and green credit policies. In addition, the government directly subsidizes green innovation and helps eco-friendly enterprises with more indirect financing methods, such as establishing better relationship with banks. This phenomenon is more significant in high polluting enterprises since such firms have greater space for access to stakeholder support.

Second, environmental disclosure increases the corporate financing ability. Similar to some previous studies, such as Dhaliwal et al. (2011), this result supports the positive role of environmental disclosure in the field of corporate financing from two aspects. On the one hand, environmental disclosure reduces information asymmetry between enterprises and investors; on the other hand, environmental disclosure signals that a firm is dedicated to environment protection.

Finally, the interaction between green innovation and environmental disclosure further mitigates corporate financing constraints. This effect may be a result of the co-existence of green innovation and environmental disclosure, each of which enhances the performance of the other. General investors can discover more future value of enterprises with both behaviours. Furthermore, implementing green innovation and environmental disclosure simultaneously can reduce the search costs of the government and help the government more accurately identify the companies that need support, further alleviating corporate financing constraints.

6. Conclusions and implications

6.1. Conclusions

Based on stakeholder theory, this study explores the relationship between green innovation and financing constraints using a sample of Chinese privately listed companies from 2012 to 2017. As green innovation is divided into *GTI* and *GMI*, both types of green innovation can reduce corporate financing constraints. Concurrently, this research verifies the mitigation effect of environmental disclosure on financing constraints and finds that the positive interaction effect (synergy effect) between green innovation and environmental disclosure can further enhance the financing capacity of firms. In addition, this study proves that green innovation in heavily polluting enterprises is more conducive to alleviating financing constraints. The above findings expand the literature in the field of green innovation, environmental disclosure and corporate finance. This research also provides an important reference for the green growth of enterprises, policy formulation by regulators and the sustainable development of society.

6.2. Theoretical implications

The contribution of this work to theory lies in the following three aspects.

First, this study expands research in the field of green innovation. Most existing studies concerning green innovation focus on the specific drivers and consequences (Albort-Morant et al., 2016; Aldieri et al., 2019; Chen et al., 2006; Dangelico, 2016; Kunapatarawong and Martínez-Ros, 2016; Ma et al., 2018). Research investigating the relationship between green innovation and corporate finance is lacking. Therefore, this study addresses this research gap and provides empirical evidence by examining a large sample of Chinese privately listed companies.

Second, the above findings enrich the literature in the domain of corporate financing constraints. Currently, the discussion regarding financing constraints generally concentrates on the influencing factors and solutions (Kuppuswamy and Villalonga, 2015; Leon, 2015). As society developed, the concept of the green behaviour of enterprises has emerged, but the impact of green innovation on financing constraints has not been explored. This study considers this topic a starting point and provides a new theoretical method for enterprises to ease their financing constraints.

Finally, this research further supplements the environmental disclosure literature, especially regarding the interaction with green innovation. Environmental disclosure is an enterprise's external measure, while green innovation is an enterprise's internal reform (Clarkson et al., 2008; Hu and Loh, 2018), and the role of internal and external integration deserves attention. However, such interaction between environmental disclosure and green innovation has not been discussed in depth. Based on the existing literature, this study validates the interaction between green innovation and environmental disclosure and provides a new theoretical foundation for corporate sustainable development.

6.3. Practical implications

The findings of this work also significantly contribute to industrial implications and social practice.

First, this study provides new ideas for the growth of emerging market firms' financing. A large number of Chinese enterprises are faced with severe financing constraints. This phenomenon hinders the development of companies, especially for small and private enterprises. This paper finds that the implementation of green innovation and environmental disclosure can reduce the financing constraints rather than create a negative impact on their financing capability. Therefore, the implementation of green innovation and environmental disclosure should be enhanced to help firms obtain more financing resources and maximize benefits and ensure the rapid development of enterprises and healthy economic practices.

Second, this research provides important help for the government to more effectively formulate and implement green policy. The government is the most important promoter of green development; it shoulders the responsibility for environmental protection, encourages enterprises to conduct green innovation and environmental disclosure and promotes the clean production and green capacity of industries. However, China's government usually focuses on overall plans, without paying sufficient attention to green innovation and environmental disclosure. This paper provides important support indicating that governments should design a framework to encourage specific corporate green practices, especially green innovation and environmental disclosure, to achieve the aim of pollution control and sustainable development. By promoting these practices, the governments can also alleviate the financing difficulties of local enterprises, enhance the vitality of the local economy and promote local green development.

Finally, a way to achieve the co-development of environment and economy is discovered in this work. Enterprise is the fundamental element of one country's market and society. Therefore, corporate green innovation is crucial for sustainable development. However, a large number of firms are currently unwilling to invest in environmental projects because they consider green innovation as high cost but low return. This issue encumbers sustainable economic development and leads to the involvement of many firms in administrative penalties and litigation. The results of this paper show that companies can receive direct financing support from stakeholders by green innovation. This finding creates a cornerstone for developing the environment and economy simultaneously because the benefits of firms will not be compromised through green innovation. Therefore, this research solves an important problem concerning how to balance the relationship between economy performance and environmental protection, and contributes significantly to the worldwide issue of environmental conservation and sustainable development.

6.4. Limitations and future research opportunities

However, this paper still has certain limitations. In this research, the main concern is the mitigation effect of green innovation on the financing constraints of enterprises, but this effect could be affected by many factors, such as enterprise characteristics, changes in the macro environment and policy impacts. There are still some gaps in this area. Therefore, a follow-up study can be initiated with these aspects to supplement the findings on the relationship between green innovation and financing constraints.

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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

Yuming Zhang: Conceptualization, Validation, Investigation, Writing - original draft, Writing - review & editing, Supervision, Funding acquisition. **Chao Xing:** Conceptualization, Methodology, Software, Data curation, Writing - original draft, Writing - review & editing. **Yuan Wang:** Writing - original draft, Writing - review & editing, Visualization.

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Appendix A. Variable Specification

Types	Variables	Abbreviation	Specification
Dependent variable	Financing constraints - SA index	*SA*	$SA = (-0.737 * Size) + (0.043 * Size^2) - (0.040 * Lage)$, where *Size* is the log of total assets, and *Lage* is the number of years the firm has been listed. A higher *SA* value indicates severe financing constraints.
Independent variables	Green technology innovation	*GTI*	*GTI* = 1 if an enterprise has acquired more than one green patent, 0 otherwise.
	Green management innovation	*GMI*	*GMI* = 1 if an enterprise has acquired the environmental certification (ISO14001 or GB/T24001), 0 otherwise.
	Environmental disclosure choice	*Dis_C*	*Dis_C* = 1 if a firm disclosed their environmental information, 0 otherwise.
	Environmental disclosure quality	*Dis_Q*	*Dis_Q* indicates the quality of disclosed environmental information. A higher *Dis_Q* value indicates better disclosure quality. See specific measurement in Appendix B.
Control variables	Ownership concentration	*Top*	*Top* is equal to the percentage of shareholding held by the largest shareholder.

(*continued*)

Types	Variables	Abbreviation	Specification
	Management stock ownership	*Maghold*	*Maghold* is equal to the percentage of shareholding held by all board members and the executive.
	Capital expenditure	*Expend*	*Expend* is equal to the cash paid for the acquisition and construction of fixed assets, intangible assets and other long-term assets divided by total assets.
	Enterprise growth	*Growth*	*Growth* is equal to the percentage increase of corporate operating revenue.
	Cash hold	*Cash*	*Cash* is equal to the cash and cash equivalents as a percentage of total assets.
	Enterprise scale	*Size*	*Size* is equal to the log of total assets.
	Asset tangibility	*PPE*	*PPE* is equal to the net value of fixed assets and inventory as a percentage of total assets.
	Cash flow	*CF*	*CF* is equal to the net cash flow from operating activities as a percentage of total assets.
	Non-debt tax shield	*NDTS*	*NDTS* is equal to the sales and management expenses as a percentage of sales revenue.
	Asset-liability ratio	*Lev*	*Lev* is equal to the total liabilities divided by total assets.
	Financial performance	*ROA*	*ROA* is equal to the net profit divided by average total assets.
Other variables	Instrumental variable for *GTI*	*IVGTI*	*IVGTI* is the proportion of enterprises with GTI in the industry in that year.
	Instrumental variable for *GMI*	*IVGMI*	*IVGMI* is the proportion of enterprises with GMI in the industry in that year.
	Change in cash holdings	*ΔCash*	*ΔCash* is equal to cash holdings in the current year subtracting cash holdings in the last year.
	Heavily polluting enterprises	*HP*	*HP* = 1 if a firm belong to the heavily polluting enterprises, 0 otherwise.

Appendix B. Specific Measurement of *Dis_Q*

A. Disclosure of environmental governance:	B. Disclosure of descriptive environmental behaviour:	C. Disclosure of environmental indicators:
1. Implementing environmental decision cooperate with stakeholders (0–2)	1. Principles of environmental protection (0–2)	1. Indicator on energy use (0–6)
2. Top executive compensation linked to environmental protection (0–2)	2. Description of environmental risk and environmental performance (0–2)	2. Indicator on water use (0–6)
3. Rewards result from environmental conservation (0–2)	3. Description of solution of environmental risk (0–2)	3. Indicator on greenhouse gas emissions (0–6)
4. Government subsidies result from environmental conservation (0–2)	4. Previous environmental activities in which companies joined (0–2)	4. Indicator on other air emissions (0–6)
5. Investment in the technology or reform of environmental conservation (0–2)	5. Future environmental activities in which companies will join (0–2)	5. Indicator on land, water and air pollution (0–6)
6. Cost of environmental governance (0–2)	6. Description of environmental technologies used (0–2)	6. Indicator on other pollution (0–6)
7. Amount of environmental debt (0–2)	7. Description of legitimacy or environmental issues (0–2)	7. Indicator on waste generation and recycling (0–6)
8. Joining in social environmental protection projects (0–2)	8. Description of industry environmental impact (0–2)	8. Indicator on biodiversity and conservation (0–6)
9. Environmental certification by third institutions (0–2)	9. Description of product environmental impact (0–2)	9. Indicator on environmental impacts of products and services (0–6)
10. Adopting GRI sustainability reporting guidelines (0–2)	10. Other supplementary description of environmental protection (0–2)	10. Indicator on legitimacy of environmental protection (0–6)

Note: values in parentheses are the range of disclosure quality. For each term of part A and B, if a firm disclosed detailed information, the value will equal 2; if it disclosed simple data, the value will be 1; if it did not disclose, the value is 0. For the terms of part C, a point is awarded for each of six aspects, i.e., 1) presented data, 2) relative to previous data, 3) relative to future targets, 4) relative to peers/industry data, 5) absolute and normalized form, 6) presented at the disaggregate level. The final value of *Dis_Q* is the sum of all individual term values.

References

Abbas, J., Sağsan, M., 2019. Impact of knowledge management practices on green innovation and corporate sustainable development: a structural analysis. J. Clean. Prod. 229, 611–620. https://doi.org/10.1016/j.jclepro.2019.05.024.

Aerts, W., Cormier, D., Magnan, M., 2008. Corporate environmental disclosure, financial markets and the media: an international perspective. Ecol. Econ. 64 (3), 643–659. https://doi.org/10.1016/j.ecolecon.2007.04.012.

Aizawa, M., Yang, C., 2010. Green credit, green stimulus, green revolution? China's mobilization of banks for environmental cleanup. J. Environ. Dev. 19 (2), 119–144. https://doi.org/10.1177/1070496510371192.

Albort-Morant, G., Leal-Millán, A., Cepeda-Carrión, G., 2016. The antecedents of green innovation performance: a model of learning and capabilities. J. Bus. Res. 69 (11), 4912–4917. https://doi.org/10.1016/j.jbusres.2016.04.052.

Aldieri, L., Carlucci, F., Cirà, A., Ioppolo, G., Vinci, C.P., 2019. Is green innovation an opportunity or a threat to employment? An empirical analysis of three main industrialized areas: the USA, Japan and Europe. J. Clean. Prod. 214, 758–766. https://doi.org/10.1016/j.jclepro.2019.01.016.

Almeida, H., Campello, M., Weisbach, M.S., 2004. The cash flow sensitivity of cash. J. Finance 59 (4), 1777–1804. https://doi.org/10.1111/j.1540-6261.2004.00679.x.

Beladi, H., Chao, C.C., Hu, M., 2018. Does tax avoidance behavior affect bank loan contracts for Chinese listed firms? Int. Rev. Financ. Anal. 58, 104–116. https://doi.org/10.1016/j.irfa.2018.03.016.

Borghesi, R., Houston, J.F., Naranjo, A., 2014. Corporate socially responsible investments: CEO altruism, reputation, and shareholder interests. J. Corp. Finance 26, 164–181. https://doi.org/10.1016/j.jcorpfin.2014.03.008.

Botosan, C.A., 1997. Disclosure level and the cost of equity capital. Account. Rev. 72 (3), 323–349. https://www.jstor.org/stable/248475.

Burns, B.L., Barney, J.B., Angus, R.W., Herrick, H.N., 2016. Enrolling stakeholders under conditions of risk and uncertainty. Strat. Entrepren. J. 10 (1), 97–106. https://doi.org/10.1002/sej.1209.

Buysse, K., Verbeke, A., 2003. Proactive environmental strategies: a stakeholder management perspective. Strat. Manag. J. 24 (5), 453–470. https://doi.org/10.1002/smj.299.

Chava, S., Livdan, D., Purnanandam, A., 2008. Do shareholder rights affect the cost of bank loans? Rev. Financ. Stud. 22 (8), 2973–3004. https://doi.org/10.1093/rfs/hhn111.

Chen, Y.S., 2008. The driver of green innovation and green image–green core competence. J. Bus. Ethics 81 (3), 531–543. https://doi.org/10.1007/s10551-007-9522-1.

Chen, Y., Lai, S., Wen, C., 2006. The influence of green innovation performance on corporate advantage in Taiwan. J. Bus. Ethics 67 (4), 331–339. https://doi.org/10.1007/s10551-006-9025-5.

Cheng, B., Ioannou, I., Serafeim, G., 2014. Corporate social responsibility and access to finance. Strat. Manag. J. 35 (1), 1–23. https://doi.org/10.1002/smj.2131.

Clarkson, P.M., Li, Y., Richardson, G.D., Vasvari, F.P., 2008. Revisiting the relation between environmental performance and environmental disclosure: an empirical analysis. Account. Org. Soc. 33 (4–5), 303–327. https://doi.org/10.1016/j.aos.2007.05.003.

Dangelico, R.M., 2016. Green product innovation: where we are and where we are going. Bus. Strat. Environ. 25 (8), 560–576. https://doi.org/10.1002/bse.1886.

Delmas, M.A., Burbano, V.C., 2011. The drivers of greenwashing. Calif. Manag. Rev. 54 (1), 64–87. https://doi.org/10.1525/cmr.2011.54.1.64.

Dhaliwal, D.S., Li, O.Z., Tsang, A., Yang, Y.G., 2011. Voluntary nonfinancial disclosure and the cost of equity capital: the initiation of corporate social responsibility reporting. Account. Rev. 86 (1), 59–100. https://doi.org/10.2308/accr.00000005.

Donaldson, T., Preston, L.E., 1995. The stakeholder theory of the corporation: concepts, evidence, and implications. Acad. Manag. Rev. 20 (1), 65–91. https://doi.org/10.5465/amr.1995.9503271992.

Flammer, C., 2013. Corporate social responsibility and shareholder reaction: the environmental awareness of investors. Acad. Manag. J. 56 (3), 758–781. https://doi.org/10.5465/amj.2011.0744.

Freeman, R.E., 1994. The politics of stakeholder theory: some future directions. Bus. Ethics Q. 4 (4), 409–421. https://doi.org/10.2307/3857340.

Glosten, L.R., Milgrom, P.R., 1985. Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. J. Financ. Econ. 14 (1), 71–100. https://doi.org/10.1016/0304-405X(85)90044-3.

Guenther, E., Guenther, T., Schiemann, F., Weber, G., 2016. Stakeholder relevance for reporting: explanatory factors of carbon disclosure. Bus. Soc. 55 (3), 361–397. https://doi.org/10.1177/0007650315575119.

Hadlock, C.J., Pierce, J.R., 2010. New evidence on measuring financial constraints: moving beyond the KZ index. Rev. Financ. Stud. 23 (5), 1909–1940. https://doi.org/10.1093/rfs/hhq009.

Harrison, J.S., Bosse, D.A., Phillips, R.A., 2010. Managing for stakeholders, stakeholder utility functions, and competitive advantage. Strat. Manag. J. 31 (1), 58–74. https://doi.org/10.1002/smj.801.

He, L., Zhang, L., Zhong, Z., Wang, D., Wang, F., 2019. Green credit, renewable energy investment and green economy development: empirical analysis based on 150 listed companies of China. J. Clean. Prod. 208, 363–372. https://doi.org/10.1016/j.jclepro.2018.10.119.

Hou, X., Li, S., Guo, P., Wang, Q., 2018. The cost effects of shadow banking activities and political intervention: evidence from the banking sector in China. Int. Rev. Econ. Finance 57, 307–318. https://doi.org/10.1016/j.iref.2018.01.019.

Hu, M., Loh, L., 2018. Board governance and sustainability disclosure: a cross-sectional study of Singapore-listed companies. Sustainability 10 (7), 2578. https://doi.org/10.3390/su10072578.

Kajander, J., Sivunen, M., Vimpari, J., Pulkka, L., Junnila, S., 2012. Market value of sustainability business innovations in the construction sector. Build. Res. Inf. 40 (6), 665–678. https://doi.org/10.1080/09613218.2012.703893.

Khwaja, A.I., Mian, A., 2005. Do lenders favor politically connected firms? Rent provision in an emerging financial market. Q. J. Econ. 120 (4), 1371–1411. https://doi.org/10.1162/003355305775097524.

Kitsikopoulos, C., Schwaibold, U., Taylor, D., 2018. Limited progress in sustainable development: factors influencing the environmental management and reporting of South African JSE-listed companies. Bus. Strat. Environ. 27 (8), 1295–1301. https://doi.org/10.1002/bse.2176.

Kock, C.J., Santaló, J., Diestre, L., 2012. Corporate governance and the environment: what type of governance creates greener companies? J. Manag. Stud. 49 (3), 492–514. https://doi.org/10.1111/j.1467-6486.2010.00993.x.

Kunapatarawong, R., Martínez-Ros, E., 2016. Towards green growth: how does green innovation affect employment? Res. Pol. 45 (6), 1218–1232. https://doi.org/10.1016/j.respol.2016.03.013.

Kuppuswamy, V., Villalonga, B., 2015. Does diversification create value in the presence of external financing constraints? Evidence from the 2007–2009 financial crisis. Manag. Sci. 62 (4), 905–923. https://doi.org/10.1287/mnsc.2015.2165.

Laughlin, R.C., 1991. Environmental disturbances and organizational transitions and transformations: some alternative models. Organ. Stud. 12 (2), 209–232. https://doi.org/10.1177/017084069101200203.

Lee, G., 2006. The effectiveness of international knowledge spillover channels. Eur. Econ. Rev. 50 (8), 2075–2088. https://doi.org/10.1016/j.euroecorev.2005.10.001.

Leon, F., 2015. Does bank competition alleviate credit constraints in developing countries? J. Bank. Finance 57, 130–142. https://doi.org/10.1016/j.jbankfin.2015.04.005.

Leonidou, C.N., Katsikeas, C.S., Morgan, N.A., 2013. "Greening" the marketing mix: do firms do it and does it pay off? J. Acad. Market. Sci. 41 (2), 151–170. https://doi.org/10.1007/s11747-012-0317-2.

Li, D., Zhao, Y., Zhang, L., Chen, X., Cao, C., 2018. Impact of quality management on green innovation. J. Clean. Prod. 170, 462–470. https://doi.org/10.1016/j.jclepro.2017.09.158.

Li, H., Meng, L., Wang, Q., Zhou, L., 2008. Political connections, financing and firm performance: evidence from Chinese private firms. J. Dev. Econ. 87 (2), 283–299. https://doi.org/10.1016/j.jdeveco.2007.03.001.

Li, L., Liu, Q., Tang, D., Xiong, J., 2017. Media reporting, carbon information disclosure, and the cost of equity financing: evidence from China. Environ. Sci. Pollut. Control Ser. 24 (10), 9447–9459. https://doi.org/10.1007/s11356-017-8614-4.

Li, S., Qiu, J., Wan, C., 2011. Corporate globalization and bank lending. J. Int. Bus. Stud. 42 (8), 1016–1042. https://doi.org/10.1057/jibs.2011.29.

Lin, H., Zeng, S.X., Ma, H.Y., Qi, G.Y., Tam, V.W.Y., 2014. Can political capital drive corporate green innovation? Lessons from China. J. Clean. Prod. 64, 63–72. https://doi.org/10.1016/j.jclepro.2013.07.046.

Liu, X., Wang, E., Cai, D., 2019. Green credit policy, property rights and debt financing: quasi-natural experimental evidence from China. Finance Res. Lett. 29, 129–135. https://doi.org/10.1016/j.frl.2019.03.014.

Liu, Z., Guan, D., Wei, W., Davis, S.J., Ciais, P., Bai, J., et al., 2015. Reduced carbon emission estimates from fossil fuel combustion and cement production in China. Nature 524 (7565), 335–338. https://doi.org/10.1038/nature14677.

