

An Empirical Analysis of the Determinants of Greenhouse Gas Voluntary Disclosure in Australia

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Abstract

Based on a comprehensive theoretical framework, we investigate the determinants of greenhouse gas emission (GHG) voluntary disclosure of non GHG registered companies. Previous studies assessed the determinants of GHG voluntary disclosure of firms subject to environmental regulation, risk and liabilities. We also employ proxies of voluntary disclosure theory and agency theory in addition to the stakeholder theory and legitimacy theory used in prior studies. The content analysis for the period 2009 to 2011 shows a positive association between GHG voluntary disclosure, firm size and corporate governance. Further, firms with superior GHG performance are more likely to engage in discretionary disclosure, and listing status plays a significant role in GHG disclosure decision which suggests that stakeholders' interests also determine disclosure decisions.

Keywords: GHG emission, Voluntary, Disclosure, Content analysis, Determinant

1. Introduction

Climate change issues and public concerns over problems caused by climate change have led to the emergence of new environmental regulations in recent years. These changes focus on the reduction of GHG worldwide by adopting strategies such as carbon pricing. One example of a regulatory disclosure requirement is the Australian National Greenhouse and Energy Reporting (NGER) Act 2007. This act mandates companies with GHG, energy consumption, or production above the specified thresholds (Note1) to report their GHG, measured in CO₂-e (carbon dioxide equivalents), as well as energy consumption and production data to the Australian Government (Note 2) (Australian Government Department of Climate Change and Energy Efficiency, 2010). However there are some corporations which do not meet mandatory reporting criteria but disclose GHG information voluntarily. One hundred and seventy-four (174) Australian Stock Exchange (ASX) listed companies out of 2317 firms in 2012 disclose different levels of GHG information while they are not subject to the NGER Act 2007. For instance, Ausenco publicly discloses its GHG information, despite the fact that its level of total carbon dioxide equivalents is only about 16½ kilo tons, below reporting criteria.

The existing literature in voluntary disclosure research area can be categorized into three groups: financial voluntary disclosure, social voluntary disclosure, and GHG voluntary disclosure. As the financial disclosure literature was gaining momentum, social disclosure studies gradually started to develop. The growing literature of social voluntary disclosure examines several determinants of disclosure. They encompass determinants identified in the financial disclosure literature, and a number of determinants linked to social responsibility concepts (e.g., Clarkson, Li, Richardson, and Vasvari (2008); O'Donovan (2002); Patten (1992)). Then when climate change became a point of concern for society, a relatively new concept formed in voluntary disclosure literature regarding GHG voluntary disclosure.

Although several previous studies (e.g., Luo et al. (2010); Prado-Lorenzo, Rodríguez-Domínguez, Gallego-Álvarez, and García-Sánchez (2009); Stanny and Ely (2008)) look at the determinants of voluntary disclosure in GHG setting, generalizing the findings of these studies leads to a sample bias problem. The findings of these studies show that firm size is a dominant factor for GHG voluntary disclosure. However these samples are chosen from the largest companies in the world such as companies in Fortune 500 US, S&P500 and Global 500 (Berk, 1983). Further, these large companies are mostly subject to the mandatory GHG reporting and the reason behind their disclosure is more likely to be regulation rather than discretion. Several researchers, such as, Luo et al. (2010) choose the sample from firms which responded to the CDP questionnaire. They claim that respondents' behaviour is discretionary, as sample

firms respond to CDP questionnaire in a voluntary manner. However, companies which responded to the CDP questionnaire are mostly large firms which are subject to a variety of environmental regulations for their plants around the globe. For example, from the Global 500 firms responding to the CDP questionnaire, in Luo et al. (2010), there are three largest Australian companies: Telstra Corporation, BHP Billiton and Woolworths (PricewaterhouseCoopers, 2009). These companies voluntarily answer detailed CDP questionnaire. At the same time, they are mandated to release GHG information to Greenhouse and Energy Data Officer (GEDO).

In this study, we aim to empirically identify the key determinants of GHG voluntary disclosure using a comprehensive theoretical model. Our research question is:

What are the key theoretical determinants of GHG voluntary disclosure?

We have broadened the use of theoretical proxies and examine the firm specific characteristics associated with GHG voluntary disclosure to overcome the shortcomings in prior studies. We do not restrict our sample merely to large corporations, instead we choose our sample among ASX listed firms which are not subject to NGER Act 2007 and which disclose a level of GHG information in their annual reports purely voluntarily. Further, the available studies on the determinants of GHG voluntary disclosure do not use a comprehensive theoretical framework for disclosure. They limit the conclusion of the determinants of GHG disclosure to support legitimacy and stakeholder theories while factors relating to voluntary disclosure theory and agency theory were ignored. In this research, we consider a range of proxies to support voluntary disclosure theory and agency theory, in addition to legitimacy theory and stakeholder theory.

