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Chinese shareholders' reaction to the disclosure of environmental violations: a CSR perspective

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Abstract

In the past decades, Corporate Social Responsibility (CSR) has attracted increasing attention, with Corporate Environmental Responsibility (CER or Environmental CSR) playing an ever important role. This paper aims to study whether and how Chinese shareholders are sensitive to the disclosure of environmental violations. Specifically, the issue is measured by the performance of the Chinese stock market. In order to answer this question, the authors conduct a two-dimensional "environment-as-a-resource" framework, which assumes that the pressure on stock price after an environmental violation is from both externalities and internalities. The external pressure comes from environmental regulations, media attention, customer sensitivity and so on. The internal pressure is rooted in firm level actions, for example, previous pollution control and previous CSR performance.

The paper starts by addressing theories of corporate social responsibility, corporate environmental management and market value management, followed by the advancement of foreign and domestic research. Then, based on the events in the Shanghai and Shenzhen stock exchanges from 2002 to 2014, the authors calculate the events' cumulative abnormal return. The explanatory factors in the regression model include external impacts of time trend and media attention; together with internal impacts of previous pollution situations and CSR performance. Complementing the notion of "environment-as-a-resource", the regression results reveal that, facing an environmental violation, Chinese shareholders react negatively. The negative reaction becomes weaker as time goes by, and is stronger in the years with heavier media environmental attention.

Furthermore, some policy suggestions are proposed in light of the current CSR implementations by Chinese companies: 1) Strengthen the government's environmental scrutiny management to help the market punish environmental violators. 2) Encourage environmental accounting and environmental auditing for public companies. 3) Build up a broad environmental information platform comprising of interactions between the government, corporations and media. 4) Cultivate environmental awareness of company managers so it becomes worthy to invest in environment resources and gain better awareness of environmental responsibility.

Keywords: Corporate social responsibility, Corporate environmental management, Shareholders' reaction, Environmental violation

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Introduction

Background

Since the past couple of decades, Corporate Social Responsibility (CSR) has been attracting increasing attention. However, research and practice on CSR usually focus on particular aspects of "social responsibility", like for example, the minimum wage, job security and poverty alleviation. Recently, with increasing environmental concerns worldwide, the discussion on CSR to incorporate activities that regenerate the quality of our natural environment has rapidly increased.

In 1970, Nobel Prize winner Friedman wrote a public article emphasizing the role of CSR in corporate management.[1] He pointed out that company managers must take social responsibility into account when seeking high economic profits. They should reserve social welfare through the promise of a no-pollution-and-no-discrimination scheme.

From the 1970s to 1990s, many Non-Governmental Organizations (NGOs) solicited companies to combine environmental responsibility with their normal business operation. The 1987 report "Our Common Future" issued by the World Commission on Environment and Development called for governments, companies and the public to attach importance to social and environmental responsibility. In the 1999 annual meeting of the World Economic Forum in Davos, the then secretary general of the United Nations proposed the Global Compact, which appealed to companies to obey ten basic principles on human rights, labor standards, environmental protection and anti-corruption. Particularly, in the environmental protection area, the Compact asked companies to take precautions actively.

The International Finance Corporation (IFC), in its 2002 report, stated that developing countries should pay more attention to social progress and environmental protection to reap holistic benefits. In 2008, the United Nations Environment Program (UNEP) launched the initiative of Green Economy, which encourages companies to regard environmental protection as an engine for development, instead of a burden. It is now become important to realize that environmental protection for a company is no longer a necessity, but a responsibility (Küskü 2007).

Among the recent literature published in this field, CSR and Corporate Environmental Responsibility (CER) take an even critical role. As shown in Fig. 1, we observe an increasing interest in the Chinese National Knowledge Infrastructure (CNKI) database respectively.

If you consider the case of China, the GDP growth rate has been exceeding 7% for more than 10 years, creating an economic miracle. But the exclusive development pattern has given rise to incessant pollution[2] problems leading to a number of environmental violations with severe

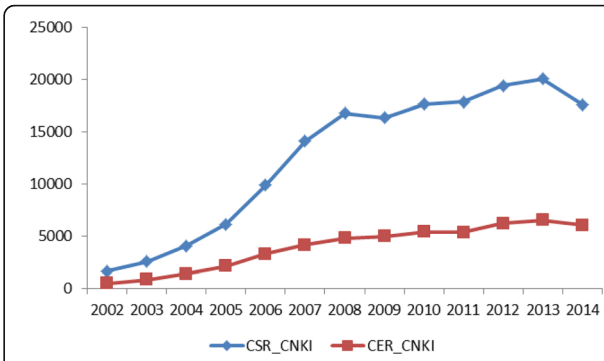

Fig. 1 Research on CSR and CER in the CNKI database Significance

consequences. Although the society in general attaches much more attention on environmental protection, publicly listed companies in China still frequently engage in activities that are harmful to the environment, which not only causes economic damage but also leads to environmental damage.

As a result, environmental protection has gained substantial prominence in governmental documents. The Chinese government committed to put "heavy efforts" for controlling pollution in the 18th Chinese communist party congress, and announced plans to accelerate the construction of the environmental legal system. In 2014, the government put forward the concept of a "New Normal", taking into consideration factors such as environmental protection while stimulating economic development. For public companies specifically, a series of mandates have been introduced such as the *Instruction on the Supervision of Public Companies' Environmental Protection*, *Announcement on the Environmental Scrutiny of Public Companies*, *Guideline for Public Companies' Environmental Information Disclosure*. In 2008, the China Securities Regulatory Commission issued the *Notice on the Environmental Scrutiny of IPOs for Heavy Pollution Industries*, setting higher environmental criteria from the very beginning for heavily polluting companies' going public. Through these measures, the government has managed to encourage companies to pay attention to CER and restrict hazardous emissions.

Motivation

Intuitively, it seems that environmental violation causes economic as well as reputational loss, which should result in a drop in the stock price. However, the Chinese stock market reveals some conflicting statistics. On one hand, VEYONG (600,803.SH) encountered a drop of 8.34% in a single day, because of its failure to pass environmental scrutiny; GSRH (600,311.SH) had 2 days' stock price decrement after the environmental violation; Resulting from pollution occurring in a subsidiary, the stock price of HPGC (600,795.SH) decreased by 7.39%,

leading to the whole electricity industry decreasing by 4%. On the other hand, GUANGJI PHARM (000952.SZ) enjoyed almost a 10% rise after a pollution accident. And Zijin Mining (601,899.SH), with an environmental violation, reached the 10% raising limit for the first trading day, and achieved almost a 50% increment in total for the first ten trading days. The above cases were sourced from the CNKI data base, the Wind database and the website of the Ministry of Environmental Protection of China.

The impacts of environmental violations in China differ a lot under different situations. This paper aims to discover the general driving force behind CSR perceptions of Chinese managers and stockholders. The two main objectives of this paper are to assist public company managers understand the outcomes of environmental violations and how such violations influence shareholders' decisions and, to enable shareholders make better investment decisions.

