
The relationships among environmental management, firm value and other firm attributes: evidence from Chinese manufacturing industry

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Abstract: Many studies have investigated the relationships among environmental management, financial performance and other firm attributes. Their results are inconsistent and contested. Most of the empirical studies to date are in the context of developed countries rather than developing countries. This study fills this gap by providing an empirical examination of the relationships among environmental management, firm value and other firm attributes in the Chinese context. In addition, this study is the first study of Chinese firms to use panel data analysis methods in the examination of the impact of environmental management on firm value. The results of panel data analysis show that environmental management has no significant impact on firm value. Pearson tests show that prior financial performance does not affect the level of environmental management. Rather, firm size is shown to be positively correlated with the level of environmental management.

Keywords: environmental management; firm value; Chinese manufacturing industry.

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1 Introduction

Managers, investors and academics are currently grappling with the question of the extent to which environmental management contributes to financial performance and is related to other firm attributes. There have been mixed opinions and conclusions on the answer to the question both theoretically and empirically. While the essence of the controversy is easy to comprehend, a consensus regarding the financial performance ramifications of environmental management initiatives and the relationship between firm attributes and environmental management efforts still eludes managers, government policymakers and scholars.

Furthermore, environmental management is a relatively new concept among Chinese firms and many Chinese managers are still convinced of neither the benefits nor the need to adopt environmentally responsible initiatives. This study offers an empirical analysis of the impact of environmental management on firm value in Chinese manufacturing industry after controlling for the influences of other factors that may affect firm value. It

also aims to evaluate the significance of firm-specific factors – such as whether a firm is state-owned – that may influence the level of environmental management at a manufacturing enterprise. The findings of this study have implications for both managers and policy makers in addition to scholars. This study is, to the best knowledge of the authors, the first empirical study to examine these issues in the Chinese context.

This paper is organised as follows. In Section 2, the authors draw on previous scholarship to explain why environmental management should be evaluated separately from environmental performance. The authors develop hypotheses based on previous studies of the relationship of firm-specific factors and environmental management. The authors next draw on previous scholarship to develop an index of environmental management. Then, this paper presents the means by which data are gathered and analysed and the empirical results of the hypothesis testing. This paper concludes with a summary of key findings and suggestions for future research.

2 Literature review and hypotheses

According to Claver et al. (2007), environmental management is

“the part of the management system that includes the organizational structure, the responsibilities, practices, procedures, processes and resources meant to achieve and maintain a specific environmental behavior that can reduce the impact caused by enterprise operations on the natural milieu”

and environmental performance is “the environmental impact that the enterprise’s activity has on the natural milieu”.

The definition of what precisely constitutes environmental management has evolved. Klassen and McLaughlin (1996) suggest that environmental management encompasses two parts:

- 1 environmental management systems
- 2 product and operation technologies designed to minimise negative environmental impacts.

They believe that environmental management improves firm financial performance by

- 1 improving market share
- 2 leading to cost savings.

Their study indicates that environmental performance is determined by environmental management initiatives and thus assessment of environmental performance can be substituted for the measurement of environmental management. They suggest that the announcement of positive environmental news (such as the receipt of environmental awards) can be used as an indicator. The sample in their study includes 96 different firms listed on the New York stock exchange or US stock exchange. Their event study shows that the announcement of positive environmental events results in significant and positive changes in market valuation.

The authors of this paper agree with Kolk and Mauser (2002) that environmental management should be distinguished from environmental performance and that environmental performance should not be treated as the only indicator of environmental