Legitimacy theory predicts that for the significance of carbon issues today, it is not inconceivable to propose that firms tend to disclose GHG information to legitimise their activities. Stakeholder theory suggests that as stakeholders have different expectations about climate change, they may impose pressure on firms to release GHG information. On the other hand, GHG voluntary disclosure can be regarded as a means by which firms can reduce information asymmetry about GHG and the subsequent agency costs, thus supporting the agency theory. Finally voluntary disclosure theory predicts that companies with superior GHG performance tend to disclose more information to the public.

In order to examine determinants of GHG disclosure, we use content analysis to investigate the annual reports of non-registered (with GEDO) companies for their GHG voluntary disclosure from financial year 2009 to 2011 (300 firm-year data for 151 sample firms). Our GHG disclosure index (see Appendix 1) for content analysis is based on a modification of e Aguiar and Fearfull (2010)'s GHG disclosure index according to the requirements in NGER 2007 Act. By differentiation of hard to mimic disclosure items from soft disclosure items we control for the quality of disclosure which makes our research design more rigorous.

In brief, our results are as follows. We find a positive association between the level of GHG voluntary disclosure, firm size and corporate governance. In other words it could be inferred that disclosing firms seek to reduce information asymmetry and the subsequent agency costs. Further, firms with superior GHG performance are more likely to engage in discretionary disclosure, as predicted by voluntary disclosure theory. We find some positive reaction to the listing status proxy which implies that sample corporations respond to stockholder pressure in general. Finally, for our sample firms we do not find any strong evidence to support industry and leverage as two determinants of GHG voluntary disclosure. One interpretation of this finding is that as these firms are not subject to NGER Act 2007, so they do not tend to seek legitimisation for possibly their good environmental performance. In other words, it can be inferred that well performed firms do not disclose for legitimization, they disclose to acquire the benefits of communicating good news (Note 3).

Understanding the determinants of GHG voluntary disclosure is important. It provides management a clearer understanding of limitations and incentives of GHG disclosure. This result is useful for other companies interested in the cost benefit trade-off associated with GHG voluntary disclosure. Further, the paper responds specifically to Simnett, Nugent, and Huggins' (2009) call for research applying a collection of archival data to examine the characteristics of corporations reporting their GHG emissions. It also responds to Cowan and Deegan (2011)'s call for research to evaluate changes in voluntary emission disclosure practices by the introduction of NGER Act 2007.

The paper is organized as follows. Following related research and theoretical determinants development, we describe our sample and methodology. We then present our results. The final section provides a summary, conclusions and a discussion of implications for future research.

2. Related research

The available studies about determinants of GHG voluntary disclosure were basically supported by stakeholder theory and legitimacy theory. For example, shareholder activism under stakeholder theoretical framework is identified to be one external factor affecting disclosure position of a firm. Reid and Toffel (2009) show that stockholder resolutions filed against a company or against other companies in the same industry cause a growth in response rate to the Carbon Disclosure Project (CDP (Note 4)) questionnaire. Similarly, Wegener (2010) investigates that shareholder activism influences Canadian firms' decision about responding to CDP questionnaire. Cotter and Najah (2011) also point out that powerful investors' impact on the climate change disclosure via corporate communication channels. In the same way Kolk, Levy, and Pinkse (2008) analyse FT500 (Note 5) firms' responses to CDP, and argue that institutional investors have been successful in urging firms to disseminate the detailed carbon information.

Industry and geographical factors (such as ratification of Kyoto Protocol (Note 6), the diversity of environmental regulations and the existence of common law or the existence of emission trading schemes (ETS) are two other determinants to justify voluntary disclosure of GHG. Industry is considered as a proxy for legitimacy theory in a number of GHG disclosure research. That means firms in the highly polluted industries are more likely to disclose carbon information publicly. Wahyuni, Rankin, and Windsor (2009) and Luo, Lan, and Tang (2010)' studies confirm the impact of industry on GHG disclosure. Moreover, Matsumura, Prakash, and Vera-Muñoz (2011) find that if the GHG disclosure increases among peer companies in an industry, a company is more likely to release the same information. For geographical factors as a determinant of GHG disclosure, Freedman and Jaggi (2005) empirically test the impact of companies' location, in a ratified or non-ratified Kyoto Protocol country, on the carbon disclosure. They show that firms from countries that confirmed the Protocol have a higher level of GHG disclosure. Further, multinational corporations that have plants in countries which accepted the Protocol but their headquarters are in non-ratified countries have a lower level of disclosure. In another study in 2011, they provide evidence that companies from countries ratifying the GHG Protocol (i.e. European Union countries, Canada and Japan) disclose a higher level of GHG information compared with companies in the United States, which has not accepted the Protocol. Their sample includes the U.S., EU, Japanese, Canadian, and Indian companies. Freedman and Jaggi (2011) also show that Indian (Note 7) firms disseminate even less GHG disclosure than all the firms from other countries in their research. In addition, they document that GHG disclosure is more frequent among Canadian and Japanese companies in comparison with European companies. Reid and Toffel (2009) also indicate that companies head offices located in a region with proposed GHG regulations are more apt to release GHG information through CDP questionnaire. In another study, Luo et al. (2010) reveal that carbon disclosure is more common among firms in countries that adopted ETS and firms in common-law countries.

