Environmental Regulation, Corporate Behavior and Corporate Performance: Evidence from China Oil and Gas Company

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Abstract

Environmental regulation plays an important role in promoting companies to balance corporate performance and environmental sustainability. In order to study the impact of environmental regulation policies on the performance of energy companies, based on the theoretical framework of "environmental Regulation policy - corporate behavior - corporate performance", we propose ten research hypotheses and construct Structural Equation Model (SEM) to test them. By using survey data collected from 636 managers in Chinese oil and gas enterprises, the empirical results show:1) Different types of environment regulation policies have opposite effects on the managers' decision-making on corporate behavior and thus alter the expectation on final corporate performance. 2) Command and control regulations have positive impact on corporate performance while market-based regulations have negative impact. 3) Corporate strategy behavior plays an important mediating role between environmental regualtions and corporate performance. The result which is robust in various embedded models also broadens the fields of literature on strategic alliance, deepens the research around the "Porter Hypothesis" and provides a meaningful reference for policymakers and managers.

Keywaords: Environmental Regulation, Corporate Behavior, Corporate Performance, Structural Equation Modeling, Balance Score Card

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1.Introduction

Water pollution, air pollution, soil pollution usually occurs in the production process, especially in developing countries. These environmental problems are gradually attracting public attention, which requires companies need to take certain social responsibility (CSR), put emphasis on the environment management and sustainable development, and thus promote comprehensive performance. The government regulates corporate behavior through environmental regulation policies in order to achieve energy conservation and environmental protection. In general, there are two types of practices: Administrative Environmental Regulation (AER) and Market-oriented Environmental Regulations (MER). The government expects to guide companies towards a green and environmentally friendly direction by monitoring corporate environmental behavior and establishing market mechanisms.

When enterprises face environmental regulation policies, they will alter corporate behavior such as strategic choice, production and technology improvement, environmental management. The change of corporate behavior will have an effect on the company's performance. This kind of "environmental regulation - corporate behavior - corporate performance" mechanism is accompanied by the transition in the entire process of production and operation of the enterprise and is also the start point of research on the impact of environmental regulation policies and corporate performance. Most studies, based on the famous "Porter Hypothesis", find that environmental regulations help enhance the competitiveness of enterprises by promoting efficiency and innovation. Different types of environmental regulation policies for different regions, enterprises of different scales, different ownership forms, and different industries have different effects. However, there are few studies focusing on how management team response to environmental regulations through an internal perspective and how corporate performance will be further influenced through an internal perspective.

Previous studies have only used financial performance measures with inconsistent results. Thus, there is a need for more empirical evidence on the relationship between environmental regulations and financial performance. Also, studies on corporate environment related issues appear to have ignored non-financial performance implications. Following Balanced Scorecard approach (BSC) developed by Kaplan and Norton (1996), we expand the measurement of corporate performance through multi-faceted analysis: financial perspective, customer relationship, internal business process, and innovation and learning, which accurately reflect the long-term performance of the corporate development strategy. Given the fact that oil and gas

enterprises are large, widely distributed, and highly differentiated, the BSC approach allows to identify the relationship among corporate internal process and external stakeholders and provides a very clear picture for executives what could be expected by applying environmental regulations.

Although BSC has received wide acceptance from academics and practitioners, it was criticized as having no formal implementation methodology, which may result in a lack of accountability (Fletcher and Smith, 2004). This paper uses the Structural Equation Model (SEM) approach to quantitatively study the functions of corporate behavior in response to the environmental regulation and its impact on performance. The four dimensions of BSC will be used as the input factors of SEM to ensure the comprehensiveness of the input-output data. The remainder of this paper is organized as follows: Section 2 points out the "environmental regulation policy - corporate behavior - corporate performance" mechanism and proposes corresponding research hypotheses. Section 3 introduces research design including survey process and variables selection. Section 4 constructs the structural equation model and analyzes the model results. Section 5 discusses the corresponding policy recommendations, research shortcomings and future research suggestions.

2. Literature and Hypothese

Whenever environmental regulation placed new pressure on firms, such a pressure would encourage firms to incorporate environmental responsibility into their strategy making. Porter and Linde (1995) argued that the firms that actively abided by environmental regulations could gain early-mover strategic advantages, since customers valuing low-pollution and energy-efficient products. Some authors emphasize the importance of developing stakeholder pressures for active environmental strategies (For example, Berry and Rondinelli, 1998; Clark, 1996). Empirical studies show that environmental regulation has a positive impact on environmentally friendly strategy. However, the impact of AER and MER on firm strategy is different. MER is more likely to motivate companies to follow environmentally friendly strategies than AER. Especially in the situation that a firm is conservative or faced with poor internal resources, firms under AER may just maintain up-to-standard emissions and have a negative attitude toward environmental regulation. In sum, AER plays its role by administrative command and has the characteristics of short-term effects. In contrast, MER plays its role in guiding firm behavior and

pursuing long-term oriented benefits. MER is more likely to motivate firm to strategically deal with long-term issues of firm development.

As early as the 1980s, two important studies (Downing and White, 1986; Milliman and Prince, 1989) have concluded that environmental regulation can provide firms incentive to promote technological change. In the 1990s, Porter and Linde (1995) further systematically demonstrated this view of the relationship between environmental regulation, innovation, and competitiveness. They claim that in a dynamic world, environmental regulation can promote innovation by signaling companies about possible resource inefficiencies and potential technological improvements and by raising awareness among companies.