Structure and contribution

The empirical analysis relies on the method of "Event Study" which is applied to calculate the cumulative abnormal return (CAR) from environmental violations, and then a regression model is used for to explain it.

The first chapter briefly introduces the background, objective and contribution, making clear the structure of the research. And the second chapter elaborates the major theories of corporate social responsibility, corporate environmental management and corporate market value management, as well as making some research advancements. The third part is concerning the research design, based on the environmental violations of Chinese public companies from 2002 to 2014. This paper calculates their cumulative abnormal return and proposes the related explanatory variables. Major variables include, from the external perspective, time trend and media attention; and from the internal perspective, previous pollution situations and CSR performance. It concludes that, the environmental violations from Chinese public companies will result in a negative reaction from the shareholders, and the external influence is stronger than the internal influence. The negative reaction weakens as time goes by, and strengthens with the higher attention from the media. Those companies which have published a CSR report in the previous year performed better when facing the accident, while previous pollution control does not show a significant impact. The fifth chapter discusses three problems that arise during the research, and promotes four policy suggestions. The sixth chapter provides a general conclusion.

The main contributions of the paper are: 1) It supplements the research on corporate environmental responsibility; 2) In the other papers written on this subject, researchers have paid more attention to the outcome of environmental violations calling for the necessity of environmental management, but not enough attention has been paid to the factors that lead to the violations; and 3) this is an attempt to analyse the Chinese perspective by focusing on the impact of pollution on the market value of Chinese public companies.

Literature review

Corporate social responsibility (CSR)

In the early seventeenth century, Adam Smith discussed the idea of CSR for the first time in his book *The Wealth of Nations*. He pointed out that the social responsibility of a company is to offer goods and service to the society while pursuing maximum profit during the operation. In other words, the social responsibility of a company is a co-product when it is seeking to maximize profit.

In 1953, Howard Bowen introduced the theory of CSR in his research *Social Responsibilities of the Businessman*, in which CSR is regarded as a component of corporate management (Bowen 1953). Later, Wallich and McGowan argued that from the perspective of a narrow sense of optimizing stockholders' earnings, it is not a good choice to take much social responsibility. Thus, early research in this field emphasized that the priority of a company is to create value for the shareholders and giving attention to CSR may impede the free growth of the company.

Recent research works however identify CSR as an important element in the operation of a company. In 1999, Richardson examined how CSR influences the stock market, drawing the conclusion that better CSR performance can stimulate market value in an upward trend. Brancoet investigated the implications of CSR from a resource-based-view, acknowledging that CSR is an important resource of a company that is expected to bring good reputation and higher employee morale (Branco and Rodrigues, 2006). Barnett applied the stakeholder theory and related influence model to explain the different impacts of CSR in various types of companies. Jamali also discussed the mutual influence and mutual promotion of CSR and operational performance (Jamali 2008). It can be said that CSR is looked upon as something that will promote positive performance of the company's operational performance, through bringing better reputation, morale and consumer loyalty.

Even though abundant research has been conducted on CSR, there is still no generally accepted definition of it. The World Business Council for Sustainable Development stresses that "CSR is the continuing commitment by businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families, as well as of the local community and society at large." The European Union

defines CSR as "… the concept that an enterprise is accountable for its impact on all relevant stakeholders. It is the continuing commitment by businesses to behave fairly and responsibly and contribute to economic development while improving the quality of life of the work force and their families as well as of the local community and society at large…".

Thus, according to the generic definitions stated above, CSR aims to integrate corporate activity with the concept of social welfare to improve stakeholders' benefits and to promote the sustainable development of society.

Corporate environmental management

Since the 1960s, the pollution problem has worsened, which led to increasing attention on environmental protection. With the active intervention of the governments and the environmental awareness of the public, more and more companies are bringing environmental management into their daily operation decisions, and are pursuing consistency in their environmental and operational goals.

The Brundtland Report which was published in 1987 as a result of World Commission on Environment highlighted the significance of CSR. Economist and business scholars have been grappling with the question of how and why corporations should incorporate environmental concerns into their own strategies.

Walley and Whitehead point out that companies should actively take into account environmental management when making a business decision. Klassen and McLaughlin think that environmental management encompasses all efforts to minimize the negative environmental impact of the firm's products throughout their life cycle (Klassen and McLaughlin 1996). Environmental performance measures how successful a firm is in reducing and minimizing its impact on the environment. Timmins lists three goals of environmental management: 1) To minimize the operational impact on the environment; 2) To take every possible effort to efficiently use the available resources; and 3) Build up an environmental management system and stimulate the employees to consider the environment during their work. Shrivastava and Hart (1995) emphasize the concept of "total environmental management" and "sustainable organizational design", meaning at each step of the value chain or lifecycle of products and services, every organizational activity from raw material usage (inputs), through production processes (throughputs), to the disposal of packages and used products (outputs) is associated with environmental problems (Shrivastava and Hart 1995). More and more companies regard environmental management as their responsibility (Hart 2000), and make special efforts to improve the environmental standards.

Thus, as a result of a lot of governments coming to put a strong emphasis on the stringent implementation of pro-environment regulations and also because of voluntary initiatives, many companies have now made environmental regeneration and protection their prime objective. The International Financial Corporation, in its report "Developing Value" noted that "businesses in emerging Markets have been involved in areas such as social development or environmental improvements, and have achieved cost savings, revenue growth and other business benefits".

Porter noted that "in many cases properly designed legal environmental standards could still trigger innovations that lower the total cost of a product or improve its value. Such innovations allow companies to use a range of inputs more productively, from raw materials to energy to labor, thus offsetting the cost of diminishing environmental impact and ending the stalemate" (Porter 2000). Chinese scholar Chen's summary of environmental management aptly encompasses this idea. He says "In the whole value chain, take the environmental issue in mind from the very beginning to the very end; through cooperation with different departments, to minimize the negative impact of environmental problems and finally realize the mutual promotion of environmental performance and financial performance".

Among all of the discussions on environmental management, the "environment-as-a-recourse" view is the most commonly accepted. Porter argues that the environmental management of corporates will provide new and competitive resources (Porter 1991). Lovis, et all. Also supplement this understanding of the resource - based management. Through an analysis of corporate environmental management, their research suggests that enterprises should take a road of "extending return", through technical innovation to realize the economic benefits and environmental benefits simultaneously.

Market value management

The theory of market value management was first raised in China, which is a theory focusing on the market value or specifically the stock value of public companies. Some scholars point out that this theory is rooted in the western classical value management theory.

In 1994, McTaggart published the paper The Value Imperative, and put forward the definition of value management or value-based management (VBM). In 1980, Porter published the book Competitive Strategy in which he produced an analysis based on value management and value chain. In the 1980s, Kaplan established the value evaluation process in his book Valuation: Measuring and Managing the Value of Companies. In the early 1990s, the American consulting company Stern and Steward raised the value management modes of Economic Value Added (EVA) and Market Value Added (MVA).

China initiated stock reforms in 2005 and basically realized the circulation of state owned shares in 2008. After the reform, the management methods under the planned economy could no longer meet the requirements of the capital market practice. So the idea of market value management emerged in response to the needs of the time.

Lots of scholars have tries to define market value management. For example, writes that market value management is to use market indexes as a tool, use the scientific and rational methods of value creation and value operation, and apply the ideas of management science, financial management, economics and so on, to maximize the value to shareholders. Points out in his study that, market value management is to take sustained, stable and effective operation and management to enhance the market value of a public company, and to make the market value reflect the company inherent value. Defines market value management as having the external goal of maximizing shareholders' value, while also having the internal goal of maximizing stakeholders' value.

Foreign academic advancement

Specifically on the topic of shareholders' reaction to the environmental violations, some studies already exist. Some scholars point out that controlling pollution and strengthening environmental management will result in additional costs for the company and thereby reduce profit. Some others argue that focusing more on the environmental management will bring better reputation for the company, thus enhancing sales and profit. Most of the researchers, including Jaggi and Freedman (1992) find that shareholders react negatively to environmental violations. Klassen and McLaughlin (1996) provide the idea that the stock price will increase after the environmental improvement events and decrease after the environmental violation. Klassen and McLaughlin (1996) draws out the relationship between environmental performance and financial performance (Fig. 2).

There are two methods used to research the above topic: event studies and the structure environmental information index.

Event study method

Gupta and Goldar (2005) analyze the situation of the paper industry, car industry and chlor-alkali industry of India. They apply the index from the Delhi based Centre for Science and Environment to divide corporate environmental performance into five levels (L1 to L5), and count the corresponding reaction from the shareholders. They find that the negative impact can be as huge as −30%.

Ziegler et al. (2007) take a special look from the industry perspective by utilizing the CAPM model of. First they analyze the average industry performance and then examine every single company. The result reveals that the overall industry environmental performance does impact the shareholders' reaction on individual companies in the industry. And the investment in environmentally friendly companies will lead to a long term positive return.

Xu et al. (2012) pay attention to the Chinese stock market in 2010, choosing variables such as industry fixed

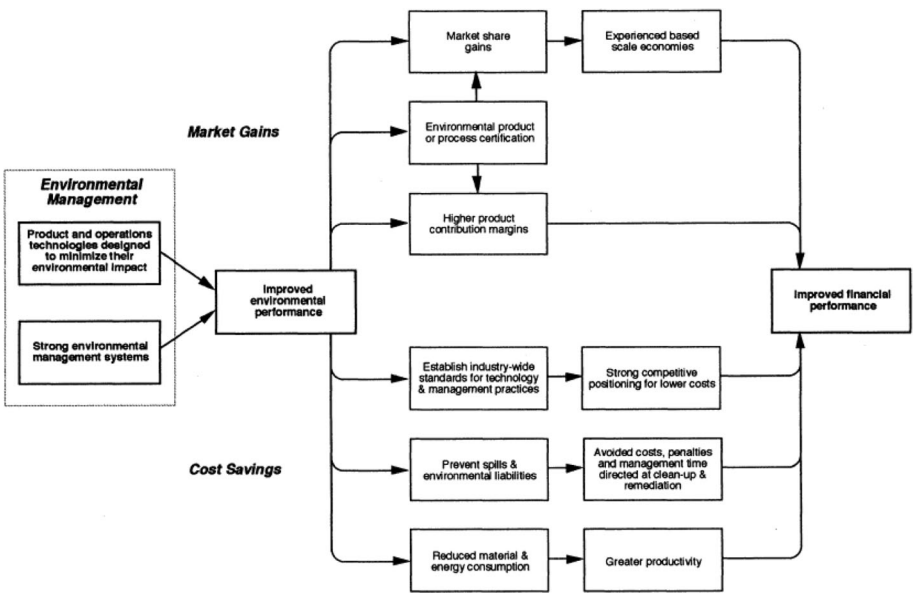

Fig. 2 Linkage of environmental management to firm profitability. Klassen, R.D. and Mclaughlin, C.P. 1996

effect, event type, disclosure level and modernization rate. They show that water pollution, major media disclosure, high modernization rate, biggest ownership share of less than 25% and high state-owned share will contribute to significant negative reactions to environmental violations.

Uses the "environment-as-a-resource" view by Porter 1991 and relies on both the external and internal perspectives to build up a two dimensional framework. He selects related news from the Wall Street Journal from 1980 to 2009 and finds that shareholders react positively to environmental improvements and negatively to environmental violations. From the external perspective, the positive (negative) effect becomes weaker as time goes by, and from the internal perspective, the positive (negative) effect is weaker for companies with better environmental responsibility performance. This framework is a very important reference for this paper.

Structure environmental information index

Yamashita et al. (1999) structure an environmental awareness index, and observe that in the America stock market, companies with good environmental awareness do not have a stock return significantly higher than the market average, but companies with bad environmental awareness have a significant lower stock return.

King and Lenox (2001) give a comparison between environmental information disclosure and financial performance. They select Company Relative Emissions and Industry Emissions to measure environmental performance and select Tobin's Q for financial performance.

Hayam Wahba (2008) starts from the stakeholder's theory and environmental resource view, analyzing the situation of Egypt. He uses passing of the ISO 14000 as a binary measurement for environmental performance and Tobin's Q for financial performance. And he concludes that companies have the necessity to invest in environmental protection.

Domestic academic advancement

Domestically, the same two methods mentioned above are used.

Event study method

Tested for the shareholders' reaction on environmental violations, and proposes that Chinese shareholders do not react significantly to environmental problems. Only few special cases show the significance.

Collected the environmental violations of Chinese public companies from 2002 to 2008. He arrives at the result that Chinese shareholders react negatively to the environmental violations, but the duration is short and the negative impact recovers by the second or third day. The negative impact is stronger for compulsory disclosure than voluntary disclosure cases.

The chooses 113 events from 2003 to 2012. The result shows that Chinese shareholders react negatively to the events in a short period, but the influence will be felt in the following 10 days. Although the Chinese government gives more and more attention to environmental protection, pollution has little impact on the stock price for the long term.

Take the case of Zijin Mining as an example, saying that environmental performance will affect the decision of managers. Also focuses on the case of Zijin Mining. His result shows the negative impact for the whole mining industry is significant but short.

Researched the 62 environmental improvements and 45 environmental violations in the Chinese main board exchange market. They found that the shareholders' negative reaction is significant and that the failure to pass environmental scrutiny has an especially significant influence. Between the years 2008 to 2010, the negative effect was most significant in 2011.

Has an investigation of 24 Chinese chemical companies, finding there is little impact of environmental disclosure and the impact of voluntary disclosure is stronger than the mandatory disclosure. Collects events from 2004 to 2013, revealing a negative reaction from the shareholders in a short period. And the general impact is not strong.

Structure environmental information index

Targets the Chemical companies in the Chinese main market from 2002 to 2003. The result shows that although the chemical industry is very sensitive to the environmental information, the environmental information disclosure is still in an early stage, which doesn't lead to added value.

Assesses 161 public companies from 7 heavy pollution industries. There are only 10 companies that are given a 'Good' score, and 40 'Fail'. In general, the environmental performance of Chinese public companies is relatively poor. Companies' size and development stage are the most important driving factors to improve environmental outcomes. But they should also enhance the environmental governance and environmental awareness.

Data and methodology

Data collection

On the 8th January 2002, the Chinese State Council had an important conference with the theme of the conference being the country environmental protection. In the conference, the tenth environmental 5 year plan was established, signaling a new stage of environmental protection in the whole country and also raises new requirements for the company environmental management. Some researchers

note that the year of 2002 should be regarded as the start of a new era for corporate environmental management in China. Considering this background, the authors take the sample period of 2002 to 2014 by using data from Shanghai and Shenzhen stock exchanges.

To address the environmental violations which reveal the situation of firms' environmental violations, the authors look to the Wind database, CNKI (Chinese National Knowledge Infrastructure) database and the website of the Chinese Ministry of Environmental Protection with the key words *pollution, explosion, oil spilling* and *waste water*.

After excluding the following data, there are 154 qualified events in total:

- ST companies, for example ST Titanium Dioxide Group (002145.SZ);
- Environmental protection technology companies, for example Fujian Longking Ltd. and Tianli Environmental Technology Ltd. (600,388.SH),
- Listed in China but the environmental violation took place in abroad, for example Chinalco Mining Corporation International (601,311.SH).

Methodology: Event study

In this paper, the methodology of event study is applied. This method was first proposed by Dolley in 1993, and it is a commonly used instrument to analyze the impact of a certain event on the financial market, by using the corresponding financial data. Here the event study methodology examines the stock price reaction to environmental violations. The stock market reaction is captured by the average cumulative abnormal return (CAR) during an "event window." CAR is a measure of how much a stock price deviates from its expected value during an event window. The data collected was processed on STATA for analysis.

1) Criteria of the Event

The first step of an event study is to make the criteria of the certain event, namely, to select the qualified events according to the research objective. This paper only takes the environmental violations and analyzes the corresponding impact on the stock market. The detailed data collection method is introduced in section 3.1

2) Measurement of Event Window and Estimation Window

Usually, the event date is defined as $t = 0$. And then the issue is to choose the event window. The same event may be disclosed by more than one media at a different time, which causes the problem of "Event Uncertainty". There are two major methods to solve this problem. Firstly, expand the event window to several days before or after.. For example, Klassen & McLaughlin, Dasgupta, Laplante & Mamingi and Flammer make use of the (−1, 1) window. Xu, Zeng & Tam use the (−10, 10) window, Yan uses (−5, 10) while Lu uses (−10, 20). Secondly, the authors conduct a robustness test with different event windows.

In this paper, the authors attempt to use three different methods. Firstly, the authors apply the most popular event window of (−1, 1); secondly, a robustness test is performed; and thirdly, the day the event happened is searched in the news for a comparison.

The estimation window is used for the prediction of a normal return. Different researchers have different standards, for example Klassen & McLaughlin use (−209,-10), and Flammer uses (−40,-21). This paper addresses the estimation window of (−180, 30).

3) Calculation of Cumulated Abnormal Return (CAR)

The event study refers to the cumulative abnormal returns to describe the event influence on company performance. First, the authors should calculate the daily normal return in the event window and then calculate the daily abnormal return by deducting the daily normal return from the daily actual return. Finally the daily return is summed in the event window. There are three major methods to calculate the normal return, namely Mean-Adjusted Returns Model, Market-Adjusted Returns Model and Capital Asset Pricing Model.

- Mean-Adjusted Returns Model

Define the estimation window which avoids the impact of the event, and use the average daily stock return as the daily normal return.

- Market-Adjusted Returns Model

Use the daily market return in the event window as normal return.

- Capital Asset Pricing Model

It is the most commonly used method, and this paper also applies this method.

Hypothesis and variables

As mentioned earlier, this paper refers to Flammer's method of a two dimensional research framework of "environment-as-a-resource". According to the framework, the environment acts as a new and competitive resource for the corporation. And there is both the

external and internal pressure for the corporation to execute environmental management. External impacts include publishing of new regulations, media attention, and consumer environmental awareness; the internal impacts include previous CSR performance. Environmental violations will cause stock abnormal return.

Data from developed countries exhibit quite a significant impact of environmental violations on the stock market. For example, the result from the America petrochemical companies shows an average drop of 1.3% in 2 days' event window Japan's public companies (including petrochemical, automobile, food and other industries) appear to have significant share price reductions after environmental violations, for the European market (Ziegler, etc., 2007) and the Indian market, the results are significant.

And regarding the research in China, argue that the negative impact is not significant while find the result is significant, but the reaction duration is short. Also support that the result is significant. In conclusion, the majority of literature identifies a significant negative impact of environmental violations and the result is more obvious using the more recent data. Thus, the paper comes up with the first hypothesis as below:

Hypothesis 1: Chinese shareholders react negatively to the disclosure of environmental violations.

Considering the external impacts, with the ever strengthening focus on environmental education and the related regulations, the environmental awareness of shareholders becomes stronger, making the environment as a resource gain better value. Klassen and McLaughlin (1996) pay attention to the time trend. Additionally, when reading previous researches, the authors find that the significance ratio of the negative effect increases.

In the authors also note that in different years, the media coverage about environment differs. Krepsand Wilson (1982) considers the media an important resource to provide public environmental pressure. The previous study mainly differs by media type, for example stock newspaper or website of the environmental protection ministry. But not much attention has been paid to the frequency. With regards to the above, this paper gives out the following hypothesis:

Hypothesis 2: Shareholders' negative reaction to the disclosure of environmental violations increases over time.
Hypothesis 3: Shareholders' negative reaction to the disclosure of environmental violations is more strongly in the year with higher media environmental attention.

The internal levels of corporate environmental management also lead to a different market response. Melnyk, et al. (2003) provide information about the importance of previous corporate environmental management on market performance.

Hypothesis 4: Shareholders' negative reaction to the disclosure of environmental violations is stronger for the corporations with a weaker pollution situation prior.

The more a company discloses its CSR information, the more investors and the public will have an understanding of its CSR performance, and will expect it to recover better from the violation, making the loss from the violation smaller. Klassen and McLaughlin (1996) think the CSR performance will affect the market performance. Use the environmental information disclosure in the annual report as an indicator.

Hypothesis 5: Shareholders' negative reaction to the disclosure of environmental violations is stronger for the corporations with weaker CSR performance.

The author picks up some commonly used control variables such as stock exchange market, industry, size, ownership intensity, ROE and PE.

