

Corporate Voluntary Carbon Information Disclosure: Evidence from China's Listed Companies

Juan Peng¹, Jianfei Sun¹ and Rui Luo²

¹*Antai College of Economics and Management, Shanghai Jiao Tong University, Shanghai, China, and*

²*School of Economics, Fudan University, Shanghai, China*

1. INTRODUCTION

CLIMATE change is becoming one of the most important issues of the twenty-first century, and firms are now playing a crucial role in driving the global transition from a high to a low carbon economy. Carbon information disclosures (CID hereafter), through which companies respond to climate change by providing standard information about their greenhouse gases emissions, is attracting increasing attention from scholars, stakeholders and regulators (e.g. Stanny, 2010; Matsumura et al., 2011).¹ This is because through CID, the stakeholders, including government and the public, can better monitor and regulate firms' carbon emissions, thus contributing to improve corporate environment performance. As a consequence, corporate CIDs have been steadily increasing in both size and complexity in the past decade.

The research on CID has begun to emerge in recent years. Different from the environmental information disclosure (EID, hereafter), CID is mandated by the ISO14064-1 and thus could offer more formal and standardised information as well as more quantitative measures of the level of corporate carbon emission disclosure than the EID.² Scholars have examined the determinants (e.g. Stanny and Ely, 2008; Prado-Lorenzo et al., 2009; Kim and Lyon, 2010) and effects (e.g. Andrew and Cortese, 2011; Matsumura et al., 2011; Haigh and Shapiro, 2012) of corporate CID. For example, Stanny and Ely (2008) show that factors, such as firm size, institutional ownership and foreign sales are related to the disclosure behaviour of US SP500 firms; to examine the effect of the Kyoto Protocol on corporate CID, Freedman and Jaggi (2011) investigate greenhouse gas reporting in Europe, Japan, Canada, India, and the US and find that except for Indian companies, companies locating in a country that ratified the protocol tend to report more. Matsumura et al. (2011) examine the choice of voluntary disclosure of SP500 firms and the effect of carbon emissions on firm value, documenting that firm value decreases with the disclosed carbon-emission levels.

Existing research on CID generally focus on the empirical test of firms in developed countries (Kolk et al., 2008; Haque and Deegan, 2010; Freedman and Jaggi, 2011). The corporate CIDs in developing countries have been little addressed in the literature. However, unlike developed countries, most developing countries, though vulnerable to the adverse impact of

Jianfei Sun is the corresponding author at sunjianfei@sjtu.edu.cn. All errors are our own.

¹ The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide and ozone.

² ISO 14064-1:2006 specifies principles and requirements at the organisation level for quantification and reporting of greenhouse gas emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organisation's greenhouse gas inventory.

climate change, may respond differently to the problem as they have to take the domestic responsibilities to meet the human-development needs of hundreds of millions of its people that are still living in poverty. In addition, carbon emission problems may be more serious in developing countries due to their generally stronger rate of economic growth and continued use of fossil fuels (e.g., Roberts and Grimes, 1997). Therefore, it is not only interesting, but also necessary to examine the economic drive and consequence associated with corporate CIDs in the developing economy. In this paper, we attempt to make some efforts along these dimensions.

Specifically, we investigate what would motivate Chinese firms to voluntarily release carbon emission information and what may influence the quality of their CIDs. The highlights of Chinese firms are based on the fact that China has topped the list of CO₂ emitting countries since 2006, contributing almost one-fourth of the global CO₂ emission (EPA).³ As the second large economic system, China has the largest population and a fast speed of development but still relies on coal as its primary energy source; the notable influence of China in reducing carbon emissions could be evidenced by the important role that China plays in the current climate change negotiations among different countries.

Unlike studies of developed countries, a major problem in studying corporate CIDs in China is related to the availability of qualified data. Many companies in developed countries disclose their carbon emissions through the Carbon Disclosure Project (CDP), which is an independent not-for-profit organisation based in the United Kingdom and works with shareholders and corporations to increase their disclosure of the greenhouse gas emissions by inviting enterprises all over the world to release information about their greenhouse gas emissions. However, among all the companies that are invited by CDP to disclose their carbon emissions together with the related risks and opportunities in 2010, 84 per cent of 'Europe 300' firms and 82 per cent of 'US S&P 500' firms responded to CDP's invitation and disclosed CID. In contrast, only 11 per cent of 'China 100' firms did the same thing (CDP, 2010), resulting in inadequate research literature on China's CID. The paucity of response may lead to the scarcity of research.

To measure the degree of corporate CID, we extract the CID-related information from annual Corporate Social Responsibility (CSR hereafter) reports. We identify a firm to commit to CID if its CSR report contains information that is officially involved in the CDP's questionnaire, and we score the collected information pursuant to ISO14064-1. Using a sample of listed non-financial companies in China from the period 2008 through 2012, we show that Chinese firms that are of high-emission industries and of higher peer pressures are more likely to disclose carbon emission. And the quality of disclosure among these firms is higher than that of their counterparts'.

Our main contribution to the corporate CID research consists of examining the determinants of corporate carbon disclosures and the drives of CID quality among Chinese companies. Relying on the new hand-collected data, we evidence that firm size, industry, competition status influence corporate decisions on whether to disclose carbon emission information and how much to disclose. This study may benefit investors as well as regulators by providing insight to the voluntary CID in transitory economies and is valuable for the worldwide effort on controlling the carbon emission as Chinese companies largely shape the effect of greenhouse gas emission throughout the world (Liu and Diamond, 2005; Bagnai, 2009).

³ Data available at <http://www.epa.gov/climatechange/ghgemissions/global.html#four>

Besides, by providing evidence on what affects corporate response to climate change in China, we facilitate extending the scope of CID literature to developing countries. Our study therefore may be of interest to investors, stakeholders and regulators throughout the world, helping them better understand firms' environmental practices and reporting behaviours in carbon emission.

The article is organised as follows: In Section 2, we review the literature and develop our hypothesis. Data and research design are presented in Section 3 and empirical findings are reported in Section 4, respectively. In Section 5, we conclude the implications.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

a. Literature Review

There is increasing interest in the literature to study the corporate responses to calls for environment protection. Issues that relate to how a firm's specific features influence its environmental economic behaviours, as well as the associate environment performance and financial implications, are widely discussed (Berthelot et al., 2003; Rothenberg and Stanley 2004; Kraft et al., 2011). Among all the related issues, the area of environmental disclosures has gained largely amounted research focus in the past decades (Deegan, 2002). It is well documented that environment disclosure has become a stakeholder requirement demand (Lee and Hutchison, 2005; Jose and Lee, 2006), which force companies to institutionalise environmental concerns through policies, procedures and systems (Russo and Fouts 1997; Jones et al. 1998): through disclosing environment activities, companies may benefit from legitimating themselves as social responsible firms (Berthelot et al., 2003; Anbumozhi et al., 2011). However, despite that several mandatory EID programmes have been implemented to enhance the reliability of EID (Wang et al., 2004; Garcia et al., 2007), some studies have shown that the information disclosed by firms could be selective – of which most tends to be positive, biased, and subject to managers' discretions (Neu et al., 1998; Berthelot et al., 2003).

