Corporate Governance and the Quality of Greenhouse Gas Emission Disclosures

Abstract

This paper examines the relation between board gender diversity and the quality of greenhouse gas emissions disclosures in company annual reports. Disclosure quality is determined by scoring based on an index derived from the content analysis framework developed by Clarkson *et al.* (2008). We test the hypothesis that board gender diversity is positively associated with the quality of company GHG emission disclosures. The results show the presence of a female director is associated with greater levels of GHG emissions disclosure, including both high and low quality disclosures. The results add to emerging evidence of the economic importance of board gender diversity.

Introduction

This paper examines the relation between board gender diversity and the quality of company greenhouse gas (GHG) emission disclosures. Specifically, we address the question as to whether the presence of female directors on company boards is associated with better quality GHG disclosures in company annual reports. We measure the quality of disclosures using the Clarkson *et al.* (2008) content analysis index, which is derived from the Global Reporting Initiative (GRI, 2011) guidelines. The index identifies disclosures as high quality (hard) disclosures that provide objective measures of environmental performance, or low quality (soft) disclosures that 'lack credibility and substantiation' (Clarkson *et al.*, 2008, p. 313). Our sample is comprised of all companies listed on the Australian Securities Exchange in 2007 that had GHG emission disclosures in their annual report, and a matched group of non-disclosing companies based on size and industry.

Our study is motivated by the increasing economic importance of GHG emission disclosures. Governments worldwide have adopted policies that encourage companies to reduce their greenhouse gas (GHG) emissions. Consequently, investors are seeking high quality information about how companies manage risks and exploit opportunities related to climate change and GHG emissions (Solomon *et al.,* 2010). According to Solomon *et al.*, 2010, there is substantial variation in the content and quality of public GHG emission disclosures. Therefore, it is important to identify factors that are associated with the quality of disclosures. The study is also motivated by increased regulatory interest in improving the gender diversity of corporate boards (Terjesen, Sealy and Singh 2009). The study adds to emerging evidence on the benefits of increasing gender diversity in company management.

Prior studies suggest that board gender diversity improves board processes and decision-making. This includes improved monitoring of managers (Adams and Ferriera 2009; Adams, Gray, and Nowland 2010); more risk averse decision-making (Powell and Ansic

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1997; Jianakopolos and Bernasek 1998; Byrnes, Miller, and Schafer 1999; Barber and Odean 2001; Brooks and Zank 2005); and, greater focus by the board on maintaining company reputation (Bear, Rahman, and Post 2010). Board decision-making on GHG emission strategy and disclosure policies should be enhanced when companies adopt a gender diverse board composition.

We are aware of only one prior study that has examined the relation between board gender diversity and GHG emission disclosures. The study by Prado-Lorenzo and Garcia-Sanchez (2010) examined the association between female board representation and the extent of GHG disclosures for 283 large multinational companies across 28 countries. They did not find an association between gender diversity and the extent of disclosures. In contrast to the Prado-Lorenzo and Garcia-Sanchez (2010) study, our analysis uses a sample of large and small companies in a single jurisdiction. In addition, our study examines the relation between board gender diversity and the extent and *quality* of GHG disclosures. We are not aware of any prior study that considers the relation between board gender diversity and quality of disclosure. Our study examines the quality of publicly available information provided in company annual reports. Accordingly, it shows whether this readily available public disclosures mechanism is useful source of information for investors to assess company management of GHG emissions issues.

We adopt the socio-politico perspective and apply legitimacy theory in developing our hypotheses about the relation between governance and GHG emission disclosures. Legitimacy theory suggests that voluntary company disclosures can be explained by their response to social and political pressure. The findings of numerous environmental disclosure studies are consistent with the legitimization explanation (Brown and Deegan, 1998; Deegan and Gordon, 1996; Deegan and Rankin, 1996; Deegan, Rankin, and Tobin, 2002; Kent and Monem, 2008).

Our results show that board gender diversity board is associated with companies making more GHG emission disclosures in company annual reports. We also find this relation is consistent for both high and low quality GHG emission disclosures.

The paper proceeds as follows. In the next section we review related literature and develop our hypotheses. This is followed by a discussion of our research method. We then present and discuss the results of our analysis. The concluding section discusses the results and their implications.

Literature Review

GHG Emission Studies

Studies of voluntary GHG emission disclosures have mainly considered factors associated with extent of disclosures. Stanny and Ely (2008) examined the decision of United States S&P500 companies to disclose GHG related information by completing the 2007 Carbon Disclosure Project survey. They reported a response rate to the survey of 48 per cent, and found that larger companies, companies that had completed the previous 2004 Carbon Disclosure Project survey, and companies that had a larger percentage of foreign sales were more likely to make GHG emissions disclosures in the Carbon Disclosure Project survey. Given the low overall level of response to the survey, Stanny and Ely (2008) concluded that investors in US companies cannot rely on voluntary disclosures to adequately assess business risk associated with climate change.

Prado-Lorenzo *et al.* (2009) examined the GHG emission disclosures of 101 Fortune 500 companies from Australia, Canada, the European Union and the United States. They developed an index to measure the extent of GHG disclosures made by the sample companies on their web sites. The disclosure index comprised 19 items, which were determined by reference to prior studies and relevant items in the Global Reporting Index. The contents of

GHG disclosures were examined, and a binary score was allocated for each index item. The results showed that company size, domicile in a country that had ratified the Kyoto Protocol, and capital market performance were positively associated with GHG emission disclosures. Operating performance was negatively associated with disclosures. Prado-Lorenzo *et al.* (2009) suggest the results are consistent with legitimizing behavior. That is, companies are concerned with legitimizing their behaviour with a view to benefiting from lower capital costs, being able to attract investment, and avoiding the substantial costs of making additional disclosures.