Stock exchange market

In China, there are the Shenzhen exchange market and Shanghai exchange market. Companies in the Shanghai exchange market usually are large scale and the percentage of state ownership is higher. On the contrary, companies in the Shenzhen exchange market are smaller but with higher private ownership. Thus, the environmental awareness in the two markets may be different and this paper would provide differentiation between them.

Industry

Industry fixed effect is a commonly used variable in the research, for example, Dasgupta, et al. (1997), Xu, etc. (2012), and. This paper also chooses industry as a control variable. According to the industry standard from Wind database, the author differentiates the polluting industry and other industries. Since the shareholders already expect the polluting industry to have environmental violations, the negative reaction from the shareholders will be relatively weaker.

Size

"Total Assets" is often used to measure the size of a company. In order to put the digits in the same order of magnitude, researchers usually use the logarithm of the total asset as a measurement. The bigger the company

size, the better capacity it has to solve the pollution problem. Those companies would have a bigger preference to show a positive social image, and to promote sustainable development. In this way, the impact of the environmental violation will be reduced. Free Dman and Jaggi (1988), choose this variable.

Ownership intensity

Companies with different ownership intensity will take out different reparation methods under the environmental violations. Dyck and Zingales (2002) think that companies with higher ownership intensity will be less likely to bear the environmental responsibility. Pays attention to the variable as well.

Return on Equity

ROE measures the rate of return for ownership interest of common stock owners. It measures the efficiency of a firm at generating profits from each unit of shareholder equity. Some researchers point out that the managers from high ROE companies would be more likely to disclose information. Those companies pretend to build up better reputation to avoid the underestimation of its value. At the same time, the higher the ROE, the more additional environmental assets the companies have to invest in.

Price-to-earnings

The P/E ratio, is an equity valuation multiple. It is defined as market price per share divided by annual earnings per share. This indicator is used to measure the growth ability of the companies. The better the growth ability is, the more the companies would like to focus on sustainable development.

Based on the above hypotheses, this paper uses the following variables:

Table 1.

Regression analysis

Significance of CAR

Figure 3 shows the summary of CAR from (−10, 10). It is clear that the stock price drops in the (−1,1) event window, and increases dramatically from the second day.

As can be seen in Table 2, the mean is −0.903% and the *P* value is 0.041, which means the result is significant with the 95% confidence interval. In other words, Chinese shareholders react negatively to the environmental violations.

Tables 3, 4 and 5.

The Fig. 4 indicates the CAR of 154 events in the event window of (−1,1). As we can see, the mean is less than zero, and the points are distributed regularly on both sides of the mean line. At the same time, there are two extreme values, point A Zijin Mining (601,899.SH) which is higher than 20%, and point B GSRH (600,311.SH) which is lower than 20%. When doing the regression, in order to avoid deviation, the authors will firstly exclude the two extreme values and then perform the robustness test. In addition to that, BBMG (601,992.SH) is also excluded because of data missing in the Wind database.

Table 1 Variables and the description

Type	Implication	Signal	Measurement	Expected sign
Explained variable	Cumulated Abnormal Return	CARi	Sum of the abnormal returns in the event window	
Explanatory Variable -External	Time Trend	Trend	Years since the event	−
	Media Attention	Media-Att	Major media attention on environmental protection. Frequency of the key words: pollution, explosion, oil spilling and waste water	+
Explanatory Variable -Internal	Previous Pollution Control	Pre-Pollution	Have(1) or not have (1) environmental violations from 2002 to the event date, dummy variable	−
	Previous CSR Performance	Pre-CSR	Published(1) or not published(0) CSR report in the previous year, dummy variable	+
Control Variables	Stock Exchange Market	Market	Shenzhen Stock Exchange(0) or Shanghai Stock Exchange(1), dummy variable	+/−
	Industry	Industry	Ordinary industry(0) or pollution industry(1), dummy variable	−
	Size	Size	Logarithm of the total asset	+
	Concentration of Ownership	Ownership	quadratic sum of the shareholding ratio of the top ten major shareholders	+
	Rate on Equity	ROE	Net profit/Total Equity	+
	Price to Earnings Ratio	PE	Net profit/Earning per share	+

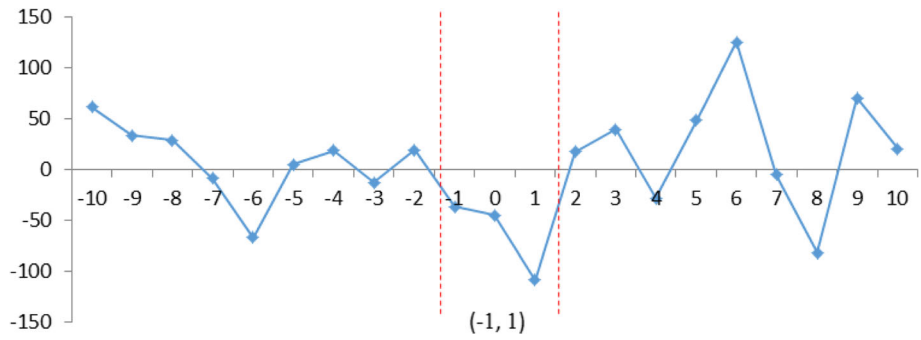

Fig. 3 Average CAR in the(−10,10)window

Regression model for CAR

Before running the regression of CAR, the author conducts two tests for the validity of the data: a test for multicollinearity and a test for heteroskedasticity.

Test for multicollinearity

In statistics, multicollinearity is a situation in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a non-trivial degree of accuracy.[3]Both the Variance Inflation Factor (VIF) method and Correlation Coefficient Table are commonly used for the test, as well in this paper.

In the VIF method, the bigger the VIF value, the variables are more highly correlated. According to the previous experience, if $0 < VIF < 10$, there is no multicollinearity; if $10 < VIF < 100$, there is multicollinearity; if $VIF > 100$, there is strong multicollinearity. As shown in Table 6, all the VIF values are less than 10, and the mean is less than 2, indicating that the model passes the VIF test and involves no multicollinearity.

In the correlation method, if the correlation of the two variables is bigger, the multicollinearity is higher. Generally speaking, if the absolute value of the correlation is bigger than 0.8 or 0.9, the result can be regarded as having multicollinearity. For this paper, as shown in Table 7, all the data presented are less than 0.6, which also indicates the weak correlation among the variables.

Test for Heteroskedasticity In statistics, a collection of random variables is heteroscedastic if there are subpopulations that have different variability from others. Here "variability" could be quantified by the variance or any other measure of statistical dispersion. Thus heteroscedasticity is the absence of homoscedasticity.[4]

Table 2 Test for significance of CAR

Event date	Estimation window	Event window	Average	*P* value
event_date_n	(−180,-30)	(−1,1)	−0.903%	0.041**

***p* ≤ 0.01, ***p* ≤ 0 .05, **p* ≤ 0.1, two tailed test

The Breusch-Pagan/ Cook-Weisberg Test and White Test are most commonly used to test for heteroskedasticity. According to both of the tests, the authors find that the null hypothesizes are rejected, and there is no significant heteroskedasticity within the 95% confidence interval (Table 8).

