Science of the Total Environment 714 (2020) 136855

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Does environmental information disclosure contribute to improve firm financial performance? An examination of the underlying mechanism

Shanyong Wang, Hualong Wang *, Jing Wang, Feng Yang

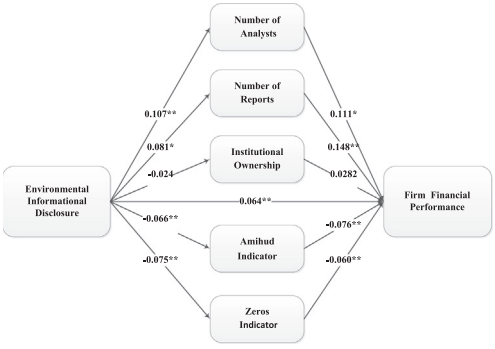
School of Management, University of Science and Technology of China, Hefei, Anhui Province 230026, PR China

HIGHLIGHTS

- Environmental information disclosure positively affects firm financial performance.
- Analyst coverage and liquidity have positively effect on firm financial performance.
- Institutional ownership has no effect on firm financial performance.
- Legitimacy and asymmetry information theory are effective to explain the findings.

GRAPHICAL ABSTRACT

The research framework of environmental information disclosure and firm financial performance.
*p < 0.01, **p < 0.05 and ***p < 0.001.



ARTICLE INFO

Article history:
Received 17 October 2019
Received in revised form 26 December 2019
Accepted 20 January 2020
Available online xxxx

Guest Editor: Malin Song

Keywords:
Environmental information disclosure
Visibility
Liquidity
Firm financial performance
Mediating effect

ABSTRACT

Given the widespread impacts of firm activities on the environment, firms are increasingly required to disclose environmental information. However, the relation between environmental information disclosure and firm financial performance is controversial and the mechanism through which environmental information disclosure affects financial performance is insufficiently investigated. This research examined the effect of environmental information disclosure on financial performance and explored the mediating effects of visibility (e.g., analyst coverage and institutional ownership) and liquidity. Panel data from 289 Chinese listed firms were analyzed with the assistance of STATA Software. The results revealed that environmental information disclosure positively (directly) affects financial performance. Further, environmental information disclosure also indirectly affects financial performance via analyst coverage (e.g., number of analysts and number of reports) and liquidity. Analyst coverage and liquidity mediate the relationship between environmental information disclosure and financial performance while institutional ownership has no mediating effect. According to the results, practical implications were discussed and future research directions were noted.

* Corresponding author at: School of Management, University of Science and Technology of China, No. 96, Jinzhai Road, Hefei, Anhui Province 230026, PR China.
E-mail address: hlwustc@mail.ustc.edu.cn (H. Wang).

https://doi.org/10.1016/j.scitotenv.2020.136855
0048-9697/

1. Introduction

With the deterioration of the environment and increasingly serious environmental problems, stakeholders pay more and more attention to the environmental responsibilities of firms (Lu et al., 2018; Pu et al., 2019). To cope with climate change, the international community and governments have taken a series of measures, for example, establishing regulations (Han et al., 2017; Wang et al., 2019a; Zhang et al., 2019b) and carbon emission trading systems (Dong et al., 2019; Yao et al., 2019b). In response to the stock market's focus on sustainable development, rating agencies (i.e., Morgan Stanley Capital International and Thomson Reuters) and financial information providers (i.e., Bloomberg) provided data on environmental society and governance (Yu et al., 2018). These measures effectively regulate the pollution behavior of enterprises and the overall number of environmental accidents has exhibited a significant downward trend from 2006 to 2015 (Cao et al., 2018). Government efforts and environmental regulation directly and indirectly influence haze pollution governance (Wang et al., 2016; Wang et al., 2017; Wang et al., 2018; Zhang et al., 2019b). In addition, the level of carbon dioxide emissions also has declined significantly in recent years (Chen et al., 2019c; Ru et al., 2019; Yang et al., 2019).

As an important source of pollution, enterprises need to increase the intensity of environmental information disclosure to deal with pressure (Gao et al., 2017; Lin et al., 2017; Shi et al., 2017). Environmental information disclosure is generally defined as a method of describing firms' environmental-related activities and information to users of financial statements (Trumpp et al., 2015). According to the report of the Institute of Governance and Responsibility, the proportion of companies in the S&P 500 index that adopt sustainability reporting increased from 53% in 2012 to 82% in 2017 (Yu et al., 2018). However, environmental information is not often disclosed by Chinese enterprises. The survey shows that only approximately one-third of listed companies disclose environmental information (Zeng et al., 2012). The inadequate implementation of environmental information disclosure may be attributed two reasons. One reason is that the legislative environment and enforcement capacity is weak and the regulatory mechanism is ineffective (Zeng et al., 2012). Another reason is that firms are worried about the cost and benefit issues of environmental information disclosure (Matsumura et al., 2013). The cost of environmental information collection, management and disclosure may outweigh the benefit. Additionally, information about process inefficiency and environmental initiatives accessible to competitors may weaken firm competition and financial performance and misleading information or errors in reports can also significantly increase the litigation cost (Matsumura et al., 2013). Therefore, it can be predicted that firms would prefer to increase environmental information disclosure when they are convinced that the benefits of environmental information disclosure offset or even exceed the associated costs.

Several studies have been performed to examine the factors that affect firm environmental information disclosure. Zeng et al. (2012) suggested that firms in environmentally sensitive industries and those with better reputations exhibit an increased probability to disclose environmental information. Zhang (2017) documented that political connection has a positive effect on firm environmental information disclosure. Li et al. (2019) provided evidence for a positive correlation between excess compensation of senior managers and environmental information disclosure. Chen et al. (2019c) explored factors that influence carbon productivity by focusing on samples in the transportation industry using an integrated carbon productivity decomposition approach. Most of the literature focuses on institutional pressure from the government or other stakeholders, and economic incentives for firms that implement environmental practices are rarely explored (Cui and Song, 2019; Song et al., 2019b; Wang et al., 2019b; Zhang et al., 2019b).

Findings from studies that explored the relationship between environmental information disclosure and firm financial performance seem to be mixed and inconsistent. Research within the voluntary disclosure theory reported that environmental information disclosure is positively associated with firm financial performance (Khlif et al., 2015). These studies claimed that superior financial performers will attempt to distinguish themselves from other firms by disclosing their favorable environmental information. Research on legitimacy theory suggested that environmental information disclosure negatively affects firm financial performance (Aragon-Correa et al., 2016). These studies reported that firm environmental information disclosure is a reaction to pressures from public stakeholders. To disclose favorable environmental information and meet stakeholders' environmental requirements, firms need to improve environmental performance, which leads to an increase in costs and reduces financial performance (Liu and Zhang, 2017). Researchers also indicated that environmental information disclosure has no relationship with financial performance (Qiu et al., 2016). Therefore, it is necessary to explore the mechanism and contingency factors of environmental information disclosure affecting firm performance.

Several studies have investigated the inconsistent relationship between environmental information disclosure and firm financial performance and indicated that the relationship among them is contingent on some moderator and mediator variables. Moderator variables, such as firm size (Dixon-Fowler et al., 2013), firm age (Wang and Bansal, 2012), innovation degree and shareholding structure (Hull and Rothenberg, 2008), industry characteristics (Baird et al., 2012) and general business environment (Flammer, 2013) were elaborated when exploring the relationship between environmental information disclosure and firm financial performance. In term of mediator variables, Surroca et al. (2010) suggested that innovation, human capital and culture play more important roles in the relationship between environmental information disclosure and firm financial performance. Innovation is an important mediator variable, and many studies explore the effect of innovation (Chen et al., 2019a; Jin et al., 2019; Song et al., 2019a; Song et al., 2020). Environmental regulation by the government also positively influences technology innovation (Song et al., 2019b). Enterprises used green technology innovations to implement environmental strategies to reduce carbon emissions (Chen et al., 2019b; Yao et al., 2019a) and consumers tend to buy green products, which improves financial performance (Loncar et al., 2019). The emergence of new technologies, such as block chain and large-scale data, also brings new challenges to the green operation ability of enterprises and sustainable development (Pan et al., 2019; Song et al., 2019a).