The study by Prado-Lorenzo and Garcia-Sanchez (2010) is the only prior study we are aware of that has examined the association between female board representation and GHG disclosures. Their study used a sample of 283 large multinational companies across 28 countries, and considered the role of the board of directors in making GHG disclosures. Consistent with the earlier study by Stanny and Ely (2008), GHG disclosure was measured using data from the Carbon Disclosure Program 2007 survey. Board gender diversity was not found to be significant in the analysis. Of the board characteristics tested, only the existence of a dual CEO / board chair person was positively associated the level of GHG information disclosed. Board independence was found to be negatively associated with disclosure for companies that operate in environmentally sensitive industries. Stanny and Ely (2008) also report that size, profitability and leverage are positively associated with the level of disclosure. Overall, Prado-Lorenzo and Garcia-Sanchez (2010) suggest their results are consistent with concerns about litigation risk from extensive GHG disclosures, and the focus by independent directors on maximizing shareholder value rather than social responsibility reporting issues.

Rankin *et al.* (2011) examined the GHG emission disclosures for 183 large companies listed on the Australian Securities Exchange. Their analysis shows that companies are more

likely to make GHG disclosures if they have implemented an environmental management system, have quality governance as indicated by the strength of board independence, make publicly available disclosures to the Carbon Disclosure Project, are larger, and operate in the energy, mining or industrial sectors. Rankin *et al*. (2011) also examined the extent and quality of GHG emissions disclosures for the 80 companies in their sample that made GHG emissions disclosures. They found that companies make more credible disclosures if they have implemented a certified environmental management system, use the Global Reporting Index to guide sustainability disclosures, and make disclosures to Carbon Disclosure Project. They also found larger companies and those in the in the mining, energy and industrial industry sectors make more credible disclosures. Rankin *et al*. (2011) suggest the results indicate that companies adopt a proactive but pragmatic approach to GHG disclosures that is focused on risk management and maintenance of international and firm specific competitive advantage.

In summary, the existing studies suggest several factors are associated with the extent and quality of GHG emission disclosures. Studies that address the role of the board of directors indicate that the extent and quality of disclosures increases as the board becomes more focused on environmental issues. This is evidenced by the observed positive association between disclosure and the implementation of environmental management systems and reporting to the Carbon Disclosure Project. In terms of the composition of the board, the results are limited and inconsistent. For example, Prado-Lorenzo and Garcia-Sanchez (2010) find lower board independence and the existence of a dual CEO is associated with more disclosure. In contrast, Rankin *et al*. (2011) find that companies with greater board independence are more likely to make disclosures.

Our study makes an incremental contribution to the existing literature. First, we revisit the finding of Prado-Lorenzo and Garcia-Sanchez (2010) that gender diversity is not

significantly associated with GHG emission disclosure. Their study used a sample of very large companies across a range of jurisdictions. In contrast, our analysis uses a sample of companies with heterogeneous size in a single jurisdiction. We suggest our research method enhances the reliability of inferences that can be made about the true direction of the association between board composition, in particular gender diversity, and GHG disclosures. Second, our study is the first that we are aware of that specifically examines the relation between board gender diversity and the quality of GHG disclosures. The dependent variable in our analysis is based on the Clarkson *et al.* (2008) index which measures the quality of GHG emission disclosures.

Hypothesis Development

Legitimacy Theory

Legitimacy theory suggests that companies adopt environmental reporting when their operations are inconsistent, or perceived to be inconsistent, with society's norms and expectations (Deegan and Blomquist, 2006). Lindblom (1994) suggests that the motive for disclosures can be to: educate and inform about environmental performance and activities in response to a legitimacy gap arising from performance failure; to change the perceptions when a legitimacy gap arises from misperceptions about the company's performance; and to manipulate perception by deflecting attention from the issue of concern to other related issues. Numerous previous studies provide evidence that legitimisation is an important motivation for companies making voluntary disclosures. One group of these studies has used proxies for social pressure to identify companies that have a propensity to make voluntary disclosures. These proxies include the incidence of environmental lobby group activity, prosecution by environmental agencies and adverse media coverage resulting in community concern (Brown and Deegan, 1998; Deegan and Gordon, 1996; Deegan and Rankin, 1996;

Deegan *et al.*, 2002; Kent and Monem, 2008). Other studies have surveyed corporate decision-makers to gain insight into their motivations for making environmental disclosures (O'Donovan, 2002; Wilmshurst and Frost, 2000). Both groups of studies show that predictions about disclosures based on legitimacy theory are consistent with the incidence of voluntary environmental disclosure. Consistent with prior literature, we rely on legitimacy theory for our hypothesis development.

Prior studies have also considered the quality of environmental disclosures, with several studies finding a tendency for companies to make self-laudatory or positive disclosures when they experience social pressure (Deegan and Rankin, 1996; Deegan *et al.*, 2002; Patten, 1991). Other studies have examined the content of environmental disclosures by the development of indices to quantified disclosure type and characteristics (Clarkson *et al.*, 2008; Ingram and Frazier, 1980; Wiseman, 1982). Of particular relevance to the current study is the research of Clarkson *et al.* (2008) who develop a disclosure index that classifies environmental disclosures as either high quality 'hard' disclosures that provide objective measures of environmental performance, and lower quality 'soft' disclosures that 'lack credibility and substantiation' (Clarkson *et al.*, 2008, p. 313). Their results showed that firms with a greater threat to their legitimacy because of poor environmental performance had a greater propensity for legitimizing environmental disclosures. Moreover, these firms had a statistically significant higher rate of soft or poor quality disclosures than firms that had good environmental disclosures. The inference that can be drawn from these prior studies is that there is a negative relation between the quality of environmental disclosures and social pressure arising from negative publicity, poor environmental performance or some other event that has resulted in a perceived 'legitimacy gap' as defined by Lindblom (1994).

Board Gender Diversity

There is an increasing regulatory focus on the gender diversity of corporate boards (Terjesen, Sealy and Singh 2009). For example, countries such as Norway and Spain have implemented regulatory quotas for female board representation. (Terjesen, Sealy and Singh 2009). In addition to regulatory requirements for board diversity, societal pressure to conform to current norms is a potential catalyst for companies to increase board gender diversity. Legitimacy theory suggests that companies adopt practices when their operations are inconsistent, or perceived to be inconsistent, with society's norms and expectations (Scott 1995). This is particularly the case for large firms that are under increased pressure for legitimacy and are therefore more likely to have gender diverse boards (Hillman, Shropshire and Cannella 2007).