Regression specification For better understanding the mechanism, the paper adopts three kinds of models for testing the external impact, the internal impact and the overall impact (Table 9). And in each of the models, the two extreme values of Zijin Mining and GSRH will be added for robustness test (Table 10).

Firstly, the test for external impact: the explained variable is CAR; the explanatory variables are Time Trend, Media Attention; and the control variables are Market, Industry, Size, Ownership, ROE and PE.

Model 1:

$CAR_i = \beta_0 + \beta_1 * Trend + \beta_2 * Media\text{-}Att + \beta_3 * Market + \beta_4 * Industry + \beta_5 * Size + \beta_6 * Ownership + \beta_7 * ROE + \beta_8 * PE.$

Secondly, the test for internal impact: the explained variable is CAR; the explanatory variables are Previous Pollution Control, Previous CSR performance; and the control variables are Market, Industry, Size, Ownership, ROE and PE.

Model 2:

$CAR_i = \beta_0 + \beta_1 * Pre\text{-}Pollution + \beta_2 * Pre\text{-}CSR + \beta_3 * Market + \beta_4 * Industry + \beta_5 * Size + \beta_6 * Ownership + \beta_7 * ROE + \beta_8 * PE.$

Thirdly, the test for overall impact: the explained variable is CAR; the explanatory variables are Time Trend,

Table 3 Test for significance of CAR: Robustness of the event date

Event date	Estimation window	Event window	Average	*P* value
event_date_n	(−180,-30)	(−1,1)	−0.903%	0.041**
event_date_h	(−180,-30)	(−1,1)	−0.764%	0.081*

***p* ≤ 0.01, ***p* ≤ 0 .05, **p* ≤ 0.1, two tailed test

Table 4 Test for Significance of CAR: Robustness of the Estimation Window

Event Date	Estimation window	Event window	Average	*P* value
event_date_n	(−180,-30)	(−1,1)	−0.903%	0.041**
event_date_n	(−180,-60)	(−1,1)	−0.849%	0.060*
event_date_n	(−120,-30)	(−1,1)	−1.002%	0.023**
event_date_n	(−60,-30)	(−1,1)	−1.165%	0.009***
event_date_n	(−30,-10)	(−1,1)	−0.820%	0.063*

***$p \leq 0.01$, **$p \leq 0$ .05, *$p \leq 0.1$, two tailed test

Media Attention, Previous Pollution Control, Previous CSR performance; and the control variables are Market, Industry, Size, Ownership, ROE and PE.

Model 3:

$CAR_i = \beta_0 + \beta_1 * \text{Trend} + \beta_2 * \text{Media-Att} + \beta_3 * \text{Pre-Pollution} + \beta_4 * \text{Pre-CSR} + \beta_5 * \text{Market} + \beta_6 * \text{Industry} + \beta_7 * \text{Size} + \beta_8 * \text{Ownership} + \beta_9 * \text{ROE} + \beta_{10} * \text{PE}$.

Based on the empirical study above, the paper derives the following explanation.

Firstly, for the external impact:

H2: The result is significant but goes to an opposite direction. That means that as time goes by, the punishment on the market value becomes weaker. However, common sense and also the previous literature exhibit that, as time goes by, the environmental awareness of the government, the companies, social media and the public become stronger, which leads to a stronger punishment by the stock market.

H3: The result is significant and goes in the same direction. So we draw the conclusion that if the media pays more attention on environment issues, the punishment is stronger.

Secondly, for the internal impact:

H4: The result is not significant but goes in the same direction. That is to say, the reward for a company having better pollution control is not obviously seen.

H5: The result is significant and goes in the same direction. In other words, the reward for a company having better CSR performance is obviously seen.

Table 5 Test for significance of CAR: Robustness of the event window

Event date	Estimation window	Event window	Average	*P* value
event_date_n	(−180,-30)	(−1,1)	−0.903%	0.041**
event_date_n	(−180,-30)	(−1,2)	−1.082%	0.038**
event_date_n	(−180,-30)	(−2,2)	−1.038%	0.064*
event_date_n	(−180,-30)	(−5,5)	−0.981%	0.255
event_date_n	(−180,-30)	(−10,10)	−0.128%	0.915

Note: In all the four tables above, event_date_n stands for the news disclosure date, and event_date_h stands for event occurrence date
***$p \leq 0.01$, **$p \leq 0$ .05, *$p \leq 0.1$, two tailed test

Thirdly, for the control variables:

In the stock exchange market, the signal is negative, meaning the shareholders investing in the companies of the Shenzhen exchange market are more negatively sensitive than the Shanghai exchange market, to the environmental violations. But the impact is not significant.

Industry: The signal is negative and significant, meaning the negative impact is weaker for the polluting industry. The reason is that shareholders have already anticipated the environmental problems. So when the problem occurs, the reaction is not significant.

Size, ownership intensity and PE: If the number is higher, the negative reaction is higher, which is consistent with the hypothesis.

ROE: The higher the ROE is, the negative reaction is weaker, which is opposite to the hypothesis. ROE is used to measure the profitability. One possible explanation may be that companies with higher profitability would prefer to invest in the operational process.

Further discussion and policy suggestion

Improve the government environmental scrutiny management to help the market punish environmental violators

The government as a vehicle of environmental scrutiny can have a tremendous impact in raising CSR activities. Dasgupta et al. (1997) finds that the environmental supervision department is not the only unit to punish pollution, as the capital market also reactions to the event. In this sense, lack of sufficient strong supervision is not the key issue that results in a bad environmental situation. If the capital market receives enough information or the shareholders have better environmental awareness, the pollution event will attract harsher punishment. Considering the result of this paper, Chinese shareholders' negative reaction to the environmental violation is weaker than that of America and Canada. Information transfer may be one of the reasons for this.