Nevertheless, prior studies were mainly focused on firms' characteristic variables and internal variables. Variables from the external stock market where investors play vital roles as important stakeholders have been seldom examined. Additionally, to our knowledge, minimal research has explored the mediating effect of stock market variables and investigated the mechanism through which environmental information disclosure affects firm financial performance via stock market characteristics. To narrow the research gap, the current study aims to do the following. For listed firms, the stock market is an important channel to concentrate funds and investors' responses to firm stock, which affects the firm's financial performance (Luo et al., 2015). Visibility and liquidity are two important characteristics of listed firms (Luo et al., 2015). The visibility of listed firms refers to the degree of exposure to stakeholders; that is, more visible firms attract more public monitoring and receive more rigorous government supervision (Wang, 2017). Under strict monitoring and supervision, the principal-agent problem could be alleviated and managers should bear the entrusted responsibility by investors. Hence, a firm's financial performance can be improved. Liquidity represents the flexibility of stocks; that is, the liquidity of stocks reflects the frequency of stock transactions (Norli et al., 2014). More trading frequency reduces stock premiums and reduces capital costs. For firms with better liquidity, lower capital costs lead to better performance through affecting the firm's financing costs. Furthermore, firms that disclose more environmental information could benefit from increased popularity and exposure, and information asymmetry

is mitigated. Further, investors might feel that the stocks are less risky and tend to buy stocks, which increases stock liquidity. In other words, environmental information disclosure could increase the visibility and liquidity of firms and ultimately affect firm financial performance. Hence, liquidity and visibility should be taken into account when exploring the mechanism by which environmental information disclosure affects financial performance. Overall, based on the information disclosure theory and asymmetry information theory, the current study aims to explore the impact of environmental information disclosure on firm financial performance, the underlying mechanism and the mediating effects of liquidity and visibility.

This research provides four contributions to previous literature. First, we focus on environmental information disclosure, which differs from the environmental performance focus of the majority of studies. Environmental information disclosure may serve as a tool to mask the actual environmental performance or reflect that the actual performance remains a puzzle (Meng et al., 2019). The relationship between information disclosure as a demonstration of strategic choice and firm financial performance is worth exploring (Minutolo et al., 2019). Second, this research mainly focused on exploring the mechanism of environmental information disclosure on financial performance from a capital market perspective, which was always omitted by previous studies. By examining the mediating effects of visibility and liquidity, the mechanism of environmental information disclosure on financial performance was identified. Third, this study examined the influence of environmental information disclosure on financial performance in the Chinese context, while most previous studies were mainly conducted in developed countries and regions with perfect supervision systems and governance mechanisms (Li et al., 2017). Hence, research conducted in China, a developing country that has different industrial and socioeconomic fabrics, could be helpful in understanding the mechanism of environmental information disclosure on financial performance and illustrating the effect of environmental information disclosure. In addition, as the largest developing country in the world, China is one of the key international players in global environmental governance and protection. Therefore, evidence and research findings from the Chinese marketplace could provide useful implications for other countries. Finally, research data were collected from Chinese listed firms from 2013 to 2017. A much larger database spanning 5 years provides us the opportunity to investigate how the completeness of the environmental information disclosed affects firm financial performance by controlling the inherent difference across firms and temporal shock over time. Panel data used in this study provide more observations, alleviate collinearity problems among the explanatory variables and prevent variable bias (Zeng et al., 2012).

The remaining sections of this paper are arranged as follows. Section 2 briefly introduced environmental information disclosure, reviewed related studies and proposed research hypotheses. Section 3 discussed the data and methodology. The empirical data analyses were presented in Section 4. Section 5 discussed the research results and highlighted research implications. Conclusions, limitations and future research directions are provided in Section 6.

2. Theoretical background and hypotheses

2.1. Environmental information disclosure

As an essential component of corporate social responsibility (CSR), firm environmental-related activities and information have been required to be disclosed to the public since the 1970s in developed countries (Beck et al., 2010; Buallay, 2019). Environmental problems have attracted people's attention, which has affected consumer's shopping behavior, changed consumer's willingness to buy green products and increased the demand for environmental information disclosure (Song et al., 2019a). Facing increasingly serious environmental problems, firms have been required to disclose information about environmental activities by the Chinese government. According to the Guide of Environmental Information Disclosure of Listed Companies enacted by Shanghai and Shenzhen stock exchanges in 2010, all listed firms should implement responsibility of environmental disclosure and publish a CSR report (including an environmental section) or independent environmental report.

Previous scholars suggested that the listed firms have started to disclose a few environment-related contents and elements in the annual or CSR reports (Zeng et al., 2012). However, the extent and level of environmental information disclosure remains low and unsatisfactory due to various reasons, including non-mandatory information disclosure requirements, inadequate public participation and insufficient government supervision (Ane, 2012). Ane (2012) indicated that the environmental information disclosure content is limited and incomplete. In addition, the disclosure pattern is single and the utility is low in heavy pollution industries of China. In fact, many firms have not yet realized the outcomes of disclosing environmental information, especially the possible influence of environmental information disclosure on firm financial performance. When firms realize that environmental information disclosure is positively associated with financial performance, they will be more likely to enhance the extent and degree of environmental information disclosure. Thus, exploring the mechanism by which environmental information disclosure affects firm financial performance may remedy the deficiencies of relevant laws and regulations and stimulate firms to spontaneously disclose environmental information.

Furthermore, to encourage companies to undertake environmental social responsibility and disclose environmental information, the new Environmental Protection Law, which has been regarded as the most rigorous law in Chinese history, was implemented in 2015. Additionally, several market-based incentives, such as green credit, green insurance and green loan, have been initiated to encourage firms to conduct environmental disclosure (Liu et al., 2010). Therefore, it is necessary to explore the extent and degree of environmental information disclosure of listed firms after the implementation of the new Environmental Protection Law.

This research is based on voluntary disclosure theory, signaling theory and asymmetry information theory (Lemma et al., 2019; Wang, 2017; Xie et al., 2019). According to these theories, better environmental performance firms prefer to disclose more information to signal that enterprises are actively fulfilling social responsibility to the product and investment market, leaving a good impression on consumers and investors to gain a competitive advantage. Given the reduction in the degree of information asymmetry, the positive response of the product and investment market to firm disclosure makes it easier for enterprises to obtain better performance. Thus, this study explores the impact of investor's response to information disclosure on financial performance.

2.2. Environmental information disclosure and visibility

A visible firm is defined as having a large number of investors who are aware the existence of the firm or a large investor base (Jeon et al., 2015). The majority of previous studies have investigated the relationship between visibility and environmental information disclosure and assumed that a firm's visibility drives it to disclose environmental information (Dawkins and Fraas, 2011; Lu and Abeysekera, 2014). This stream of literature suggests that more visible firms are susceptible to external scrutiny, and more information related to environmental issues needs to be disclosed to meet the information demand of stakeholders (Dawkins and Fraas, 2011).

However, prior literature failed to consider the reverse causation from organizational visibility to environmental information disclosure and primarily explored the effect of environmental information disclosure on organizational visibility. According to voluntary disclosure theory and signaling theory, firms with better environmental performance prefer to disclose more information to distinguish them with poor

environmental performance firms (Lemma et al., 2019). As a strategic choice, environmental information disclosure releases the signal that enterprises are actively fulfilling social responsibility to the product and investment market, leaving a good impression on consumers and investors to gain a competitive advantage. Analysts are more likely to follow firms with a great level and better quality of information disclosure, and analysts would prefer to deliver the information to investors in an understandable language (Amores-Salvado et al., 2014). In emerging countries such as China, where the problem of information asymmetry is serious, analysts play an important intermediary role between investors and firms. When the relevant information is disclosed, analysts could use the information to reduce the information distance between firms and investors and increase organizational visibility. Thus, when facing increasing demands for firms' environmental information, environmental information disclosure first attracts analysts' concerns. In other words, environmental information disclosure could improve firm visibility. Hence, the following was proposed:

Hypothesis 1. Environmental information disclosure is positively related to visibility.

2.3. Visibility and firm financial performance

Visible firms more easily attract attention from various stakeholders and are driven to engage in sustainability (Schreck and Raithel, 2018). Higher visibility draws more attention from regulatory stakeholders to judge whether the environmental information disclosure meets the standards formulated by the government. The behavior of firms with high visibility meets the expectations of stakeholders, which indicates that firms obtain legitimacy and a high standard of firm citizenship. Thus, they can more easily to access financial capital and preferential political support after establishing relationships with multiple regulatory stakeholders (Zhao, 2012). Thus, firm financial performance can be improved.

In addition, visible firms could attract more attention from investors and create a clear prediction about firm prospects. With the reduction of information asymmetry, investors could better evaluate firm financial performance and reduce the return on investment because the stock risk premium is effectively cured. Previous studies also indicated that organizational visibility could reduce the cost of equity, which can improve the firm's financial performance (Yao and Liang, 2019). Further, under higher levels of scrutiny from external stakeholders, visible firms could reduce the cash flow to managers and controlling shareholders, which ultimately decreases agency costs and increases financial performance. In addition, empirical evidence suggested that visibility moderates the effect of green CSR on innovation (Wu et al., 2018). When visible firms receive broad attention from stakeholders, they have more channels to obtain knowledge and facilitate the translation of green CSR into innovation using involuntary knowledge flows, subsequently improving firm financial performance (Wu et al., 2018). Given the reduction in equity cost and agency cost and easy access to more financial and political resources, visibility could improve firm financial performance. Hence, the second hypothesis was proposed:

Hypothesis 2. Visibility is positively associated with firm financial performance.

2.4. Environmental information disclosure and liquidity

According to information disclosure theory, the functioning of efficient capital markets is based on firm information disclosure (Armstrong et al., 2011). Previous studies demonstrated that asymmetric information caused by insufficient information disclosure leads to the problem of adverse selection (An et al., 2011). When market makers and other participants lack relevant trading information, they may suffer losses and reduce willingness to trade (He et al., 2013). As the market liquidity decreases, market transaction costs will increase, which subsequently leads to the increase in firm equity capital cost. Information disclosure is an effective method to decrease information asymmetry. Therefore, firms that disclose more information can maintain market efficiency and increase liquidity.

From the perspective of legitimacy theory, firms would prefer to disclose more environmental information to obtain legitimacy (Aragon-Correa et al., 2016). Investors are more likely to purchase shares of firms that disclose more environmental information due to the small legitimacy risk or high transparency of environmental information. The increasing trading demand can improve a firm's stock liquidity. Previous studies also indicated that information disclosure mitigates information asymmetry and improves liquidity in the second market (Goldstein and Yang, 2017). Therefore, it was plausible to assume that environmental information disclosure can improve liquidity.

Hypothesis 3. Environmental information disclosure is positively related to liquidity.

2.5. Liquidity and firm financial performance

Most previous studies agree that liquidity is positively associated with firm financial performance. Liquidity promotes a firm's performance by increasing monitoring and reducing agency costs. Investors are more likely to accumulate a large number of stocks when the liquidity of the stock is better (Norli et al., 2014). As block stockholders, more firm monitoring activities could reduce agency costs and stimulate managers to promote firm financial performance. Facing tremendous pressures and strong threats of institutional investors withdrawing from the liquidity market, managers must work hard to improve financial performance, especially when their salaries are linked to the stock price (Edmans and Manso, 2010).

In addition, liquidity has a positive impact on firm financial performance through informative price and performance-sensitive managerial compensation (Fang et al., 2009). Liquidity affects corporate performance by influencing the response of the capital market and corporate governance. Companies with high stock liquidity participate in extreme tax avoidance and the impact of stock liquidity on tax avoidance is of economic significance (Chen et al., 2019). Li et al. (2012) showed that liquidity enhances corporate governance and improves firm valuation. Thus, the following was hypothesized:

Hypothesis 4. Liquidity is positively associated with firm financial performance.

2.6. Environmental information disclosure and firm financial performance

Environmental information disclosure affects firm financial performance in many ways. According to information disclosure theory, firms with more information disclosure have better stock liquidity, which further reduces transaction and capital costs and increases financial performance (Bidhari et al., 2013). Investors would prefer to purchase the stocks with more credible information disclosure to reduce the potential risks. Therefore, the necessary rate of return on investment required by investors is decreased, and the cost of capital is reduced, which subsequently leads to the increase in financial performance. Based on the same logic, as the content and degree of environmental information disclosure increase, stock liquidity will also increase, which subsequently improves financial performance.

Firms can increase their visibility by disclosing more environmental information. For visible firms, investors are more likely to buy their stocks and increase trading volume, and the customers are more likely to patronize and buy products or services from these firms that go green (Song et al., 2019a). Other firms are willing to cooperate with

the firms that perform in an environmentally responsible manner. All these responses from outside stakeholders lead to superior sales and ultimately improve firm financial performance. Moreover, visible firms more easily attract attention and strict supervision from external stakeholders, which subsequently reduces agency costs through cash flow effects and increases firm financial performance. Thus, environmental information disclosure positively influences visibility, which subsequently leads to increased financial performance. Therefore, the following hypotheses can be proposed:

Hypothesis 5. Environmental information disclosure is positively correlated with firm financial performance via visibility and liquidity.

Hypothesis 5a. Visibility mediates the relationship between environmental information disclosure and firm financial performance.

Hypothesis 5b. Liquidity mediates the relationship between environmental information disclosure and firm financial performance.

The research framework is presented in Fig. 1.

3. Research methodology

3.1. Data collection and the sample

The research sample was obtained from Chinese Stock "A" markets (Shanghai Stock Exchange and Shenzhen Stock Exchange). Most prior studies, which have explored the motivation of environmental information disclosure or examined the impact of environmental information disclosure on financial performance, often selected manufacturing listed firms as the research samples (Liu and Zhang, 2017; Zhang, 2017). This sample was chosen because manufacturing firms cause more environmental problems than any other industries and should be responsible for environmental pollution (Zhang, 2017). Hence, the current research also selected manufacturing firms from Chinese Stock "A" markets as the research samples. We also included other industries in the sample to examine whether the relationship exists in wider industry scope.

Environmental information disclosure data were gathered from annual reports, separate CSR reports, sustainability reports and environmental reports of listed firms through content analysis. Data on firms' liquidity and visibility and other financial data were collected from the China Stock Market and Accounting Research database (CSMAR). The time range of the data was from 2013 to 2017. Firms that have been specially treated (marked with ST,*ST, or PT) were deleted from the sample to avoid the abnormal data of financial performance and environmental information disclosure. Additionally, firms with incomplete data on research variables were also removed from the sample. Finally, the sample included 289 listed firms, and 1054 firm-year observations were obtained.

3.2. Measures

3.2.1. Dependent variable

Return on equity (ROE) was used to gauge firm financial performance, and return on assets (ROA) was used to implement robustness tests. ROE represents the effective use of the total equity and is also an indicator of the profit generated in each unit of investment in equity (Villalonga et al., 2019). ROA and ROE are frequently used to evaluate firm financial performance (Villalonga et al., 2019). Further, ROA and ROE are also widely used to measure financial performance in studies related to CSR and environmental information disclosure (Wang et al., 2015). Hence, ROA and ROE were used to measure financial performance in the current research.

3.2.2. Independent and mediating variables

3.2.2.1. Environmental information disclosure (EID). According to existing studies, EID is measured by firm's environmental disclosure content and degree (Beck et al., 2010). Early scholars measure the level of EID by using the total number of sentences related to environmental information in annual report or even the number of words (Gray et al., 2001). In recent years, an information disclosure scoring method based on content analysis has frequently been employed in EID research (Liu and Zhang, 2017; Zou et al., 2019).

EID could be divided into two categories: voluntary and compulsory. Mandatory EID is based on national legal regulations, which vary across countries (Gray et al., 2001). The Shanghai Stock Exchange formulated the Guidelines for Environmental Information Disclosure of Listed Companies, which encouraged listed firms to reveal environmental information associated with investment and finance, in 2008. The Ministry of Ecology and Environment (MEP) has released the Guidelines for Environmental Information Disclosure of Listed Companies in 2010. Based on the regulations of MEP, Shanghai Stock Exchange regulations and other literature (Dias et al., 2017; Katmon et al., 2017; Zhang, 2017), a 13-item list to measure the content and level of EID was constructed.

We quantified the level of EID using an indexing technique that classified environmental information as monetary or quantitative-related and non-monetary or qualitative-related information (Katmon et al., 2017). Each indicator is rated on a 4-point scale between 0 and 3 (0 indicates no environmental information, 1 means only general environmental information is disclosed, 2 means specific but not non-monetary or qualitative environmental information is disclosed and 3 indicates monetary or quantitative environmental information is disclosed).The EID data were gathered manually from annual reports of listed firms, corporate social responsibility reports and sustainable development reports. We summed the annual scores of each firm for all items and obtained the scores of each sample. The total score of EID

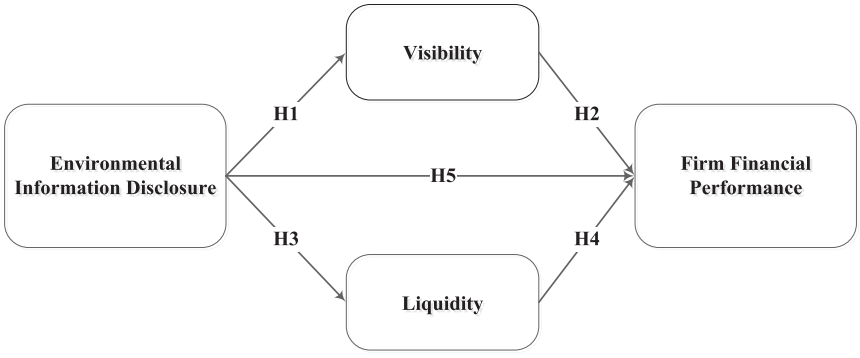


Fig. 1. Theoretical research framework.

