The Effects of Ownership and Capital Structure on Environmental Information Disclosure: Empirical Evidence from Chinese Listed Electric Firms.

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Abstract: - Based on 2006 sustainability reporting guidelines and environmental information disclosure measurement issued by the Global Reporting Initiative (GRI), this paper proposes a quantitative estimation of ownership structure, capital structure and environmental information disclosure (EID) for 25 listed firms in Chinese electric industry, presents the empirical evidence of the effects of ownership and capital structure on environmental information disclosure. Our 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. Compared with listed electric firms who own higher non-state ownership, listed firms owned higher state ownership tend to disclose more environmental information in an active and voluntary behavior. Listed firms with an increase of ownership concentration and financial leverage voluntarily disclose more environmental information, which is helpful for stakeholders to reducing environmental and financial risk. Compared with short-term debt, long-term debt have a significant effect on EID, listed firms owned greater long-term debts tend to disclose more environmental information, it is helpful for creditors to decreasing financial and environmental risks. Finally we propose a series of policies and advices such as strengthening the control capacity of state-owned assets, strictly carrying out environmental regulation policies, improving ownership and capital structure, and providing capital market and green financing policies etc.

Key-Words: - ownership structure; ownership concentration; capital structure; environmental information disclosure; listed electric firms

1 Introduction

In recent years, environmental information disclosure (EID) has a hot topic with increasingly severe deterioration of ecological environment. Chinese government has issued a serial of environmental regulation policies and environmental protection rules, such as the environmental information disclosure notice of listed firms in 2003 and environmental information disclosure approach in 2007 issued by state environmental protection administration, environmental information disclosure guidelines of listed firms in the Shanghai stock exchange platform in 2008 etc. Now China has 22 laws and rules related with environmental information disclosure, such as 4 environmental protection laws issued by China government, 11 environmental policies and opinions issued by state environmental protection administration and financial administration, 8 rules and guidelines issued by Chinese securities regulation administration, Chinese banking regulation administration, Shanghai and Shenzhen stock exchange. Chinese listed firms increasingly face many interest demands and environmental protection pressures from government, society and media, government, society and stakeholders gradually pay much attention to EID of listed firms. EID and environmental performance have significant impacts on financial performance, economic performance and operation risk of listed firms, meanwhile EID has become important part in the process of the annual report, the social responsibility report and other information disclosure.

Good many literatures suggest that firm ownership and capital structure decisions reflect

attempts to mitigate agency problems between various stakeholders. Firm ownership is organized in order to maximize firm value, accounting for potential conflicts of interest between a controlling shareholder and minority investors. Ownership structure is the basic factor to affect firms' ownership and control allocation, and it has a strong impact on firm performance. The effect of ownership structure on financial performance mainly considers ownership type, ownership concentration and capital market value of listed firms. Capital structure continues to be a topic of interest in financial economics and has produced an enormous volume of research. Agency theory posits that capital structure is determined by agency costs due to conflicts of interest. Corporate governance exists to provide checks and balances between shareholders and management and thus to mitigate agency problems. Many foreign scholars have verified that ownership and capital structure have significant effects on firm performance. King and Santor (2008) present the empirical evidence of the effect of family ownership on firm performance and capital structure for 613 Canada listed firms, their results show that the freestanding family-owned firms with a single share class have similar market performance than other firms based on Tobin's q ratios, and higher financial leverage based on debt-to-total assets [1]. Bruton and Filatotchen et al. (2010) examine the effects of ownership structure and firm governance on the financial performance with the initial public offering (IPO) in the United Kingdom and France, and their empirical results show that two types of private equity investors (venture capitalists and business angles) and legal institutions investors have significantly different impacts on firms performance, higher concentrated ownership improves IPO firms' performance [2]. Li, Yue and Zhao (2009) examine the effects of ownership structure and institutional development on debt financing of non-publicly traded Chinese firms, they find that Chinese state-owned firms are positively associated with leverage and firms' access to long-term debt, while non-state owned firms tend to lower short-term and total debts than state-owned firms in less developed regions [3]. Margaritis and Psillaki (2010) investigate that the relationship between capital structure, ownership structure and firm performance using a sample of French manufacturing firms. Their empirical results show that listed firms with more dispersed ownership face greater agency costs and lower debts financing efficiency, and then gain lower debts, while listed firms with more concentrated ownership have higher debts financing efficiency and lower agency costs, and then gain more debts [4]. Cespedes, Gonzalez and Molina (2010) evaluate the capital-structure determinants of Latin American firms, higher ownership-concentrated firms avoid issuing equity, have higher financial leverage and improve firms performance, listed firms with greater tangible assets size are more leveraged and less profitable [5]. Debt can potentially reduce the misaligned incentives and constrain overinvestment reducing free cash flows and increasing monitoring by creditors. Firms' financial leverage imposes constraints on managerial discretion, while agency theory suggests that managers may be motivated to adopt sub-optimal leverage that does not maximize shareholders' wealth. More concentrated ownership makes minority larger shareholders control firms' decision rights while ignoring medium and small investors' interests. Major institution shareholders actively monitor and govern listed firms with more ownership-concentrated firms and then improve operation performance, while mistake decision directly bring listed firms about credit crisis and firms performance decline. State-owned firms and private firms have huge difference in the ownership types and firms governance, which lead to different capital structure and financial performance of listed firms.