There is considerable existing research showing that board gender diversity increases company value, and several theoretical perspectives have been applied to explain this relation. An explanation in agency theory outlined by Adams and Ferreira (2009) is that female directors enhance board governance in a similar manner to the oversight that can be provided by independent directors. In addition, studies adopting organisational theory suggest that female directors improve board processes by their bringing different perspectives, experiences and networks to the board; their being ready to discuss difficult issues; by their tendency to engage in independent thinking; and, by their enhancing communication (Huse and Solberg 2005; Hillman *et al.* 2007; Adams and Ferreira 2009; Terjesen *et al.* 2009). Also, research in psychology and behavioural finance indicates there is a difference in the propensity for risk taking behaviour between males and females, which results in improved decision-making at the board level (Barber and Odean, 2001; Jianakopolos and Bernasek, 1998; Brooks and Zank, 2005).

Relevant to this study is that board gender diversity has been found to extend to improved disclosure of financial and non-financial information. For example, Bear *et al.* (2010) found a positive relation between the number of female directors and the strength of corporate social responsibility disclosures. Krishnan and Parsons (2008) examined whether gender diversity in top management for US firms was associated with the quality of reported earnings. They found several earnings quality measures were positively associated with gender diversity. Srinidhi *et al.* (2011) also examined the relation between earnings quality and board gender diversity for US companies from 2001 to 2007, and found that greater female board participation is associated with higher earnings quality. Barua, Davidson, Rama, and Thiruvedi (2010) examined the relation between chief financial officer (CFO) gender and accruals quality and found that companies with a female CFO have better quality accruals.

We argue that board gender diversity is associated with improved board decision-making and disclosure regarding GHG emissions. To the extent that female directors improve board monitoring, bring different perspectives and independent thinking to board decision-making, promote the discussion of difficult issues, enhance board communication and reduce propensity for risk-taking we expect that a gender diverse board will more effectively identify and respond to legitimization threats. We anticipate gender diversity will be associated with better management of GHG emissions issues, and will result in better transparent communication of its strategy and performance to shareholders. We therefore test the following hypotheses:

Hypothesis 1a: Board gender diversity is positively related to the number of corporate GHG emission disclosures.

Hypothesis 1b: Board gender diversity is positively related to high quality corporate GHG emission disclosures.

Hypothesis 1c: Board gender diversity is negatively related to the number of low quality corporate GHG emission disclosures.

Research Method

Sample and Data

Annual reports for 2059 companies listed on the Australian Securities Exchange in 2007 were sourced from AspectHuntley FinAnalysis database or company websites. For each report, an electronic search of text for the words environment, sustain, emission, and carbon and their variants was conducted, and relevant disclosures were documented. Only statements relating to the natural environment were scrutinized and therefore references to "business environment", "economic environment", "business sustainability" and the like were ignored. Annual reports that could not be electronically searched were read, and any relevant disclosures were extracted. A total of 231 companies were found to have made GHG emission disclosures, which is about 11 per cent of listed companies. After removing companies with missing data, a final sample of 214 GHG emission disclosing companies was included in the analysis. A matched group of non-disclosing companies based on industry and size measured by total assets was identified from the remaining listed companies. Sampling with replacement was used so as to obtain a suitable match for a few companies. The final sample was 428 companies; of which 214 disclosed GHG emission data and 214 did not. Board gender diversity, governance, and shareholder data were collected directly from company annual reports. Financial data were downloaded from the AspectHuntley FinAnalysis database, and missing data were obtained from company annual reports where available.

Dependent Variable

Disclosure indices have been used for content analysis over a substantial period of time and various disclosure indices have been developed (Marston and Shrives, 1991; Cerf, 1961; see Beattie, McInnes, and Fearnley, 2004 for a summary of the characteristics of such indices). While the formation of disclosure indices is subjective, they have been found to be a valuable research tool (Marston and Shrives, 1991).

This study uses the Clarkson *et al.* (2008) index as a framework for conducting content analysis of GHG emission disclosures. The Global Reporting Initiative Sustainability Reporting Guidelines (2002) influenced the disclosure items included in the Clarkson *et al.* (2008) index. It was their conjecture that a polluting company's adoption of reporting guidelines espoused by the Global Reporting Initiative reports was evidence of a thoroughly voluntary disclosure and sincerity in revealing their environmental performance credentials. The degree of sincerity was determined by whether the disclosures relate to 'hard' disclosure items concerning the environmental substance of governance systems, external oversight and verification, environmental performance indicators, and amounts spent or saved on environmental initiatives, issues or fines. These 'hard' disclosures signal a genuine corporate concern for the environment that cannot be easily mimicked by others with poor environmental performance. The second type of disclosures captured by the Clarkson *et al.* (2008) index are 'soft' disclosure items. These are mainly unverifiable claims about corporate vision, strategy, policies and initiatives of an environmental nature. Because of the unsubstantiated nature of soft disclosure items, poor environmental performers can easily imitate good environmental performers through their environmental disclosures without necessarily having a deep commitment to the protection of the environment.

Modifications to the Clarkson *et al.* (2008) index were necessary for our analysis of GHG emission disclosures and to further reflect the nature of our enquiry. We excluded their

governance structure and management systems item "Existence of an environmental and/or a public issues committee in the board" as our model includes the presence of an environmental committee as an independent variable. Instead of using Clarkson *et al.'s* (2008) ten environmental performance indicator items, we collected only GHG performance disclosures and maintained Clarkson *et al.'s* (2008) six-level scoring scale for these. All other items included in the index were retained. In keeping with the Clarkson *et al.* (2008) index scoring system, individual items for each category of disclosure are scored one (1) if information is provided and zero (0) if a disclosure is not present. Details of our modified content analysis index are provided in Table 1.

The content of each company's disclosures was assessed and scored according to the terms of our modified index. Two raters read the text of collated disclosures and assigned and scored the sections of the text in correspondence with the seven disclosure categories above. Only one point was awarded per disclosure category regardless of how many times disclosures matched the criteria. The raters compared their scoring results and discrepancies were resolved. The dependent variables used in the multivariate analysis presented are the 'total', 'hard' and 'soft' disclosures derived from our modified Clarkson *et al.* (2008) index.