Table 1
Variable definitions.

Variables	Names		Symbols	Definitions
Dependent variable	Financial performance		ROE	It measured as net income to equity
Independent variable	Environmental information disclosure		EID	Standardized score of EID quality
Mediating variables	Visibility	Analyst coverage	NOA	The number of analysts making recommendations for a stock and reports
			NOR	The number of reports related to the target firms
		Institutional shareholders	INST	The percentage of outstanding shares held by institutional investors
	Liquidity	Amihud	AMI	Amihud indicator
		Zeros	ZEROS	The percentage of trading days with zero returns in the fiscal year
Control variables	Industry		IND	It takes the value of 1 if the firm belongs to environmentally sensitive industries and 0 otherwise
	Firm size		EMPL	The number of employees
			EQUITY	The book value of equity
	Financial leverage		LEVEL	It is measured by the ratio of firm's year-end asset-liability
	Ownership structure		HLD	It takes the value of 1 for state-owned firms and 0 for others
	The quality of financial report		BIG4	It takes the value of 1 if the financial report is audited by one of the big four audit firms and 0 otherwise

for firm i in year t is noted as follows:

$$EID_{it} = \sum_{j=1}^{n} SCID_{ijt}$$

where $SCID_{ijt}$ is the score of the jth component of EID for firm i in year t, and EID_{it} is the total score of firm i in year t, in which $j = 1,2, \ldots,13$ and $t = 2013,2014, \ldots,2017$. Higher score indicates great degree of EID.

3.2.2.2. Visibility. Visibility was a latent variable that cannot be measured directly, and scholars often used other observable variables to measure it. Early research adopted firm size to measure visibility, while later scholars found that firm size captures more information than visibility itself (Puck et al., 2013). Thus, it was inappropriate to use firm size to measure visibility. According to the definition of visibility and based on recent studies (Schreck and Raithel, 2018), the current study used analyst coverage and institutional ownership (INST) to measure visibility.

Institutions prefer more visible stocks because they are more liquid and less risky (Hassan, 2018). According to the stock exchange rules, institutions holding >5% of the shares are required to disclose this information in the interim report. The change of institutional shareholders' share and the proportion of shareholdings will attract more attention from the other investors, especially individual investors. Therefore, institutional ownership could reflect visibility.

We measured analyst coverage using the number of analysts (NOA) and the number of reports related to the target firms (NOR). Regarding information intermediaries, analysts first collect and analyze information and then produce and distribute reports to audience. Recommendations of analysts in the report affect investor's expectations and act as a proxy for a market's belief. Analysts increase the demand for common shares through reporting information of firms they followed, incorporating them into industrial reports, or comparing them with larger firms in their industries, further increasing the visibility of firms. Prior literature provided evidence that small firms enhance their visibility by hiring professionals related to investors to recommend their stocks to analysts (Bushee and Miller, 2012).

3.2.2.3. Liquidity. We used two equity market indicators from CRMAR to gauge liquidity. The first indicator is the Amihud indicator constructed by Amihud (2002), which is extensively used in studies related to liquidity and information disclosure (Egginton and McBrayer, 2019). The second is Zeros, which is an indicator that measures the percentage of trading days with zero returns in the fiscal year (Atanasova and Li, 2018). The Zeros indicator was also used widely in the literature related to stock liquidity (Atanasova and Li, 2018; Brogaard et al., 2017). Lower Amihud and Zeros values indicated a higher level of equity liquidity.

3.2.3. Control variables

To eliminate possible confounding effects, the current study considered a wider range of control variables, which have been generally used in prior studies and have confirmed effects on firm financial performance, including firm size (Zeng et al., 2012), financial leverage, industry, ownership structure and the quality of financial report (Big 4) (Hassan, 2018).

Large firms have more resources and greater competitive advantages in the market and more easily achieve better performance (Bernard et al., 2019). Large firms receive more attention from the public, and pressures to implement EID and achieve better financial performance are greater. Firm size is judged by the quantity of staff and the book value of equity.

Financial leverage is a symbol of financial risk in firms and affects the decision-making of important stakeholders (Xu et al., 2016). Firms are vulnerable to financial burdens. Firms with high financial leverage are more prone to lose market shares, which could reduce profitability, financial performance and market value. Financial leverage is gauged by the proportion of a firm's year-end asset-liability (Xu et al., 2016).

Industry has been suggested as a factor that affects environmental and financial performance (Lucato et al., 2017). Firms in heavy polluting industries are facing more institutional pressures and should increase investments in environmental protection. Previous studies showed that industry differentiation moderates the relationship between corporate social responsibility and financial performance (Baird et al., 2012). Industry type is a dummy variable that takes the value of 1 if an enterprise belongs to environmentally sensitive industries and 0 otherwise. The classification of environmentally sensitive industries referenced the regulations of the National Environmental Protection Bureau and was adjusted based on Industry Classification Guidance of Listed

Table 2
Results of descriptive analysis.

Variables	Mean	S.D.	Min	Max	Skewness	Kurtosis
EID	14.622	6.093	0.000	32.000	0.081	2.548
ROE	0.085	0.055	−0.058	0.293	0.531	3.130
NOA	9.509	8.971	0.000	48.000	1.126	3.978
NOR	20.469	23.193	0.000	134.000	1.745	6.532
INST	4.638	3.963	0.000	21.520	1.246	4.693
AMI	0.020	0.016	0.001	0.092	1.437	5.018
ZEROS	0.028	0.022	0.000	0.130	1.312	4.861
IND	0.315	0.465	0.000	1.000	0.797	1.635
EMPL	13,852.730	28,039.020	40.000	291,149.000	5.434	40.420
EQUITY	1.01E+10	1.67E+10	4.90E+08	1.64E+11	4.635	31.737
LEVEL	0.512	0.190	0.037	0.940	−0.203	2.356
HLD	0.624	0.485	0.000	1.000	−0.513	1.263
BIG4	0.157	0.364	0.000	1.000	1.890	4.573

Table 3
Pearson's correlation matrix.

Variables	EID	ROE	NOA	NOR	INST	AMI	ZEROS	IND	EMPL	EQUITY	LEVEL	HLD	BIG4
EID	1												
ROE	0.185**	1											
NOA	0.179**	0.475***	1										
NOR	0.159**	0.474***	0.944***	1									
INST	−0.020	0.171***	0.283***	0.277***	1								
AMI	−0.186**	−0.227***	−0.332***	−0.310***	−0.122**	1							
ZEROS	−0.085**	−0.131***	−0.171***	−0.163***	−0.096**	0.223**	1						
IND	0.116***	−0.008	−0.019	−0.052*	0.047	0.047	−0.027	1					
EMPL	0.239**	0.125***	0.276***	0.277***	−0.006	−0.259**	0.009	−0.109**	1				
EQUITY	0.248**	0.217***	0.324***	0.341***	0.015	−0.315**	0.068**	−0.022	0.711**	1			
LEVEL	−0.036	0.0490	0.011	0.023	−0.005	0.026	0.245**	−0.164**	0.205**	0.165**	1		
HLD	0.016	−0.125***	−0.102***	−0.107***	−0.192**	−0.043	−0.009	−0.014	0.079**	0.157**	0.0150	1	
BIG4	0.270**	0.169***	0.158***	0.161***	−0.087**	−0.153**	−0.011	−0.005	0.402**	0.491**	0.079*	0.178*	1

Companies issued. The following are environmentally sensitive industries: mining, food and beverages, textiles, paper making and printing, water production and supply, construction, medicine and biological products, chemistry and plastics, metal and nonmetal mining, electric power, petroleum and coal gas.

Chinese firms can be distinguished into state firms and private firms. Different ownership causes various responses to government regulation of EID (Zeng et al., 2012). Previous studies indicated that state-owned firms obtain more support to implement EID, and EID behavior is more likely to translate into performance (Zeng et al., 2012). Ownership structure takes the value of 1 for state-owned firms and 0 for others.

Financial reporting quality influences firm financial performance (Aldamen et al., 2012). Big 4 is used to measure the financial report quality. The value is 1 if the firm financial report is audited by one of the big four accounting firms, and 0 otherwise.

Definitions, abbreviations and descriptions of major variables are presented in Table 1.

4. Results

4.1. Descriptive analysis

Table 2 presents the results of descriptive analysis of 1054 firm-year observations. The results indicate that the average value of EID for all observations was 14.622, and the percentage of firms with disclosure scores less than10 points was 26%, indicating that the level of EID in China is not high. This finding is consistent with previous studies that suggested that the extent of EID in China is insufficient (Meng et al., 2019). The average firm in the sample is followed by 10 financial analysts, and 20 analysis reports are published a year. The average proportion of institutional ownership is 4.638%, the average number of employees is 13,853, and the financial leverage rate is 51.2%. Approximately 31.5% firms belong to heavy pollution industries, and only 15.7% firms are audited by Big 4.

Pearson's correlation coefficients are reported in Table 3. The data demonstrate that firms that disclose more environmental information have more analyst coverage (NOA and NOR), and their financial performance (ROE) is considerably improved. Firms with more visibility (NOA, NOR and INST) and liquidity (AMI and ZEROS) always perform better (ROE). Nonetheless, these outcomes only show the pair wise correlations between variables, and multiple regression analysis may produce different results. Table 3 also demonstrates that the correlation coefficients among independent, mediating and control variables are <0.70, indicating that the multicollinearity problem is not serious (Zeng et al., 2012).

Table 4
The effects of EID, visibility and liquidity on ROE.

Variables	ROE			
	Model1	Model2	Model3	Model4
1. Control variables				
IND	−0.006	−0.017	0.002	−0.005
EMPL	−0.056*	−0.069**	−0.086**	−0.093**
EQUITY	0.158***	0.152***	0.073*	0.070*
LEVEL	0.010	0.016	0.040	0.042*
HLD	−0.103***	−0.100***	−0.065**	−0.063**
BIG4	0.068*	0.052	0.065*	0.055
2. Independent variable				
EID		0.097***		0.064**
3. Mediating variables				
NOA			0.122*	0.111*
NOR			0.141**	0.148**
INST			0.024	0.0282
AMI			−0.080**	−0.076**
ZEROS			−0.065**	−0.060**
Constant	0.029	0.050	0.037	0.051
Year	Yes	Yes	Yes	Yes
R-squared	0.092	0.109	0.273	0.281
Observations	1054	1054	1054	1054

Note: *** $p < 0.001$, ** $p < 0.05$, * $p < 0.01$.

4.2. Regression analysis

Table 4 provides the results of the multiple regression analysis. Only control variables and dependent variables are employed in Model 1.An explanatory variable (EID) was added to test the main effect in Model 2. The results indicate that EID is positively related to ROE ($\beta = 0.097$, $p < 0.001$), which supports H5. Model 3 presented the effects of mediating variables on the dependent variable. The results demonstrate that NOA ($\beta = 0.122$, $p < 0.01$) and NOR ($\beta = 0.141$, $p < 0.05$) are positively related to ROE, while INST has no remarkable effect on ROE ($\beta = 0.024$, $p > 0.01$). Hence, H2 was partially supported. AMI ($\beta = -0.080$, $p < 0.05$) and ZEROS ($\beta = -0.060$, $p < 0.05$) are negatively related to ROE, which supports H4.[1]

Models 5 to 7 examined the effect of EID on visibility. The effects of EID on NOA ($\beta = 0.107$, $p < 0.05$) and NOR ($\beta = 0.081$, $p < 0.01$) are significant, while the effect on INST ($\beta = -0.024$, $p > 0.1$) is not significant. Thus, H1 was partially supported. Models 8 and 9 examined the effect EID on liquidity. The effect of EID on AMI ($\beta = -0.066$, $p < 0.05$) and ZEROS ($\beta = -0.075$, $p < 0.05$) are significant, thus supporting H3. (See Table 5.)

4.3. Mediating effect analysis

To test the mediating effects of visibility and liquidity, we conducted a Sobel-Goodman test (Table 6). The results indicated that NOA ($b = 0.0004$, $z = 3.1160$, $p < 0.01$), NOR ($b = 0.0003$, $z = 2.4990$, $p < 0.05$),

[1] The lower the AMI and ZERO values are, the higher the liquidity value.

Table 5
The effects of EID on visibility and liquidity.

Variables	NOA	NOR	INST	AMI	ZEROS
	Model5	Model6	Model7	Model8	Model9
1. Control variables					
IND	−0.023	−0.049	0.038	0.036	0.012
EMPL	0.069	0.039	−0.015	−0.071*	−0.091**
EQUITY	0.273***	0.294***	0.087	−0.178***	0.134**
LEVEL	−0.044	−0.037	0.001	0.055*	0.193***
HLD	−0.135***	−0.136***	−0.143***	−0.010	−0.018
BIG4	−0.007	−0.006	−0.074*	0.011	−0.026
2. Independent variable					
EID	0.107**	0.081*	−0.024	−0.066**	−0.075**
Constant	0.144**	0.054	−0.107*	0.378***	−0.103*
Year	Yes	Yes	Yes	Yes	Yes
R-squared	0.178	0.171	0.057	0.263	0.226
Observations	1054	1054	1054	1054	1054

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

AMI (b = 0.0002, z = 3.0950, p < 0.01) and ZEROS (b = 0.0001, z = 2.2210, p < 0.05) are significant and partially mediate the effect of EID on ROE, while INST (b = 0.0000, z = 2.4990, p > 0.1) is not significant.

Moreover, bootstrap test analysis was also performed to examine the mediating effect. Table 7 presents the multi mediator model results with 1000 bootstrapped samples. Bootstrap test confirmed that NOA (SE = 0.009, CI = [0.013,0.049]), NOR (SE = 0.009, CI = [0.007,0.043]), AMI (SE = 0.004, CI = [0.007,0.021]) and ZEROS (SE = 0.008, CI = [0.002,0.016]) play mediating roles in the relationship between EID and ROE, while INST (SE = 0.004, CI = [−0.010,0.005]) has no mediating effect. Therefore, H5a was partially supported, and H5b was fully supported.

4.4. Robustness test

4.4.1. Endogeneity

The two-stage least squares method was used to address the endogeneity problem. EID with one lag period (LEID), which is used as an instrumental variable, was used to estimate the two-stage least squares model. It is generally agreed that firm financial performance in the current period would not be affected by the lag EID, while the lag EID would affect the current period EID because EID is traditionally considered as a variable with inertia. The Hausman specification test indicated that the endogenous problems are not serious, and it is effective to use the ordinary least squares method (OLS) rather than the instrumental variables method (IV).

Table 6
The results of Sobel-Goodman test analysis.

Variables	Test	Coef	Std Err	Z	P > Z
NOA	Sobel	0.0004	0.0001	3.1160	0.0018
	Goodman-1(Aroian)	0.0004	0.0001	3.1100	0.0019
	Goodman-2	0.0004	0.0001	3.1230	0.0018
NOR	Sobel	0.0003	0.0001	2.4990	0.0124
	Goodman-1(Aroian)	0.0003	0.0001	2.4940	0.0126
	Goodman-2	0.0003	0.0001	2.5050	0.0122
INST	Sobel	0.0000	0.0000	−0.5902	0.5550
	Goodman-1(Aroian)	0.0000	0.0000	−0.5795	0.5623
	Goodman-2	0.0000	0.0000	−0.6016	0.5474
AMI	Sobel	0.0002	0.0001	3.0950	0.0020
	Goodman-1(Aroian)	0.0002	0.0001	3.0610	0.0022
	Goodman-2	0.0002	0.0001	3.1310	0.0017
ZEROS	Sobel	0.0001	0.0000	2.2210	0.0263
	Goodman-1(Aroian)	0.0001	0.0000	2.1870	0.0287
	Goodman-2	0.0001	0.0000	2.2560	0.0241

Table 7
Bootstrap test for mediating effect analysis.

Mediator	Observed coefficient	S.E.	Z-value	LL 95% CI	UL 95%CI
NOA	0.029	0.009	3.080	0.013	0.049
NOR	0.023	0.009	2.470	0.007	0.043
INST	−0.002	0.004	−0.550	−0.010	0.005
AMI	0.013	0.004	3.610	0.007	0.021
ZEROS	0.008	0.003	2.370	0.002	0.016

Note: LL = lower limit, UL = upper limit and CI = confidence interval.