Ma, Y., Hou, G., Yin, Q., Xin, B., Pan, Y., 2018. The sources of green management innovation: does internal efficiency demand pull or external knowledge supply push? J. Clean. Prod. 202, 582–590. https://doi.org/10.1016/j.jclepro.2018.08.173.

Mitchell, R.K., Agle, B.R., Wood, D.J., 1997. Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts. Acad. Manag. Rev. 22 (4), 853–886. https://doi.org/10.5465/amr.1997.9711022105.

Orens, R., Aerts, W., Cormier, D., 2010. Web-based non-financial disclosure and cost of finance. J. Bus. Finance Account. 37 (9–10), 1057–1093. https://doi.org/10.1111/j.1468-5957.2010.02212.x.

Passetti, E., Cinquini, L., Tenucci, A., 2018. Implementing internal environmental management and voluntary environmental disclosure: does organisational change happen. *Accounting*. Audit. Account. J. 31 (4), 1145–1173. https://doi.org/10.1108/AAAJ-02-2016-2406.

Paulraj, A., 2009. Environmental motivations: a classification scheme and its impact on environmental strategies and practices. Bus. Strat. Environ. 18 (7), 453–468. https://doi.org/10.1002/bse.612.

Peloza, J., Shang, J., 2011. How can corporate social responsibility activities create value for stakeholders? A systematic review. J. Acad. Market. Sci. 39 (1), 117–135. https://doi.org/10.1007/s11747-010-0213-6.

Qin, Y., Harrison, J., Chen, L., 2019. A framework for the practice of corporate environmental responsibility in China. J. Clean. Prod. 235, 426–452. https://doi.org/10.1016/j.jclepro.2019.06.245.

Qiu, Y., Shen, T., 2017. Organized labor and loan pricing: a regression discontinuity design analysis. J. Corp. Finance 43, 407–428. https://doi.org/10.1016/j.jcorpfin.2017.02.007.

Shu, C., Zhou, K.Z., Xiao, Y., Gao, S., 2016. How green management influences product innovation in China: the role of institutional benefits. J. Bus. Ethics 133 (3), 471–485. https://doi.org/10.1007/s10551-014-2401-7.

Song, W., Yu, H., 2018. Green innovation strategy and green innovation: the roles of green creativity and green organizational identity. Corp. Soc. Responsib. Environ. Manag. 25 (2), 135–150. https://doi.org/10.1002/csr.1445.

Sufi, A., 2007. Bank lines of credit in corporate finance: an empirical analysis. Rev. Financ. Stud. 22 (3), 1057–1088. https://doi.org/10.1093/revfin/hhm007.

Weng, H., Chen, J., Chen, P., 2015. Effects of green innovation on environmental and corporate performance: a stakeholder perspective. Sustainability 7 (5), 4997–5026. https://doi.org/10.3390/su7054997.

Xie, X., Huo, J., Zou, H., 2019. Green process innovation, green product innovation, and corporate financial performance: a content analysis method. J. Bus. Res. 101, 697–706. https://doi.org/10.1016/j.jbusres.2019.01.010.

Yadav, P.L., Han, S.H., Rho, J.J., 2016. Impact of environmental performance on firm value for sustainable investment: evidence from large US firms. Bus. Strat. Environ. 25 (6), 402–420. https://doi.org/10.1002/bse.1883.

Young, W., Hwang, K., McDonald, S., Oates, C.J., 2010. Sustainable consumption: green consumer behaviour when purchasing products. Sustain. Dev. 18 (1), 20–31. https://doi.org/10.1002/sd.394.

Yu, W., Ramanathan, R., 2015. An empirical examination of stakeholder pressures, green operations practices and environmental performance. Int. J. Prod. Res. 53 (21), 6390–6407. https://doi.org/10.1080/00207543.2014.931608.

Zhang, B., Yang, Y., Bi, J., 2011. Tracking the implementation of green credit policy in China: top-down perspective and bottom-up reform. J. Environ. Manag. 92 (4), 1321–1327. https://doi.org/10.1016/j.jenvman.2010.12.019.

Zhang, D., Rong, Z., Ji, Q., 2019. Green innovation and firm performance: evidence from listed companies in China. Resour. Conserv. Recycl. 48–55. https://doi.org/10.1016/j.resconrec.2019.01.023.

Zhao, L., Chen, Y., 2019. Optimal subsidies for green products: a maximal policy benefit perspective. Symmetry 11 (1), 63. https://doi.org/10.3390/sym11010063.