According to utility theory, environmental regulation will provide economic incentives for the protection of the environment, so companies will actively shift behavior to green development (Fryxell and Lo, 2001). There is evidence that leaders of some of the world's most successful companies are recognizing the enormous potential for economic opportunities that meet the ethical requirements of stakeholders (Hitt and Collins, 2007). Some authors also point out that environmental regulation promotes a shift in environmental management behavior to green: for example, investments in abatement technologies (Jorgenson and Wilcoxen, 1990); capital investments in very expensive pollution control technologies (Kagan et al., 2003). Purchasing environmentally friendly raw materials, establishing an environmental management system to reduce pollutant emissions (Liu, 2009); providing environmental training and education to employees, and emphasizing environmental management practices (Gangdalalan, 2006). Therefore, we came to the following hypothesis of this study:

H1a: AER encourage firms to adopt environmentally friendly strategies.

H1b: MER encourage firms to adopt environmentally friendly strategies.

H2a: AER has a positive impact on firm technological innovation.

H2b: MER has a positive impact on firm technological innovation.

H3a: AER has a positive impact on firm environmental management.

H3b: MER has a positive impact on firm environmental management

AER tends to force companies to bear similar pollution control burdens regardless of cost. They usually do this by setting a uniform standard for the business, the most common of which is based on performance and technology standards. However, keeping all companies at the same target can be expensive and, in some cases, counterproductive, as standards often achieve

relatively high costs by forcing companies to take too expensive pollution control measures. Since the cost of controlling emissions may vary from company to company and even from different sources within the same company, appropriate technology in one case may not be cost effective in another. There is some evidence indicating a positive relationship. Mitsutsugu Hamamoto (2006) show that increases in R&D investment stimulated by the regulatory stringency have a significant positive effect on the growth rate of total factor productivity. Paul Lanoie (2008) suggests that more severe environmental regulation may have a positive effect on firm performance by stimulating innovation. However, it is unclear to what extent this is due to the inability to measure the true differences in the effectiveness, or because they are not binding on typical practices in many cases. It reminds people that typical commands and controls may have little effect if they are set lower than existing practice standards.

MER including emissions taxes, transaction allowances or pollution standards is more conducive to innovation than technical standards because they give companies more freedom to find technical solutions to minimize compliance costs. Jaffe and Palmer (1997) call it the narrow version of the Porter hypothesis. There have been many studies in this area that provide evidence for this "narrow" version of the Porter hypothesis. For example, Burtraw (2000) concluded that the transition from command and control methods to more flexible emissions trading schemes enhances innovation and promotes organizational change and competition in the upstream input market. In other words, the project provides companies with the flexibility to choose the best mitigation strategy, including switching to coal with lower sulphur content. If market-based instruments generate revenue (for example, from taxes or allow auctions), effective recycling of these revenues can increase competitiveness outcomes. For example, Andersen (2007) analyze environmental tax revenues in seven EU countries, which are recycled for other tax cuts (labor or income) and find a neutral or slightly positive net impact on gross domestic product (GDP). Finally, Lankoski (2010) reviews empirical evidence to date on the impact of policy instrument types on competitiveness and draws conclusions similar to Porter (1995) that regulates "policies should strive to achieve win-win compatibility". Therefore, we put forward the following hypothesis:

H4: AER has little effect on promoting corporate performance in total.

H5: MER has large positive effect on promoting corporate performance in total.

Researchers and managers argue about the value of investing in green technologies and green production. Hoffman (2000) pointed out that environmental strategies will create a win-win situation in which manufacturers can improve their environmental performance while achieving economic benefits. Making the same product with fewer resources and/or energy is a good strategy to make money. Because improving efficiency by preventing waste is both economical and efficient, management should recognize that the cost of a green manufacturing plan will be paid for by the money saved in a more efficient system, which in turn will positively affect the ROI.

Also, strategy expects to play an important role in the development of corporate environmental innovation. As O'Reilly (1997) point out, the role of strategy is critical to promote creativity and innovation. According to Bansal. (2003), green strategy is positively related to the scope and speed of the company's response to environmental issues. If the managers of the company attach great importance to and pay attention to the environment and its protection based on environment-friendly strategy, then they are likely to adopt an environmental innovation. In weakly regulated countries, the level of environmental response of companies varies widely. Some companies have adopted significant environmental-friendly strategies and have better environmental innovation than others in seemingly similar situations (Dasgupta, Hettige, & Wheeler, 2000).

The differentiation advantage may come from best practices in environmental management that focus on product characteristics and product markets (Shrivastava,1995). Best practices in these product sets include redesigning packaging and products, developing new environmentally responsible products in a more environmentally responsible manner, and promoting the environmental benefits of the product (Reinhart, 1998). Differentiating advantages create the potential to increase product prices, resulting in higher revenues. Empirical results show that income improvement is the main economic motivation and outcome of implementing best practices that focus on product characteristics and markets (Lederer and Rhee, 1995; Stead & Stead,1995). Hence, we arrive in the following hypothesis:

H6: Environmental-friendly strategy has a positive impact on technology innovation and production choice.

H7: Environmental-friendly strategy has a positive impact on environmental management.

The environment-friendly strategy will positively affect a firm's competitive advantage (i.e., cost or market differentiation, preemptive moves, positional advantage) (Hart, 1995). A firm's performance will reflect the multiple competitive advantages that will be provided by the combination of these strategic resources (Klassen and Whybark, 1999). By meeting stakeholders' expectations and aligning them more closely to environment-friendly strategy, the firm may experience increased levels of performance (Clarkson, 1995; Elijido-Ten,2010). The adoption of an environment-friendly strategy will result in improved attention to the interests of key external and internal stakeholders, as a precursor to good quality management practice. In turn, this level of practice may provide benefits beyond their costs that are eventually reflected in performance, represented in this study by four dimensions of firm performance by BSC approach. Consequently, the environment-friendly strategy is simply a way of doing business that is expected to lead to a positive influence on firm performance

Discovering general forms of innovation is not necessarily related to the environmental aspects of operations management and is positively related to the choice of pollution prevention technologies. Pollution prevention technologies often yield benefits in terms of cost and quality. The competitive advantage generated by environmental innovation is twofold. First, collaboration involves knowledge integration and collaboration between organizations (Grant,1996). Therefore, manufacturing organizations that work with their suppliers and customers can develop organizational capabilities (Lorenzoni and Lipparini, 1999). Case evidence supports links to increase productivity, while limited surveys show improved product quality and financial performance (Carter et al. 2000).

Pollution is the representation of the inefficient uses of resources. Businesses can increase resource productivity through green innovation to make up with the environmental costs. Besides, the companies that pioneer in the new markets will enjoy the first mover advantages, which allow them to ask for higher prices for green products, to improve the corporate image, to sell their environmental technologies or services, and even to create new markets (Hart, 1995; Porter and Linde, 1995). Businesses that adopt the proactive environment management strategies could integrate the objectives of environmental protections with different departments in the company to solve the environmental problems by utilizing the innovative environmental technology (Henriques and Sadorsky, 1999). Moreover, adoption of environmental management might not only apart from preventing the company from facing environmentalist protests or penalties, but also help businesses develop new market opportunities and increase competitive

advantage (Berry, 1998; Henriques and Sadorsky, 1999). On the other hand, companies can apply green environmental ideas into the designs and packaging of the products to increase the advantages of product differentiation (Shrivastava, 1995).

H8: Environmental-friendly strategy has a positive impact on firm performance.

H9: Technological innovation and Production decision has a positive impact on firm performance.

H10: Environment management has a positive impact on firm performance.

3. Research design

3.1 Survey design

Questionnaire design is a process of quantifying non-directly measurable variables in the scientific research process. It is widely used in the study of environmental problems. Its rationality first affects the validity of data quality and secondly affects the differentiation of data and also plays an important role in the objectivity of the research results. The following research procedures were applied to the questionnaire design of this paper: (1) Carefully consult the relevant literature. (2) Discuss the validity and completeness of the questionnaire with experts in related fields. (3) Issue a certain number of questionnaires to determine the quality of the responses to the questionnaire. The sample in this study includes the most senior executives and managers randomly selected at the China oil and gas enterprises due to the rationale that executives have concerns with the environmental regulation and firm performance more than staff members. A total of 636 usable questionnaires were obtained from China oil and gas enterprises which are aged from 20 to 70 years old. With respect to geographical distribution, 58.3% of respondents were in the western region. Also, in the enterprise size and business ownership, the highest percentage of respondents was in enterprises with more than 2000 employers (78.1%), and in state-owned enterprises. The make-up of the samples is consistent with the fact that the gas and oil industry is dominated by large-scale state-owned enterprises.

Table 1 Raw data distribution

Classification		Frequency	Percentage (%)
Years of company establishment	≤25	136	21.38%
	50≥n>25	289	45.44%
	>50	211	33.18%
Location	Eastern region	191	30.03%
	Central region	74	11.64%

	Western region	371	58.33%
Enterprise size (number of employees)	≤100	9	1.42%
	499≥n>100	52	8.18%
	1999≥n>500	74	11.64%
	≥2000	497	78.14%
Business ownership	State-owned enterprises	551	86.64%
	Foreign-capital enterprises	20	3.14%
	Private-owned enterprises	27	4.25%
	Joint venture enterprises	22	3.46%
Total		636	100.00%

Note: State-owned enterprises stand for the companies owned by Chinese government; Foreign-capital enterprises refer to enterprises established in China under Chinese law, independently invested by foreign investors; Private-owned enterprises are for-profit economic organizations based on the employment of a natural Chinese person or controlled by a natural Chinese person; Joint venture enterprises refer to enterprises jointly invested by Chinese investors and foreign investors.

3.2 Selection of research variables

Chosen appropriate variables is critical when conducting survey-based research. By reading related reference, we use 5 and 3 observable indicators to stand for administrative environmental regulations and market-based regulations. In terms of corporate behavior perspective equal number of variables were used to represent corporate environmental strategies, technology improvements and product process and corporate environmental management practices. According to the concept of Balanced scorecard, financial perspective, customer perspective, internal business process, innovation and learning were chosen as unobservable variables to present overall performance of companies. We also listed the resources of different variables in table 2.