The existence of environmental management system (EMS) is considered as the other factor of GHG voluntary disclosure (Wahyuni, et al., 2009). Wahyuni et al. (2009) investigate GHG voluntary disclosure procedure of ASX300 firms in 2007 (before execution of mandatory reporting NGER Act 2007) using a legitimacy theory framework. Using a logistic regression analysis, they find that the existence of an EMS in a firm, availability of a certified EMS, industry and firm size are the dominant factors of discretionary GHG disclosure. They emphasized on voluntary phase of GHG reporting of their sample firms by analysing the years before the enactment of NGER Act 2007. However, many of the highly polluter firms in Australia have been the ones preparing carbon reports before the enactment of NGER Act 2007 and were subject to state ETS. For example AGL Energy Limited is one sample firm in Wahyuni et al. (2009)' study which is a large polluter and is subject to state regulations (Note 8) before the enactment of NGER. Apparently, this study does not consider the effect of state regulations regarding tackling GHG problems before the execution of NGER mandatory reporting in Australia. Thus, Wahyuni et al. (2009) assumption of discretionary phase of GHG reporting was not met.

In summary, previous studies assessed determinants of GHG voluntary disclosure of large companies which were mainly subject to a number of environmental regulation, GHG risk and probable GHG liabilities using a limited theoretical framework. In this study we avoid sample selection bias by choosing our sample from merely voluntarily disclosing firms and by not limiting our sample to large corporations. We also apply a more comprehensive approach by incorporating proxies for voluntary disclosure theory, agency theory and resource based theory, in addition to the stakeholder theory and legitimacy theory which were used in previous studies.

2.1 Theoretical determinants development

Social and environmental voluntary disclosure is difficult to explain and there are a number of theories (e.g., legitimacy theory, stakeholder theory, agency theory and voluntary disclosure theory) which have been used to empirically examine such an exposure of information. There exists overlap between theories. In this study theories

are considered together in order to explain why companies make decision to disclose social and environmental information voluntarily. We employ a range of proxies to support legitimacy, stakeholder, agency and voluntary disclosure theories to describe the determinants of GHG voluntary disclosure.

As companies are part of a broader social system, there is a social contract between companies and members of society. Society gives companies the authority to obtain and use natural resources and to employ employees (Mathews, 1993) which is not an innate right. In return, companies provide goods, services and waste to society. This authority continues to the extent that the benefits of companies to society outweigh their costs. As a result companies should always consider the unwritten social contract in their decision makings (Mäkelä & Näsi, 2010). Moreover, one responsibility of companies is to consider the influences of their activities on all the members of society (not only investors). Otherwise society would not legitimize the operation of the company and the survival of the company will be threatened. Therefore, legitimacy is a needed resource for companies' survival. This recourse is dynamic and changes over time. A company that was legitimate before might not be legitimate today for several reasons (e.g., norms of society changes over time).

A crucial issue in today's society is climate change, particularly when there is a massive pollution. This issue could be seen as a breach of social contract and thus a threat to a company's legitimacy. One factor affecting a company's response in order to legitimise its activities is the development of awareness and concern in society about climate change. As companies are dependent on community's expectations, if legitimacy gap happens, it could have irretrievable economic impacts on companies (e.g., loss of investors and customers or even discontinuity of operations) (Mäkelä & Näsi, 2010). According to Guthrie and Parker (1989), legitimacy theory implies that companies tend to create similarity between the social values of their operations and societal norms. Disclosure of information is considered as an effective approach to communicate company's activities and management perspectives to specific environmental, social and other corporate issues. Given the latest attention on how companies manage, describe, and measure their GHG, it is reasonable to expect that they try to legitimise their operations by voluntary disclosure.

Stakeholder concept was first developed by Freeman (1984) to explain corporate behaviour and social performance. According to stakeholder theory companies are responsible to all stakeholders and their responsibilities are not restricted to value creation for shareholders (Barsky, Hussein, & Joblonsky, 1999). As one value in today society is the concern about climate change, stakeholders have different expectations in this regard. They pursue their needs through imposing pressure (directly or indirectly) on companies to release environmental information. Companies through disclosure of information provide a medium of communication that receive the support of stakeholders.

Management has superior information to outsiders on the firms' operations. Investors demand information for monitoring contracts with companies and assessing companies' valuation. As a result, firms will be motivated to disclose information voluntarily as disclosure may help them to obtain resources on the best terms and conditions (Gray, Meek, & Roberts, 1995). According to agency theory, the information asymmetry increases agency costs. Hence, companies may voluntarily choose to disclose information to reduce both information asymmetry (Richardson & Welker, 2001) and agency costs. