

The Effect of Environmental Information Disclosure on Firms' Market Value : Empirically Comparative Study from Panel Data of Heavy-pollution Industries in China

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Abstract: - This article proposes empirically comparative study of the effect of environmental information disclosure on market value of listed firms using unbalanced panel data samples in Chinese heavy-pollution industries. Environmental information disclosure (EID) is mutually causal relationship with market value of listed firms, environmental information disclosure has a significant impact on market value of listed firms at the 90% significant level. Environmental information disclosure has a significantly positive impact on market value of listed firms in coal-oil-gas mining and steel industries at the 90% significant level. However EID is negatively related with market value of listed firms in thermal-electronic, nonferrous metals, chemical, construction and building-materials and textile-garment -leather industries at the 90% significant level. Compared with their effects of EID on market value of listed firms, listed firms in coal-oil-gas mining and steel industries with significantly positive effects voluntarily disclose more environmental information than listed firms in other heavy-pollution industries with negative effects. From the fixed effects coefficients of panel data, the intercept effects EID on market value of listed firms have obviously periodic divergence from 2008 to 2012.

Key-Words: - environmental information disclosure; market value; heavy-pollution industries; Tobin's Q; unbalanced panel analysis;

1 Introduction

With environmental problems ever-increasingly deteriorated, Chinese Ministry of Environmental Protection and social public have paid much attention on environmental management of listed firms. Environmental information disclosure (EID) is of the main information channels for stakeholders to understand environmental management activities and environmental performance of listed firms. Quality improvement of environmental information disclosure is not only helpful for stakeholders to supervise firms' environmental management behaviours and improve firms' environmental performance, but also helpful for stakeholders to transmit the information fulfilled environmental responsibility and maintain firms' social images. If pricing scheme of capital market fully plays the key

role of market information, better or worse environmental information disclosure has a significant impact on financial performance of listed firms.

The relationship between EID and financial performance is the core issue of environmental management. Current home and abroad scholars argue that the relationship issues between environment information disclosure and financial performance has three different effects: significantly positive correlation, significantly negative correlation and non-significant correlation. Some scholars' results show that the relationship between EID and financial performance exhibits a significantly positive correlation. Earnhart and Lizal (2006) believe that financial performance and ownership structure have positive impacts on

environmental information disclosure, and their results show that state ownership and concentrated ownership is better than private ownership in environmental information disclosure, better financial performance can improve future EID quality in a transition economy [1]. Clarkson, Overell and Chapple (2011) examine that firms size, leverage, Tobin's Q value, and stock price volatility have significant impacts on EID, and listed firms with heavy pollution voluntarily disclose more reliable and accurate environmental performance indicators using various forms among annually financial reporting, environmental reporting, and sustainability reporting, enhanced mandatory reporting requirements and improved enforcement can improve future environmental performance and financial performance of listed firms with heavy pollution [2]. Zeng et al. (2009), Zeng et al. (2012) show that industry type, firm size, marketization and ownership structure have significant effects on environmental information disclosure [3-4]. Liu and Anbumozhi (2009) identify that better economic performance, environmental sensitivity and marketization have significant impacts on EID [5]. Russo and Fouts (1997), Dowell et al. (2000) verify that excellent environmental performance may improve firms' operating efficiency, enhance stakeholders' market expectations and increase market value of listed firms [6-7]. Konar and Cohen (2001) examine that better information disclosure of greenhouse gas increases market value of listed firms, while worse information disclosure of greenhouse gas and waste reduces market value of intangible assets [8]. Orlitzky et al. (2003), Salama (2005) find that if listed firms can control greenhouse gas and waste emission, better EID inclines political risk costs, environment-related costs and other production costs, and then achieves greater capital returns [9-10]. Montabon, Sroufe and Narasimhan (2007), Lucas and Wilson (2008) verify that better environmental management practices improve firm's financial performance, firms leaders in environmental information disclosure have higher financial performance than firms laggards [11-12]. Wahba (2008) examines that listed firms with active environmental investment are more attractive to institutions investors, information disclosure of environmental responsibility increases investment preferences of institution investors [13]. Nakao et al. (2007), Monevan and Ortas (2010) believe that better environmental regulatory policies and stakeholders' pressures force corporate managers to highlight an effective environment-protection policies in strategic management, and then improve financial performance and meet stakeholders'

interests demands in environmental management [14-15]. Sueyoshi and Goto (2010), Thoumy and Vachon (2012) examine that research and development in environmental technology and green environment-protection practices increase firms' profitability in environmental management practices and then improve financial performance of listed firms. Resource and environment efficiency theory believes that environment pollutions exhibit non-efficient and non-effective resource allocation, stringent environmental regulation and EID stimulate firms to push low-carbon technology progress and management innovation in environmental protection [16-17]. EID may reduce operating costs and enhance market competitive advantages of listed firms [9-10], may create good social reputation and increase investors' confidence [2][13], may effectively use market opportunities [2][8], these advantages significantly improve financial performance of listed firms.

Traditionally classic theory suggests that actively environmental protection and market competitiveness are contradictory. Listed firms achieve social benefits from environmental protection practices while inevitably increasing private producing costs, and then reduce their market competitiveness. Whether or not heavy-pollution firms attain benefits from environment-protection practices has paid much attention by supervisors in Ministry of Environmental Protection, corporate managers and stakeholders. Some scholars' results exhibit that the relationship between EID and financial performance exhibits significantly negative or non-significant correlation. Filbeck and Gorman (2004) suggest that stringent environmental regulations increase environment-related operating costs under the U.S. clean air act, and damage maximum shareholders wealth, accordingly active EID reduces financial performance of listed energy firms [18]. Sueyoshi and Goto (2009) examine that information disclosure in environmental investment and expenditure has an obviously different effect on financial performance, information disclosure of environmental investment is positively related with corporate financial performance, while information disclosure of environmental expenditure is negatively related with corporate financial performance [19]. Firms' managers and market investors argue that disclosing more environmental expenditure information may increase financial burdens of heavy-pollution firms. Iwata and Okada (2011) argue that environmental indicators such as greenhouse gas and waste emissions have significantly different impacts on financial

performance of manufacturing firms in Japanese, information disclosure of greenhouse gas emissions is positively related with financial performance, while information disclosure of waste emissions is not significantly related with financial performance [20]. Lioui and Sharma (2012) examine that EID has a significantly negative impact on ROA and Tobin's Q value, greater EID drives corporate managers to increase research and development investment, and then inclines investment returns in environmental protection projects [21]. Chang and Wang et al. (2012) propose a new N-factor affine term structure model for CO₂ futures price and their empirical results show that CO₂ futures prices and convenience yields follow significant mean-reversion process [22]. Chang et al. (2012) find that term structure of stochastic multi-factors has a significant effect on futures options valuation for CO₂ emission allowances, and they estimate the theoretical futures options valuation by using historical market information [23]. Chang (2013) propose the market behaviour of convenience yields and examine the options feature of convenience yields for emission allowances, their empirical evidence show that market participants can flexibly adjust portfolio policies of emission allowances assets and achieve extra market arbitrage revenues through exchanging emission allowances assets between spot and futures [24]. Chang (2013) presents the empirical evidence of the effects of ownership and capital structure on environmental information disclosure, their empirical results show that state legal-person ownership, non-state ownership, ownership concentration, financial leverage, long-term debts and short-term debts have significantly positive impacts on environmental information disclosure [25]. Zhu and Dong(2013) simulate this kind of fractals and their geometric constructions in Matlab environment and our results are also interesting results to enrich the theoretical and applied research of fractal simulation[26].Mou and Zhang (2013) develop a stochastic chance-constrained programming model (SCCPM) for minimizing the crew cost and maximizing the passenger satisfaction in order to take into account of effects of random factors such as weather, air traffic control, passenger demand, etc[27].Many countries have greater differences in political system, legal system, institution environment and economic growing phase, listed firms in different industries undertake differently environmental responsibility, environmental information disclosure degree exhibits significantly different. In brief, environmental investment, environmental regulations, environmental management practices

and environmental information disclosure may have adverse effects on financial performance of listed firms.

Does EID degree of listed firms have an active impact on stock pricing scheme and firms' financial performance? Heavy-pollution industries are greater emission and heavier pollution industries, those industries are frequently supervised by Ministry of Environmental Protection and other stakeholders. Chinese government urge listed firms in heavy-pollution industries to strictly carry out environment-protection laws and regulatory policies, and to avoid environmental risk, investment risk and political risk induced by environmental pollution problems. Listed firms confront enormously political and social pressures, they have a strong motivation to voluntarily disclose more environmental information using annually financial reporting, environmental reporting and social responsibility reporting etc, and thus greater EID may improve financial performance and meet stakeholders' interests.

Compared with the above literatures, we have three innovative contributions in this article. Firstly, Chinese capital market is an emerging and immature market, we collect listed firms disclosing environmental information in eight heavy-pollution industries from 2008 to 2012, and propose the effect of environmental information disclosure on financial performance using unbalanced panel data. Secondly, based on 30 environmental performance indicators issued by global reporting initiative (GRI), we provide statistical estimation of environmental information disclosure for listed firms in eight heavy-pollution industries from 2008 to 2012. Thirdly, we comparatively analyze greater behaviour divergences in disclosing environmental information, our empirical results show that EID has a significantly positive impact on market value of listed firms in coal-oil-gas mining and steel industries, while EID has a significantly negative effect on market value of listed firms in thermal-electronic, nonferrous metals, chemical, building-materials and textile-garment-leather industries. Our empirical results are not only helpful for stakeholders to explain behaviour motivation in environmental information disclosure, and corporate managers can improve financial performance and increase shareholders wealth using environmental information disclosure, but also helpful for government decision-makers to urge listed firms to carry out environmental management practices using market scheme and capital market platforms, and then government decision-makers

can make scientific and correct environment-regulatory policies.

The remainder of this paper is organized as follows. Section 2 discusses theory analysis and related hypothesis. Section 3 presents estimated methodology and variables explanation. Section 4 discusses data source and statistical description of environmental information disclosure. Section 5 proposes empirical results. Section 6 concludes the paper.

2 Theory Analysis and Hypothesis Development

The effect of environmental information disclosure on financial performance has two different theory. Traditional environment theory argues that environmental management practices have negative impacts on financial performance of listed firms. Environmental management activities increase research and development inputs of environmental technology and assets investment of environmental facilities. As a result, those behaviours increase depreciation and administration fee of environmental assets, enhance related cost of EID and waste disposal costs etc, those activities increase environmental management cost and market operating risks. Traditional environment theory holds that environmental management problems of listed firms force the governors to strengthen environmental regulation and intervention, and improve social effects of environmental management using rigid regulation laws and economic penalties. Supporting environment theory believe that environmental management activities have positive impacts on financial performance of listed firms. Environmental management practices improve energy use efficiency and production efficiency using energy-saving and emission-reduction technologies, and then reduce operating costs of listed firms. Those costs savings include direct and indirect energy assumption inclines, material losses decline, the abatement of waste disposal cost and environmental recovery costs, the incline of pollution-controlling costs and political risk costs etc. Supporting theory holds that many environmental management practices is helpful to relieve the pressures from stakeholders, improve firms' brand images and social images, expand market shares and improve market competitiveness by attracting more and more consumers buy green products, and strengthen stakeholders' investment confidence and returns of assets. Supporting environment theory holds that

listed firms effectively avoid government regulation, laws sanction and the loss of customers' confidence and investors' confidence induced by environmental problems. Environmental management problems can be solved by market scheme, and EID can transmit good information of environmental protection practices through capital market platform, enhance stakeholders' good market responses, and then promote positively interacted environmental protection effects between governors and enterprisers.

Discretionary disclosure theory believes that listed firms disclose beneficial information while substituting adverse information when they voluntarily disclose information [28]. With an increase of assets and capital sizes, listed firms are able to develop more efficient environment-protection technologies with sufficient finance resources, carry out environmental protection practices and voluntarily disclose more environmental information. Higher EID is helpful for listed firms to communicate with stakeholders using verified environmental information. Listed firms with greater assets size voluntarily deliver and communicate more environmental information using social responsibility reporting, sustainability reporting and environmental reporting etc. Stakeholders theory debates that listed firms require stakeholders supports and recognitions when continually improving financial performance and environmental performance, and tell stakeholders firms' supporting standpoint, efforts and achievements in executing environmental responsibility [29]. Governors and social public pay much attention to supervising listed firms in heavy-pollution industries. Listed firms should voluntarily disclose more environmental information, strengthen stakeholders' investment confidence, reduce external stakeholders misunderstanding environment-protection practices, and improve their public relationship. Listed firms in heavy-pollution industries should achieve exceptive balance of these conflicting targets both environmental performance and financial performance. In adverse side, rigid environment-protection laws and stakeholders' pressures compelled listed firms to increase green investment, to carry out energy-saving and emission-reduction policies. Those measures increase listed firms' operating costs and market risk, enhance their financial burdens and then reduce their financial performance. In favourable side, many environmental management activities cut down their environment-related costs and improve their profitability and financial performance. Listed firms in heavy-pollution industries require the most

optimized balance relationship from two conflicting interests. More EID can eliminate misunderstanding and anxiety of environmental performance for stakeholders through transmitting more environmental responsibility information. Based on the above theoretical analysis, we propose two following hypothesis.

Hypothesis 1: there is a causal relationship between environmental information disclosure and market value of listed firms.

Hypothesis 2: environmental information disclosure is significantly related with market value of listed firms.

3 Methodology Estimation

In order to examine the effect of environmental information disclosure on market value of listed firms, foreign scholars select Tobin's Q value as estimating market value of listed firms. Konar and Cohen (2001) [8], King and Lenox (2002) [30] verify that greenhouse gas information disclosure has a significant impact with Tobin's Q value. Nokao et al. (2007) find Japanese manufacturing firms have strong motivation to disclose more environmental information, outstanding environmental performance significantly improve financial performance of listed firms, such as returns of assets (ROA) and Tobin's Q value. Market values of listed firms are composed of market values both tangible and intangible assets [14]. Market values of tangible assets include the placement value of assets, such as plant, equipment, cash and inventory. Market values of intangible assets are composed of product factors higher than returns of tangible assets and excess profitability of special resources, mainly including patents, brands, owned special resources (monopoly and natural resources) and firms reputation. In brief, we select Tobin's Q value as estimating market value of listed firms, considering environmental information disclosure, assets size, leverage of assets, capital intensity and income growth, we propose the following empirical model.

$$Q_{it} = \alpha_0 + \alpha_1 EID_{it} + \alpha_2 SIZE_{it} + \alpha_3 LEV_{it} + \alpha_4 CAP_{it} + \alpha_5 GROWTH_{it} + \mu_j + \varepsilon_{it} \quad (1)$$

Where i denotes the firm, j shows the industry, μ_j is the industry-specific fixed effects, and ε is the standard error term. Q_{it} denotes market value of listed firms estimated as Tobin's Q value at

time t year. EID_{it} denotes environmental information disclosure at time t . $SIZE_{it}$ denotes assets size of listed firms at time t , estimated the natural logarithm of book value of total assets at t year-end. LEV_{it} denotes the assets leverages at time t , estimated that total liabilities are divided by book value of total assets. CAP_{it} denotes capital intensity at time t , estimated that total revenues are divided by owned equity. $GROWTH_{it}$ denotes revenues growth, estimated that the difference of total revenues between year-end and year-beginning are divided by total revenues at the beginning of year.