Many foreign scholars have paid much attention to environmental information disclosure and environmental performance of listed firms. Cho, Pattern and Roberts (2006) verify that environmental information disclosure of listed firms is positively related with firms' political activity, social and environmental performance, listed firms of with poorer EID spend more on political activities than their counterparts with better EID. If unreasonable strategy design of listed firms hinder social responsibility disclosure and distort environmental information disclosure, these greater mistakes may cause serious environmental problems and increase the risks of political expenditure [6]. Montabon, Sroufe and Narasimhan (2007) expose that environmental management practices have positive impacts on firm performance, manager who use more environmental information can significantly improve firms' economic performance [7]. Earnhart and Lizal (2010) examine empirical evidence of the effect of economic performance on firm-level environmental performance using Czech listed firms in a transition economy [8]. Their results show that increased financial management efforts distract environmental management efforts aimed at controlling pollutant and greenhouse emissions, and liquidity constraints may restrain environmental investments. Liu and Narasimhan

(2009) identifies the determinant factors of EID for Chinese listed firms, listed firms with better economic performance tend to disclose more environmental information such as environmental investment and pollution control cost, more concerns of firm's stakeholders on environmental issues can promote listed firms disclose more environmental information and improve environmental performance [9]. Liu et.al (2011) find the content and degree of EID of listed firms exhibit significant differences, some firms with lower economic performance are likely to disclose more environmental information [10]. Clarkson, Overell and Chapple (2011) examine the effects of firm size, financial leverage, profitability, stock volatility and Tobin's Q value on EID, their results show that listed firms voluntarily disclose accurately environmental information through the firm's annual reports, environmental reports and sustainability reports etc, and the degree of EID are significantly related with environmental performance and financial performance [11]. Lioui and Shaema (2012) examine the effect of EID on financial performance using firm's returns of assets (ROA) and Tobin's Q value, EID has a negative impact on market value of listed firms [12]. Lin (2008) proposes the competitive strategies of the Taiwanese Small and Medium Enterprises (SMEs) in the Environmental Management Systems (EMS) as a case study using SWOT analysis, his results show that Taiwanese SMEs need to build up their environmental management and improve company's image and profitability under the impact of environmental factors within the global markets [13]. Oros and Davorin (2009) focuses primarily on the research in Sustainable Business and environmental Indicators of 120 Slovenian companies, in view of a general environmental management model, they conclude that at a declarative level, environmental care is reflected in leadership and policy, strategy and organizational culture in the area of environmental management [14]. 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 in the Kyoto phase [15]. Chang and Wang et.al (2012) develop the general model of the futures options valuation under the term structure of stochastic multi factors, their empirical results show that the term structure of arbitrary multi factors has a significant effect on the futures options valuation for CO2 emissions allowances [16]. Chang and Wang (2011) present the significant relationship between convenience yields and options value of futures spreads in the emissions allowances markets [17]. Neri(2005) proposes an agent tool for analyzing markets behaviour of information diffusion including several parameters of information diffusion like methodology advertisement efforts, consumers' memory span and word of mouth [18]. Neri(2011) investigates financial time series model by combining natural computation and agent based simulation, the natural computation technique finds the most suitable parameter for the simulator [19].Sekozawa (2012) discusses the options for adaptability to environmental change inherent in Enterprise Resource Planning (ERP) systems, the value of these options, and methods to asses the ERP value [20]. Wu et al. (2012) focuse on combining ultra-capacitor with LiFePO4 battery to improve the performance of energy storage system, the NEDC cycle simulation results demonstrate that compared with the battery only system, the EV with the HESS system is more efficient and the energy efficiency improvement is 3.5% [21]. As a result, environmental information disclosure is significantly related with political scheme, industry types, financial performance and economic performance.

As the content of voluntary disclosure, corporate governance structure and capital structure have significant impacts on environmental information disclosure. Earnhart and Lizal (2010) analyze the effects of ownership structure and financial performance on firm environmental performance using Czech listed firms, their empirical results show that successful financial performance undermines good environmental performance, and state ownership actively decline pollutions and greenhouse emissions than private ownership [8]. Xiao (2002) puts forward the idea of the environment-protection accounting, which is to broaden the scope of the producers responsibilities, and then discusses the qualities, category, essential factors and some other aspects of the corporate environmental accounting [22]. Shao and Gao (2004) focus on the contents and models of environmental information disclosure of corporate accounting, and then they proposal a serial of improving environmental information disclosure models suitable to Chinese practice and strengthening environmental protection [23]. Peng and Ren (2004) present environment control as a typical government measure has more important influence, the enterprises proper and right strategic reaction is helpful to have advantage of initial operation and maintains competitive advantage [24].Zeng et.al (2009) examine that EID of listed firms has the