Independent Variable

Our test of the relation between board gender diversity and measures of GHG emission disclosure includes a dummy variable coded one (1) for the existence of at least one female director on the board of directors, and zero (0) otherwise.

Control Variables

We include controls for board governance strength. Independence of the board is included as a control, as prior studies have shown this is associated with GHG emission disclosure

(Prado-Lorenzo and Garcia-Sanchez, 2010; Rankin et al, 2011). We include a dummy variable for whether the board has a majority of independent directors, which is coded one (1) if the company has a majority of independent directors and zero (0) otherwise.

We also include as a control board structure with a combined CEO / board chair. One view of the dual CEO/board chair structure is that separating the roles of the CEO and board chair is likely to enhance board leadership and ability to exercise oversight of management (Kiel and Nicholson, 2003; Muth and Donaldson, 1998; Palmon and Wald, 2002). In contrast, stewardship theory argues that CEO/board chair duality empowers the CEO and motivates achievement and facilitates more effective and efficient implementation of strategic decisions (Chahine and Tohmé, 2009; Kiel and Nicholson, 2003; Muth and Donaldson, 1998). The study by Prado-Lorenzo and Garcia-Sanchez (2010) found the existence of a dual CEO / board chair person was positively associated with the level of GHG information disclosed. The analysis includes an indicator variable coded one (1) if the company has a dual CEO/board chair structure, and zero (0) otherwise.

Prior research indicates the benefits of audit committees in terms of strengthening reporting quality (Davidson *et al.*, 2005; Kent and Stewart, 2008; Rainsbury *et al.*, 2008). Accordingly, a dummy variable is included that indicates whether the firm has formed an audit committee. The variable is coded one (1) if the company has an audit committee and zero (0) otherwise.

In addition to controlling for governance provided by formal internal governance mechanisms, we include a measure of shareholder concentration. Substantial shareholders are likely to provide monitoring and this enhances governance. Shareholder concentration is measured as the percentage of ordinary shares held by shareholders with a 5 per cent or larger interest in the company.

Clarkson *et al.* (2008) find that annual capital investment, which is a proxy for equipment age, is positively related to the extent of environmental disclosures. They suggest companies with newer, less polluting equipment are motivated to signal their environmental type. We include a control for the age of equipment measured as the ratio of accumulated depreciation of property, plant and equipment to its acquisition cost.

We also control for the experience of the board members as indicated by the number of their external directorships (Ferris, Jagannathan and Pritchard 2003; Carcello, *et al.* 2011; Haw, Ho and Yuansha 2011; Johnstone, Chan and Rupley 2011) consistent with prior studies that have considered the role of gender diversity (Adams and Ferreira 2009).

Prior studies have indicated that companies that demonstrate board commitment to the GHG emission issue are more likely to make disclosures and that those disclosures will be more credible (Stanny and Ely, 2008; Rankin *et al.*, 2011). Therefore we include a dummy variable that indicates whether the board has formed an environment or sustainability committee. The variable is coded one (1) if the company has a sustainability or environment committee, and zero (0) otherwise.

To control for the effect of social pressure, we include an indicator variable that takes a value of one (1) if the company had an adverse media report and zero (0) otherwise. We consider companies have greater social pressure when they are the subject of unfavorable media reports, and will have a greater propensity to make legitimizing disclosures. We searched the Factiva electronic database for any news items relating to the sample companies for the period 1 January 2006 to 31 December 2008 to identify whether the companies had adverse media reports regarding the natural environment. Search terms used included environment, carbon, greenhouse, emissions, sustainability and energy use.

Companies are more likely to make voluntary environmental disclosures if it will materially reduce their agency costs of debt (Kent and Chan, 2009). Companies that conduct

their business activities in an environmentally irresponsible manner increase their default risk with a resulting negative effect on both access to debt and its cost (Cornell and Shapiro, 1987; Kent and Chan, 2009). Leverage is included in our analysis to control for reporting incentives arising from reliance on debt financing for company operations (Roberts, 1992). We also include dummy variables that indicate whether the company obtained either new debt or equity financing in their accounting period after 2007. This was determined by examining the 2008 statement of cash flows and identifying companies that reported proceeds from borrowings and proceeds from issues. We use the forward year because this would suggest that in 2007 the companies identified were concerned with increasing their debt or equity capital in the short term.

Voluntary reporting of environmental information is costly; therefore, financial performance is related to the probability that companies will undertake such reporting (Kent and Chan, 2009; Roberts, 1992). Moreover, economically successful companies are subject to greater public scrutiny and have greater incentives to report on their environmental performance. Economic performance, measured by Tobin's Q, is included as a control variable in our analysis.

Statistical Analysis

Equation 1 shows the regression model estimated for testing the hypotheses:

$Total / Hard / Soft = \beta_0 + \beta_1\ Female\ director + \beta_2\ Shareholder\ concentration + \beta_3$ $Performance + \beta_4\ Equipment\ age + \beta_5\ Leverage + \beta_6\ Majority\ independence + \beta_7\ Dual$ $CEO/board\ chair + \beta_8\ Audit\ committee + \beta_9\ Environment\ committee + \beta_{10}\ Adverse\ media +$ $\beta_{11}\ New\ debt + \beta_{12}\ New\ equity + e$ (1)

Where:

Total = Number of GHG emission disclosures determined by content analysis index.

Hard = Number of hard GHG emission disclosures determined by content analysis index.

Soft = Number of soft GHG emission disclosures determined by content analysis index.

Leverage = total liabilities divided by total assets.

Shareholder concentration = percentage of ordinary shareholders with 5% or greater shareholding.

Performance = Tobin's Q, calculated as the sum of market value of common equity plus the book value of total debt and preferred shares divided by book value of total assets, winsorised at 1 percent.

Equipment age = Accumulated depreciation of property plant and equipment divided by cost property plant and equipment, winsorised at 1%.

Female director = dummy variable, coded 1 if the board has a female director, and 0 otherwise.

Majority independence = dummy variable, coded 1 if the company has a majority of independent directors on the board, and zero otherwise.

Dual CEO/Chair = dummy variable, coded 1 if the CEO is also the board chair, and 0 otherwise.

Audit committee = dummy variable, coded 1 if the company has an audit committee, and 0 otherwise.

Environment committee = dummy variable, coded 1 if the company has an environment or sustainability committee, and 0 otherwise.

Adverse media = dummy variable, coded 1 if adverse media reporting regarding its environmental performance in 2006 to 2008, and 0 otherwise.

New debt = dummy variable, coded 1 if the company has proceeds from borrowing recorded in the 2008 statement of cash flows, and 0 otherwise.

New equity = dummy variable, coded 1 if the company has proceeds from issues recorded in the 2008 statement of cash flows, and 0 otherwise.

Results

Descriptive Statistics

Table 1 presents the disclosure quality index and reports the summary statistics for the high quality (hard) and low quality (soft) disclosure categories. For the 214 disclosing companies in our sample, soft disclosures were made more frequently than hard disclosures. We found that of the disclosing companies, 69.16 per cent made hard disclosures while 92.99 per cent made soft disclosures. The highest rate of disclosure for soft items was 81.94 per cent for statements relating to GHG emission vision and strategy, compared to the highest rate of hard disclosure of 55.09 per cent for statements connected to external certification or verification. For the other groups of soft disclosures, 79.63 per cent described the environmental profile of the company, and 25.93 per cent outlined their environmental initiatives. For hard disclosures, 48.15 per cent of companies provided information about governance structure and management systems, 26.85 percent supplied specific greenhouse or energy performance data, and 10.65 percent disclosed information concerning environmental spending.

Table 1 about here

Table 2 shows the descriptive statistics for the independent variables, with Panel A reporting those for the continuous variables and Panel B for the binary variables. For the board gender diversity variable, 35.75 per cent of the sample companies have a female director. Results for the governance variables indicate overall strong independence for the sample companies. The proportion of companies with majority board independence is high at

66.59 per cent, and relatively few companies have a dual CEO/board chair at only 12.15 per cent. A substantial majority of companies formed an audit committee, at 88.79 per cent. The overall relatively strong governance is likely to be related to the large average company size of $7 981 million in total assets. While average company size is large, the range of is from $18 337 to $564 634 million in total assets. The percentage of shares held by shareholders with a 5 per cent or greater holding was on average 29.00 percent, suggesting the companies had reasonably high levels of dispersed shareholding. Adverse media regarding environmental performance over the period from 2006 to 2008 was received by 21.73 per cent of the companies. Finally, for the financial controls the following were observed. The average Tobin's Q measure was 2.07, which indicates a relatively high market performance; average leverage was moderate at 0.46; the equipment age variable suggests that the average level of accumulated depreciation of property plant and equipment is about 37.00 per cent of cost or fair value. A substantial proportion of companies obtained new debt and new equity at 56.54 and 61.21 percent respectively.

Table 2 about here

Table 3 reports the correlation matrix. The highest correlation is 0.33 between the female director indicator variable and leverage. The female director indicator variable is positively correlated with board independence, the existence of an audit committee, and the existence of an environmental committee. This suggests that firms with overall stronger governance are more likely to have a gender diverse board. Correlations were not of a sufficient magnitude to raise concerns about multicollinearity for the regression analyses conducted (Tabachnick and Fidell, 2001).

Table 3 about here

Table 4 presents univariate tests of differences in the independent variables between

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companies that made GHG emissions disclosures and those that did not. The results show that the characteristics of the two groups are systematically different. The female director variable is significantly different between the groups (at $p<0.05$). Of disclosing companies, 39.72 per cent have a female director compared to 31.78 per cent for non disclosing companies. A significant difference ($p<0.01$) is found for performance, with the average Tobin's Q value for GHG emissions disclosers at 2.23, compared to 1.81 for non disclosers. Disclosers also had a significantly lower rate of adoption of a dual CEO/chair board structure: 7.48 per cent of disclosers adopted this board structure, compared to 16.82 per cent for non disclosers ($p<0.01$). GHG disclosers form an audit and environment committee at a significantly greater rate than non disclosers: 92.06 per cent versus 85.51 per cent and 16.36 per cent versus 8.41 per cent respectively ($p<0.05$). Finally, the new debt dummy variable shows that 67.29 per cent of GHG emission disclosing companies obtained new debt, compared to 45.79 per cent for non disclosers (significantly different at $p<0.01$).

The leverage and adverse media variables were marginally significantly different at $p<0.10$. Mean leverage was higher for disclosers at 48.00 per cent, compared to 44.00 per cent for non disclosers. Adverse media coverage was received by 25.23 per cent of disclosers, compared to 18.22 per cent of non disclosers.

Table 4 about here

Multivariate Results

Table 5 provides results of the ordinary least squares regression analysis (model shown in Equation 1) for the sample of 428 companies. Analysis is presented for total disclosures, high quality (hard) disclosures, and low quality (soft) disclosures.

The total disclosures analysis (Model 1) is significant at $p<0.01$ ($F=8.23$), and has an adjusted R Square of 0.18. The female director variable is significant at $p<0.05$ and has a

positive coefficient. Therefore, the existence of a gender diverse board is associated with a greater number of corporate GHG emission disclosures, which supports Hypothesis 1a. The results also show that board independence is positively related to total disclosures.

For the control variables, the indicator variable for a majority of independent directors is significant ($p<0.05$) and positive, while the existence of a dual CEO/board chair is marginally significant ($p<0.10$) and negative. The existence of an environmental board sub-committee is also associated with a greater number of disclosures ($p<0.01$). Consistent with a legitimacy theory based explanation for voluntary GHG emission disclosures, the adverse media variable is positive and highly significant ($p<0.01$). The result supports the view that disclosure is motivated by a need to change or manipulate perceptions when a legitimacy gap arises. The performance variable is significant ($p<0.05$) and its coefficient is positive, which suggest that better performing companies have a greater propensity to make GHG emission disclosures. Issue of new debt is also related to increased total disclosures. This is consistent with companies signaling that they conduct their business activities in an environmentally responsible manner so as to increase access to debt and reduce its cost. Finally, contrary to expectations, we find that concentrated shareholding is negatively associated with total GHG emission disclosures. A possible explanation for this result is that companies with concentrated shareholding provide private information to investors regarding risk and opportunities related to GHG emission, thereby mitigating the need for significant additional public disclosures.

Table 5 about here

The high quality (hard) GHG disclosures analysis (Model 2) is significant at $p<0.01$ (F=6.55), and has an adjusted R Square of 0.15. The female director variable in this model is marginally significant at $p<0.10$ and has a positive coefficient. Therefore, the existence of a gender diverse board is associated with a greater number of high quality GHG emission

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disclosures, which supports Hypothesis 1b. For the control variables, the results are substantively the same as those reported for Model 1 except for the shareholder concentration and performance variables, which are not significant.

The low quality (soft) GHG disclosures analysis (Model 3) is significant at $p<0.01$ (F=7.31), and has an adjusted R Square of 0.16. The female director variable in this model is again marginally significant at $p<0.10$ and has a positive coefficient. Therefore, the existence of a gender diverse board is associated with a greater number of low quality GHG emission disclosures. This result is opposite to expectations and does not support Hypothesis 1c. For the control variables, the results are substantively the same as those reported for Model 1.

In summary, the results show that the existence of a gender diverse board of directors is associated with greater GHG emissions disclosure. We find that this relation is consistent for analysis of both high and low quality GHG emission disclosures in company annual reports. The results suggest that companies consider both high and low quality disclosures to be relevant and reliable, and do not distinguish between them in developing their reporting strategy.

Conclusion

This paper examines the relation between board gender diversity and the quality of company greenhouse gas (GHG) emissions disclosure. Disclosure quality is determined by scoring based on an index derived from the content analysis framework developed by Clarkson *et al.* (2008). The hypothesis tested is that board gender diversity is positively associated with the quality of company GHG emission disclosures. The results show the presence of a female director is associated with greater overall GHG emissions disclosure, including both high and low quality disclosures. The results add to emerging evidence of the

economic importance of board gender diversity. Overall, the results suggest that examination of board structure, in particular gender diversity, is useful in assessing the quality of company GHG emission disclosures.

Regarding the extent of GHG emission disclosure, we found only 11 percent of listed Australian companies made disclosures in their 2007 annual reports. This low rate is consistent with the prior finding that public disclosures are not sufficient to assess business risk associated with GHG emissions (Stanney and Ely, 2008; Solomon *et al.*, 2010). This suggests there is still much policy work to be done to promote more extensive GHG emissions reporting. Our results indicate that continued focus on enhancing board diversity will assist in this regard.

Our results are consistent with prior research suggesting that GHG emission disclosures being motivated by legitimization (Prado-Lorenzo *et al.*, 2009). This is indicated by the consistent positive relation observed between disclosure and adverse media reports. Consistent with prior studies, our findings suggest that these legitimizing disclosures are made with a view to benefiting from lower capital costs and maintenance of competitive advantage (Prado-Lorenzo *et al.,* 2009; Rankin *et al.*, 2011).

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Table 1: GHG Emissions Disclosure Index (*n*=214)

	Panel A: High Quality (Hard) Disclosure Items	% Companies	Average Score	Highest (lowest) Score
	Companies making disclosures	**69.16**		
A1	**Governance structure and management systems (max score is 5)**	**48.15**	**0.62**	**3(0)**
1	Existence of a Department for pollution control and/or management positions for environmental management (0-1)	6.48	0.06	
2	Existence of terms and conditions applicable to suppliers and/or customers regarding environmental practices (0-1)	6.94	0.07	
3	Stakeholder involvement in setting corporate environmental policies (0-1)	32.87	0.33	
4	Implementation of ISO 14001 at the plant and/or firm level (0-1)	12.04	0.12	
5	Executive compensation is linked to environmental performance (0-1)	4.17	0.04	
A2	**Credibility (max score is 10)**	**55.09**	**0.92**	**5(0)**
1	Adoption of GRI sustainability reporting guidelines or provision of a CERES report (0-1)	3.70	0.04	
2	Independent verification/assurance about environmental information disclosed in the EP report/web (0-1)	5.09	0.05	
3	Periodic independent verifications/audits on environmental performance and/or systems (0-1)	12.50	0.12	
4	Certification of environmental programs by independent agencies (0-1)	11.57	0.12	
5	Product Certification with respect to environmental impact (0-1)	2.78	0.03	
6	External environmental performance awards and/or inclusion in a sustainability index (0-1)	20.83	0.21	
7	Stakeholder involvement in the environmental disclosure process (0-1)	0.46	0.00	
8	Participation in voluntary environmental initiatives endorsed by EPA or Department of Energy (0-1)	8.33	0.08	
9	Participation in industry specific associations/initiatives to improve environmental practices (0-1)	18.52	0.18	
10	Participation in other environmental organisations/associations to improve environmental practices (0-1)	8.33	0.08	
A3	**GHG Performance Indicators (max score is 6)**	**26.85**	**0.47**	**5(0)**
1	Performance data is presented (0-1)	26.39	0.26	
2	Performance data is presented relative to peers/rivals or industry (0-1)	0.93	0.01	
3	Performance data is presented relative to previous periods (trend analysis) (0-1)	7.41	0.07	
4	Performance data is presented relative to targets (0-1)	4.63	0.05	
5	Performance data is presented both in absolute and normalized form (0-1)	3.24	0.03	
6	Performance date is presented at disaggregate level (i.e., plant, business unit geographic segment) (0-1)	4.63	0.05	
A4	**Environmental spending (max score is 3)**	**10.65**	**0.12**	**2(0)**
1	Summary of dollar savings arising from environment initiatives to the company (0-1)	3.70	0.04	
2	Amount spent on technologies, R&D and/or innovations to enhance environmental performance and/or efficiency (0-1)	4.17	0.04	
3	Amount spent on fines related to environmental issues (0-1)	4.63	0.05	