Nowadays, developed countries rely more on market mechanisms to promote environmental protection. For example, institutional investors (pension fund, insurance company) use the shareholders' voting right to enhance the environmental management. The environmental supervision of developed countries is more complete, and the institutional investors are more mature, hence they tend to invest in companies with better environmental performance. On the other hand, developing countries rely more on government supervision and financial regulation, in order to guide the companies to be more environmentally responsible. It is not easy to compare these two modes, especially in the long term. Concurrently, the two modes show a trend of merging. For example, in the developed countries, more and more

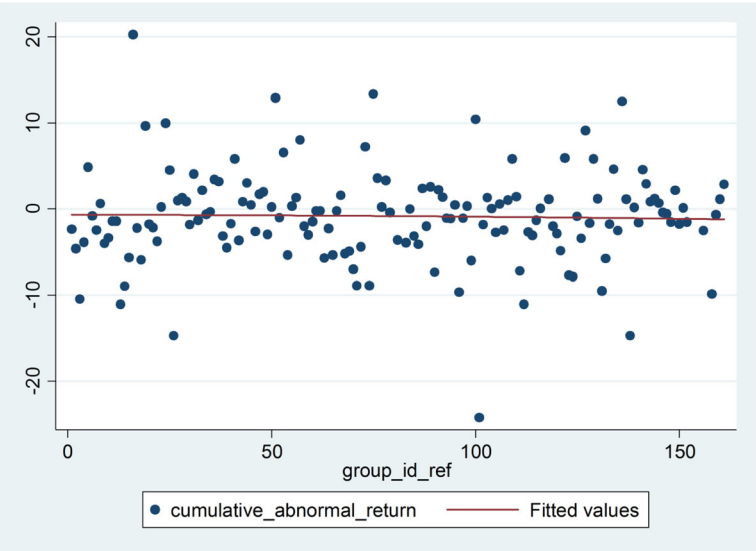

Fig. 4 Scatter diagram of cumulated abnormal return

people realize that it is difficult to have a sustainable market by relying only on the market mechanism and the government should be a very important actor. At the same time, there are some concerns on developing countries' administrative intervention. Researchers acknowledge some drawbacks associated with compulsory environmental governance dominance. And that the government should pay more attention to guiding the market willingness and creating a better market atmosphere so as to promote better cooperation with the market.

Strengthen environmental accounting and environmental auditing for public companies

Nowadays, the environmental information disclosure mechanism of Chinese public companies is not very smooth and efficient. The content is simple and without a uniform format; and has more qualitative disclosure than quantitative disclosure; more good news than bad news. In 2014, only 633 companies among 2516 listed in the Chinese main board published a CSR report. And only 14 companies published an environmental responsibility report, a mere 0.55% of Chinese listed companies.

Table 6 Test for multicollinearity (VIF)

Variable	VIF	1/VIF
Pre_CSR	2.21	0.452
Trend	1.81	0.552
PE	1.77	0.564
Pre_Pollution	1.60	0.625
Media_Att	1.45	0.690
Ownership	1.18	0.847
Industry	1.17	0.857
ROE	1.16	0.862
Market	1.11	0.902
Size	1.08	0.929
Mean VIF	1.45	

The Chinese Ministry of Environmental Protection enacted a document on Environmental Information Disclosure on May 1st, 2008. This document requires companies to disclose their environmental information in a timely and accurate manner. The m = Ministry introduced the Guidance for Environmental Information Disclosure in 2010, asking the public polluting companies to provide certain environmental information. On April 10th 2014, the Ministry announced that it would conduct a survey on environmental responsibility countrywide to urge companies to set up an environmental responsibility reporting mechanism. On March 6th, 2015, the Ministry issued a notice about the pilot projects on environmental auditing, promoting environmental auditing to a higher level for which Gansu province was chosen as the first pilot.

Public companies are encouraged to introduce environmental accounting and environmental auditing and to put more environmental information into their balance sheet and income sheet. Giving out better environmental accounting information is a positive signal of environmental responsibility. And this is a good way for the companies to move away from profit-oriented development to overall sustainable development.

It is of great necessity to build up an environmental information platform with the regulators, publicly listed companies, the media and the general public thereby

Table 7 Correlation coefficient table

	Mean	Std.err.	CAR_i	Trend	Media- Att	Pre-Poll-ution	Pre-CSR	Market	Industry	Size	Ownership	ROE	PE
CAR_i	−0.914	0.395	1										
Trend	5.252	0.253	0.027 (0.741)	1									
Media-Att	812.080	21.982	0.142 (0.082)	−0.491 (0.000)	1								
Pre-Pollution	0.419	0.020	−0.048 (0.557)	0.100 (0.223)	−0.177 (0.030)	1							
Pre-CSR	9.844	0.069	0.122 (0.137)	−0.317 (0.000)	0.091 (0.268)	0.503 (0.000)	1						
Market	0.702	0.037	−0.026 (0.753)	−0.083 (0.314)	−0.016 (0.845)	0.087 (0.288)	0.246 (0.002)	1					
Industry	7.652	1.089	−0.166 (0.041)	0.133 (0.105)	−0.126 (0.123)	0.329 (0.000)	0.214 (0.009)	−0.025 (0.765)	1				
Size	36.473	17.641	0.161 (0.048)	0.100 (0.222)	0.083 (0.309)	−0.035 (0.665)	−0.093 (0.255)	0.053 (0.521)	0.016 (0.845)	1			
Ownership	0.437	0.041	0.091 (0.267)	0.002 (0.984)	−0.086 (0.295)	−0.165 (0.043)	−0.242 (0.003)	0.020 (0.812)	−0.019 (0.815)	−0.070 (0.395)	1		
ROE	0.205	0.033	−0.070 (0.392)	−0.152 (0.062)	0.101 (0.219)	0.124 (0.129)	0.298 (0.000)	0.044 (0.588)	0.016 (0.847)	0.103 (0.209)	−0.117 (0.151)	1	
PE	0.397	0.040	0.114 (0.163)	−0.415 (0.000)	0.079 (0.335)	0.159 (0.052)	0.545 (0.000)	0.204 (0.012)	0.048 (0.560)	−0.080 (0.330)	−0.279 (0.001)	0.291 (0.000)	1

encouraging the companies to disclose more environmental information and care more about their environmental image. Referring to the index system developed by the Chinese Academy of Environmental planning, this area would benefit from a scientific system developed from environmental law, environmental management and environmental performance. At the same time, such a system would require active support from the government, through expert judgment and independent verification from third-parties to confirm the validity of the data. Chinese Rankins CSR Ratings Company (RKS) is attempting to build up such a platform, although it is still in a very early stage.

Also, some foreign social responsibility indexes can be taken into consideration to promote the environmental management and development. For example MSCI KLD 400 (KLD's Domini 400 Social Index) and (Dow Jones Sustainability Indexes, DJSI). The MSCI KLD 400 Social Index was launched in 1990 and is designed to help socially conscious investors weigh social and environmental factors in their investment choices. And The Dow Jones Sustainability Indices (DJSI) are a family of indices evaluating the sustainability performance of the largest 2500 companies listed on the Dow Jones Global Total Stock Market Index. They are the longest-running global sustainability benchmarks worldwide and have become the key reference point in sustainability investing for investors and companies alike.

Table 8 Test for heteroskedasticity

Test method	Hypothesis	Test result	Conclusion
Breusch-Pagan/ Cook-Weisberg	H_0: sigma(i)^2= sigma^2 for all i	chi2(10) = 17.66 Prob > chi2 = 0.061	Reject H_0
White	H0: sigma(i)^2= sigma^2 for all i	chi2(61) = 79.56 Prob > chi2 = 0.056	Reject H_0

Cultivate public environmental awareness, especially for the corporation managers.

The government should take the responsibility to educate the public and use different methods for different segments of citizens to improve the environmental awareness of the whole society. This needs to be done for two main reasons: Firstly, to stimulate corporate managers to be actively involved in environmental management; Secondly, to help ordinary workers generate better environmental ideas thereby introducing consumers to the green consumption concept.