Table 2 Development of constructs, unobserved variables, and observed indicators

Construct	Unobserved Variable	Observed indicator	Reference
Environmental Regulations (ER)	Administrative environmental regulations (AER)	1. Emission standards (AER1)	Magat (1979), Liu (2009)
		2. Fines (AER2)	Liu (2009)
		3. Supervision (AER3)	Experts interview
		4. Environmental assessment system (AER4)	Che et al. (2011)
		5. Production technology standards (AER5)	Lopez-Gamero et al. (2010)
	Market based regulations (MER)	1. Tax credits/emission subsidies (MER1)	Magat (1979), Milliman and Prince (1989)
		2. CDM (MER2)	Experts interview
		3. Cap & trade (MER3)	Milliman and Prince (1989)
Corporate Behaviors (CB)	Strategy (ST)	1. Transfer to clean industry (ST1)	Christian and Volker (2009), Phillips (2011)
		2. Clean product innovation (ST2)	Porter and Linde (1995), Phillips (2011)

		3. Stress renewable energy development (ST3)	Hartl and Kort (1997), Phillips (2011)
		4. Investing in environmental protection industry (ST4)	Hartl and Kort (1997), Phillips (2011)
	Technology and Production (TP)	1. Cleaner input substitution (TP1)	Xepapadeas (1992), Hartl and Kort (1997), Sharma (2000)
		2. End-of-pipe abatement (TP2)	Hartl and Kort (1997)
		3. Energy-saving equipment (TP3)	Magat (1979), Richard et al. (2004)
		4. Improvements in overall Technical innovation ability (TP4)	Downing and White (1986), Milliman and Prince (1989)
	Environmental Management (EM)	1. Establishing EM system (EM1)	Liu (2009)
		2. Reducing pollutant emissions (EM2)	Harford (1978), Xepapadeas (1992), Liu (2009)
		3. Stressing education and training (EM3)	Gangadharan (2006)
		4. Investing in the fields of environmental protection (EM4)	Jorgenson and Wilcoxen (1990), Kagan et al. (2003), Richard et al. (2004)
Corporate Performance (BSC)	Financial Perspective (FP)	1. Return on Capital (FP1)	(Kaplan & Norton 1992, 1993, 1996)
		2. Cash Flow (FP2)	(Kaplan & Norton 1992, 1993, 1996)
		3. Reduction of debt (FP3)	(J. Sánchez-Ortiz et al. 2016)
		4. Variations against budget (FP4)	(Bhagwat R, 2007)
	Customer Perspective (CP)	1. Competitive Price (CP1)	(Kaplan & Norton 1992, 1993, 1996)
		2. Enhancing customer relationship management (CP2)	(Shen et al. 2016)
		3. Social responsibilities (CP3)	(Elbanna S, 2015)
		4. Reputation (CP4)	(Park J et all, 2005)
	Internal Business Process (IB)	1. Engineering Efficiency (IB1)	(Kaplan & Norton 1992, 1993, 1996)
		2. Improvement of efficiency in energy use (IB2)	(J. Sánchez-Ortiz et al. 2016)
		3. Improved training process (IB3)	(Shen et al. 2016)
		4. Responsiveness to urgent order (IB4)	(Park J et all, 2005)
	Innovation and Learning (IL)	1. Continuous Improvement (IL1)	(Kaplan & Norton 1992, 1993, 1996)
		2. Improved operational efficiency (IL2)	(Shen et al. 2016)
		3. Process improvement initiatives (IL3)	(Elbanna S, 2015)
		4. Supplier cost saving initiatives (IL4)	(Bhagwat R, 2007)

3.3 Research model

Combined with the discussion of the hypothesis section and the selection of the study variables, Figure 1 shows the specific research model. Where "e1-e5" are the residual terms of the corresponding variables; the arrow between the hidden variables represents the relationship to be studied, corresponding to the relevant hypothesis. Combining research methods and related literatures, synthesizing corporate financial indicators, corporate customer relationship level indicators, internal business process level indicators and enterprise innovation learning process levels into overall corporate performance indicators.

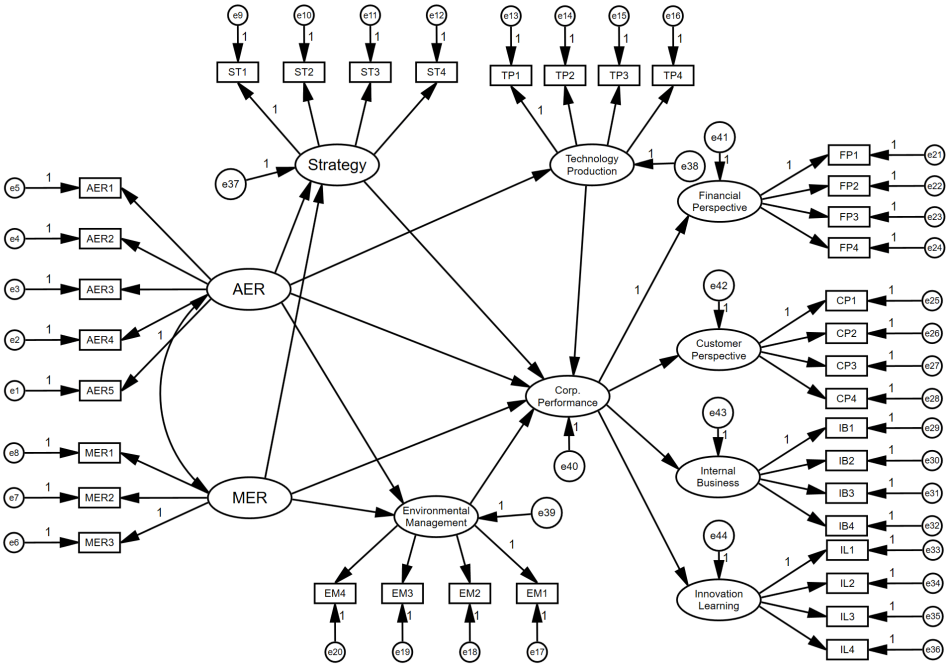

Fig. 1 Research model for the impact of environmental regulation on corporate performance through behavior adjustment.

4. Structural equation model process and empirical results

4.1 Structural equation model setting

The concepts used in the theoretical hypothesis model proposed in this study cannot be directly observed or measured but can be indirectly reflected by multiple explicit indicators in the questionnaire. This is the unobserable variable in statistical analysis. The traditional statistical analysis method can not properly handle the relationship between latent variables. Therefore, it is necessary to choose the appropriate empirical test method. This paper chooses the structural equation model method for empirical research.

The complete structural equation model contains two sub-models of measurement equations and structural model. The measurement model is shown in equation (5.1) and is used to describe the relationship between unobserable variables (indicated by η and ξ), and measurement terms (with y and x). Λ_y and Λ_x represent the correlation between the measured item and the hidden variable, ε and δ are the measurement errors of the measured variables x and y, respectively.

$$y = \Lambda_y \eta + \varepsilon \tag{5.1}$$

The structural model is used to reflect the relationship between unobserable variables, as shown in equation (4.2), η representing endogenous unobserable variables, ξ representing exogenous unobserable variables, B and Γ srepresenting the effcts of endogenous and exogenous unobserable variables on dependent variables, respectively. The error term of the structural equation is ζ .

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta \qquad (5.2)$$

4.2 Reliability and validity test

Reliability refers to the internal consistency of each variable and the overall consistency of the scale in the same dimension. According to the measurement standard, the value of Cronbach alpha (α) coefficient is used as the basis for the reliability index. Cronbach alpha (α) coefficient value $\geqslant$ 0.50 means more reliable, greater than 0.70 means credible, and greater than 0.90 means very reliable,that is, the internal consistency between the indicators is high. Table 3 shows the reliability test of model variables, Cronbach alpha (α) values are greater than 0.7 which means the results are credible and the mean, SD, Corrected item-total correlation and Factor Loading of every variables is in the proper ranges.

Table 3 Reliability condition of model variables

Variable	Code	Mean	S.D.	Corrected item-total correlation	Factor Loading	Cronbach s alpha (α)	Cumulative variance
Administrative Environmental Regulation(AER)						0.865	0.655
Emission standards	AER1	3.961	1.969	0.691	0.744		
Fines	AER2	3.377	1.644	0.769	0.835		
Supervision	AER3	3.833	1.694	0.692	0.751		
Environmental assessment system	AER4	3.484	1.864	0.598	0.689		
Production technology standards	AER5	3.700	1.777	0.699	0.756		
Market-oriented Environmental Regulation (MER)						0.787	0.701
Tax credits/emission subsidies	MER1	3.428	1.746	0.668	0.817		
CDM	MER2	3.443	1.585	0.613	0.706		
Cap & trade	MER3	3.838	1.642	0.602	0.708		
Strategy						0.836	0.671
Transfer to clean industry	ST1	3.945	1.399	0.743	0.830		
Clean product innovation	ST2	4.154	1.339	0.594	0.671		

Stress renewable energy development	ST3	3.84	1.414	0.647	0.737		
Investing in environmental protection industry	ST4	3.772	1.43	0.685	0.761		
Production and Technology innovation						0.863	0.711
Cleaner input substitution	TP1	4.511	1.473	0.674	0.715		
End-of-pipe abatement	TP2	4.256	1.457	0.789	0.893		
Energy-saving equipment	TP3	3.848	1.486	0.612	0.643		
Improvements in technical innovation ability	TP4	4.259	1.561	0.775	0.879		
Environmental management						0.842	0.679
Establishing EM system	EM1	4.945	1.603	0.743	0.754		
Reducing pollutant emissions	EM2	5.009	1.543	0.722	0.865		
Stressing education and training	EM3	4.385	1.427	0.618	0.588		
Investing in fields of environmental protection	EM4	4.332	1.452	0.628	0.732		
Finance						0.86	0.706
Return on Capital	FP1	4.59	1.752	0.666	0.772		
Cash Flow	FP2	3.992	1.69	0.756	0.876		
Reduction of debt	FP3	3.777	1.916	0.753	0.773		
Variations against budget	FP4	4.789	1.731	0.657	0.635		
Customer						0.818	0.651
Competitive Price	CP1	4.887	1.797	0.655	0.761		
Enhancing customer relationship management	CP2	4.37	1.692	0.636	0.726		
Social responsibilities	CP3	3.84	1.389	0.64	0.711		
Reputation	CP4	4.656	1.603	0.643	0.727		
Internal Process						0.85	0.695
Engineering Efficiency	IB1	4.642	1.753	0.661	0.757		
Improvement of efficiency in energy use	IB2	4.03	1.434	0.737	0.813		
Improved training process	IB3	4.343	1.567	0.681	0.749		
Responsiveness to urgent order	IB4	4.715	1.717	0.696	0.769		
Learning and Growth						0.835	0.67
Continuous Improvement	IL1	4.736	1.688	0.67	0.76		
Improved operational efficiency	IL2	3.915	1.482	0.634	0.716		
Process improvement initiatives	IL3	4.421	1.545	0.691	0.781		
Supplier cost saving initiatives	IL4	4.634	1.626	0.67	0.739		

Validity refers to the extent to which empirical measurements reflect the true meaning of the concept. Firstly, the research indicators have undergone a rigorous screening process, so the questionnaire has good content validity. Secondly, test the convergence validity value correlation degree between items under the same indicator. It can be seen from the Table 4 that the questionnaire has a good convergence validity (bold values indicate that the specific cell values

are greater than the other cell values for the same row). Thirdly, test the differential validity which refers to the degree of relevance of each item under different indicators. Table 5 shows the correlations among the unobserable variables, most of the correlation coefficients in Table 5 are significantly correlated, indicating that they belong to the same research facet, so the scales of this paper has a good differential validity.