significant differences, and the level of EID is obviously related with industry types, firm size, firm ownership and marketization level [25]. Zeng et.al (2012) analyze the driving factors of EID using publicly listed manufacturing firms from 2006 to 2008 in China, ownership types, capital size and marketization have significant impacts on EID, state-owned firms actively disclose more environmental information in order to achieve better social reputation, and then organizational image and reputation has a obvious impact on the content of EID [26]. Walls, Berrone and Phan (2007) comprehensively explore the link between firm governance and environmental performance, firms' owner, manager and boards of directors have significant impacts on environment performance [27]. Xu, Li and Hong (2011) find that listed firms with increased level of EID can significantly decline financing constraints of bank debts, these firms easily obtain bank borrowings which are affected by firms' ownership types and institutional environment [28]. Yang, Li and Shen (2011) propose that state ownership, equity shares of the largest shareholder, corporate governance factors such as the audit committee and environmental protection establishment have significant impacts on the level of EID, while green financing policies strengthen environmental efficiency of those factors [29]. Zhang and Wang (2010) propose provincial panel data to examine the relationship between economic growth and air pollutants using Environmental Kuznets Curve (EKC). There exists a rising, not inverted- U relation between pollution and income based on different environmental data [30]. Cai and Xu (2011) analyze the relationship between commercial bank loan decisions and environmental information disclosure after considering the effect of the nature of property rights and different marketization, their results show that environmental protection enterprise can obtain a more favorable bank loan, namely green loan is of objective existence [31]. Yao (2012) propose the implementing of environmental policy determines the effect of environmental regulation with the given environmental control technology and environmental policy, the spring theory model is used to prove existence of the political connection buffer, and the conclusion is that the political connection buffer leads to a bad effect of environmental policy [32]. In order to break political connection buffer effect between the local government and some regulated firms, the environmental performance appraisal system towards local governments is implemented to resolve the soft constraints of environmental regulation in the long run. Zhang and Xu (2012) find that the quantity and quality of environmental performance disclosure in social responsibility report remarkably improved from 2008 to 2010, and have significant differences between geographical regions, between capital markets, and between companies [33]. Yan and Zhong (2012) present that coexistence of economic decentralization and political centralization and excessive competition among local governments guided by central government are core essence of Chinese-style fiscal decentralization [34].Capital markets in China are nascent markets, ownership and capital structure have significant differences compared with the mature markets in the developed countries, listed firms in China have huge differences in the environmental information disclosure. In brief, ownership structure, ownership concentration and capital structure have significant impacts on the content and degree of EID.

State-owned and non-state-owned firms face similar agent problems. Listed firms have different ownership types, ownership concentration and corporate governance. They exhibit significant differences in the degree and driving factors of environmental information disclosure. Chinese electric industry is an industry of higher pollutions and greater greenhouse emissions. Compared with the electric industry in developed countries, Chinese electric industry has significant differences in the ownership types, ownership concentration, financial leverage, long-term debt and short-term debt. This paper seek to examine the effects of ownership structure and capital structure on the affecting degree of EID, our empirical results are helpful to disclosing environmental information and monitoring environmental management for the government decision-makers, firm managers and stakeholders.

The remainder of the article is organized as follows. Section 2 proposes theoretical analysis and research hypothesis. Section 3 describes data source and statistical description of environmental information disclosure, ownership structure and capital structure. Section 4 gives the empirical evidence of hypothesis. Section 5 concludes.

2 Theoretical Analysis and Research Hypothesis

Agency theory argues that capital structure is determined by agency costs, which enhance from potential conflicts of interests. Debt can help mitigate agency interest conflicts between

shareholders and managers. Holding constant the managers' absolute investment in the firm, enhances in the fraction of the firm financed by debts improve the manager's shares of the corporate equity, thereby bringing the manager's and shareholders' interests into better alignment. Firm governance is put into place specifically to ensure that the managers take important roles in the process of shareholders' interests, accordingly firm governance is designed to minimize agency conflicts. Due to agency costs, firm managers may adopt leverage choices that improve their own private benefits rather than maximize shareholders wealth.

Based on agency theory, firm ownership is divided as the separate degree between residual claims and ultimate control in the diversified modern enterprise scheme. Private firms controlled by personal investment exhibit the lowest agency cost because their separate degree between residual claims and ultimate control is minimum, while state-owned firms controlled by state investment exhibit the highest agency cost because their separate degree between residual claims and ultimate control is maximum [35]. Firm ownership types undermine firm's governance structure which leads to obvious differences in the agency cost and efficiency. Listed firms with different ownership types exhibit the greater differences in the management decision-makers, internal and external monitoring and capital financing structure, the degree of EID exhibits an obvious difference. Corporate ownership and capital structure decisions reflect the attempts to mitigate agency problems among various stakeholders, the managers of listed firms organize and coordinate the potential conflicts of interests between minority equity-controlled shareholder and many medium and small investors, and then maximize firm market value [36]. Ownership concentration directly affects organizational structure, operating style, managing methods and decision-making process, the content of environmental information disclosure of listed firms exhibits an obvious difference and then improve firms' ownership and capital structure.