management. Firstly, by definition, environmental management encompasses all the efforts that the firm makes to minimise its negative impact on the environment, while environmental performance measures how successful the firm is in reducing its negative environmental impacts. Environmental management is the process while environmental performance is the result. Secondly, some industries are inherently more environmentally damaging than others. Even within industries, companies begin with different baselines of performance. Thus, firms in different industries and even firms within the same industry can require vastly different amounts of time – even with equivalent environmental management efforts – to alter their environmental impacts. Thirdly, in the scholarly literature concerning the construction of environmental performance measurement (EPM) models, environmental management is treated as a distinct variable (Xie and Hayase, 2007). Fourthly, according to Claver et al. (2007), optimal environmental performance is not necessarily a result of optimal environmental management, arguing that “we must separate the results obtained (environmental performance) from the policies and measures applied to achieve them (environmental management)”. Finally, Xie and Hayase (2007) have also concluded through empirical study that corporate efforts in environmental management may not necessarily lead to good environmental performance. However, a firm’s environmental management efforts can have both short- and long-term effects on the environment. Some environmental management practices have immediate effects which can be effectively measured by environmental performance indicators. Some objective evaluations of environmental performance may therefore reasonably remain among several elements that constitute an evaluation of environmental management. This literature review will now explore previous research into the links between environmental management and financial performance to develop hypotheses.

While there is a broad range of research on the linkages between corporate environmental performance and financial performance since the 1970s (e.g. Bragdon and Marlin, 1972; Elsayed and Paton, 2005; Konar and Cohen, 2001; Spicer, 1978; Wagner et al., 2002), there is relatively less literature investigating the impact of environmental management on financial performance. For example, Stanwick and Stanwick (2000) measured environmental responsiveness by examining the environmental disclosure of firms. Their study utilises contingency tables to examine the issue based on 469 firms listed in the 1994 Forbes 500. The firms were asked whether their organisation had a formal environmental policy and/or environmental commitment. The results show that firms classified as high financial performers disclose environmental policies and/or descriptions of environmental commitment more often than firms classified as low performers, while firms classified as medium financial performers have the highest rates of disclosing firm environmental policies and/or descriptions of their environmental commitment. Through a case study in a farming cooperative in Spain, Claver et al. (2007) conclude that voluntary environmental management improves financial performance relative to competitors in the same industry. Schaltegger and Figge (2000) argue that environmental protection neither adds nor weakens shareholder value, concluding that the effect environmental protection exerts on shareholder value is determined by the manner in which corporate environmental management is practiced. In the Chinese context, Wang and Lin (2006) and Wang and Yuan (2004) have examined the impact of ISO14000 certification on stock price and firm value, respectively, and concluded in both studies that the market rewards firms with ISO14000 certification; however, the event study methodology used in this study is incapable of including the other factors that could

influence stock price and firm value. To the best knowledge of the authors, there has been no empirical study on the relationship between environmental management and firm value in the Chinese context after controlling the influences of other factors that can affect firm value. Following Claver et al. (2007) and previous related studies in China, we arrive at the following hypothesis:

H1: Better environmental management improves firms' financial performance.

Previous studies have examined the effect of some firm-specific factors on environmental management. The following hypotheses concern the effect of firm-specific factors on environmental management for the purposes of the present study.

According to the slack resources theory, better financial performance potentially could result in the availability of slack resources that provide the opportunities for companies to invest in social performance domains like improved environmental management. Better financial performance could lead to improved corporate social performance (Waddock and Graves, 1997). Therefore, we test the following hypothesis.

H2: Firms with better prior financial performance have better environmental management.

Next, firm size appears to affect corporate social performance according to some empirical studies (e.g. Henriques and Sadosky, 1996; Waddock and Graves, 1997; Wagner et al., 2002). The theoretical model for such an effect is based on the fact that larger firms are more publicly visible and therefore have more to gain if they are seen to be conducting business responsibly. Similarly, the larger the firm, the more susceptible it may be to critical public scrutiny, and hence larger firms may be more prone to experience negative external pressure to reform environmental management practices. Additionally, large firms usually have more financial and human resources than small ones; large firms may therefore be more capable of allocating resources to environmental management purposes. Thus, we have tested the following hypothesis.

H3: Larger firms have better environmental management.

Institutional pressure posed by firms' ownership may affect firms' environmental management endeavours (Darnell et al., 2008). In the People's Republic of China, the managers of state-owned firms have close ties with the government. They may draw more public attention and they are far more susceptible to the direct control of public policy makers. On the other hand, close ties with government officials may result in favoured treatment, meaning that state-owned firms may be less likely to be punished for violating environmental regulations. This would suggest that state-owned firms have poorer environmental management compared to other firms. Wang and Jin (2002) found that, according to their survey, state-owned firms in the People's Republic of China have worse environmental performance than firms that were either private, collective or foreign-owned. Therefore, we test the following hypothesis.

H4: State-owned firms have worse environmental management than other types of firms.

Finally, older firms may have stronger environmental management than the younger ones as the older ones would have more experience in managing relationships with stakeholders. Additionally, the managers of older firms may care more about protecting their reputations. Thus, we test the following hypothesis.

H5: Older firms have better environmental management.

To summarise, besides testing for a link between environmental management and firm value, this paper endeavours to answer the question of whether any of the factors above play a role in determining a firm's level of environmental management. As stated by Henriques and Sadorsky (1996), in the process of promoting environmental protection, government regulation is necessary because of externalities and imperfect information. If it is possible to determine what type of firms are less likely to engage in environmental management, this could assist policymakers in crafting appropriate incentives and disincentives and developing efficient and effective oversight. Therefore, it may be useful for policymakers to learn what firm-specific factors are likely to make a firm adopt rigorous environmental management.

3 Models of environmental management

Many models have been developed to measure the rigor of environmental management (Kolk and Mauser, 2002). There are different criteria and foci among the models to evaluate environmental management. Kolk and Mauser (2002) summarise that environmental management involves environmental strategies, policies, communication and commitment. Identical to the elements of the ISO14031 standard, environmental performance evaluation in their study is composed of three elements: environmental management indicators, environmental condition indicators and environmental performance indicators. Among them, environmental management indicators include management efforts to influence an organisation's environmental performance, with regard to

- 1 vision
- 2 strategy
- 3 policy
- 4 organisational structure related to environmental management
- 5 management systems and related documentation
- 6 management commitment to environmental issues
- 7 communication to internal and external stakeholders.

In the European Union, the eco-management and audit scheme (EMAS) is a management tool for companies and other organisations to evaluate, report, and improve their environmental performance. The scheme has been available for participation by companies since 1995. The environmental management index (EMI) of the EMAS consists of four components measured by ten indicators (Official Journal of the European Communities, 2001), as represented in Table 1.

Based on the summary and review of previous EPM models, Xie and Hayase (2007) constructed their own EPM model. In their model, environmental management indicators include the following (Table 2).

Table 1 Components of the EMI of the EMAS

<i>EMI components</i>	<i>Indicators</i>
Costs, investments and operational costs and savings related to the environment	An absolute total: environmentally related investments/year A fraction: environmentally related investments/total investments
Level of implementation and integration of environmental policy and management system	Number of employees trained Number of managers with environmental responsibilities Number of suppliers certified as meeting an environmental standard
Evolution of the relations with local communities, authorities and media	Number of environmentally related complaints Number of negative or positive press reports on company's environmental activity Number of external environmentally related initiatives supported by the company
Conformity with requirements	Level of compliance with both internal or voluntary standards and legal requirements

Table 2 Environmental management components of Xie and Hayase's EPM model

<i>EMI components</i>	<i>Indicators</i>
Organisational system	Existence of an environmental policy and targets Existence of an environmental management system Existence of an environmental accounting and auditing Existence of employee training
Stakeholder relations	Existence of environmental disclosure Environment-related contributions to local communities
Operational countermeasures	Countermeasures to global warming Countermeasures to negative environmental impacts in process and product design Countermeasures to the risks of environmentally damaging accidents
Environmental tracking	Actions taken by a company to track its environmental results

4 Constructing an index of environmental management for evaluating Chinese firms in the present study

Given the fact that environmental reporting has not yet become popular in China, information, that is, needed in any of the above measurement models is sometimes not available, especially as to the quantitative measures such as the number of employees trained and managers with environmental responsibilities. Therefore, in this study, rather than the quantitative indicators used in the EMAS, we use qualitative indicators which are disclosed in firms' annual reports to determine an EMI score.

Firstly, in all of the models above, environmental strategy and targets are a key component (either explicitly listed as such or implied by the indicators in the EMAS). By including environment into its vision statement, a firm publicly acknowledges the environment as one of its stakeholder impacts, which is a precondition to engaging in significant environmental responsibility initiatives.

Secondly, the common component is some measure of the implementation of an environmental protection strategy inside the organisation. In practice, for a firm to protect the environment, there should be pollution prevention measures to mitigate harm to the environment and these measures should be supplemented by remediation measures to offset unavoidable negative impacts. There are several ways for a firm to mitigate its negative environmental impacts. Firstly, a foundation of environmental management is the measurement and tracking of a firm's environmental impacts. Secondly, the existence of an organisational structure related to environmental management provides for managerial oversight and control of these impacts. Thirdly, environmental capacity-building for employees, such as regular workshops on environmental protection, can be an effective means to raise organisational environmental responsibility. Finally, the adoption of less polluting equipment and technology, the research and development of environment-friendly products and the redesign of production processes can all contribute to the reduction of negative environmental impacts. Endeavours in each of the areas above show that a firm is environmentally conscious and taking steps to measure and mitigate negative impacts on the environment. These four indicators have all been included in the previous EPM models.

Thirdly, besides efforts to minimise its own negative environmental impacts, it is also note-worthy if a firm participates in local, national or international environmental remediation or offset programs. Endeavours in these aspects indicate that a firm is, at a minimum, aware of the importance of being seen to be taking actions to preserve common environmental resources. To varying degrees, all the established models include some indicator of this component.

Finally, adopting environmental management standards and receiving local, national or international awards provides evidence of transparent monitoring and compliance with objective, externally determined standards. Complying with voluntary external standards and receiving environmental protection awards lends credibility to the firm's environmental management endeavours.

Based on the foregoing literature review and with supporting reference to prior models of environmental management, the four components and ten specific indicators of the EMI in this paper are shown in Table 3.

Together these ten indicators are demonstrative of more than just a firm's pronouncements and intentions with regard to environmental management; these indicators also demonstrate that a firm is actually implementing environmental management initiatives. This is crucial to the proper measurement of environmental management in the sense that firms may claim that they are environmentally responsible but do not act accordingly, as found by Ulrich et al. (2003).

Table 3 The EMI used in the present study

<i>EMI components</i>	<i>Indicators</i>
Vision, strategy, policy	Specific and explicit mention of environmental protection in the company's vision and strategy
Environmental protection endeavours inside the organisation	Disclosure of the pollution the company has caused Existence of a department charged with environmental protection Occurrence of environmental protection training Development of new technologies that are more environmentally friendly Deployment of new equipment, that is, more environmentally friendly Research and development on new products and processes that are more environmentally friendly
Environmental protection endeavours outside the organisation	Participation in local, national or international environmental remediation or offset programs
Objective evaluation	Certified by ISO14000 Granted environmental protection awards

To establish an EMI score based on these qualitative factors, one point is added to each firm's score for each indicator statement, that is, found to be true. The minimum possible score is therefore zero while the maximum possible score is ten. A higher EMI score indicates a greater rigor of environmental management. A score cannot be reduced by the disclosure of negative information – even if a firm were to report negative information, a point could only conceivably be added, not removed. The reason is that greater disclosure of any kind is treated as an indicator of conscientious environmental management efforts.

As described below, the annual reports of companies are used as the source of data for determining the EMI score of companies.

5 Sampling and modelling

5.1 Sampling

Manufacturing firms listed on the Shanghai stock exchange are specifically chosen as the sample population to avoid the inclusion of drastically different businesses. Those firms that issue B-shares (which are Renminbi-denominated shares traded in US dollars) or H-shares (which are registered in the Chinese mainland but listed and traded in Hong Kong) and those listed as ST (firms getting special treatment on the stock market) are excluded to ensure consistency among samples and to ensure further similarity among the companies in the sample. In all, 337 firms are included in the sample. The sampling period is composed of four years, from 2004 to 2007.

5.2 Measurement of firm value

The most common proxies for firm value include return on equity (ROE), return on assets (ROA), price/earning (P/E) ratio, earnings per share (EPS) and Tobin's q . Lang and Stulz (1994) argue that Tobin's q serves as the best proxy for firm value when making comparisons between firms. This is because accounting measures or the application of other ratios based on stock return requires risk-adjustment or normalisation among firms for comparison. Moreover, firm value is fundamentally related to share value as decided by stock exchanges. Consistent with the definition used by Lang and Stulz (1994), the work of Chung and Pruitt (1994) resulted in a simplified Tobin's q model which yields similar results but depends on fewer financial variables. The present study utilises the simplified Tobin's q model because not all of the firms in the sample disclose all of the data needed for the more complicated means of calculating Tobin's q . The simpler means of calculating Tobin's q is as follows:

$$q = \frac{\text{MVE} + \text{PS} + \text{DEBT}}{\text{TA}}$$

where MVE is the product of share price and the number of common stock shares outstanding, PS is the liquidating value of outstanding preferred stock, DEBT is the value of the firm's short-term liabilities net of its short-term assets plus the book value of the long term debt and TA is the book value of the total assets.

5.3 Controlling variables

When testing Hypothesis 1, a series of variables are included to control for other potential influences on firm performance. Al-Tuwaijria et al. (2004) have proven that growth (measured by the ratio of equity market value to book value) should be introduced to the firm value equation. Wahba (2008) demonstrates that capital intensity, risk and size all have significant impacts on the relationship between environmental responsibility and firm value. Chapple et al. (2001) assert that firms with different capital intensity impose different influences on the environment. To take into account the differences between light and heavy industry, capital intensity is introduced into our model. According to Konar and Cohen (2001), Elsayed and Paton (2005) and Wahba (2008), capital intensity ought to be measured by the ratio of fixed assets to total assets. McWilliams and Siegel (2001) argue that efforts to differentiate products may include investment in R&D projects to add social and environmental attributes to the product that are potentially valued by customers and advertising may help to raise consumer awareness of environmental friendly products and how they differ from other products. Therefore, it is necessary to control for the influences that R&D and advertising expenditures may have on firm value. The ratio of R&D expenditures to sales and the ratio of intangible assets to total assets are chosen as proxies for R&D and advertising, respectively.

Table 4 Variable names, meaning, attribute and measurement

<i>Name</i>	<i>Meaning</i>	<i>Attribute</i>	<i>Measurement</i>
EMI	Environmental management index	Ordinal	Scores collected from annual reports
q	Firm value	Ratio	(share price \times number of common shares + liquidating value of preferred stocks + short-term liabilities – short-term assets + long-term liabilities)/Total asset
CI	Capital intensity	Ratio	Fixed asset/Total asset
DA	Asset-liability ratio	Ratio	Liabilities/Total asset
SIZE	Firm size	Ratio	Logarithm of total asset
MBE	Growth	Ratio	Market value of equity/Book value of equity
RD	R&D spending	Ratio	R&D expenditure/Sales
ADV	Advertising spending	Ratio	Intangible asset/Total asset
OWN	Ownership	Nominal	1 if state-owned or controlled, 0 otherwise
AGE1	Number of years since the foundation of a firm	Ratio	Number of years since the foundation of a firm
AGE2	Number of years since the IPO of a firm	Ratio	Number of years since the IPO of a firm

As to the tests of Hypotheses 2 and 3, the measure of prior firm value and firm size are described immediately above. For Hypothesis 4, a dummy variable is introduced to show the type of firm ownership with the value of 1 indicating that the firm is state-owned or state-controlled and 0 otherwise. Then, firm age must be added to test Hypothesis 5. Here, we list two types of firm age: age calculated from the date of the firm's founding and, separately, the firm's age calculated from the date of the firm's listing, as determined by the firm's initial public offering (IPO).