4.4.2. Alternative measure of firm financial performance

To ensure the benchmark results were not affected by other indicators to measure corporate financial performance, this study used ROA to measure financial performance and then conducted the estimation following a prior study (Qiu et al., 2016). Results indicated that the research findings were robust.[2]

4.4.3. Further testing

Analysts act as a bridge between firms and investors. Analysts deliver environmental information that is disclosed by firms to investors. Then, investors' stock trading affect liquidity and further affect firm financial performance. A prior study also indicated that more attention from retail investors could improve stock liquidity (Ding and Hou, 2015). Therefore, we considered that liquidity may mediate the relationship between visibility and financial performance. Hence, Sobel-Goodman and bootstrap tests were conducted to test this hypothesis. The results indicated that a mediating effect exists.[3]

5. Discussions and practical implications

5.1. Discussion of the research results

This research explored the effect of environmental information disclosure on financial performance. In addition, we also examined the mediating effects of visibility and liquidity. The results revealed that environmental information disclosure has a positive relation with financial performance. This result is consistent with voluntary disclosure theory, and firms disclose more environmental information to obtain economic benefits rather than to respond to institutional pressure (Minutolo et al., 2019). This finding is consistent with prior studies (Hassan, 2018; Lemma et al., 2019; Xie et al., 2019) that revel a higher degree of environment information disclosure is associated with better firm performance; these results are contrary to the research findings of Qiu et al. (2016) and Liu and Zhang (2017), who suggested that there is no or a negative correlation between environmental information disclosure and financial performance. Some possible reasons for the current research findings can be explained as follows. First, by disclosing environmental information, firms could gain many intangible benefits, such as better brands, increased sales in the product market and lower financing costs in the stock market, which would improve financial performance (Ye and Zhang, 2011). Second, many visible and direct benefits, such as government subsidies and tax deduction related to environmental protection, can also improve financial performance (Meng et al., 2019).

Furthermore, this research adopted three indicators (number of analysts, number of reports and institutional ownership) to measure visibility. However, they played different roles in the relationship between environmental information disclosure and financial performance. Specifically, the number of analysts and the number of reports mediate the relationship between environmental information disclosure and financial performance. Valuable information is especially important for

[2] Results are not presented but are available upon request.
[3] Results are not shown but are provided upon request.

investors in this information explosion era. Analysts act as a bridge between firms and investors. The analysts collected and analyzed the valuable environmental information disclosed by firms and incorporated this information into industrial research reports, which were distributed to investors and subsequently affected their decision-making (Wang, 2017). The findings of further tests also provided evidence for this conclusion. Furthermore, these reports also affected the capital cost, valuation and market evaluation of firms, and they ultimately affected the firm financial performance. Hence, the number of analysts and the number of reports mediate the impact of environmental information disclosure on financial performance. However, institutional ownership has no mediating effect between environmental information disclosure and financial performance. One of the possible reasons may be that institutional shareholding is more strategic rather than focusing on short-term profitability. The increase in environmental information disclosure in a short time does not attract the attention of institutional investors; however, environmental information disclosure is conducive to the realization of corporate value in the long run (Liu and Zhang, 2017). Moreover, the proportion of institutional shareholding is generally large, and increases and decreases in institutional shareholding need to be announced, which is not conducive to the flexible change in the proportion of institutional shareholding with the change in environmental information disclosure.

In addition, this research also suggested that liquidity mediates the relationship between environmental information disclosure and financial performance. The improvement of liquidity associated with the increased disclosure of environmental information reduces information asymmetry and eventually makes financial markets more equitable (Egginton and McBrayer, 2019). In an equitable stock market, investors would prefer to accumulate liquid stock and increase firm scrutiny. The reduction of trade cost with less information asymmetry and the decline in principal-agent cost with more scrutiny ultimately improves firm financial performance.

Further tests showed that liquidity mediates the relationship between analyst coverage and financial performance. This finding was consistent with Luo et al. (2015) and revealed that analysts' behaviors affect investors' decision-making. Investors preferred to purchase stocks with more analyst coverage, which subsequently increased liquidity and then affected financial performance. In other words, the effect of analysts on financial performance partly occurs through liquidity, and analysts play an important role in reducing information asymmetry between investors and firms.

5.2. Practical implications

The results have several realistic implications for supervisory institution. First, the results indicated that more environmental information disclosure could lead to better financial performance. Prior research indicated that individual efforts are weak and need to build a joint governance system (Zhang et al., 2019a). Therefore, regulators should consider designing a mechanism to stimulate firms to disclose more environmental information and achieve a win-win situation for all stakeholders. For example, they can perfect market mechanisms to encourage analysts to follow firms, which disclosure more environmental information. Second, as a communication tool between companies and stakeholders, environmental information disclosure reduces information asymmetry and capital cost (Yu et al., 2018). It is also important that governments or non-governmental organizations establish a platform to collect these reports. These reports provided by the platform should be available to the public, consumers, investors, researchers and other stakeholders. Stakeholders could supervise firms' environmental practices and reduce agency problems. These measures will help to establish a virtuous circle between environmental information disclosure and firm financial performance.

This research also provided implications for managers. Managers need to realize the importance of disclosing more environmental information if they want to achieve better financial performance. These findings help executives to achieve sustainable development and make important cost-benefit trade-offs in disclosing environmental information (Lemma et al., 2019). Given that the average level of environmental information disclosure is lower in Chinese manufacturing firms, firms have more room to improve the extent of environmental information disclosure and enhance financial performance. In addition, it is worth noting that as a management tool, an environmental information disclosure strategy can be used to improve visibility and liquidity. Managers could meet financial analysts and present them with the disclosed environmental information to improve visibility and financial performance. Finally, managers could provide effective and adequate communication with analysts and release information to investors, which would promote the trade of stocks and ultimately reduce financial costs. Then, managers will be able to capitalize on a more liquid secondary market to achieve better financial performance (Egginton and McBrayer, 2019).

6. Conclusions, limitations and future research directions

As environmental problems become increasingly serious, more stakeholders are concerned about the influence of business activities on the environment and the level of corporate environmental responsibility fulfillment. This research examined the impact of environmental information discourse on firm financial performance and explored the mediating effects of visibility and liquidity using a sample of 1054 firm-year observations from 2013 to 2017. The ordinary least squares method was employed to address the relationship, and the Sobel-Goodman test and bootstrap test were used to examine the mediating effects. The results indicated that environmental information discourse has a significant and positive effect on financial performance after considering control variables. Further, this research examined the mediating effects of visibility (number of analysts, number of reports and institutional ownership) and liquidity. The findings indicated that the number of analysts, the number of reports and liquidity mediate the relationship between environmental information discourse and financial performance, while institutional ownership has no mediating effect. The current research highlighted the significance of environmental information discourse, enriched our understanding about how environmental information discourse affects financial performance and provided practical implications for regulators and mangers.

Although the current research is interesting and meaningful, it has certain limitations. First, the channels through which environmental information disclosure affects firm financial performance are varied, and we only considered two mediating variables from the capital market perspective. Future studies could explore the mediating effects of more variables; for example, prior research explored how going green promotes innovation, and consumers tend to buy green products, which improve financial performance (Loncar et al., 2019). Second, this research is based in China. The results may have practical implications for developing countries but may not be applicable to other developed countries. In other countries with different cultural atmospheres and economic systems, the interpretation of these results should be performed carefully, and further tests are needed in the future. Finally, the sample of this research is mainly obtained from large listed firms. Future studies could expand this research by using samples from small and medium firms. In addition, other proxies for environmental information disclosure, visibility and liquidity could be applied to small and medium firms since these firms may not publish environmental reports, and the current measurements of visibility and liquidity are inappropriate, especially for non-listed small and medium companies. It would be meaningful to replicate this study using large-scale data as well as other proxies for variables to assess the consistency of these results in subsequent studies.

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.

Acknowledgements

This work was supported by the National Natural Science Foundation of China (Grant number 71974177) and the USTC Research Funds of the Double First-Class Initiative (Grant number YD2160002002).

Author contributions

Shanyong Wang: The overall research framework, introduction and literature review.

Hualong Wang: Data collection and analysis, result discussions and implications.

Jing Wang and Feng Yang: The development of research idea and result discussions.