Table 4 Convergent validity of model variables

Indicator	1	2	3	4	5	6	7	8	9
AER1	**0.775**	0.112	0.095	0.140	0.105	0.048	0.033	0.073	0.156
AER2	**0.776**	0.11	0.137	0.069	0.099	0.206	0.129	0.105	0.152
AER3	**0.759**	0.102	0.071	0.145	0.084	0.108	0.125	0.131	0.098
AER4	**0.614**	0.119	0.122	0.086	0.140	0.218	0.077	0.115	0.196
AER5	**0.773**	0.135	0.112	0.109	0.047	0.083	0.070	0.107	0.122
MER1	0.138	0.099	-0.036	0.005	-0.051	-0.029	0.174	-0.053	**0.820**
MER2	0.088	0.052	-0.075	-0.032	-0.052	0.061	0.065	0.020	**0.834**
MER3	0.157	0.118	-0.013	-0.023	-0.04	-0.11	0.100	-0.082	**0.770**
ST1	0.052	0.133	0.016	0.017	0.035	0.086	**0.843**	0.000	0.128
ST2	0.016	0.129	0.059	0.037	-0.014	0.103	**0.748**	-0.007	0.075
ST3	0.105	0.142	0.031	0.017	0.047	0.091	**0.766**	0.04	0.109
ST4	0.115	0.119	0.005	-0.012	0.033	0.088	**0.802**	-0.003	0.119
TP1	0.061	**0.772**	-0.004	-0.053	0.01	0.118	0.179	0.006	0.142
TP2	0.121	**0.867**	-0.030	0.006	0.011	0.092	0.143	-0.007	0.105
TP3	0.111	**0.739**	-0.039	-0.024	-0.051	0.093	0.098	-0.073	0.060
TP4	0.112	**0.865**	-0.012	-0.002	0.001	0.103	0.126	-0.036	0.068
EM1	0.115	0.141	0.143	0.082	0.104	**0.82**	0.091	0.100	-0.018
EM2	0.175	0.137	0.123	0.153	0.134	**0.745**	0.135	0.185	-0.047
EM3	0.012	0.094	0.124	0.106	0.055	**0.787**	0.063	0.028	0.056
EM4	0.190	0.086	0.120	0.080	0.158	**0.697**	0.148	0.092	-0.093
FP1	0.117	0.021	**0.738**	0.139	0.27	0.061	0.046	0.110	-0.068
FP2	0.071	-0.013	**0.785**	0.183	0.214	0.178	0.023	0.140	-0.08
FP3	0.112	-0.035	**0.787**	0.197	0.151	0.168	0.038	0.188	-0.015
FP4	0.100	-0.065	**0.782**	0.127	0.061	0.125	0.024	0.111	-0.019
CP1	0.095	-0.045	0.157	0.193	0.163	0.103	0.026	**0.735**	-0.08
CP2	0.036	-0.034	0.180	0.180	0.126	0.081	0.019	**0.747**	-0.013
CP3	0.072	-0.022	0.106	0.108	0.073	0.109	-0.028	**0.785**	-0.058
CP4	0.180	-0.024	0.073	0.138	0.166	0.067	0.017	**0.757**	0.004
IB1	0.136	0.011	0.183	**0.677**	0.255	0.153	0.041	0.212	-0.018
IB2	0.084	-0.007	0.150	**0.805**	0.181	0.112	-0.028	0.166	-0.03
IB3	0.104	-0.04	0.159	**0.785**	0.123	0.091	0.022	0.137	-0.039
IB4	0.104	-0.038	0.151	**0.786**	0.164	0.079	0.035	0.151	0.016
IL1	0.109	-0.005	0.163	0.147	**0.753**	0.145	-0.029	0.153	-0.084
IL2	0.129	0.009	0.140	0.193	**0.717**	0.142	0.039	0.129	-0.009
IL3	0.084	-0.035	0.174	0.197	**0.762**	0.086	0.018	0.157	-0.034
IL4	0.020	-0.008	0.170	0.150	**0.784**	0.072	0.076	0.109	-0.069

Extraction Method: Principal Component Analysis.
Rotation Method: Equamax with Kaiser Normalization.
A rotation converged in 8 iterations.

Table 5 Correlations among the Latent Variables

	Mean	S. D.	AER	MER	Strategy	Technology & Production	Environmental Management	Corporate Performance
AER	3.671	1.445	1					
MER	3.570	1.389	.312**	1				
Strategy	3.928	1.143	.260**	.281**	1			
Technology & Production	4.219	1.258	.293**	.250**	.347**	1		
Environmental Management	4.668	1.242	.382**	-0.023	.275**	.270**	1	
Corporate Performance	4.396	1.048	.407**	-.120**	.099*	-0.035	.451**	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

4.3 Empirical Results

The structural model illustrated in Table 6 shows standardized path coefficients. AER has a significantly positive effect on the strategy, technology & production, environmental management corporate performance. MER is significantly connected to the strategy, environmental management corporate performance. While MER has negative effect on environmental management and corporate performance in the short run, it has a positive effect on technology & production, environmental management corporate performance with strategy as mediating role. The direct effect of strategy on corporate performance isn't significant. Technology and production, environmental management both have a significant positive effect on corporate performance. Thus, strategy positively affect the corporate performance through the path of technology and production, environmental management. Results of path coefficient was showed in fig.2 and table 6. Table 7 demonstrates the model fit results which are in proper range. Hypotheses testing results are showed in this paper are explained in detail in Table 6.