The names, meanings, attributes and measurements of variables are listed in Table 4.

5.4 Data source

All of the financial and accounting data used in this study is from the Wind database (Wind is a leading financial data and financial software provider in mainland China). Manufacturing firms are identified in accordance with the Industry Classification Benchmarks issued by the China Security Regulatory Commission. The annual reports are available at the Shanghai stock exchange website and are the source of data for this study.

5.5 Methodology

Panel data models are used to model the impact of environmental management (measured by EMI) on firm financial performance (measured by Tobin's q) from 2004 to 2007. Panel data sets possess several major advantages over conventional cross-sectional or time-series data sets. Using panel data leads to a large number of data points, an increased degree of freedom, and reduced collinearity among explanatory variables,

improving the efficiency of the estimates. We estimate two variable-intercept models – fixed effect and random effect – and then test for the consistency of the random effects estimator by conducting the standard Hausman test statistics. A significant value for the Hausman test statistic would imply that the random effects estimators are inconsistent and that the fixed effects estimates are more appropriate.

Because environmental management was most widely adopted in 2007, data from 2007 are used to test the relationship between EMI and firm-specific variables. Cross tables are used to measure the correlation. Firstly, the firms are separated into three different groups based on the value of Tobin's q in 2006. The first group, labelled low performers, consist of firms having Tobin's q scores in the lowest third of all firm scores in the sample. The second group, medium performers, represents firms in the middle third of this ranking. The third group, or high performers, includes the top third of firms based on the value of their Tobin's q . Secondly, the firms are separated into three different groups according to their size. The small firms are those in the smallest third based on firm size. The second group includes the firms in the middle third in terms of firm size. The third group, large firms, represents the top one-third of firms based on their size.

6 Empirical results

6.1 Scores on the EMI

The mean and range of EMI scores of different sub-sectors in the manufacturing industry are shown in Table 5.

Table 5 Mean and range of EMI each year

<i>Manufacturing sub-sectors</i>	<i>Sample size</i>	<i>Mean of EMI</i>				<i>Range of EMI</i>			
		2004	2005	2006	2007	2004	2005	2006	2007
Food & Beverage	25	0.20	0.28	0.52	2.56	2	2	4	5
Textile & Clothing & Leather	25	0.28	0.44	0.52	2.20	2	2	3	7
Wood & Furniture	2	0.5	1.0	1.0	2.0	1	2	2	4
Paper & Printing	13	1.46	1.69	1.77	3.15	6	6	6	6
Oil & Chemical & Plastic	59	0.75	1.75	2.00	3.02	3	5	5	7
Electronics	23	0.57	0.83	1.04	0.96	2	4	5	4
Metal & Metalloid	54	0.74	1.70	1.80	2.80	4	7	7	6
Machine & Equipment & Instruments	84	0.75	1.31	1.42	1.39	3	4	5	7
Medicine & Biologicals	42	0.71	0.86	0.98	1.79	3	6	7	5
Others	10	0.6	0.8	1.1	1.1	3	2	4	3
Total	337	0.68	1.22	1.37	2.13	6	7	7	7

It can be seen from the bottom line of Table 5 that environmental management is generally weak among Chinese firms relative to the top scores that are theoretically possible and relative to the top scores that are actually achieved by firms in this sample. This is possibly a result of the lack of popularity of environmental data reporting and lack of the awareness that environmental disclosures may be valued in annual reports. The scores are not relatively low as result of negative disclosures because more disclosure – even a negative disclosure – results in a point being added to an EMI score. Secondly, this table demonstrates that environmental management has been strengthened from 2004 to 2007, which may reflect the increasing attention of society and government to corporate environmental responsibility. Thirdly, the large range of EMI scores across firms illustrates the big differences in the levels of environmental awareness and responsibility among different firms.