Table 1: GHG Emissions Disclosure Index (*n*=214) cont'd

	Panel B: Low Quality (Soft) Disclosure Items	% Companies	Average Score	Highest (lowest) Score
	Companies making disclosures	**92.99**		
A5	**Vision and strategy claims (max score is 6)**	**81.94**	**1.97**	**6(0)**
1	CEO statement on environmental performance in letter to shareholders and/or stakeholder (0-1)	9.72	0.10	
2	A statement of corporate environmental policy, values and principles, environmental codes of conduct (0-1)	54.17	0.54	
3	A statement about formal management systems regarding environmental risk and performance (0-1)	50.46	0.50	
4	A statement that the firm undertakes periodic reviews and evaluations of its environmental performance (0-1)	31.94	0.32	
5	A statement of measurable goals in terms of future environmental performance (if not awarded under A3) (0-1)	9.72	0.10	
6	A statement about specific environmental innovations and/or new technologies (0-1)	41.67	0.41	
A6	**Environmental profile (max score is 4)**	**79.63**	**0.99**	**3(0)**
1	A statement about the firm's compliance (or lack thereof) with specific environmental standards (0-1)	72.22	0.72	
2	An overview of environmental impact of the industry (0-1)	3.70	0.04	
3	An overview of how the business operations and/or products and services impact the environment (0-1)	22.22	0.22	
4	An overview about specific environmental innovations and/or new technologies (0-1)	0.93	0.01	
A7	**Environmental initiatives (max score is 6)**	**25.93**	**0.29**	**3(0)**
1	A substantive description of employee training in environmental management and operations (0-1)	4.17	0.04	
2	Existence of response plans in case of environmental accidents (0-1)	0.00	0.00	
3	Internal environmental awards (0-1)	0.93	0.01	
4	Internal environmental audits (0-1)	13.89	0.14	
5	Internal certification of environmental programs (0-1)	0.93	0.01	
6	Community involvement and/or donations related to environment (if not awarded under A1.4 or A2.7) (0-1)	9.72	0.10	

(Adapted from Clarkson *et al.*, 2008)

Table 2: Descriptive Statistics (*n*=428)
Panel A - Continuous Variables

Variable	Mean	Median	Std. Dev	Min.	Max.
Total Assets	7 981m	526m	44 513m	18 337	564 634m
Leverage	0.46	0.48	0.25	0.00	1.00
Shareholder concentration	0.29	0.20	0.34	0.00	2.42
Performance	2.07	1.53	1.79	0.00	11.74
Equipment age	0.37	0.39	0.26	0.00	0.98

Panel B: Binary Variables

Variable	Number Coded 1 (%)
Female director	153 (35.75%)
Majority independence	285 (66.59%)
Dual CEO/board chair	52 (12.15%)
Audit committee	380 (88.79%)
Environment committee	53 (12.38%)
Adverse media	93 (21.73%)
New debt	242 (56.54%)
New equity	262 (61.21%)

Notes: All variables are measured in 2007 unless noted.
Variable definitions:
Leverage = total liabilities divided by total assets.
Shareholder concentration = percentage of ordinary shareholders with 5% or greater shareholding.
Performance = Tobin's Q, calculated as the sum of market value of common equity plus the book value of total debt and preferred shares divided by book value of total assets, winsorised at 1%.
Equipment age = Accumulated depreciation of property plant and equipment divided by cost of property plant and equipment, winsorised at 1 percent.
Female director = dummy variable, coded 1 if the board has a female director, and 0 otherwise.
Majority independence = dummy variable, coded 1 if the company has a majority of independent directors on the board, and zero otherwise.
Dual CEO/Chair = dummy variable, coded 1 if the CEO is also the board chair, and 0 otherwise.
Audit committee = dummy variable, coded 1 if the company has an audit committee, and 0 otherwise.
Environment committee = dummy variable, coded 1 if the company has an environment or sustainability committee, and 0 otherwise.
Adverse media = dummy variable, coded 1 if the company experiences adverse media reporting regarding its environmental performance in 2006 to 2008.
New debt = dummy variable, coded 1 if the company has proceeds from borrowing recorded in the 2008 statement of cash flows, and 0 otherwise.
New equity = dummy variable, coded 1 if the company has proceeds from issues recorded in the 2008 statement of cash flows, and 0 otherwise.

Table 3: Correlations (*n*=428)

	Female director	Shareholder concentration	Performance	Equipment age	Leverage	Majority independence	Dual CEO/board chair	Audit committee	Environment committee	Adverse media	New debt	New equity
Female director	1											
Shareholder concentration	-0.03	1										
Performance	-0.18***	0.12**	1									
Equipment age	0.14***	-0.05	-0.03	1								
Leverage	0.33***	0.07	-0.30***	0.16***	1							
Majority independence	0.25***	0.07	-0.15***	-0.04	0.22***	1						
Dual CEO/board chair	-0.16***	-0.03	0.02	0.08	-0.13***	-0.04	1					
Audit committee	0.19***	0.07	-0.08	-0.02	0.29***	0.20***	-0.15	1				
Environment committee	0.15***	0.05	-0.08	-0.06	0.03	0.13***	-0.05	0.11**	1			
Adverse media	0.10**	0.23***	-0.03	-0.12**	0.10**	0.13***	-0.04	0.15***	0.18***	1		
New debt	0.09	0.09	-0.08	-0.09	0.25***	-0.02	-0.06	0.16***	0.12**	0.04	1	
New equity	-0.02	0.15***	0.22***	0.08	-0.08	-0.02	0.00	0.10**	-0.05	0.01	0.09	1

Notes: *** and ** represent significance levels of 0.01 and 0.05 level respectively. All variables are measured in the year 2007 unless noted.

Variable definitions:

Female director = dummy variable, coded 1 if the board has a female director, and 0 otherwise.

Shareholder concentration = percentage of ordinary shareholders with 5% or greater shareholding.

Performance = Tobin's Q, calculated as the sum of market value of common equity plus the book value of total debt and preferred shares divided by book value of total assets, winsorised at 1%.

Equipment age = Accumulated depreciation of property plant and equipment divided by cost property plant and equipment, winsorised at 1%.