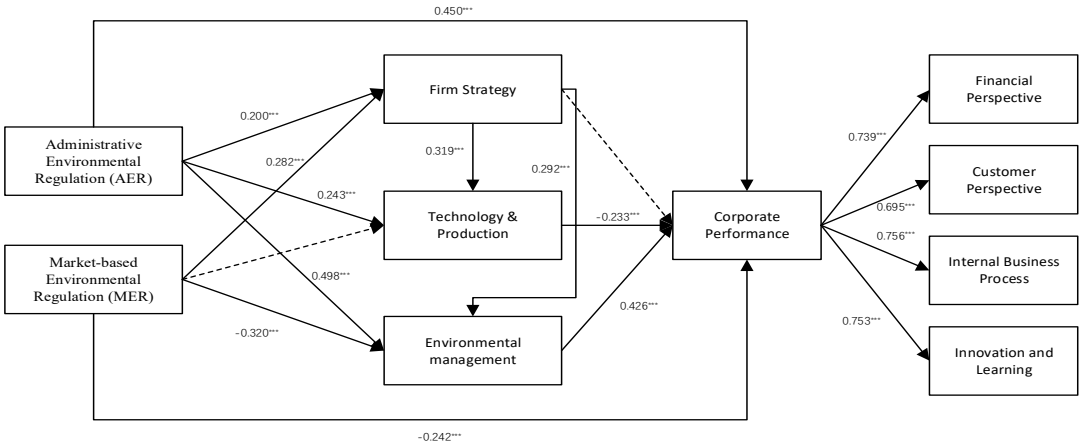

Fig.2 Path coefficients and effect

Table 6 Estimation results of path coefficient of structural equation model

Path	Standard path coefficient	C.R. Value	p	Conclusion
AER → Strategy	0.202	4.147	***	H1a Supported
AER → Technology & Production	0.214	4.541	***	H2a Supported
AER → Environmental Management	0.481	9.439	***	H3a Supported
AER → Corporate Performance	0.462	7.542	***	H4 Supported
MER → Strategy	0.278	5.343	***	H1b Supported
MER → Technology & Production	0.097	1.962	0.050	H2b not Supported
MER → Environmental Management	-0.300	-5.837	***	H3b not Supported
MER → Corporate Performance	-0.250	-4.527	***	H5 not Supported
Strategy → Technology & Production	0.292	5.972	***	H6 Supported
Strategy → Environmental Management	0.285	5.957	***	H7 Supported
Strategy → Corporate Performance	0.024	0.480	0.631	H8 not Supported
Technology & Production → Corporate Performance	-0.236	-4.918	***	H9 not Supported
Environmental Management → Corporate Performance	0.4040	6.866	***	H10 Supported

Table 7 SEM models result (Test of Overall model)

MODEL FIT METRICS	χ^2	df	SRMR	CFI	AGFI	RFI	TLI	PNFI
	959.774	576	0.0365	0.965	0.911	0.909	0.962	0.838

4.4 Effect Decomposition

To help elucidate the relationships among the various mediating variables in the hypothesized model, we conducted an effects decomposition to further understand the direct and indirect effects. Specific indirect effects represent the portion of the total effect that works through a single intervening variable. The result is presented in Table 8. Our effects decomposition yielded a coefficient of -0.112 ($p < .05$) for the indirect effect of MER on corporate performance through intrinsic corporate behavior, which accounted for 30.8 percent of the total effect of MER on corporate performance. Additionally, the coefficient for the indirect effect of AER on corporate performance through corporate behavior was .165 ($p < .05$), and the effect accounted for 26.8 percent of the total effect of AER on corporate performance.

Table 8 Standardized Total effect, Standardized Direct effect and Standardized Indirect effect

	AER	MER	Strategy	Technology & Production	Environmental Management	Corporate Performance
	STE=0.200					
	SDE=0.200	STE=0.282				
	SIE=0.000	SDE=0.282				
Strategy	STE=0.307	SIE=0.000				
Technology & Production		STE=0.090	STE=0.319	STE=-0.238		

	SDE=0.498 SIE=0.064 STE=0.557	SDE=0.000 SIE=0.090	SDE=0.319 SIE=0.000	SDE=-0.320 SIE=0.082		
Environmental Management	SDE=0.498 SIE=0.058 STE=0.615	SDE=-0.320 SIE=0.082	SDE=0.292 SIE=0.000	SDE=-0.320 SIE=0.082		
Corporate Performance	SDE=0.450 SIE=0.165	SDE=-0.242 SIE=-0.122	SDE=0.000 SIE=0.050	SDE=-0.320 SIE=0.082	SDE=0.426 SIE=0.000	SDE=-0.233 SIE=0.000

Note: STE=Standardized Total effect, SDE=Standardized Direct effect, SIE=Standardized Indirect effect.