The government should encourage companies to enact the ISO 14000 environmental management and to include environmental management ideas in the whole process of the company management. Companies should be recommended to have an environmental management team. At the same time, companies should ensure collaboration between environmental management, financial management and social management, creating an overall organism that shares sources. Applying the requirements of total environmental management (Fig. 5), companies should have a complete plan for the production procedure to achieve the desired environmental improvements.

Table 9 Regression result −1

Variables	Model 1–1		Model 2–1		Model 3–1	
	Coef.	P > t	Coef.	P > t	Coef.	P > t
Trend	0.409***	0.010	–	–	0.498***	0.002
Media_Att	0.004**	0.011	–	–	0.004**	0.013
Pre_Pollution	–	–	−1.415	0.457	−1.759	0.358
Pre_CSR	–	–	1.606**	0.012	1.880***	0.004
Market	−0.861	0.303	−1.355	0.116	−1.373	0.101
Industry	−0.068**	0.018	−0.076**	0.012	−0.084***	0.005
Size	0.004**	0.025	0.005***	0.003	0.005***	0.010
Ownership	1.948**	0.016	1.729**	0.032	2.255***	0.005
ROE	−1.694*	0.083	−2.118**	0.035	−2.204**	0.024
PE	3.370***	0.000	1.262	0.189	2.321**	0.020
cons	−7.371***	0.001	−15.608***	0.006	−24.595***	0.000
observations	151		151		151	
R^2	0.169		0.157		0.220	
Adjusted R^2	0.123		0.110		0.165	

***$p < .01$, **$p < .05$, *$p < .1$, two tailed test

Shrivastava and Hart (1995) put forward the concept of total environmental management (Fig. 5), suggesting that companies should pay more attention to environmental protection throughout the whole value chain.

Conclusion

This paper starts from the perspective of Corporate Social Responsibility, and focuses on the problem of environmental management on corporate market value. The paper applies the two dimensional research framework, to analyze the external influence and internal influence, resulting in the difference on the stock market after an environmental violation. The major explanatory variables include external norms, time trend and media attention; and internal levels, previous pollution control and previous CSR performance. The empirical research reveals that facing an environmental violation, the Chinese shareholders react negatively. The negative reaction becomes

Table 10 Regression Result −2

Variables	Model 1–2		Model 2–2		Model 3–2	
	Coef.	P > t	Coef.	P > t	Coef.	P > t
Trend	0.393**	0.029	–	–	0.478***	0.009
Media_Att	0.004*	0.051	–	–	0.004*	0.056
Pre_Pollution	–	–	−0.708	0.740	−1.114	0.609
Pre_CSR	–	–	1.524**	0.034	1.817**	0.013
Market	−0.976	0.302	−1.440	0.137	−1.481	0.120
Industry	−0.057*	0.075	−0.068**	0.045	−0.076**	0.023
Size	0.004**	0.050	0.005*	0.011	0.005**	0.024
Ownership	2.096**	0.022	1.908**	0.035	2.416***	0.008
ROE	−0.932	0.394	−1.375	0.218	−1.447	0.187
PE	3.802***	0.000	1.737	0.109	2.756***	0.015
cons	−7.189***	0.005	−15.495***	0.016	−24.098***	0.001
observations	153		153		153	
R^2	0.131		0.127		0.172	
Adjusted R^2	0.083		0.078		0.113	

***$p < .01$, **$p < .05$, *$p < .1$, two tailed test

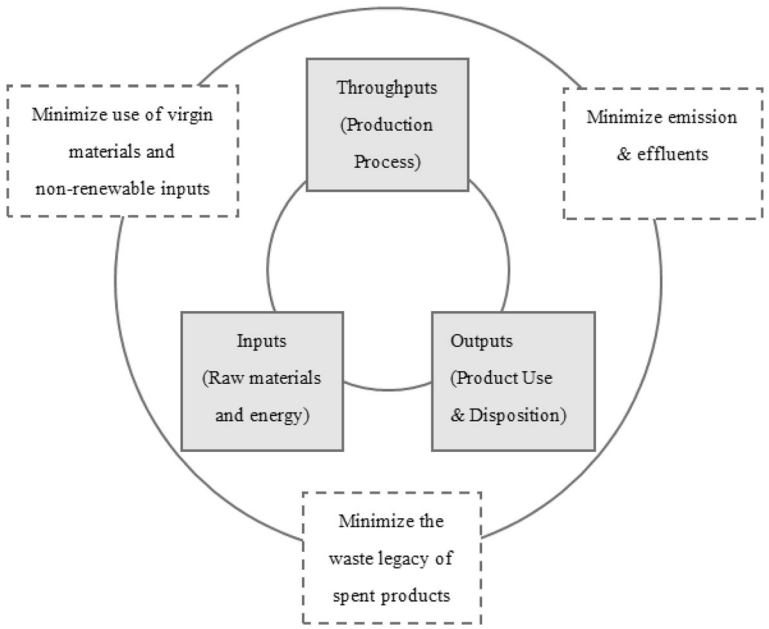

Fig. 5 Total environmental management. Shrivastave and Hart (1995)

weaker as time goes by, and becomes stronger in the year with heavier media attention. The negative effect is weaker if the company published the CSR report in the previous year.

In conclusion, the paper supports the notion "environment-as-a-resource". The empirical study shows that when pollution occurs, the company is punished by the stock market. With higher external and internal pressure, the negative reaction from the shareholders becomes stronger. So it is worthwhile to invest in environment resource and gain better awareness of environmental responsibility.

The paper investigates the Chinese shareholders' reaction on the environmental violations, and the research's result is basically consistent with the hypotheses. But there are still some limitations, which may deserve future improvement. For example:

1) The paper uses the event study to analyze the short term impact of the event without taking the long term impact into consideration.
2) If some of the investors are aware of the change of corporate environmental management, then the market value may be influenced before the disclosure.
3) The CER reflects in both the environmental violations and environmental improvements. This paper only focuses on the negative side and a further discussion on the positive side may be of importance.

Endnotes

[1]Friedman, Milton. "The Social Responsibility of Business is to Increase its Profits." *The New York Times Magazine.* September 13, 1970

[2]Definition of Pollution: The introduction of contaminants into the natural environment that cause adverse change. Merriam-Webster Online Dictionary. (2010). For simplicity, this paper does not make a distinction between pollution and environmental violation.

[3]The definition is from Wikipedia website

[4]The definition is from Wikipedia website

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Authors' contributions
HH came up with the idea and topic of research and supervised the quality of data. DW collected the data, conducted the econometric analysis and interpreted the results. GJ participated in the data analysis, reviewed the literature and wrote the paper. All the three authors have approved the manuscript for submission to the International Journal of Corporate Social Responsibility.

Competing interests
The authors declare that they have no competing interests.

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