References

Aldamen, H., Duncan, K., Kelly, S., McNamara, R., Nagel, S., 2012. Audit committee characteristics and firm performance during the global financial crisis. Account. Financ. 52, 971–1000.
Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. J. Financ. Mark. 5, 31–56.
Amores-Salvado, J., Martín-de Castro, G., Navas-López, J.E., 2014. Green corporate image: moderating the connection between environmental product innovation and firm performance. J. Clean. Prod. 83, 356–365.
An, X., Deng, Y., Gabriel, S.A., 2011. Asymmetric information, adverse selection, and the pricing of CMBS. J. Financ. Econ. 100, 304–325.
Ane, P., 2012. An assessment of the quality of environmental information disclosure of corporation in China. Syst. Eng. Procedia 5, 420–426.
Aragon-Correa, J.A., Marcus, A., Hurtado-Torres, N., 2016. The natural environmental strategies of international firms: old controversies and new evidence on performance and disclosure. Acad. Manag. Perspect. 30, 24–39.
Armstrong, C.S., Core, J.E., Taylor, D.J., Verrecchia, R.E., 2011. When does information asymmetry affect the cost of capital? J. Account. Res. 49, 1–40.
Atanasova, C., Li, M., 2018. Multi-market trading and liquidity: evidence from cross-listed companies. J. Int. Financ. Mark. Institutions Money 53, 117–138.
Baird, P.L., Geylani, P.C., Roberts, J.A., 2012. Corporate social and financial performance reexamined: industry effects in a linear mixed model analysis. J. Bus. Ethics 109, 367–388.
Beck, A.C., Campbell, D., Shrives, P.J., 2010. Content analysis in environmental reporting research: enrichment and rehearsal of the method in a British–German context. Br. Account. Rev. 42, 207–222.
Bernard, A.B., Moxnes, A., Saito, Y.U., 2019. Production networks, geography, and firm performance. J. Polit. Econ. 127 (2), 639–688.
Bidhari, S.C., Salim, U., Aisjah, S., Java, E., 2013. Effect of corporate social responsibility information disclosure on financial performance and firm value in banking industry listed at Indonesia stock exchange. Eur. J. Bus. Manag. 5, 39–46.
Brogaard, J., Li, D., Xia, Y., 2017. Stock liquidity and default risk. J. Financ. Econ. 124, 486–502.
Buallay, A., 2019. Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector. Management of Environmental Quality: An International Journal 30 (1), 98–115.
Bushee, B.J., Miller, G.S., 2012. Investor relations, firm visibility, and investor following. Account. Rev. 87, 867–897.
Cao, G., Yang, L., Liu, L., Ma, Z., Wang, J., Bi, J., 2018. Environmental incidents in China: lessons from 2006 to 2015. Sci. Total Environ. 633, 1165–1172.
Chen, J., Gao, M., Li, D., Song, M., 2019a. Analysis of the rebound effects of fossil and non-fossil energy in China based on sustainable development. Sustain. Dev. 1–10.
Chen, J., Gao, M., Ma, K., Song, M., 2019b. Different effects of technological progress on China's carbon emissions based on sustainable development. Bus. Strateg. Environ. 1–12.
Chen, J., Xu, C., Cui, L., Huang, S., Song, M., 2019c. Driving factors of CO2 emissions and inequality characteristics in China: a combined decomposition approach. Energy Econ. 78, 589–597.
Chen, Y., Ge, R., Louis, H., Zolotoy, L., 2019. Stock liquidity and corporate tax avoidance. Rev. Account. Stud. 24, 309–340.
Cui, L., Song, M., 2019. Economic evaluation of the Belt and Road Initiative from an unimpeded trade perspective. Int. J. Logist. Res. Appl. 22, 25–46.
Dawkins, C.E., Fraas, J.W., 2011. Erratum to: beyond acclamations and excuses: environmental performance, voluntary environmental disclosure and the role of visibility. J. Bus. Ethics 99, 383–397.
Dias, A., Lima Rodrigues, L., Craig, R., 2017. Corporate governance effects on social responsibility disclosures. Australas. Accounting, Bus. Financ. J. 11, 3–22.
Ding, R., Hou, W., 2015. Retail investor attention and stock liquidity. J. Int. Financ. Mark. Institutions Money 37, 12–26.
Dixon-Fowler, H.R., Slater, D.J., Johnson, J.L., Ellstrand, A.E., Romi, A.M., 2013. Beyond "does it pay to be green?" A meta-analysis of moderators of the CEP–CFP relationship. J. Bus. Ethics 112, 353–366.
Dong, F., Dai, Y., Zhang, S., Zhang, X., Long, R., 2019. Can a carbon emission trading scheme generate the Porter effect? Evidence from pilot areas in China. Sci. Total Environ. 653, 565–577.
Edmans, A., Manso, G., 2010. Governance through trading and intervention: A theory of multiple blockholders. Rev. Financ. Stud. 24, 2395–2428.
Egginton, J.F., McBrayer, G.A., 2019. Does it pay to be forthcoming? Evidence from CSR disclosure and equity market liquidity. Corp. Soc. Responsib. Environ. Manag. 26, 396–407.
Fang, V.W., Noe, T.H., Tice, S., 2009. Stock market liquidity and firm value. J. Financ. Econ. 94, 150–169.
Flammer, C., 2013. Corporate social responsibility and shareholder reaction: The environmental awareness of investors. Acad. Manag. J. 56, 758–781.
Gao, L., Wang, S., Li, J., Li, H., 2017. Application of the extended theory of planned behavior to understand individual's energy saving behavior in workplaces. Resources Conservation and Recycling 127, 107–113.
Goldstein, I., Yang, L., 2017. Information disclosure in financial markets. Annu. Rev. Financ. Econ. 9, 101–125.
Gray, R., Javad, M., Power, D.M., Sinclair, C.D., 2001. Social and environmental disclosure and corporate characteristics: a research note and extension. J. Bus. Financ. Account. 28, 327–356.
Han, L., Wang, S., Zhao, D., Li, J., 2017. The intention to adopt electric vehicles: Driven by functional and non-functional values. Transp. Res. A Policy Pract. 103 (C), 185–197.
Hassan, O.A.G., 2018. The impact of voluntary environmental disclosure on firm value: does organizational visibility play a mediation role? Bus. Strateg. Environ. 27, 1569–1582.
He, W.P., Lepone, A., Leung, H., 2013. Information asymmetry and the cost of equity capital. Int. Rev. Econ. Financ. 27, 611–620.
Hull, C.E., Rothenberg, S., 2008. Firm performance: the interactions of corporate social performance with innovation and industry differentiation. Strateg. Manag. J. 29, 781–789.
Jeon, J.Q., Lee, C., Nasser, T., Via, M.T., 2015. Multiple lead underwriter IPOs and firm visibility. J. Corp. Financ. 32, 128–149.
Jin, P., Peng, C., Song, M., 2019. Macroeconomic uncertainty, high-level innovation, and urban green development performance in China. China Econ. Rev. 55, 1–18.
Katmon, N., Mohamad, Z.Z., Norwani, N.M., Al Farooque, O., 2017. Comprehensive board diversity and quality of corporate social responsibility disclosure: evidence from an emerging market. J. Bus. Ethics 1–35.
Khlif, H., Guidara, A., Souissi, M., 2015. Corporate social and environmental disclosure and corporate performance: evidence from South Africa and Morocco. J. Account. Emerg. Econ. 5, 51–69.
Lemma, T.T., Feedman, M., Mlilo, M., Park, J.D., 2019. Corporate carbon risk, voluntary disclosure, and cost of capital: South African evidence. Bus. Strateg. Environ. 28, 111–126.
Li, D., Cao, C., Zhang, L., Chen, X., Ren, S., Zhao, Y., 2017. Effects of corporate environmental responsibility on financial performance: The moderating role of government regulation and organizational slack. J. Clean. Prod. 166, 1323–1334.
Li, Q., Li, T., Chen, H., Xiang, E., Ruan, W., 2019. Executives' excess compensation, legitimacy, and environmental information disclosure in Chinese heavily polluting companies: the moderating role of media pressure. Corp. Soc. Responsib. Environ. Manag. 26, 248–256.
Li, W.-X., Chen, C.C.-S., French, J.J., 2012. The relationship between liquidity, corporate governance, and firm valuation: evidence from Russia. Emerg. Mark. Rev. 13, 465–477.
Lin, S., Wang, S., Marinova, D., Zhao, D., Hong, J., 2017. Impacts of urbanization and real economic development on CO2 emissions in non-high income countries: empirical research based on the extended STIRPAT model. J. Clean. Prod. 166, 952–966.
Liu, X., Zhang, C., 2017. Corporate governance, social responsibility information disclosure, and enterprise value in China. J. Clean. Prod. 142, 1075–1084.
Liu, X., Yu, Q., Fujitsuka, T., Liu, B., Bi, J., Shishime, T., 2010. Functional mechanisms of mandatory corporate environmental disclosure: an empirical study in China. J. Clean. Prod. 18, 823–832.
Loncar, D., Paunkovic, J., Jovanovic, V., Krstic, V., 2019. Environmental and social responsibility of companies cross EU countries – panel data analysis. Sci. Total Environ. 657, 287–296.
Lu, Y., Abeysekera, I., 2014. Stakeholders' power, corporate characteristics, and social and environmental disclosure: evidence from China. J. Clean. Prod. 64, 426–436.
Lu, Y., Wang, Y., Zuo, J., Jiang, H., Huang, D., Rameezdeen, R., 2018. Characteristics of public concern on haze in China and its relationship with air quality in urban areas. Sci. Total Environ. 637–638, 1597–1606.
Lucato, W.C., Costa, E.M., de Oliveira Neto, G.C., 2017. The environmental performance of SMEs in the Brazilian textile industry and the relationship with their financial performance. J. Environ. Manag. 203, 550–556.
Luo, X., Wang, H., Raithel, S., Zheng, Q., 2015. Corporate social performance, analyst stock recommendations, and firm future returns. Strateg. Manag. J. 36, 123–136.
Matsumura, E.M., Prakash, R., Vera-Muñoz, S.C., 2013. Firm-value effects of carbon emissions and carbon disclosures. Account. Rev. 89, 695–724.
Meng, X., Zeng, S., Xie, X., Zou, H., 2019. Beyond symbolic and substantive: strategic disclosure of corporate environmental information in China. Bus. Strateg. Environ. 28, 403–417.
Minutolo, M.C., Kristjanpoller, W.D., Stakeley, J., 2019. Exploring environmental, social, and governance disclosure effects on the S&P 500 financial performance. Bus. Strateg. Environ. 28, 1083–1095.