Despite some successful EID programmes (Al-Tuwaijri et al., 2004; Garcia et al., 2007; Blackman, 2008), most literature has suggested that the level as well as the quality of EID is generally lower in developing countries (e.g. Elijido-Ten, 2011; Uwalomwa and Uadiale, 2011). As for the EID in China, prior research has indicated that factors, including firm size, financial performance, industries, ownership structure and firm locations, may affect levels, quality and attributes of EIDs of Chinese firms (Zhang et al., 2008; Yu et al., 2011).

Besides those voluminous studies in corporate environmental disclosure, some interesting research on CIDs has begun to emerge in recent years. For example, Stanny and Ely (2008) report that the firm size, previous CIDs and foreign sales are related to whether SP500 firms choose to commit to CIDs. Further evidence has been presented by Prado-Lorenzo et al. (2009) who find that firms that are larger, operating in high-pollution industries and located in countries ratifying the Kyoto protocol report more information associated with carbon emissions. Similar results are documented in the study of Freedman and Jaggi (2011) where the authors show that compared with US firms, firms from countries ratifying the Kyoto protocol where the limits on the emission of GHG are set, appear more willing to disclosure their carbon emissions, indicating that the implement of the Kyoto protocol may improve the percentage of firms engaging in voluntary CIDs. In a study focusing on US firms, Kim and Lyon (2010) suggest that with the presence of institutional investors, the involvement in CDP

could increase shareholder value, especially in more environment conscious circumstances. Likewise, Choi et al. (2010) find that for Australian firms, the firm size, profitability and industry sector are related to whether a firm engages in CID.

Andrew and Cortese (2011) investigate the carbon disclosures among Australian firms and document that corporate carbon disclosure could be a useful voluntary mechanism for internal and external decision making. Haigh and Shapiro (2012) focus on the significance of carbon emissions reporting for investment banking. They use interviews to provide insights into investors' motivations for environmental investing, and find that carbon emissions reports have had some use in investors' assessments of UK firms' corporate governance. For a sample consisting of SP500 firms' response to the CDP, Matsumura et al. (2011) document a negative relationship between voluntarily disclosed carbon emission levels and firm value.

The possible benefits of voluntary CID, according to the literature, are the reduced information asymmetry between the firm and stakeholders (Healy and Palepu, 2001; Johnston, 2005); the declined regulatory intervention (Blacconiere and Patten, 1994). CID may also induce additional compliance costs to firms and invite costly litigation cases by previously uninformed victims through the higher compliance costs.

To highlight the possible drives behind corporate CID, we integrate both the external and internal factors and model managers' disclosure decisions as a function of various firm- and industry-level characteristics. Key factors of this study are depicted as follows.

b. External Factors

(i) Regulatory Pressure

The socio-political theory indicates that corporate voluntary disclosure is related to social and political pressures a firm countered with (Patten, 2002). Due to an increasing number of international, national and regional programmes, many companies are facing new and expanding regulatory compliance risks. Regulatory pressure has become one of the primary factors that shape the companies' strategies regarding environmental and carbon disclosure. To address this potential asymmetry, we draw on socio-political theories (Patten, 2002), which argue that corporate voluntary disclosure is a function of social and political pressures facing the firm. Empirical evidence has been documented from developing countries such as Taiwan (Huang and Kung, 2010) and China (Zeng et al., 2011). Zeng et al. (2011) argue that, compared with private firms, state-owned enterprises (SOE) are more sensitive to regulatory pressure, thus often acting as pioneers in implementing EID.

Hypothesis 1A: SOEs are more likely to make CID than private companies.

Hypothesis 1B: SOEs are more likely to disclose more carbon emissions related information than private companies.

In 2011, for the first time, the Chinese Academy of Sciences publicly reported on the carbon dioxide emissions by different industries.⁴ In China's 12th Five-Year Plan, the comprehensive energy reduction programme emphasised on reducing carbon emissions from the key

⁴ Report (in Chinese) available at <http://news.163.com/11/0122/12/6R0JKCLI00014JB5.html>.

areas of manufacturing, transportation, construction, etc. Companies operating in industries with large emissions came under more pressure to reduce the greenhouse gases they emit.⁵

In addition, the legitimacy theory suggests that the desire to legitimise their business may incite managers to report their environmental information (Hughes, 2000; Deegan, 2002; Adams, 2004). Environment disclosures help companies unravel their environmental performance, present a favourable image and reduce potential compliance costs; and high-pollution firms are more likely to make legitimate efforts (Clarkson et al., 2008; Cho et al., 2009). Collectively, we hypothesise that:

Hypothesis 2A: Companies of sectors with larger greenhouse gas emissions are more likely to make CID than others.

Hypothesis 2B: Companies of sectors with larger greenhouse gas emissions are more likely to disclose more carbon emission-related information than others.

(ii) Industrial Peers

The isomorphism theory suggests that firms are inclined to mimic one another when facing uncertainties (Cyert and March, 1963; DiMaggio and Powell, 1983; Rao and Sivakumar, 1999; Brown, 2011).⁶ As a consequence, the organisational forms are often largely determined by the rules, norms and shared beliefs surrounding the organisations (Scott, 2007). As a result, it is very likely for firms to follow their peers' strategic choices. That is, industrial peers might be considered as another source of external pressure that influences firm decisions towards CID. Taking this into account, we hypothesise that:

Hypothesis 3A: The more companies in the same industry choose to disclose carbon emission information, the more likely it is for a company to choose to disclose.

Hypothesis 3B: The more carbon emission information the companies in the same industry choose to disclose, the more carbon emission information a company will choose to disclose.

(iii) Competition within Industry

In line with isomorphism theory, we speculate that pressure from competition within an industry should be a force that drives firms to implement CID. Through the contagion process among peer firms to adapt to fashionable practices (Haveman, 1993), competition may contribute to the establishment of peer pressure which forces non-adopters to join the ranks (March, 1981). In addition, competition may also compel firms to create competitive advantage through carbon emission disclosure. This leads us to hypothesise that.

⁵ Report (in English) available at <http://www.britishchamber.cn/content/chinas-twelfth-five-year-plan-2011-2015-full-english-version>.

⁶ Isomorphism is a notion in the institutional theory proposed by DiMaggio and Powell (1983). As DiMaggio and Powell (1983, p. 150) write, 'coercive isomorphism results from both formal and informal pressures exerted on organisations by other organisations upon which they are dependent and by cultural expectations in the society within which organisations function'.

Hypothesis 4A: The more competitive industry a firm is in, the more likely it is for the firm to make CID, compared to firms in other industries.