Hypothesis 1 state-owned firms voluntarily disclo -se more environmental information than non-state-owned firms.

State-owned firms engender multi-level agency ownership relationship from the central and local government and corporate operators. The central and local government establishes state-owned assets supervision and administration committee (SASAC) to supervise environmental information disclosure of state-owned firms, the national audit office in China conduct regular audit for environmental management activities of state-owned firms, and board of directors, board of supervisors, minority equity-controlled shareholders, medium and small investors and other stakeholders pay much attention to EID of state-owned firms. The electric industry is an industry with higher pollutions and greater greenhouses emissions, state-owned firms are necessary to undertake more social responsibility, more pressure from the government, society and stakeholders is forced to disclose more environmental information. Alchian (1965), Hermalin and Katz (2006) propose ownership structure can encourage firms to achieve maximum firm value of business strategy, and strongly motivate private firms to increase revenues and reduce costs [37],[38]. Private owners consider that environmental protection need increase research and development of environmental technology and environmental investment, enhance depreciated costs of assets and administrative costs, increase related cost of EID and disposal costs of waste and greenhouse etc, accordingly environmental management incline market competitive ability and increase operating risks of listed firms. Compared with state-owned firms, non-state-owned firms seek to abate waste and greenhouse emissions, reduce operation costs and risk in order to meet stakeholders' interest, as a result, non-state owners seek to disclose less environmental information. In order to examine the effects of state ownership and non-state ownership on the degree of EID, based on the hypothesis 1 and theory analysis, we propose the following model,

$$EID_{it} = a_1 SO_{it} + a_2 NSO_{it} \quad (1)$$

Here EID_{it} denotes the environmental information disclosure indicator of listed firm i in t year. SO_{it} denotes equity-holding ratio of state legal-person ownership of listed firm i in t year, where state owners include central and local government, and centrally-owned firms. NSO_{it} denotes equity-holding ratio of non-state ownership of listed firm i in t year, where non-state owners include collective firms, private firms, foreign and institution investors, medium and small investors. a_1, a_2 denote related coefficients of state ownership and non-state ownership.

Hypothesis 2 Ownership concentration of listed firms is positively related with environmental information disclosure.

The appropriate ownership concentration gives minority equity-controlled shareholders to

effectively encourage and monitor managers' ability, improves the ability of controlling firm performance. More concentrated ownership may improve the owners' ability to control firm's costs including environmentally-related costs, however more concentrated ownership may also thwart managers' ability to control costs by reducing incentive to acquire information [22]. If the improvement of monitoring managers' ability is dominant, greater ownership concentration leads to better cost control. Conversely, if the decrease in managerial incentive is dominant, greater ownership concentration results in less cost control. Wang, Guthrie and Xiao (2012), Tsionas, Merikas and Merika (2012) find that ownership concentration has a significantly positive impact on firm performance, minority equity-controlled shareholders strengthen the ability of supervising and controlling managers with an increase of ownership concentration of listed firms [39][40]. Greater ownership concentration helps solve managers' free-riders problems, monitor and stabilize managers' behavior and improve firm performance. If firm ownership is dispersed, medium and small investors estimate environmental management effectiveness by using voluntarily environmental information disclosure of listed firms. If listed firms are reluctant to disclose more environmental information, asymmetric information between the firm and stakeholders permits firm to disseminate value-relevant information to meet more external stakeholders, accordingly less EID brings medium-small investors higher investment risk and reduces managerial discretion over future investment opportunities [41]. Firm performance are significantly related with EID, minority equity-controlled shareholders require more EID with an increase of concentrated ownership of listed firms, accordingly listed firms voluntarily disclose more environmental information. Based on the above theory analysis and hypothesis 2, we propose the following equation,

$$EID_{it} = b_1 OC_{it} \quad (2)$$

Here OC_{it} denotes ownership concentration of listed firms i in t year, ownership concentration is estimated by the sum of equity-holding ratios of three largest shareholders, c_1 denotes the related coefficients between ownership concentration and EID.

Hypothesis 3 Financial leverage are positively related with environmental information disclosure

Chinese government has stepped up the supervision of firms' environmental performance and carried out the policies and rules of state environmental protection adninistration to supervise environmental managerial behavior of listed firms in heavy-pollution industry since 2006. Meanwhile Chinese government introduced a serial of audit rules of environmental protection through debt financing from capital market. Based on agency theory, listed firms with higher financial leverage need more external capital and increase debt ratio in the capital structure, enhance interest conflict among shareholders, creditors and managers, and then increase agency cost of listed firms. Firm decision-makers voluntarily disclose more environmental information, listed firms actively accept the supervisor of environmental management by government, society and stakeholders. Socio-political theories justify that environmental information disclosure is a function of social and political pressures [42]. Firms with poor environmental performance face these pressures and have greater incentives to disclose more environmental information, and then attempt to alter their public image using soft or unverifiable information disclosure. Voluntary disclosure theory argues that better environmental performances will communicate with stakeholders using hard or verifiable information disclosure which are difficult to mimic by poor environmental performances [11]. Social responsibility theories suggest that listed firms keep good creditor-debtor relationship with stakeholders which helps enhance firm performance stability and reduce financial risk. Listed firms with greater financial leverage face higher financial risk, these firms are happy to disclose more environmental information, and then communicate with external creditors using hard or verifiable information disclosure. Based on these theories analysis and hypothesis 3, we propose the following equation,

$$EID_{it} = c_3 LEV_{it} \quad (3)$$

Here LEV_{it} denotes financial leverage of listed firms, we measure financial leverage as book value of total debt ratio, financial leverage is equal to book value of total debt / Book value of total assets.

Hypothesis 4 Firms with greater book value of long-term debt ratio tend to disclose more enviro -nmental information than firms with greater book value of short-term debt ratio.

Environmental information disclosure is an important factor to grasp environmental performance, forecast future firm profitability, determine investment risk and adjust capital structure for market investors. Booth et.al (2001),

Bhabra, Liu and Tritiroglu (2008), Erol and Tritiroglu (2012) suggest that listed firms can optimize different capital structure between short-term debt and long-term debt, the complex factors such as asymmetric information, firm performance, greater ownership concentration and scanty capital market control etc have important impacts on capital structure between short-term and long-term debts [43][44][45]. Stakeholders argue that asymmetric information bring listed firms with more long-term debt about greater investment risk and environmental management risk. Listed firms reduce risk anticipation of environmental management, incline agency cost engendered from asymmetric information and maintain good creditor-debtor relationship with stakeholders, and then tend to actively disclose more environmental information. In brief, firms with greater book value of long-term debt ratio tend to disclose more environmental information than firms with greater book value of short-term debt ratio. Based on the above theory analysis and hypothesis 4, we propose the following equation,

$$EID_{it} = d_1 SDEBT_{it} + d_2 LDEBT_{it} \quad (4)$$

Here $SDEBT_{it}$ denotes book value of short-term debt ratio for listed firm i in t year, where is equal to book value of fluid debt/book value of total assets. $LDEBT_{it}$ denotes book value of long-term debt ratio for listed firm i in t year, where is equal to book value of non-fluid debt/book value of total assets. d_1, d_2 denote the related coefficients of book value of short-term debt and book value of long-term debt.

Firstly, the main characteristic of China's state-owned firm reform is the separation of ownership and control. Ownership of state-owned firm assets is distributed among the government, institutional investors, managers, employees and private investors. This distinctive shareholding structure creates conflict of interest not only between inside managers and outside investors, but also between large shareholders and minority investors. Secondly, Second, board of directors in publicly listed electric firms in China consists mainly of representatives or officials from the government and other state firms. Board members have no doubt to care more about carrying out the wishes of the government, such as disclosing more environmental information, carrying out more social responsibilities etc. Compared with listed firms in foreign, listed electric firms in China have special ownership structure and capital structure, thereby capital and ownership structure exhibit different impact with environmental information disclosure of listed firms in China.

3 Data Source and Statistical Description

3.1 Data Source

In order to examine the effects of ownership and capital structure on environmental information disclosure, this paper selects listed electric firms as empirical samples in Chinese Shanghai and Shenzhen Stock Exchange from 2008 to 2011. Considering the continuity and comparability in social responsibility reports, 25 listed electric firms in China issued 100 social responsibility reports from 2008 to 2011. All the social responsibility reports of listed electric firms are sourced from CNINF and SynTao-sustainability Solutions network, data sample of ownership and capital structure are sourced from CNINF network and GENIUS finance service platform. CNINF network is a famous information disclosure network designated Securities Regulatory Commission in China, and a multi-level capital market of information disclosure of Chinese listed firms. Syntao is a consulting organization dedicated to provide our customers with related consulting, research and training sevices, his business focuses on corporate social responsibility (CSR) and socially responsible investment (SRI) field. As the oldest CSR professional consulting organizations, SynTao has included demestic and foreign enterprises, international organizations, government agencies, non-governmental organizations, the media and academic institutions including many institutions to establish a good relationship of cooperation. GENIUS finance service platform is a Web online edition based on the financial database development which proposes real-time financial information and financial data platform for professionals in the financial sector to provide financial information, and financial data and investment analysis tools.