Norli, Ø., Ostergaard, C., Schindele, I., 2014. Liquidity and shareholder activism. Rev. Financ. Stud. 28, 486–520.
Pan, X., Pan, X., Song, M., Ai, B., Ming, Y., 2019. Blockchain technology and enterprise operational capabilities: an empirical test. Int. J. Inf. Manag. 1–10.
Pu, S., Shao, Z., Fang, M., Yang, L., Liu, R., Bi, J., Ma, Z., 2019. Spatial distribution of the public's risk perception for air pollution: a nationwide study in China. Sci. Total Environ. 655, 454–462.
Puck, J.F., Rogers, H., Mohr, A.T., 2013. Flying under the radar: Foreign firm visibility and the efficacy of political strategies in emerging economies. Int. Bus. Rev. 22, 1021–1033.
Qiu, Y., Shaukat, A., Tharyan, R., 2016. Environmental and social disclosures: link with corporate financial performance. Br. Account. Rev. 48, 102–116.
Ru, X., Qin, H., Wang, S., 2019. Young people's behaviour intentions towards reducing PM2.5 in China: extending the theory of planned behaviour. Resources Conservation and Recycling 141, 99–108.
Schreck, P., Raithel, S., 2018. Corporate social performance, firm size, and organizational visibility: distinct and joint effects on voluntary sustainability reporting. Bus. Soc. 57, 742–778.
Shi, H., Wang, S., Zhao, D., 2017. Exploring urban resident's vehicular PM2. 5 reduction behavior intention: an application of the extended theory of planned behavior. J. Clean. Prod. 147, 603–613.
Song, M., Fisher, R., Kwoh, Y., 2019a. Technological challenges of green innovation and sustainable resource management with large scale data. Technol. Forecast. Soc. Change 144, 361–368.
Song, M., Zhu, S., Wang, J., Zhao, J., 2020. Share green growth: regional evaluation of green output performance in China. Int. J. Prod. Econ. 219, 152–163.
Song, Y., Guo, S., Zhang, M., 2019b. Assessing customers' perceived value of the anti-haze cosmetics under haze pollution. Sci. Total Environ. 685, 753–762.
Surroca, J., Tribó, J.A., Waddock, S., 2010. Corporate responsibility and financial performance: The role of intangible resources. Strateg. Manag. J. 31, 463–490.
Trumpp, C., Endrikat, J., Zopf, C., Guenther, E., 2015. Definition, conceptualization, and measurement of corporate environmental performance: a critical examination of a multidimensional construct. J. Bus. Ethics 126, 185–204.
Villalonga, B., Trujillo, M.A., Guzmán, A., Cáceres, N., 2019. What are boards for? Evidence from closely held firms in Colombia. Financ. Manag. 48 (2), 537–573.
Wang, D.H.-M., Chen, P.-H., Yu, T.H.-K., Hsiao, C.-Y., 2015. The effects of corporate social responsibility on brand equity and firm performance. J. Bus. Res. 68, 2232–2236.
Wang, S., Fan, J., Zhao, D., Yang, S., Fu, Y., 2016. Predicting consumers' intention to adopt hybrid electric vehicles: using an extended version of the theory of planned behavior model. Transportation 43 (1), 123–143.
Wang, S., Li, J., Zhao, D., 2017. The impact of policy measures on consumer intention to adopt electric vehicles: evidence from China. Transp. Res. A Policy Pract. 105 (C), 14–26.
Wang, S., Li, J., Zhao, D., 2018. Institutional pressures and environmental management practices: the moderating effects of environmental commitment and resource availability. Bus. Strateg. Environ. 27 (1), 52–69.
Wang, S., Wang, J., Lin, S., Li, J., 2019a. Public perceptions and acceptance of nuclear energy in China: the role of public knowledge, perceived benefit, perceived risk and public engagement. Energy Policy 126, 352–360.
Wang, S., Wang, H., Wang, J., 2019b. Exploring the effects of institutional pressures on the implementation of environmental management accounting: do top management support and perceived benefit work? Bus. Strateg. Environ. 28, 233–243.
Wang, T., Bansal, P., 2012. Social responsibility in new ventures: profiting from a long-term orientation. Strateg. Manag. J. 33, 1135–1153.
Wang, Z., 2017. Firm visibility and voluntary environmental behavior: evidence from hydraulic fracturing. Land Econ. 93, 654–666.
Wu, W., Liu, Y., Chin, T., Zhu, W., 2018. Will green CSR enhance innovation? A perspective of public visibility and firm transparency. Int. J. Environ. Res. Public Health 15, 268–279.
Xie, J., Nozawa, W., Yagi, M., Fujii, H., Managi, S., 2019. Do environmental, social, and governance activities improve corporate financial performance? Bus. Strateg. Environ. 28, 286–300.
Xu, X.D., Zeng, S.X., Zou, H.L., Shi, J.J., 2016. The impact of corporate environmental violation on shareholders' wealth: a perspective taken from media coverage. Bus. Strateg. Environ. 25, 73–91.
Yang, S., Cheng, P., Li, J., Wang, S., 2019. Which group should policies target? Effects of incentive policies and product cognitions for electric vehicle adoption among Chinese consumers. Energy Policy 135, 1–9.
Yao, S., Liang, H., 2019. Analyst following, environmental disclosure and cost of equity: research based on industry classification. Sustainability 11, 300–310.
Yao, X., Cheng, Y., Song, M., 2019a. Assessment of collaboration in city logistics: from the aspects of profit and CO2 emissions. Int. J. Logist. Res. Appl. 22, 576–591.
Yao, X., Huang, R., Song, M., 2019b. How to reduce carbon emissions of small and medium enterprises (SMEs) by knowledge sharing in China. Prod. Plan. Control 30, 881–892.
Ye, K., Zhang, R., 2011. Do lenders value corporate social responsibility? Evidence from China. J. Bus. Ethics 104, 197–198.
Yu, E.P., Guo, C.Q., Luu, B. Van, 2018. Environmental, social and governance transparency and firm value. Bus. Strateg. Environ. 27, 987–1004.
Zeng, S.X., Xu, X.D., Yin, H.T., Tam, C.M., 2012. Factors that drive Chinese listed companies in voluntary disclosure of environmental information. J. Bus. Ethics 109, 309–321.
Zhang, C., 2017. Political connections and corporate environmental responsibility: adopting or escaping? Energy Econ. 68, 539–547.
Zhang, M., Li, H., Xue, L., Wang, W., 2019a. Using three-sided dynamic game model to study regional cooperative governance of haze pollution in China from a government heterogeneity perspective. Sci. Total Environ. 694, 133–143.
Zhang, M., Liu, X., Ding, Y., Wang, W., 2019b. How does environmental regulation affect haze pollution governance?—An empirical test based on Chinese provincial panel data. Sci. Total Environ. 695, 133–145.
Zhao, M., 2012. CSR-based political legitimacy strategy: managing the state by doing good in China and Russia. J. Bus. Ethics 111, 439–460.
Zou, H., Xie, X., Qi, G., Yang, M., 2019. The heterogeneous relationship between board social ties and corporate environmental responsibility in an emerging economy. Bus. Strateg. Environ. 28, 40–52.