4 Data Source

Ministry of Environmental Protection in China (MEPC) had issued the notice of environmental protection verification on applying for initial public offering and refinancing of listed firms (MEPC [2003], No.101) and the notice of environmental protection verification on further regulation of initial public offering and refinancing of manufacturing firms in heavy-pollution industries (MEPC [2007], No.105). Those notices provide that heavy-pollution industries include 13 industries, such as thermal electronic, steel, non-ferrous metals, chemical, coal-mining, petrochemical, building-materials, papermaking, brewing, pharmaceutical, textile, leather etc. This paper select that thermal-electronic, steel, nonferrous metal, chemical, coal-mining and petrochemical, building-materials pharmaceutical and textile-leather industries, listed firms in eight heavy-pollution industries disclose environmental information using social responsibility reporting and sustainable environment reporting. Considering the continuity and comparability of social responsibility reporting and environmental reporting issued by listed firms, we choose social responsibility reporting issued by listed firms from 2008 to 2012 as empirical data samples, including 23 firms in thermal-electronic industry, 16 firms in steel industry, 19 firms in nonferrous metal industry, 20 firms in chemical industry, 14 firms in coal-mining and petrochemical industry, 14 firms in building materials industry, 24 firms in pharmaceutical industry, and 12 firms in textile and leather industry. We eliminate missing data of social responsibility reporting and environmental reporting induced by individual firms, and then we collect 684 social responsibility reports and environmental reports. Social responsibility reporting and environmental

reporting are from syntao-sustainability solutions network and CNINFO network. Based on 30 environmental performance indicators in sustainability reporting guidelines issued by global reporting initiative (GRI) in 2006, we collect and estimate EID score. Tobin’s Q value and other related financial performance are from CSMAR database, CNINFO database and GENIUS finance database.

5 Environmental Information Disclosure Estimation

Environmental information disclosure (EID) is measured as the actual score of environmental performance indicators (EPI) are divided by optimal score 124 of environmental performance indicators. Based on 30 environmental performance indicators issued by global reporting initiative (GRI), we provide a combinative estimation of quantitative and qualitative methodology, including 17 core indicators and 13 supplementary indicators. Estimated benchmarks are defined as following methodology. Measured the core indicators, we propose a combination of quantitative and qualitative estimation. Detailed information disclosure is marked 5 score, however inadequate disclosure is marked 3 score in quantitative and qualitative disclosure. Only qualitative description is marked 1.5 score, undisclosed environmental information is marked 0 score. Measured the supplement indicators, detailed information disclosure is marked 3 score, inadequate disclosure is marked 1 score and undisclosed environmental information is market 0 score.

$$EID_t = \frac{\sum_{j=1}^{30} EPI_{jt}}{124} \tag{2}$$

Table 1: Statistical description of environmental information disclosure of listed firms in heavy-pollution industries.

<i>Industries</i>	Thermal electric	Steel	Non-ferrous metal
mean	0.208976	0.285243	0.176910
maximum	0.629032	0.600806	0.600806
minimum	0.028226	0.052419	0.028226
Standard deviation	0.130366	0.125830	0.105730
samples	115	77	95
Industries	Chemical	Coal-oil-gas	building-materials

		mining	
mean	0.144851	0.265286	0.144921
maximum	0.479839	0.685484	0.403226
minimum	0.008065	0.040323	0.020161
Standard deviation	0.116981	0.173996	0.101508
samples	91	67	67
Industries	Pharma-ceutical	Textile, garment-leather	
mean	0.150692	0.140309	
maximum	0.552419	0.399194	
minimum	0.016129	0.008065	
Standard deviation	0.116183	0.104769	
samples	113	59	

Seen from table 1, listed firms in different industries have greater divergence in environmental information disclosure. The mean of EID from listed firms in steel industry is the highest, the mean of EID from listed firms in textile, garment-leather industry is lowest. Listed firms in steel and coal-oil-gas mining industries voluntarily disclose more environmental information, while listed firms in thermal-electronic, chemical, building-materials pharmaceutical and textile-garment-leather industries disclose lower environmental information. From the standard deviation of EID, the standard deviation of EID from listed firms in coal-oil-gas mining industry is the greatest, the standard deviation of EID from listed firms in textile, garment-leather industry is smallest. Listed firms in thermal-electric, steel and coal-oil-gas mining industries have greater divergence in environmental information disclosure, while listed firms in nonferrous metals, building-materials and textile, garment-leather industries have smaller divergence in environmental information disclosure.

6 Empirical Results Discussion

6.1 Examining Causal Effects of EID on Market Value of Listed Firms

In order to examine the causal effects of environmental information disclosure on market value of listed firms, we propose empirical causal relationship using Granger causal methodology. Seen from table 2, in the original hypothesis of the effect of Tobin’s Q value on environmental information disclosure, F-statistic values are much greater than 1 and their probabilities are lower than

5% in thermal-electronic, chemical, building-materials and textile-garment-leather industries, these results reject the original hypothesis at the 95% confident level, these results show that Tobin's Q values have causally related with EID at the 95% significant level. Similarly Tobin's Q values are causally related with EID at the 90% confident level in steel, nonferrous metal, coal-oil-gas mining and pharmaceutical industries. In the original hypothesis of the effect of EID on Tobin's Q value, F-statistic values are much larger than 1, and their probabilities are significantly lower than 5% in thermal-electronic, nonferrous metals, chemical, coal-oil-gas mining, building-materials and textile-garment-leather industries, those results show that EID has significantly causal relationship with Tobin's Q value at the 95% significant level except at the 90% confidence level in steel and pharmaceutical industries. In brief, EID has mutually causal relationship with financial performance, more environmental information disclosure has obvious impact on market value of listed firms, those results support hypothesis 1.

Table 2 Empirical results of Granger causal methodology between EID and market value of listed firms

<i>Thermal electronic industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	2	3.10365	Reject(95%)
EID_t does not granger cause Q_t	2	3.22154	Reject(95%)
<i>Steel industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	2	2.69625	Reject(90%)
EID_t does not granger cause Q_t	2	2.07927	Reject(90%)
<i>Nonferrous metals industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	2	2.21012	Reject(90%)
EID_t does not granger cause Q_t	2	2.34057	Reject(95%)
<i>Chemical industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	2	9.57352	Reject(99%)
EID_t does not granger cause Q_t	2	2.35374	Reject(95%)

<i>Coal-oil-gas mining industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	3	2.24279	Reject(90%)
EID_t does not granger cause Q_t	3	3.02044	Reject(95%)
<i>Construction and building materials industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	3	4.94238	Reject(99%)
EID_t does not granger cause Q_t	3	3.97047	Reject(99%)
<i>Pharmaceutical industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	4	2.03812	Reject(90%)
EID_t does not granger cause Q_t	4	2.03840	Reject(90%)
<i>Textile, garment-leather industry</i>			
Original hypothesis	Lag n	F-statistic	Judgment
Q_t does not granger cause EID_t	3	3.41215	Reject(95%)
EID_t does not granger cause Q_t	3	4.58102	Reject(99%)

Note: reject(99%),reject(95%) and reject(90%) denote rejecting the original hypothesis at the 99%, 95% and 90% confidence level, lag n denote the lag number.

6.2 Empirical Results Analysis and Discussion

We propose the empirical evidence of the effects of environmental information disclosure on market value of listed firms using unbalanced panel data in heavy-pollution industries from 2008 to 2012. From table 3, listed firms in different heavy-pollution industries have greater divergent opinions in the effect of EID on market value of listed firms. Environmental information disclosure has a significantly positive impact with market value of listed firms in coal-oil-gas mining industry at the 99% significant level. EID is positively related with market value of listed firms in steel industry at the 90% significant level, except the correlated coefficient in pharmaceutical industry is not significant. Compared with positively related coefficients, the related coefficient in coal-oil-gas mining industry is greatest, the coefficient in steel industry is smaller, and the coefficient in pharmaceutical industry is smallest. Those empirical

results hold discretionary disclosure and stakeholder theory. In recent years, Chinese government strengthen environmental regulation and efforts, establish target responsibility system of energy-saving and emission-reduction using comprehensive program of energy-saving and emission-reduction, and then strengthen government's and firms' responsibility using constraint policies system of energy-saving and emission-reduction. These corporate managers and shareholders believe that listed firms in coal-oil-gas mining, steel and pharmacy industries voluntarily disclose more environmental information for stakeholders, directly try their best to carry out their outpoints and efforts in carrying out environmental and social responsibility, and then achieve better environmental benefits and financial performance. Listed firms in coal-oil-gas mining, steel and pharmaceutical industries voluntarily communicate with stakeholders using social responsibility reporting and environmental reporting, weaken stakeholders' anxiety in environmental management problems, reduce their misunderstanding in environment-protection practices and then improve stakeholders' confidence and psychological expectations through predominant environmental performance. More efficient environment-protection activities, technologies innovation and policies decrease energy and materials consumption, reduce waste disposal costs, environmental recovery costs and alleviate greenhouse and waste emission etc.

Table 3 Empirical results of the effect of EID on market values of listed firms in heavy-pollution industries

Variable coefficients	Thermal electric industry	Steel industry	Non-ferrous metal industry
α_0	3.1027*** (6.4904)	1.6669*** (4.8389)	8.3555*** (3.3934)
α_1	-0.9449*** (-3.5221)	0.3266* (1.2993)	-0.6615** (-2.6341)
α_2	-0.0593*** (-2.6534)	-0.0286*** (-2.1462)	-0.2454*** (-2.2239)
α_3	-0.3779* (-1.5605)	-0.0744 (-0.6125)	-1.4363** (-2.2880)
α_4	0.0379 (1.2032)	0.0213 (2.0518)	0.0050 (1.2108)
α_5	-0.1068 (-1.3806)	-0.0210 (-0.4499)	0.7064 (1.6154)
Fixed effects			
08Y-C	-0.1781	-0.0490	-0.5292
09Y-C	0.1794	0.1784	0.6416
10Y-C	0.1801	0.0310	0.3414
11Y-C	-0.0896	-0.0484	-0.3685

12Y-C Variable coefficients	Chemical industry	Coal-oil-gas mining industry	Construction and building-materials industry
α_0	5.7510** (2.7319)	15.1362*** (9.9666)	4.1199*** (7.2534)
α_1	-2.2025** (-1.8764)	1.8431*** (2.2705)	-0.3244* (-1.7664)
α_2	-0.0422 (-0.2703)	-0.6035*** (-8.4993)	-0.1062*** (-4.2106)
α_3	-5.2846*** (-6.7869)	0.6806 (1.4953)	-0.7042*** (-2.5183)
α_4	0.0814 (0.6148)	0.2568** (2.9157)	0.0057 (0.2313)
α_5	-0.0172 (-0.1370)	-0.4156** (-1.9182)	0.2955* (1.7145)
Fixed effects			
08Y-C	-0.6099	-0.5816	-0.2919
09Y-C	0.5036	0.5482	0.1063
10Y-C	0.6744	0.4866	0.2194
11Y-C	-0.3191	-0.1572	-0.0146
12Y-C	-0.4911	-0.3214	-0.0534
Variable coefficients	Pharma-ceutical industry	Textile, garment-leather industry	
α_0	12.7906*** (3.8958)	4.7145*** (2.4683)	
α_1	0.1502 (0.1375)	-2.2108*** (-2.9631)	
α_2	-0.4821*** (-3.2457)	0.1178* (1.3312)	
α_3	1.6244*** (6.2913)	-1.4157** (-2.1074)	
α_4	-0.1157** (-2.0295)	0.3009 (1.3558)	
α_5	-0.0083 (-0.0259)	-0.0254 (-0.4992)	
Fixed effects			
08Y-C	-1.1687	-0.2907	
09Y-C	0.2941	0.2817	
10Y-C	0.6571	0.2509	
11Y-C	-0.0155	-0.0068	
12Y-C	-0.0178	-0.2117	

Note: ***, **, * denote the 99%, 95% and 90% confident level, the number in the parentheses is t-statistic values.

Environmental information disclosure has a significantly negative impact on market value of listed firms in thermal-electronic, non-ferrous metals, chemical and textile-garment-leather industries at the 95% confident level, while EID is negatively related with market value of listed firms

in construction and building-materials industry at the 90% significant level. Compared with negative coefficients in those heavy-pollution industries, the absolute value of negative coefficients in chemical and textile-garment-leather industries is much greater than 1, the absolute value of negative coefficients in thermal-electronic, nonferrous metals, construction and building-material industries is smaller than 1. These corporate managers and shareholders in those heavy-pollution industries hold traditionally classic theory. They argue that more environmental information disclosure has to increase research and development inputs of environmental technology and environmental facilities, enhance depreciate and administration costs of environmental assets, and increase environmental costs and operating costs. Those factors lead to higher financial burdens and greater market risks, and then reduce market value of listed firms in heavy-pollution industries. Based on social responsibility and pressures theory, with an increase of assets size and financial performance, listed firms in those heavy-pollution industries have to undertake more and more social responsibility, and accept more and more social pressures from governors, public and society. More environmental information disclosure denote that listed firms will undertake more social responsibility and pressures, more EID plays active roles in improving product brand images and firms reputations and enhancing market competitiveness, and then weaken market value deterioration of listed firms. More EID is a communicating way in environmental management activities with stakeholders, alleviate misunderstanding in environment-protection practice, and then improve stakeholders' investment confidence. Those empirical results support hypothesis 2 except pharmaceutical industry.

Seen from the positive effects of EID on market value of listed firms in coal-oil-gas mining and steel industries, they voluntarily disclose higher environmental information than other heavy-pollution industries. Seen from the negative effects of EID on market value of listed firms in thermal electronic, nonferrous metals, chemical, construction, building-materials and textile, garment-leather industry, they disclose lower environmental information than steel and coal-oil-gas mining industries. Listed firms in thermal electronic industry have greater state-owned ownership and higher ownership concentration, they have to disclose more environmental information in order to undertake more social responsibility and pressures. From the fixed effects coefficients of panel data, the intercept effects EID on market value

of listed firms have obviously periodic divergence in different periods.

7 Conclusion

Based on collecting thermal-electronic, steel, nonferrous metals, chemical, coal-oil-gas mining, construction, building-materials, pharmaceutical and textile-garment-leather industries, we propose empirically comparative study of the effects of environmental information disclosure on market value of listed firms using unbalanced panel data samples. Listed firms in different industries have greater divergence in environmental information disclosure quality. Listed firms in thermal-electronic, steel and coal-oil-gas mining industries voluntarily disclose more environmental information than chemical, building-materials, pharmaceutical and textile, garment-leather industries. Listed firms in thermal-electronic, steel and coal-oil-gas mining industries have greater divergent opinions in environmental information disclosure than listed firms in other heavy-pollution industries. EID has mutually causal relationship with market value of listed firms, more environmental information disclosure has significant impact on market value of listed firms at the 90% significant level, those results support hypothesis 1.

Environmental information disclosure has a significantly positive impact with market value of listed firms in coal-oil-gas mining and steel industries at the 90% confident level. EID is negatively related with market value of listed firms in thermal-electronic, nonferrous metals, chemical, construction and building-materials and textile, garment-leather industries at the 90% significant level. Compared with their effects of EID on market value of listed firms, listed firms in coal-oil-gas mining and steel industries with significantly positive effects voluntarily disclose more environmental information than listed firms in other heavy-pollution with negative effects. From the fixed effects coefficients of panel data, the intercept effects EID on market value of listed firms have obviously periodic divergence from 2008 to 2012.

We propose the following policies and advices. Firstly, Chinese government should establish a supervising system of environmental information disclosure and encourage listed firms voluntarily disclose more environmental information and establish environmental management records. Secondly, the governors should improve operating scheme of capital market and establish symmetric scheme of market information, and enough play positively guiding function of market information

including environmental information, and then market information plays true assets pricing mechanism. Thirdly, listed firms should turn externally environmental management problems into internal problems, strengthen environmental regulation and market adjusting mechanism for listed firms in heavy-pollution industries, enhance social and political cost induced environmental management problems, and then promote listed firms to improve their environmental performance. Fourthly, we should strengthen supervising roles of media and society, improve listed firms' governance structure, build rapid response mechanism in environmental management and costs information, and then enough play positively pricing mechanism of environmental information disclosure in capital market.

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