Leverage = total liabilities divided by total assets.

Majority independence = dummy variable, coded 1 if the company has a majority of independent directors on the board, and zero otherwise.

Dual CEO/Chair = dummy variable, coded 1 if the CEO is also the board chair, and 0 otherwise.

Audit committee = dummy variable, coded 1 if the company has an audit committee, and 0 otherwise.

Environment committee = dummy variable, coded 1 if the company has an environment or sustainability committee, and 0 otherwise.

Adverse media = dummy variable, coded 1 if adverse media reporting regarding its environmental performance in 2006 to 2008, and 0 otherwise.

New debt = dummy variable, coded 1 if the company has proceeds from borrowing recorded in the 2008 statement of cash flows, and 0 otherwise.

New equity = dummy variable, coded 1 if the company has proceeds from issues recorded in the 2008 statement of cash flows, and 0 otherwise.

Table 4: Univariate Statistical Tests

Variable	Disclosing Companies Mean or % (*n*=214)	Non Disclosing Companies Mean or % (n=214)	*t* statistic	Chi-square
Female director	39.72%	31.78%		**2.94
Shareholder concentration	0.26	0.30	1.28	
Performance	2.23	1.81	***-2.96	
Equipment age	0.36	0.39	1.55	
Leverage	0.48	0.44	*-1.77	
Majority independence	70.56%	62.62%		2.39
Dual CEO/board chair	7.48%	16.82%		***8.75
Audit committee	92.06%	85.51%		**4.11
Environment committee	16.36%	8.41%		**6.22
Adverse media	25.23	18.22%		*3.09
New debt	67.29%	45.79%		***20.12
New equity	61.68%	60.75%		0.04

Notes : ***, ** and * represent significance levels of 0.01, 0.05, and 0.10, respectively.

Variable definitions:

Female director = dummy variable, coded 1 if the board has a female director, and 0 otherwise.

Shareholder concentration = percentage of ordinary shareholders with 5% or greater shareholding.

Performance = Tobin's Q, calculated as the sum of market value of common equity plus the book value of total debt and preferred shares divided by book value of total assets, winsorised at 1%.

Equipment age = Accumulated depreciation of property plant and equipment divided by cost of property plant and equipment, winsorised at 1 percent.

Leverage = total liabilities divided by total assets.

Majority independence = dummy variable, coded 1 if the company has a majority of independent directors on the board, and zero otherwise.

Dual CEO/Chair = dummy variable, coded 1 if the CEO is also the board chair, and 0 otherwise.

Audit committee = dummy variable, coded 1 if the company has an audit committee, and 0 otherwise.

Environment committee = dummy variable, coded 1 if the company has an environment or sustainability committee, and 0 otherwise.

Adverse media = dummy variable, coded 1 if the company experiences adverse media reporting regarding its environmental performance in 2006 to 2008.

New debt = dummy variable, coded 1 if the company has proceeds from borrowing recorded in the 2008 statement of cash flows, and 0 otherwise.

New equity = dummy variable, coded 1 if the company has proceeds from issues recorded in the 2008 statement of cash flows, and 0 otherwise.

Table 5: Regression Results (*n*=428)

	Expected Sign	Model 1: Total Disclosures		Model 2: Hard Disclosures		Model 3: Soft Disclosures	
		Coefficient	*t* statistic	Coefficient	*t* statistic	Coefficient	*t* statistic
Constant		-0.16	-0.23	-0.18	-0.49	0.02	0.04
Female director	+	0.64	**1.74	0.30	*1.56	0.34	*1.59
Shareholder concentration	+	-1.06	**-2.11	-0.29	-1.12	-0.77	***-2.62
Performance	+	0.16	**1.69	0.03	-0.31	0.13	***2.40
Equipment age	+	-0.39	-0.61	0.12	0.35	-0.51	*-1.35
Leverage	+	0.59	0.79	-0.02	-0.06	0.61	*1.40
Majority independence	+	0.83	**2.25	0.43	***2.27	0.40	**1.83
Dual CEO/board chair	-	-0.64	*-1.28	-0.37	*-1.45	-0.27	-0.91
Audit committee	+	0.56	1.03	0.20	0.73	0.35	1.11
Environment committee	+	2.22	***4.47	1.10	***4.30	1.12	***3.84
Adverse media	+	1.14	***2.73	0.58	***2.71	0.56	***2.27
New debt	+	1.71	***4.98	0.76	***4.30	0.95	***4.72
New equity	+	-0.19	-0.56	-0.07	-0.38	-0.12	-0.62
Model							
Adjusted R Square		0.18		0.15		0.16	
F Statistic		***8.23		***6.55		***7.31	

Notes: *** and ** represent significance levels of 0.01 and 0.05 level respectively. All variables are measured in the year 2007 unless noted.

Variable definitions:

Female director = dummy variable, coded 1 if the board has a female director, and 0 otherwise.

Shareholder concentration = percentage of ordinary shareholders with 5% or greater shareholding.

Performance = Tobin's Q, calculated as the sum of market value of common equity plus the book value of total debt and preferred shares, divided by book value of total assets, winsorised at 1%.

Equipment age = Accumulated depreciation of property plant and equipment divided by cost property plant and equipment, winsorised at 1%.

Leverage = total liabilities divided by total assets.

Majority independence = dummy variable, coded 1 if the company has a majority of independent directors on the board, and zero otherwise.

Dual CEO/Chair = dummy variable, coded 1 if the CEO is also the board chair, and 0 otherwise.

Audit committee = dummy variable, coded 1 if the company has an audit committee, and 0 otherwise.

Environment committee = dummy variable, coded 1 if the company has an environment or sustainability committee, and 0 otherwise.

Adverse media = dummy variable, coded 1 if adverse media reporting regarding its environmental performance in 2006 to 2008, and 0 otherwise.

New debt = dummy variable, coded 1 if the company has proceeds from borrowing recorded in the 2008 statement of cash flows, and 0 otherwise.

New equity = dummy variable, coded 1 if the company has proceeds from issues recorded in the 2008 statement of cash flows, and 0 otherwise.