3.2 Environmental Information Disclosure

Based on 30 environmental performance indicators in the sustainability reporting guidelines issued by the Global Reporting Initiative (GRI) in 2006, this paper estimates EID of 25 listed electric firms. We propose the quantitative estimation of EID indicators on the basis of the degree of EID, taking

into account the weight differences of 17 core indicators and 13 supplement indicators. The criterion of estimating score is as following: (1) Estimated the core indicators, we present the combination of quantitative and qualitative analysis, more detailed environmental information disclosure is marked 5 score. Environmental information disclosure has quantitative and qualitative analysis but inadequate disclosure, we mark 3 score. Environmental information disclosure has only qualitative description, we mark 1.5 score. Undisclosed environmental information is marked 0. (2) Estimated supplement indicators, more detailed environmental information disclosure is marked 3 score, inadequately environmental information disclosure is marked 1 score, undisclosed environmental information is marked 0. EID indicator is equal to the ratio of the actual score of EID with the optimal score of EID.

3.3 Statistical Description of EID

Seen form figure 1, the overall level of EID of listed electric firms in China is lower, EID indicators of few firms are bigger than 0.5, the content of EID of listed firms exhibits a greater difference. In the table 1, the means of EID in social responsibility reports of listed electric firms in China are 0.1744, 0.1918, 0.1942 and 0.2171 from 2008 to 2011, the overall score of EID exhibits a lower level, while the means of EID exhibit an increasing trend from 2008 to 2010. These signs show that listed electric firms in China gradually pay attention to the content of EID and EID helps make scientific decision for stakeholders. The standard deviations of EID of listed electric firms are 0.1200, 0.1223, 0.1353 and 0.1486 from 2008 to 2011, they exhibit an enlarging trend. These signs show that listed electric firms have the greater differences in the environmental information disclosure.

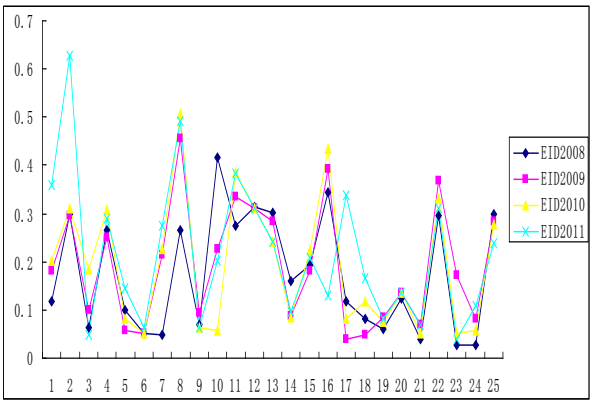

Fig 1 Environmental information disclosure of listed electric firms in China

Table 1 Statistical description of environmental information disclosure of listed electric firms in China

EID	*Mean*	*minimum*	*maximum*	*Std.dev*
2008	0.1744	0.0282	0.4153	0.1200
2009	0.1918	0.0403	0.4556	0.1223
2010	0.1942	0.0524	0.5081	0.1353
2011	0.2171	0.0403	0.6290	0.1486

3.4 Statistical Description of Ownership and Capital Structure

Table 2 show the statistical description of ownership structure of listed electric firms in China. The means of equity-holding ratios of state legal-person ownership are 0.3507, 0.2388, 0.1816 and 0.1406 from 2008 to 2011, their standard deviations are 0.2298, 0.2402, 0.2358 and 0.2050, the means and standard deviations of equity- holding ratio of state legal-person ownership exhibit an inclining trend. These signs show that equity-holding ratio of state legal-person ownership of listed firms in electric industry exhibits a declining trend. The means of equity-holding ratios of non-state ownership are 0.6493, 0.7612, 0.8184 and 0.8594 from 2008 to 2011, their means exhibit an increasing trend. The means of ownership concentration of listed firms in electric industry are 0.5607, 0.5698, 0.5584 and 0.5673, their standard deviations are 0.1467, 0.1499, 0.1578 and 0.1515. These signs show that ownership concentration of listed electric firms exhibits a higher-concentration trend, the degree of ownership concentration exhibits an obvious difference. The state-owned assets supervision and administration commission (SASAC) of the state council in China had issued the guideline of equity-split reform of state-controlled firms on June 2006, its abbreviation is the guideline of equity-split reform. On the basis of adjusting structure layout of state economy and promoting stable development of capital market, the guideline of equity-split reform emphasizes that equity-controlled shareholders of state-owned firms should conform minimum equity-holding ratio of listed firms after equity-split reform. Electric industry is an important and key industry significantly related with national energy safety and economy pillar, Chinese government is necessary to keep a higher equity-controlling proportion of state ownership in a certain period. Electric industry in China has been a key industry mainly controlled by state-owned capital or assets, a good many energy

resources are directly controlled or monopolized by listed firms of equity-controlled state capital or assets. Equity-holding ratio and ownership concentration of state-owned capital or assets in electric industry in China are relatively higher than other industries.

Table 2 Statistical description of ownership structure of listed firms in Chinese electric industry

SO	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.3507	0	0.7651	0.2298
2009	0.2388	0	0.7282	0.2402
2010	0.1816	0	0.7282	0.2358
2011	0.1406	0	0.5537	0.2050
NSO	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.6493	0.2718	1.0000	0.2231
2009	0.7612	0.2718	1.0000	0.2401
2010	0.8184	0.2718	1.0000	0.2359
2011	0.8594	0.4463	1.0000	0.2050
OC	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.5607	0.3272	0.8757	0.1467
2009	0.5698	0.3099	0.8006	0.1499
2010	0.5584	0.3267	0.7980	0.1578
2011	0.5673	0.3103	0.7986	0.1515

Note: SO, NSO, OC denote equity-holding ratios of state legal-person ownership, equity-holding ratios of non-state ownership and ownership concentration.

Table 3 Statistical description of capital structure of listed firms in Chinese electric industry

LEV	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.5990	0.2928	0.9569	0.1596
2009	0.6109	0.3085	0.8758	0.1658
2010	0.5927	0.3041	0.8567	0.1750
2011	0.6186	0.3032	0.8670	0.1558
SDEBT	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.3388	0.0796	0.8702	0.1669
2009	0.3148	0.1352	0.8224	0.1506
2010	0.3142	0.1175	0.8342	0.1452
2011	0.3200	0.0772	0.8012	0.1399
LDEBT	*mean*	*minimum*	*maximum*	*Std.dev*
2008	0.2603	0.0219	0.5046	0.1586
2009	0.2960	0.0168	0.6039	0.1573
2010	0.2785	0.0179	0.6129	0.1564
2011	0.2987	0.0216	0.5943	0.1558

Note: LEV, SDEBT, LDEBT denote asset-liability ratio, book value of short-term debt ratio and book value of long-term debt ratio.

Table 3 show statistical description of capital structure of listed firms in Chinese electric industry. The means of asset-liability ratio of listed firms in Chinese electric industry are 0.5990, 0.6109, 0.5927 and 0.6186 from 2008 to 2011, the total level of assets-liability ratio of listed firms is higher, different firms have obvious differences in the asset-liability ratio. For listed firms in electric industry, the means of book value of short-term debt ratio are higher than book value of long-term debt ratio from 2008 to 2011, their standard deviations of short-term and long-term debts exhibit an inclining trend. These signs show that short-term and long-term debts of listed firms have an obvious difference which has a declining trend.

4 Empirical Evidence of Hypothesis

Table 4 shows the statistical results of empirical evidence from hypothesis 1 to hypothesis 4. The related coefficients of state legal-person ownership and non-state ownership on environmental information disclosure (EID) are 0.2246 and 0.1851, their related coefficients exhibit a significantly positive relation at the 99% confidence level, and *t* -statistical values exhibit larger values. These empirical results show that state legal-person ownership and non-state ownership have significant impacts on EID, These results support hypothesis 1. Compared with greater non-state ownership, listed electric firms with greater state legal-person ownership tend to voluntarily disclose more environmental information, this result is similar as empirical results of Earnhart and Lizal (2010) [8]. Central and local government, managers, board of directions, board of supervisors, equity-controlled shareholders and other stakeholders establish a multi-level of supervising, managing and auditing environmental management activities for state-owned firms, which is a complex agency relationship. Compared with non-state ownership, voluntary disclosure theory suggests that listed firms with state legal-person ownership voluntarily disclose more environmental information, credible EID can communicate and meet interest demands of different stakeholders to reduce environmental management conflicts. Socio-political theory argues that state-owned firms controlled by state-owned capital or assets actively undertake more social responsibility and face more pressures from government, society and stakeholders, accordingly state-owned firms voluntarily disclose more environmental information.

Table 4 empirical results of hypothesis tests

variable	*Equation (1)*	*Equation (2)*
SO	0.2246^{***}	
	(5.1046)	

NSO	0.1851***	
	(10.1538)	
OC		0.3490***
		(17.5486)
variable	Equation (3)	Equation (4)
LEV	0.3038***	
	(13.9132)	
SDEBT		0.1520***
		(2.8944)
LDEBT		0.4732***
		(8.2071)

Note: *** denotes estimated coefficients are significant at the 99% confidence level, the numbers in the parentheses are t-statistical value.

The related coefficient between ownership concentration and EID is 0.3490, ownership concentration has a significantly positive impact on EID at the 99% confident level, and t-statistical value exhibits a higher value. This result shows that listed firms voluntarily disclose more environmental information with an increase of ownership concentration. Chinese electric industry is a typical industry with greater ownership concentration. Chinese government makes a higher market access to enter electric market for private firms, state-owned firms with greater scale strongly control and monopolize energy resources. Concentrated ownership implies that minority equity-controlled shareholders are able to control and supervise firm's manager, control operation cost and environmental management cost, and enhance firm efficiency and profitability. In recent years, Chinese government has paid much attention to ecological environment management, has strengthened rules regulation and political constraints for environmental management, accordingly listed firms face higher environmental and political risks. Equity-controlled shareholders require that listed firms should disclose more environmental information with an increase of ownership concentration, reduce political and environmental risks induced by asymmetric information. In brief, listed firms with greater ownership concentration voluntarily disclose more environmental information and meet equity-controlled shareholders more interest demands of environmental management, this result supports hypothesis 2.

The related coefficient between financial leverage and EID is 0.3038, financial leverage has a significantly positive impact on EID at the 99% confidence level. This result shows that listed electric firms voluntarily disclose more environmental information with an increase of financial leverage. Listed firms with an increase of financial leverage need raise more operating capital through banks or capital markets, their creditors engender more environmental management and interest conflicts. Chinese government has issued a serial of environmental protection auditing rules of listed firms through financing from capital market since 2006, listed firms can raise more social capital through auditing and estimating environmental management. Listed firms voluntarily disclose more environmental information with an increase of financial leverage, reduce stakeholders environmental and financial risks, and then maintain good creditor-debtor relationship, this result supports hypothesis 3.

The related coefficients of the effects of short-term and long-term debts on EID are 0.1520 and 0.4732, short-term and long-term debts have a significantly positive impact on EID at the 99% confidence level. Compared with short-term debt, long-term debt has a more significant impact on EID. Capital markets in China are nascent and immature, short-term debt financing is from banks lending, long-term debt financing is from the institution investors such as pension funds, insurance companies and trust funds etc [37]. Because of capital market constraints and asymmetric information, listed firms have greater market constraints to raise long-term debt channels from capital markets. Compared with short-term debt, long-term debt faces a higher financial and environmental risk. In order to strengthen symmetric information and maintain good creditor-debtor relationship, institution investors require more environmental information disclosure and improve financial and environmental risks management. Listed electric firms voluntarily disclose more environmental information with an increase of long-term debt and then reduce creditors financial and environmental risks, this result supports hypothesis 4.

5 Conclusion and Policy Proposals

Based on 30 environmental performance indicators in the sustainability reporting guidelines issued by the Global Reporting Initiative (GRI), we propose the empirical evidence of the effects of ownership and capital structure on EID for 25 listed firms in Chinese electric industry. The main conclusions are as following: Firstly, the means of EID in social responsibility reports of listed electric firms in China are 0.1744, 0.1918, 0.1942 and 0.2171 from 2008 to 2011, the overall score of EID exhibits a lower level. the means of EID indicators exhibit an increasing trend from 2008 to 2011, listed firms

have paid gradually attention to the content and degree of EID. Equity-holding ratio of state legal-person ownership of listed firms in electric industry exhibits a declining trend, while equity-holding ratios of non-state ownership exhibit an increasing trend. Ownership concentration of listed electric firms exhibits a higher-concentration trend. Secondly, State legal-person and non-state ownership has a significantly positive impact on EID, compared with non-state ownership, listed electric firms tend to voluntarily disclose more environmental information with an increase of state legal-person ownership. Thirdly, ownership concentration has a positively related with the content of EID, listed firms voluntarily disclose more environmental information with an increase of concentrated ownership, and then meet interest demands of environmental management required by minority equity-controlled shareholders. Fourthly, financial leverage has a obviously positive impact on EID, listed firms voluntarily disclose more environmental information with an increase of financial leverage, and then reduce environmental and financial risks of external stakeholders, maintain good creditor-debtor relationship. Fourth, short-term and long-term debts have significantly positive impacts on EID, compared with short-term debt, long-term debt has an more obvious effect on EID. Listed firms voluntarily disclose more environmental information with an increase of long-term debt, and then incline creditor financial and environmental risks.

Based on our empirical results, we propose the following policy proposals: Firstly, State-owned firms with larger scale strongly control and monopolize energy resources, enhance equity-holding ratio of listed electric firms controlled by state-owned capital or assets. State-owned firms increase the ability of environmental protection and strengthen the degree of EID controlled by state-owned capital or assets. Secondly, non-state ownership lack voluntary EID and environmental management records, Chinese government should strengthen environmental regulation for non-state firms. Audit and supervision administration administration should strictly implement environmental management rules, take effective incentives to issue more closely environmental information disclosure index and technological documents, and then regulate environmental management system of non-state firms. Thirdly, state environmental protection administration should provide advanced supporting policy of environmental technology for ownership-dispersed firm, strictly carry out environmental regulation policies for ownership-concentrated firms. Fourthly, Chinese capital markets are nascent and immature, government should make some market rules, broaden liquidity constraints of capital market, strengthen listed firms long-term debt control etc. Fifth, Chinese securities regulation committee (CSRC) improves green finance policy of capital financing demands, external environment problems are converted into environment internalization. CSRC should regulate and supervise environmental management of listed firms using market means, improve environmental performance of listed firms. Sixth, listed firms promote environmental information disclosure standard, advocate a separate environmental report and introduce the third-party assurance mechanism. We should make good use of corporate governance to quickly reply external market, and then effectively improve the quality of environmental information disclosure. All the above policy proposals can promote more listed firms to carry out environmental performance and social responsibility.

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