4.5 stability test

4.5.1 Impact of state-owned enterprises

SOEs (state-owned enterprises) in China are mainly controlled by the government and have more influence on society than the other companies, they account for 84% of our samples which contain 551 surveys. In order to test the impact of different environmental policies on the SOEs (state-owned enterprises), we used the data of SOEs in our sample to see if the results stay the same with the whole sample. The model is in good fit which can be seen from table 9. By comparing the result in part 4.5.1 and 4.3, we found little has been changed in these two sences, so the impact of state-owned enterprises to a certain extent also represents the way in which Chinese oil and gas companies are affected by environmental regulation policies.

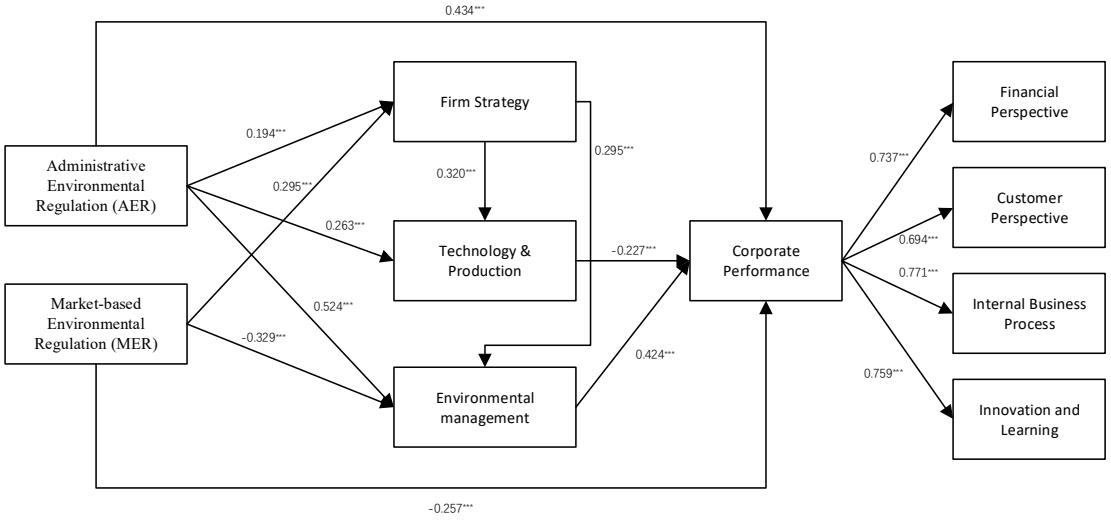

Fig. 4. Path coefficients and effect of SOEs

Table 9 SEM models result (Test of SOEs)

MODEL FIT METRICS	χ^2	df	SRMR	CFI	AGFI	RFI	TLI	PNFI
Test of SOEs	858.972	576	0.0374	0.970	0.910	0.906	0.967	0.836

4.5.2 Impact from environmental policies to corporate financial performance

To test the concept of corporate performance in a way just present financial perspective out of four concepts from balanced scorecard. All indicators of the model are within the specified range. The impacts of environmental policies are quite same with the standardized model, the impact of AER on the financial perspective is significant at 0.461 which means AER has positive impact on the corporate performance in terms of financial perspective; the impact of MER on the financial perspective is -0.309 which is also significant. What's more, the model is in good fit which is demonstrated in table 10. So, the results of this paper is robust on the traditional financial perspective.

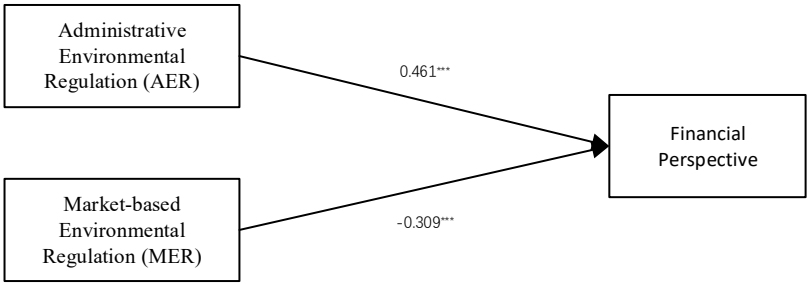

Fig. 5. Path coefficients and effect between environmental policies to corporate financial performance

Table 10 SEM models result (test of traditional financial concept)

MODEL FIT METRICS	χ^2	df	SRMR	CFI	AGFI	RFI	TLI	PNFI
	203.180	50	0.0325	0.956	0.924	0.925	0.942	0. 714

5. Conclusion

Our research makes five distinct contributions. Firstly, our overall contribution is that we have built and tested a conceptual model that uniquely corporate behavior with important multi-dimension corporate performance. Secondly, our study contributes to both the environmental regulation literature and the strategic management literature by examining and confirming strategy as a mediating mechanism through which environmental regulation ultimately influences corporate performance in the long run. Our findings are congruent with past research pointing to a positive association between self-determination aspect of strategy and corporate performance. Thirdly, our study is unique in explicating the connection of corporate performance with not only financial indicators, but also customer relationship, employ learning and growth,

internal business process. Fourthly, we specifically contribute to the environmental regulation literature by demonstrating the importance of different types of regulation in explaining comprehensive performance. Moreover, we demonstrate the important mediating role of strategy with respect to both technology & production and environmental management itself. Our results indicate that strategy plays an important role in orienting enterprises into sustainable development. Finally, this study also demonstrates mediation by corporate behavior between environmental regulation and corporate performance directly and also indirectly, through its influence on strategy, technogy & technology and environmental management. More specifically, our study shows that, beyond all expectations, MER was negatively related to environmental management and thus has negative effect on corporate performance in the long run.

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