Hypothesis 4B: The more competitive industry a firm is in, the more carbon emission related information the firm will disclose.

c. Internal Factors

(i) Relative Status within Industry

Consistent with signal theory, we conjecture that carbon disclosures are favourable to a company with good performance because it helps the company to distinguish itself from relatively poor performers (Spence, 1973; Milgrom, 1981). Poor performance firms, on the other hand, may prefer to release less information so as to benefit from the replacement of their true type by the 'average' performance of all firms (Healy and Palepu, 2001). We hypothesise that:

Hypothesis 5A: The higher a company ranks within an industry, the more likely it is that the company will choose to make CID.

Hypothesis 5B: The higher a company ranks within an industry, the more carbon emission-related information the company will disclose.

(ii) Corporate Governance

Corporate governance is a set of procedures, customs and policies that determine how a company is managed, administered or controlled. In this study, we use the discrepancy between control right and cash-flow right to test how corporate governance affects companies' decisions regarding CID. Relying on prior studies which suggest that separation between the control and cash-flow right could affect a company's disclosure decisions (Lee, 2007) and companies with dispersed ownership are significantly more likely to make voluntary environmental disclosures (Brammer and Pavelin, 2006), we conjecture that greater separation may incline a company to disclose more (Lee, 2007). This leads to the following hypotheses:

Hypothesis 6A: Companies in which the separation between the control rights and the cash-flow rights are larger are more likely to make CID than others.

Hypothesis 6B: Companies in which the separation between the control rights and the cash-flow rights are larger are more likely to disclose more carbon emission information than others.

(iii) Organisational Image and Reputation

Whetten and Mackey (2002) claim that image and reputation are treated as a symmetrical communication process between the organisation and relevant stakeholders. Companies with good reputation and image are more likely to disclose relevant carbon emission information demanded by stakeholders, because the quality of such disclosure may be considered as part

of the creation of corporate reputation among stakeholder groups, as is pointed out by Hasseldine et al. (2005). While measuring the image and reputation of a company is relatively difficult, we consider that blue-chip companies in China, which are the 100 largest firms in the Shanghai and Shenzhen stock markets, may care more about their reputations and thus have a greater incentive to disclose relevant carbon information. These companies are included in the Zhongzheng 100 index. Hence, we have hypothesis 7A and hypothesis 7B as follows:

Hypothesis 7A: Companies of Zhongzheng 100 are more likely to make CID than others.

Hypothesis 7B: Companies of Zhongzheng 100 are more likely to disclose more carbon emission information than others.

3. DATA AND RESEARCH DESIGN

a. Data

In this study, we examine China's non-financial A-share listed companies of both Shenzhen and Shanghai Stock Exchanges from 2008 to 2012, excluding all the marked companies (e.g., marked with ST or PT).⁷ We have examined 7,948 CSRs, of which 1,744 firms are identified as ones that contain the carbon emissions data (those we defined according to the CDP standards).⁸ The carbon-related variables are obtained from the firms' CSRs and all the other data are from the CSMAR database.⁹ Table 1 shows the distribution by industrial sectors and years of companies in our datasets that make CID.

Table 1 reports the distribution of industries (Panel A) and of years (Panel B) for our full sample firms (Sample A), and those that voluntarily disclose their carbon emissions information (Sample B). There are 7,948 observations, out of which 3,031 belong to 13 greenhouse gas emissions industries and the rest 4,917 belong to other industries. Among 7,948 firms, there are 21.94 per cent or 1,744 firms that choose to release their carbon emissions information in the period from 2008 to 2012. Of all 1,744 firm-years making the CID, 783 (44.90 per cent of 1,744) operate in one of the TOP 13 greenhouse gas emission industries; the proportion of firms operating in the top 13 high-emission industries is 25.83 per cent for the whole sample (with and without CID). As is shown in Panel B of Table 1, the proportion of firms reporting carbon-related information in their CSR reports increases from 19.91 per cent in 2008 to 26.50 per cent in 2012, suggesting that in general more and more firms include carbon emissions information in their CSR reports although they are not required to do so. One may notice that the proportion of firms that operate CID decreases from 19.91 to 18.78 per cent in 2010 as the number of firms in the full sample increase by 30.8 per cent in 2008–10 but the number of firms in the sample with CID only increase by 23.38 per cent.

⁷ ST stands for special treatment and PT represents particular transfer. Both ST and PT firms are ones that are going to be delisted if nothing changes. They are similar to 'pink sheet' firms of the US.

⁸ We will define the variables of carbon emission data in next section.

⁹ The CSMAR database is built and managed by the China Accounting and Finance Research Center of Hong Kong Polytechnic University and Shenzhen GTI Financial Information Limited.

TABLE 1
Distribution of the Samples by Sectors and Years

	<i>Sample A All</i> 7,948 Firms		<i>Sample B</i> 1,744 Firms with CID		<i>N(B)/N(A)</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	
Panel a: by sectors					
Electricity, steam, hot water production industry	241	3.03	100	5.73	41.49
Textile industry	173	2.18	33	1.89	19.08
Nonmetal mineral products industry	219	2.76	53	3.04	24.20
Ferrous metal smelting and rolling processing industry	151	1.90	69	3.96	45.70
Manufacture of chemical fibres	90	1.13	15	0.86	16.67
Chemical materials and products manufacturing	542	6.82	100	5.73	18.45
Transportation equipment manufacturing	230	2.89	130	7.45	56.52
Agro-food processing industry	120	1.51	19	1.09	15.83
Petroleum processing and coking industry	63	0.79	21	1.20	33.33
Communications and related equipment manufacturing	639	8.04	98	5.62	15.34
Paper and paper products industry	88	1.11	20	1.15	22.73
Special equipment manufacturing industry	305	3.84	57	3.27	18.69
Non-ferrous metal smelting and rolling processing industry	170	2.14	68	3.90	40.00
Top 13 greenhouse gas emissions industries (above)	3,031	38.14	783	44.90	25.83
Other industries	4,917	61.86	961	55.10	19.54
Total	7,948	100.00	1,744	100.00	21.94
Panel b: by years					
2008	1,396	17.56	278	15.94	19.91
2009	1,485	18.68	309	17.72	20.81
2010	1,826	22.97	343	19.67	18.78
2011	1,594	20.06	385	22.08	24.15
2012	1,647	20.72	429	24.60	26.05
Total	7,948	100.00	1,744	100.00	21.94

b. Research Design

(i) Dependent Variable

To investigate the factors that drove Chinese listed companies to implement CID, we identify corporate disclosed information about carbon emissions from eight items (I_1 to I_8). These eight items are strictly referred to CDP's questionnaire when we collect the data. Following is the detailed variables of the eight items:

- I_1 : Targets and results of emission reduction;
- I_2 : Method of measuring carbon emission;
- I_3 : Scope 1 emission data: direct greenhouse gas emissions;
- I_4 : Scope 2 emission data: indirect greenhouse gas emissions of energy;
- I_5 : Scope 3 emission data: other indirect greenhouse gas emissions;
- I_6 : Energy consumption of total operation in the reporting year;
- I_7 : Emissions trading and
- I_8 : Other carbon-related information.

Items I_1 to I_8 are detailed information about carbon emission. We score these items in accordance with ISO14064-1.¹⁰ The scores range from 0 to 3 points. For I_1 to I_6 , a score of 0 means that no information is provided, and a score of 1 is given for general non-quantitative information. A score of 3 means different things for the different items. For I_1 , 3 is for detailed quantitative information including the time, quantitative targets, completeness of targets; for I_2 , 3 is given for detailed measuring process including the method used, the formula used and the parameter applied; for I_3 , I_4 , and I_5 , 3 is given for detailed quantitative information including the boundaries used for Scope 1, 2 or 3 greenhouse gas inventory and emissions figures in metric tons of CO₂; for I_6 , 3 is for detailed quantitative information including fuel consumption data in tons and per value. A score of 2 means the same for all items I_1 to I_6 , meaning that some quantitative information. For I_7 and I_8 , the scoring methodology is a little different than for the rest. While 0 is still the same as before, meaning that no information is provided, 1 is given for general non-monetary information, 3 awarded for monetary information and 2 corresponds to other concrete non-monetary information (Wiseman, 1982). Usually, the concrete non-monetary information includes such information as the goals or plans of the company, whereas general non-monetary information may just be a mention of the firms' concern for climate change or environmental pollution.

For example, we score the level of the disclosure of energy consumption of total operations in the reporting year, that is, I_6 , as follows: the 2009 annual CSR of Shanghai Electric says that 'in 2009, Shanghai Electric consumed a total of 414,710t standard coal, an increase of 1.3 per cent from 409,268t in 2008; in terms of output, the standard coal consumption was 0.6160t per thousand RMB output value, a decrease of 0.4 per cent from 0.6185t in 2008'. According to the scoring method, Shanghai Electric gets three points in this item I_6 . In contrast, the 2008 annual CSR of Guangshen Rail says that 'the energy used for dining cars on train was changed from coal to electricity, and this can save energy consumption and reduce waste gas emission'. For this kind of disclosure, the company gets one point for I_6 .

Each company is assigned a score of CID level based on equation (1).

$$Score(CID)_i = \sum_{j=1}^8 Score(I_i^j), \quad (1)$$

where $Score(CID)_i$ is the total score of CID for firm i ; and $Score(I_i^j)$ is the score of the j^{th} item for firm i , in which $j = 1, 2, \dots, 8$. In our analysis, we first construct a dummy variable – disclosure or not, which is equal to 0 when $Score(CID)_i$ equals 0 and 1 otherwise. Then we restrict our attention to firms that made CID (i.e., $Score(CID)_i$ is greater than 0) and use the value of $Score(CID)_i$ as a measure for the extent of disclosure.

(ii) Empirical Models

As aforementioned, two related issues are tested in our research, which are (i) the decision of whether to disclose; and (ii) the content of disclosure. The choice of firms to disclose carbon emissions information is modelled as a function of various firm specific features and is tested in a logistic model as follows:

¹⁰ ISO14064-1 specifies with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals.

$$\ln \left[\frac{P_{it}}{(1 - P_{it})} \right] = \alpha_0 + \alpha_1 X_{it} + \alpha_2 Z_{it} + \mu, \quad (2)$$

where P_{it} is the probability of the *CID* disclosure for company i in year t . Logistic specification is appropriate here as the dependable variable is dichotomous. X_{it} is a vector of independent variables and will be selected based on the research hypotheses, while Z_{it} refers to a set of control variables. As for the content of the disclosure, a linear OLS regression analysis is applied:

$$\text{Score}(\text{CID})_i = \alpha_0 + \alpha_1 X_{it} + \alpha_3 Z_{it} + \mu. \quad (3)$$

As mentioned above, X_{it} , the vector of independent variables in the hypotheses tests, are detailed as follows:

1. *GOV*: *GOV*, a dummy variable which equals to 1 when the firm is state-owned and 0 otherwise, is used to test hypotheses 1A and 1B.
2. *INDUSTRY*: We use *INDUSTRY* as the dummy variable to test hypotheses 2A and 2B. *INDUSTRY* is 1 when a company is in one of the following largest GHG emission industries: electricity, steam, hot water-production industry; textile industry; non-metal mineral products industry; ferrous metal smelting and rolling processing industry; manufacture of chemical fibres; chemical materials and chemical products manufacturing; transportation equipment manufacturing; agro-food processing industry; petroleum processing and coking industry; communications and related equipment manufacturing; non-ferrous metal smelting and rolling processing industry; paper and paper products industry; special equipment manufacturing industry.
3. *INDUSTRY PEER*: It is included in the regression to test hypotheses 3A and 3B. Industry peer is measured as the percentage of companies implementing *CID* in each industry every year. However, to test the content of the disclosure, we quantify the variable to the industrial average score of *CID* disclosure, that is, $\text{Score}(\text{CID})_i$, for each year.
4. *COMPETITION*: It is included in the regression to test hypotheses 4A and 4B. We use the Herfindahl index (also known as Herfindahl–Hirschman index, or HHI) to measure the level of competition among forms within an industry. Generally, with all other things being equal, the lower the Herfindahl index, the greater the competition and the weaker the market power in an industry. For example, if there are two companies in an industry with market share 80 and 20 per cent, respectively, then HHI of this industry is 0.68 ($= 0.8^2 + 0.2^2$). However, if there are three companies in that industry with market shares of 60, 20 and 20 per cent, respectively, the HHI changes to 0.44, which is smaller than 0.68. This indicates that the industry is more competitive in the latter situation.
5. *RANK*: It is included in the regression to test hypotheses 5A and 5B. Companies in the dataset are ranked within each industry by their sales. The greater the value of *RANK* is, the lower the sales of the firm are within the industry.
6. *SEPARATION*: It is included in the regression to test hypotheses 6A and 6B. It is the discrepancy between the control right (or voting right) and the cash-flow right for the ultimate owner.
7. *IMAGE*: It is included in the regression to test hypotheses 7A and 7B. It is a dummy variable which is 1 if the company is a component of Zhongzhen 100 and 0 otherwise.
8. *LNSIZE*: It is the natural logarithm of the total book value of the assets of the company at the end of each year.