Table 5 also shows different EMIs among different sub-sectors. The Paper & Printing sector maintains a relatively higher level of environmental management, while the Metal & Metalloid and Oil & Chemical & Plastic sectors show the fastest development in environmental management. This is not surprising, considering that these three sub-sectors generate relatively heavier negative impacts on the environment and therefore have greatest potential and the strongest pressure to improve. This is also consistent with a well-established pattern in more developed economies: companies with heavier negative impacts on the environment are the early adopters of the practice of greater voluntary environmental reporting on their environmental initiatives and performance. The data also clearly indicate that 2007 was the year in which disclosures related to environmental management grew the most. Except for the EMI scores of the Electronics sub-sector and the sub-sector labelled Machine & Equipment & Instruments, both of which experienced a slight decrease, the EMI scores of all the sub-sectors have increased by a large percentage. The data in Table 5 suggest that environmental management has become increasingly popular; at a minimum, it indicates that Chinese firms are publicly disclosing more information related to environmental management.

6.2 Descriptive statistics and correlation coefficients of key variables

The mean, standard deviation, correlation coefficient and the significance of the key variables are presented in Table 6. Moreover, to detect the degree of multicollinearity among the key independent variables in the firm-value and EMI equation, the variance inflation factors (VIFs) of the independent variables are calculated, also listed in Table 6. It is shown that the multicollinearity among the key independent variables is not a problem for data modelling.

Table 6 Descriptive statistics and correlation coefficients of key variables

	Mean	SD	Q	EMI	CI	DA	SIZE	MBE	RD	ADV	AGE1	AGE2
Q	1.4187	1.08795	1									
EMI	1.47	1.672	0.074**	1								
CI	0.3752	0.17148	-0.161**	0.163**	1							
DA	0.4779	0.16482	-0.104**	0.121**	0.093**	1						
SIZE	21.3818	0.91618	-0.033	0.248**	0.126**	.375**	1					
MBE	2.2041	2.50087	0.838**	0.098**	-0.186**	.113**	0.042	1				
RD	0.0016	0.00668	-0.05	-0.068*	-0.057*	-.100**	-0.029	-.083**	1			
ADV	0.0312	0.03615	0.061*	-0.074**	-0.101**	.093**	-.111**	.096**	-0.02	1		
AGE1	9.39	3.504	0.124**	0.02	-0.078**	.123**	.144**	.185**	-.082**	.182**	1	
AGE2	6.05	3.379	0.153**	0.057*	-0.089**	.201**	.260**	.217**	-.129**	.214**	.609**	1
VIF				1.103753	1.091703	1.20919	1.246883	1.082251	1.02145	1.052632		

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

6.3 Result of the test for Hypothesis 1

Hypothesis 1 is tested by both the fixed effects model as well as the random effects model. The environmental management coefficient is not significant in the fixed effects and random effects models at conventional levels. Meanwhile, the Hausman test is highly significant, suggesting that the random effects estimates may be inconsistent. Thus, the panel model provides little evidence that environmental management significantly affects firm performance (Table 7). Thus, Hypothesis 1 is rejected.

Table 7 The impact of environmental management on financial performance using panel data analysis

<i>Dependent variable (Tobin's q)</i>	<i>Fixed effect</i>	<i>Random effect</i>
Constant	−0.768025 (1.452469)	1.126314** (0.379344)
EMI	0.020075 (0.013722)	0.007201 (0.009443)
CI	0.292106 (0.255869)	0.103920 (0.092334)
DA	−2.085851*** (0.270198)	−1.354840*** (0.101147)
SIZE	0.106221 (0.068804)	0.002943 (0.018495)
MBE	0.361616*** (0.007668)	0.375253*** (0.006211)
RD	−9.251673** (3.522665)	0.251795 (2.275852)
ADV	−0.285221 (0.823732)	−0.005161 (0.428006)
Hausman		31.295399***
Number of observations	1348	1348

**The value is significant at 1% significance level.

***The value is significant at 0.1% significance level.

Note: Figures in parentheses are standard errors.