9. *LEVERAGE*: It is the ratio that indicates what proportion of debt a company has relative to its assets at the end of each year.
10. *MARKET*: It is used to measure the marketisation level of the province in which each company is located. Since the latest edition of Annual Report of the Marketization Index of China (Fan et al., 2007) only provides the index from 1997 to 2007 and our data is from 2008 till 2010,¹¹ we will assume that the marketisation situation of each province is the same as it was from 1997 to 2007. Specifically, we first rank provinces based on their average marketisation index for each year during 1997–2007, with 1 being the province of the highest marketisation and 31 being the lowest. Then we define two dummy variables, which is *Market_High* (ranking from 1 to 10) and *Market_Low* (ranking from 22 to 31), respectively.
11. *MB*: It is the Market-to-Book ratio, defined as the market value divided by the book value.
12. *AGE*: It measures the number of years that have passed since a company's IPO.
13. *SHAREFORE*: It is the percentage of foreign-owned shares within a company, and it is included to measure the impact of foreign stakeholders on firm's decisions related to CID.

Table 2 presents the summary statistics of variables. Table 3 reports correlation coefficients. *CID* and *GOV* are positively correlated, which may result from the positive correlation between *GOV* and *LNSIZE*. As is documented by the prior research (e.g. Stanny and Ely, 2008; Stanny, 2010; Matsumura et al., 2011), firm size is positively related to the probability that firms make CID for larger firms have higher emissions. Therefore, the positive correlation between *CID* and *GOV* may be due to that larger firms of which the proportion of SOE is high also have higher carbon emissions. Consistently, the correlation between *INDUSTRY* and *LNSIZE* is positive.

4. EMPIRICAL RESULTS

Table 4 reports the results of the logistic model of the driven factors for Chinese companies to disclose the greenhouse gas emission information. Following Zeng et al. (2011), we test the hypothesis with (Model I) and without industry effects (Model II), respectively. More specifically, in the regression with industry effects, we examine whether firms of higher emission industries are more likely to make CID, and we involve the variable of 'INDUSTRY_PEER' to test the effect of the peer pressure on corporate CID decisions without industry effects (Zeng et al. 2010). Year effects are controlled to account for unobserved factors that do not vary across firms in a given year but change over time.

As Table 4 shows, the coefficient on our first variable of interest, *GOV*, is positive but insignificant in both models, showing that the decision to disclose of SOE firms is similar to that of private firms in China. Another variable to test the impact of regulatory pressure on corporate CID implement is *INDUSTRY*, which equals 1 if the firm operates in high GHG-emission industries, and zero otherwise. Consistent with our prediction, the coefficient of *INDUSTRY* is positive and weakly significant. The coefficient is 0.173, indicating that the probability of disclosure is 17.3 per cent higher if the firm belongs to high-emission

¹¹ The Annual Report of the marketization index of China is a series of reports produced by a national programme led by Gang Fan.

TABLE 2
Descriptive Statistics of Variables

<i>Variable</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Minimum</i>	<i>Maximum</i>
CID	1,744	5.02	4.16	1.00	25.00
Gov	1,744	0.37	0.48	0.00	1.00
Industry_peer	1,744	0.32	0.20	0.04	1.00
Industry	1,744	0.35	0.48	0.00	1.00
Competition	1,744	0.16	0.17	0.02	1.00
Rank	1,744	14.79	15.24	1.00	144.00
Separation	1,744	0.06	0.09	0.00	0.43
Image	1,744	0.12	0.33	0.00	1.00
Lnsiz	1,744	22.76	1.45	18.27	28.14
Leverage	1,744	0.51	0.19	0.02	1.15
Market_high	1,744	0.62	0.48	0.00	1.00
Market_low	1,744	0.13	0.34	0.00	1.00
MB	1,744	0.94	1.34	0.00	16.01
Age	1,744	10.26	5.05	0.00	22.00
Sharefore	1,744	0.01	0.06	0.00	0.72

industries, thus supporting H2A that companies in high-emission industries are more likely to make the CID.

Consistent with the prediction of isomorphism that the action of industry peers to commit to CID may impose non-disclosers to disclose their carbon emissions, the coefficient of *INDUSTRY PEER*, as is shown in Table 4, is positive and significant. The regression results stem from the H3A and are pursuant to the conclusion of prior research like Matsumura et al. (2011), in the sense that companies may follow the industry peers' moves on CID. The underlying mechanism may reflect the mimetic isomorphism within an industry that pushes firms to imitate their industry peers' actions when facing great uncertainty about future government regulations regarding climate change.

The prediction made by H4A that fierce competition may force firms to implement CID is not supported by the results. As the variable *COMPETITION* is measured by the Herfindahl index and negatively correlated to competitive pressure within an industry, the coefficient of *COMPETITION* in model I, 1.132, suggests that the likelihood of disclosure decreases by 1.132 if competition strength is one unit higher, contradicting to our conjecture. However, the coefficient of *COMPETITION* in model II is not significant.

RANK is used to test the influence of relative status of the firm in a given industry. *RANK* equals 1 if the company has the highest sales within the industry. Consistent with the signal theory that firms with good performance tend to differentiate themselves through releasing private information, our results support H5A and show that companies with higher sales within an industry are more likely to disclose.

The point estimate of *SEPARATION* is around 0.961, weakly significant for models I and II. The results show that the likelihood of disclosing carbon-related information is higher for firms with greater separation between the control rights and the cash-flow rights, as is predicted in H6A predicts. The incentive to maintain good reputation through releasing carbon emission information, as H7A suggested, is not supported by our examination, as the *IMAGE* coefficient is positive but not significant.

Additionally, as shown in Table 4, *LNSIZE* has a significant positive correlation with CID. Pursuant to previous research on US SP500 firms (Matsumura et al., 2011), the odds ratios

TABLE 3
Pearson Correlation of Variables

	CID	Gov	Industry Peer	Industry	Competition	Rank	Separation	Image	Lnsz	Leverage	Market High	Market Low	MB	Age	Sharefore	
CID	1.000															
Gov	0.046	1.000														
Industry peer	0.377	0.105	1.000													
Industry	0.072	0.065	0.086	1.000												
Competition	0.008	0.019	0.120	-0.156	1.000											
Rank	-0.094	0.044	0.136	-0.070	0.392	1.000										
Separation	-0.008	-0.161	-0.016	0.012	-0.010	-0.008	1.000									
Image	0.280	0.134	0.221	-0.007	0.075	0.050	-0.020	1.000								
Lnsz	0.487	0.236	0.358	0.047	0.014	-0.107	-0.003	0.472	1.000							
Leverage	0.078	0.137	0.082	0.059	-0.011	-0.094	0.036	0.060	0.252	1.000						
Market high	0.003	-0.118	-0.072	-0.079	0.005	-0.046	-0.029	-0.009	0.004	-0.057	1.000					
Market low	0.032	0.113	0.082	0.037	0.024	0.024	0.036	0.063	0.048	0.037	-0.463	1.000				
MB	-0.185	-0.004	-0.090	-0.035	0.013	-0.002	0.001	-0.005	-0.215	0.387	-0.019	0.002	1.000			
Age	0.197	0.129	0.129	-0.005	-0.035	-0.078	0.030	-0.021	0.222	0.315	-0.118	0.074	0.002	1.000		
Sharefore	-0.028	-0.080	-0.038	-0.031	0.025	0.004	0.070	-0.018	-0.047	-0.073	0.103	-0.061	-0.036	-0.153	1.000	

TABLE 4
Firm's Choice to Disclose Carbon Emissions

	<i>Predicted Sign</i>	<i>Whole Sample(Logistic Model)</i>	
		<i>Model I</i>	<i>Model II</i>
Constant		-19.738***	-18.0413***
Gov	+/-	442.17	591.58
		0.045	-0.03
Industry	+	0.25	0.16
		0.173*	
Industry_peer	+	4.44	4.3010***
			348.62
Competition	-	1.132**	0.26
		14.98	1.22
Rank	-	-0.003*	-0.00601***
		5.32	25.13
Separation	+	0.961*	0.9278*
		4.14	6.10
Image	+	0.208	0.20
		0.99	1.48
Lnsiz	+	0.791***	0.6858***
		316.21	378.55
Leverage	+	-0.984***	-0.9126***
		18.55	32.61
Market_high	+	0.015	0.1261*
		0.03	2.88
Market_low	-	0.124	-0.06
		0.92	0.30
MB	+	0.015	0.0939***
		0.24	40.97
Age	+	0.112***	0.0658***
		214.44	106.90
Sharefore	+	-1.705*	-0.45
		5.94	0.85
Year effects		Yes	Yes
Industry effects		Yes	No
Observations		7,948	7,948

Note:

***Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

(2.205 for model I and 1.985 for model II) indicate that one standard deviation increase in firm size approximately doubles the likelihood to make CID. The possible reason for this observation is that larger firms have higher GHG emissions. Moreover, our results reveal that firm age is positively related to the disclosure possibility, and firms operating in higher marketed provinces are more likely to disclose.

The results of the content of CID are reported in Table 5. Similarly, we follow Zeng et al. (2011) and separately test the OLS model with (model III) and without industry effects (Model IV). *INDUSTRY* is included in the regression with industry effects and the variable of *INDUSTRY PEER* is investigated in model IV without industry effects (Zeng et al. 2010). Year effects are controlled in models III and IV.

TABLE 5
Disclosure Content and Firm Specific Features

	<i>Predicted Sign</i>	<i>Sample with CID (OLS Model)</i>	
		<i>Model III</i>	<i>Model IV</i>
Constant		-19.030***	-16.481***
Gov	+/-	-6.15	-6.11
		-0.080	-0.238
		-0.33	-1.44
Industry	+	1.273**	
		2.85	
Industry_peer	+		0.500
			0.25
Competition	-	-1.211***	-0.743
		-4.12	-0.62
Rank	-	0.004	-0.007
		1.52	-1.10
Separation	-	1.026	-0.012
		0.54	-0.01
Image	+	0.621**	0.508***
		3.06	4.27
Lnsize	+	1.132***	0.970***
		7.50	5.70
Leverage	+	-2.557***	-1.964***
		-8.52	-3.96
Market_high	+	0.018	-0.114
		0.18	-0.72
Market_low	-	0.078	0.263
		0.31	1.17
MB	+	-0.705**	-0.639*
		-3.67	-2.47
Age	+	0.044	0.083**
		1.41	3.33
Sharefore	+	-1.314	-0.606
		-1.13	-1.09
Year effects		Yes	Yes
Industry effects		Yes	No
Observations		1,744	1,744

Note:

***Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

Similar to the findings reported in Table 4, the coefficient for GOV (which equals 1 if a company is owned by the state) is positive but insignificant. We therefore conclude that the carbon-disclosure behaviour is indiscriminate between state-owned firms and private firms.

H2B states that firms operating in high-emission industries may report more carbon information is affirmed by the significantly positive coefficient of *INDUSTRY*, as Table 5 shows. In this regard, we relate our research to Clarkson et al. (2008) and Cho et al. (2012), in the sense that firms in high-emission industries may have the incentive to report more emission information so as to reduce compliance costs.

Table 5 also shows that a unit increase in the proportion of industry firm disclosures result in 0.500 unit growth in the content of CID, supporting the H3B. Therefore, our results

indicate that the ratcheting effect or herding effect from the industry peers may not only influence corporate decisions of whether to disclose, but also affect their disclosure content. In line with the isomorphism notion, the significantly negative coefficient for *COMPETITION* support our assumption (H4B) that firms in a fiercely competitive industry would provide more carbon emission disclosures.

The insignificant coefficient of *RANK* suggests that companies with higher sales within the industry, though are more likely to make the CID, the content of their disclosure is not significantly different from their peer firms with lower sales. It follows that H5B, which predicts that companies with higher sales within an industry are willing to disclose more, is not supported by our results.

Similar to the findings of the logistic model, the effect of the separation of control right from cash-flow right (H6B) and corporate governance reputation (H7B) on corporate disclosure content receive little empirical support. As for the control variables, firm size are evidenced to be positively correlated to the quality of disclosed information and the negative signs of *LEVERAGE* imply that firms with high leverage may be less willing to release carbon information and tend to release less. Marketisation level, though affect the decision of CID, appear no impact on the content of CID. The variable 'MB' bears statistically significant coefficients in models I and II but not in models III and IV. As for the variable *AGE*, our results show that *AGE* has a significant influence on how much information a listed company would like to disclose and the firms' decision whether to disclose or not. Lastly, no clear evidence is found for *SHAREFORE* in models III and IV.

5. CONCLUSIONS

With the continued increase in environmental pollution, corporations have been encouraged and required by their stakeholders as well as by regulatory institutions to improve and disclose their management of carbon emissions. In recent years, China has also been brought into line with this course of action. In their annual CSRs, China's listed companies now disclose carbon emission information and document how they deal with problems relevant to climate change and environmental pollution.

In this study, we use hand-collected data from the annual CSRs of listed companies in China during 2008–10 to investigate two questions: (i) what factors cause the companies' decisions of whether or not to make CID and (ii) what forces influence the extent to which carbon emission information is disclosed. In this paper, we examine both external and internal factors, and we find that companies operating in high-emission sectors are more likely to make CID and tend to disclose more information. In addition, firms which have better performance are more willing to make the CID, but the content of their disclosure does not significantly differ from those with relatively poorer performance. Our study also shows that a company may be more likely to make CID when the number of industry competitors engaging in CID increases. Finally, our results suggest that companies' decisions of whether to make CID may follow the moves of their industry peers.

Our research contributes to the literature in several aspects. First, relying on a new dataset, we extend the research on corporate CIDs to the context of developing countries by investigating the impact factors that influence Chinese firms CID behaviours. This extension could be both of importance and interest as the carbon emission problems are generally more serious in developing countries where fossil fuels are still widely used. Our findings suggest that the process of marketisation may incite firms to disclose more carbon information; while

the impact of government promotion through state-owned firms are insignificant for Chinese firms' carbon-disclosure decisions. In addition, our research may contribute to the growing number of studies that investigate the involvement of firms in the environment protection actions. We show that the responses of firms may vary across firms with different firm and industry-specific characters; therefore, our study should be of interest to investors, outside stakeholders as well as regulators.

In recent years, China has begun to put a lot of efforts on controlling carbon emissions, but results do not seem as good as expected. The growth rate of the Chinese economy remains high and environmental problems are becoming more severe for China. While our paper tries to study what would affect Chinese-listed firms to make CID, a lot of questions still remain unanswered. For example, in terms of controlling carbon information, what would be effective force? Would the force be similarly effective to both SOE and non-SOE? There exist a lot of important questions that need to be answered during China's fast development, which bring us future research directions.

REFERENCES

- Adams, C. A. (2004), 'The Ethical, Social and Environmental Reporting-Performing Portrayal gap', *Accounting, Auditing and Accountability Journal*, **17**, 5, 731–57.
- Al-Tuwaijri, S. A., T. E. Christensen and K. E. Hughes II (2004), 'The Relations Among Environmental Disclosure, Environmental Performance and Economic Performance: A Simultaneous Equations Approach', *Accounting, Organizations, and Society*, **29**, 5, 447–71.
- Anbumozhi, V., Q. Chotichanathawong and T. Muruges (2011), *Information Disclosure Strategies for Green Industries* (Tokyo, Japan: Asian Development Bank Institute) Available at: <http://www.adbi.org/workingpaper/2011/08/22/4678.info.disclosure.strategies.green.indu> (accessed 1 June, 2012).
- Andrew, J. and C. Cortese (2011), 'Carbon Disclosures: Comparability, the Carbon Disclosure Project and the Greenhouse Gas Protocol', *Australasian Accounting Business and Finance Journal*, **5**, 4, 6–17.
- Bagnai, A. (2009), 'The Role of China in Global External Imbalances: Some Further Evidence', *China Economic Review*, **20**, 3, 508–26.
- Berthelot, S., D. Cormier and M. Magnan (2003), 'Environmental Disclosure Research: Review and Synthesis', *Journal of Accounting Literature*, **22**, 3, 1–44.
- Blacconiere, W. G. and D. M. Patten (1994), 'Environmental Disclosures, Regulatory Costs, and Changes in Firm Value', *Journal of Accounting and Economics*, **18**, 3, 355–77.
- Blackman, A. (2008), 'Can Voluntary Environmental Regulation Work in Developing Countries? Lessons From Case Studies', *Policy Studies Journal*, **36**, 1, 119–41.
- Brammer, S. J. and S. Pavelin (2006), 'Voluntary Environmental Disclosures by Large UK Companies', *Journal of Business Finance & Accounting*, **33**, 7/8, 1168–88.
- Brown, J. L. (2011), 'The Spread of Aggressive Corporate Tax Reporting: A Detailed Examination of the Corporate-Owned Life Insurance Shelter', *Accounting Review*, **86**, 1, 23–57.
- CDP. (2010). 'Carbon Disclosure Project 2010 Global 500 Report'. Available at: <https://www.cdproject.net/CDPResults/CDP-2010-G500.pdf> (accessed 1 June 2012).
- Cho, C. H., M. Freedman and D. M. Patten (2012), 'Corporate Disclosure of Environmental Capital Expenditures: A Test of Alternative Theories', *Accounting, Auditing & Accountability Journal*, **25**, 3, 486–507.
- Choi, B. B., D. Lee and J. Psaros (2010), 'An Analysis and Explanation of Australian Company Carbon Emission Disclosures', paper presented at 2010 AFAANZ Conference, Christchurch, 3–5 July.
- Clarkson, P. M., Y. Li, G. D. Richardson and F. P. Vasvari (2008), 'Revisiting the Relation Between Environmental Performance and Environmental Disclosure: An Empirical Analysis', *Accounting, Organizations and Society*, **33**, 4, 303–27.
- Cyert, R. and J. G. March (1963), *A Behavioral Theory of the Firm* (Englewood Cliffs, NJ: Prentice Hall).

- Deegan, C. (2002), 'The Legitimizing Effect of Social and Environmental Disclosures: A Theoretical Foundation', *Accounting, Auditing and Accountability Journal*, **15**, 3, 282–311.
- DiMaggio, P. J. and W. W. Powell (1983), 'The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields', *American Sociological Review*, **48**, 2, 147–60.
- Elijido-Ten, E. (2011), 'Media Coverage and Voluntary Environmental Disclosure: A Developing Country Explanatory Experiment', *Accounting Forum*, **35**, 3, 139–57.
- Fan, G., X. L. Wang and H. P. Zhu (2007), *The Marketization Index in China* (Beijing: Beijing Economy Science Press).
- Freedman, M. and B. Jaggi (2011), 'Global Warming Disclosures: Impact of Kyoto Protocol Across Countries', *Journal of International Financial Management and Accounting*, **22**, 1, 46–90.
- Garcia, J., T. Sterner and S. Afsah (2007), 'Public Disclosure of Industrial Pollution: The Proper Approach for Indonesia?', *Environment and Development Economics*, **12**, 6, 739–56.
- Haigh, M. and M. A. Shapiro (2012), 'Carbon Reporting: Does it Matter?', *Accounting, Auditing & Accountability Journal*, **25**, 1, 105–25.
- Haque, S. and C. Deegan (2010), 'Corporate Climate Change-related Governance Practices and Related Disclosures: Evidence From Australia', *Australian Accounting Review*, **20**, 4, 317–33.
- Hasseldine, J., A. I. Salama and J. S. Toms (2005), 'Quantity Versus Quality: The Impact of Environmental Disclosure on the Reputations of UK plcs', *British Accounting Review*, **37**, 2, 231–48.
- Haveman, H. (1993), 'Follow the Leader: Mimetic Isomorphism and Entry Into New Markets', *Administrative Science Quarterly*, **38**, 4, 593–627.
- Healy, P. M. and K. G. Palepu (2001), 'Information Asymmetry, Corporate Disclosure, and the Capital Markets: A Review of the Empirical Disclosure Literature', *Journal of Accounting & Economics*, **31**, 1, 405–40.
- Huang, C. L. and F. H. Kung (2010), 'Drivers of Environmental Disclosure and Stakeholder Expectation: Evidence From Taiwan', *Journal of Business Ethics*, **96**, 3, 435–51.
- Hughes II, K. E. (2000), 'The Value Relevance of Non-financial Measures of Air Pollution in the Electric Utility Industry', *Accounting Review*, **75**, 2, 209–28.
- ISO (2006), *International Standards Organization, ISO 14064-1: Greenhouse Gases - Part 1: Specification With Guidance at the Organization Level for Quantification and Reporting of Greenhouse gas Emission and Removal* (London: ISO).
- Johnston, J. S. (2005), 'Signaling Social Responsibility: On the Law and Economics of Market Incentives for Corporate Environmental Performance'. Scholarship at Penn Law. Working paper 66, University of Pennsylvania Law School. Available at: http://lsr.nellco.org/upenn_wps/66 (accessed 23 January 2013).
- Jones, K., T. Alabaster and J. Walton (1998), 'Virtual Environments for Environmental Reporting', *Greener Management International* **21**, 1, 121–37.
- Jose, A. and S.-M. Lee (2006), 'Environmental Reporting of Global Corporations: A Content Analysis Based on Website Disclosures', *Journal of Business Ethics*, **72**, 4, 307–21.
- Kim, E. and T. P. Lyon (2010), 'Strategic Environmental Disclosure: Evidence From the DOE's Voluntary Greenhouse Gas Registry', *Journal of Environmental Economics and Management*, **61**, 3, 311–26.
- Kolk, A., D. Levy and J. Pinkse (2008), 'Corporate Responses in an Emerging Climate Regime: The Institutionalization and Commensuration of Carbon Disclosure', *European Accounting Review*, **17**, 4, 719–45.
- Kraft, M. E., M. Stephan and T. D. Abel (2011), *Coming Clean: Information Disclosure and Environmental Performance* (Cambridge, MA: MIT Press).
- Lee, K. W. (2007), 'Corporate Voluntary Disclosure and the Separation of Cash Flow Rights From Control Rights', *Review of Quantitative Finance and Accounting*, **28**, 4, 393–416.
- Lee, T. M. and P. D. Hutchison (2005), 'The Decision to Disclose Environmental Information: A Research Review and Agenda', *Advances in Accounting*, **21**, 1, 83–111.
- Liu, J. G. and J. Diamond (2005), 'China's Environment in a Globalizing World', *Nature*, **435**, 35, 1179–86.
- March, J. G. (1981), 'Decisions in Organizations and Theories of Choice', in A. Van de Ven and W. F. Joyce (eds.), *Perspectives on Organization Design and Behavior* (New York: Wiley), 205–44.

- Matsumura, E. M., R. Prakash and S. C. Vera-Munoz (2011), 'Voluntary Disclosures and the Firm-Value Effects of Carbon Emissions'. Working Paper (University of Wisconsin-Madison, Georgetown University, and University of Notre Dame).
- Milgrom, P. R. (1981), 'Good News and Bad News: Representation Theorems and Applications', *Bell Journal of Economics*, **12**, 2, 380–91.
- Neu, D., H. Warsame and K. Pedwell (1998), 'Managing Public Impressions: Environmental Disclosures in Annual Reports', *Accounting, Organizations, and Society*, **23**, 3, 265–82.
- Patten, D. M. (2002), 'The Relation Between Environmental Performance and Environmental Disclosure: A Research Note', *Accounting, Organizations and Society*, **27**, 8, 763–73.
- Prado-Lorenzo, J. M., L. Rodriguez-Dominguez, I. Gallego-Alvarez and I. M. Garcia-Sanchez (2009), 'Factors Influencing the Disclosure of Greenhouse gas Emission in 137 Companies World-wide', *Management Decision*, **47**, 7, 1133–57.
- Rao, H. and K. Sivakumar (1999), 'Institutional Sources of Boundary-spanning Structures: The Establishment of Investor Relations Departments in the Fortune 500 Industrials', *Organization Science*, **10**, 1, 27–42.
- Roberts, J. T. and P. E. Grimes (1997), 'Carbon Intensity and Economic Development 1962–91: A Brief Exploration of the Environmental Kuznets Curve', *World Development*, **25**, 2, 191–98.
- Rothenberg, S. and M. Stanley (2004), 'Public Environmental Accountability: From Information to Action', in K. E. Karim and R. W. Rutledge (eds.), *Environmental Disclosure Practices and Financial Performance* (Westport, CT: Praeger), 103–24.
- Russo, M. V. and P. A. Fouts (1997), 'A Resource-based Perspective on Corporate Environmental Performance and Profitability', *Academy of Management Journal*, **40**, 3, 534–59.
- Scott, W. R. (2007), 'Institutional Theory: Contributing to a Theoretical Research Program', in G. Smith Ken and A. Hitt Michael (eds.), *Great Minds in Management: The Process of Theory Development* (Oxford: Oxford University Press), 460–84.
- Spence, A. M. (1973), 'Job Market Signaling', *Quarterly Journal of Economics*, **87**, 3, 355–74.
- Stanny, E. (2010), 'Voluntary Disclosure of Emissions by US Firms'. Working paper (Rohnert Park, CA: Sonoma State University). Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1454808 (accessed 23 September 2013).
- Stanny, E. and K. Ely (2008), 'Corporate Environmental Disclosures About the Effects of Climate Change', *Corporate Social Responsibility and Environmental Management*, **15**, 6, 338–48.
- Uwalomwa, U. and O. M. Uadiale (2011), 'Corporate Social and Environmental Disclosure in Nigeria: A Comparative Study of the Building Material and Brewery Industry', *International Journal of Business and Management*, **6**, 2, 258–64.
- Wang, H., J. Bi, D. Wheeler, J. Wang, D. Cao, G. Lu and Y. Wang (2004), 'Environmental Performance Rating and Disclosure: China's Green Watch Program', *Journal of Environmental Management*, **71**, 2, 123–33.
- Whetten, D. A. and A. Mackey (2002), 'A Social Actor Conception of Organizational Identity and its Implications for the Study of Organizational Reputation', *Business and Society*, **41**, 4, 393–414.
- Wiseman, J. (1982), 'An Evaluation of Environmental Disclosure Mode in Corporate Annual Reports', *Accounting, Organizations and Society*, **7**, 1, 53–63.
- Yu, Z., J. Jian and P. He (2011), 'The Study on the Correlation Between Environmental Information Disclosure and Economic Performance: With Empirical Data From the Manufacturing Industries at Shanghai Stock Exchange in China', *Energy Procedia*, **5**, 1, 1218–24.
- Zeng, S. X., X. D. Xu, Z. Y. Dong and V. M. Tam (2010), 'Towards Corporate Environmental Information Disclosure: An Empirical Study in China', *Journal of Cleaner Production*, **18**, 12, 1142–48.
- Zeng, S. X., X. D. Xu, H. T. Yin and C. M. Tam (2011), 'Factors That Drive Chinese Listed Companies in Voluntary Disclosure of Environmental Information', *Journal of Business Ethics*, **109**, 3, 309–21.
- Zhang, B., J. Bi, Z. Yuan, J. Ge, B. Liu and M. Bu (2008), 'Why do Companies Engage in Environmental Management? An Empirical Study in China', *Journal of Cleaner Production*, **16**, 10, 1036–45.

Copyright of World Economy is the property of Wiley-Blackwell and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.