6.4 Results of the tests for Hypotheses 2–5

The chi-square tests in Table 8 show that the EMI score is positively correlated with firm size at the significance level of 5%. Thus, Hypothesis 3 is supported; firm size does appear to be a good predictor of the rigor of a firm's environmental management. Hypotheses 2, 4 and 5 are rejected at the significance level of 5%.

Table 8 Chi-square tests for the correlation between environmental management and firm-specific factors

<i>Statistics</i>	<i>Paired variables</i>	<i>Statistics value</i>	<i>p-value</i>
Pearson chi-square	EMI and prior financial performance	15.454	0.348
	EMI and firm size	31.549	0.005*
	EMI and firm ownership	9.938	0.192
	EMI and firm age (foundation)	20.494	0.115
	EMI and firm age (listing)	19.576	0.144

*The Spearman correlation is 0.244 with *p*-value of 0.000.

The lack of correlation between prior financial performance and environmental management among the companies in this study is significant in as much as it may contribute, over time, to a body of findings that refute the widely held presumption that only thriving firms can afford to be environmentally responsible.

According to a survey conducted in 2001 by Ulrich, Fang and Lu although larger companies were heavier polluters, these companies had a less positive attitude towards environmental management than the average. Several years later in 2007, we find that larger firms have attached more importance to environmental management relative to smaller companies. Therefore, the one proven hypothesis of this study is highly significant, inasmuch as the positive correlation between firm size and the rigor of environmental management indicates increasing engagement by Chinese managers – especially at larger firms – in environmental management.

7 Conclusions

Previous studies have examined the relationship among environmental management, firm value and firm attributes using data from the USA, Canada and other developed countries but relatively few empirical studies have used data from the developing world. This study enriches the scholarship of the relationship among environmental management, firm value and firm attributes by filling this critical gap. Data on Chinese manufacturing companies listed on the Shanghai stock market from 2004 to 2007 are analysed. Companies are scored using an EMI and financial data are collected from these four years. Panel data regression tests and Pearson correlation tests are performed using these data.

Our panel data estimates suggest no significant impact of environmental management on financial performance. This conclusion is consistent with the theoretical argument of Schaltegger and Figge (2000) but in contradiction with previous studies in the People's Republic of China. Given the different conclusions of the studies, one may speculate that, besides the influence of different samples and varying methodologies, the impact of environmental management on shareholder value depends on the specific ways that environmental management initiatives are implemented. This would be consistent with the suggestion of Christmann (2000) that different environmental management practices affect different types of competitive advantage. Schaltegger and Synnestvedt (2002) have also argued that the variety of environmental management influences its financial impacts. Therefore, while this study enriches knowledge on the relationship between environmental management and financial performance, it also introduces the need to further identify the precise ways in which various elements of environmental management impact firm value in the Chinese context.

As to the correlation between firm-specific factors and environmental management, the Pearson tests show that larger firms tend to attach more importance to environmental management. There is no significant correlation between prior financial performance and environmental management, thus refuting the widely held presumption that only thriving firms can afford environmental responsibility initiatives. Neither the correlation between the type of ownership and environmental management nor the correlation between firm age and environmental management is significant at conventional levels. These conclusions are helpful for both policy makers intent on promoting corporate environmental responsibility and for scholars engaged in this field of research.

Finally, this study shows that Chinese firms are, at a minimum, disclosing more information related to environmental management, which points to two directions for future research. Firstly, in light of the increasing disclosures, the EMI used in this study can be refined in future studies. Secondly, the sampling period of 2004–2007 was a germination stage for Chinese environmental management and a very initial stage in the promotion of corporate environmental responsibility, which has become popular in the majority of Western countries. As the Chinese public's awareness of environmental issues grows, the relationship between environmental management and firm value as well as the ways in which environmental management may affect firm value will continue to merit attention and investigation.

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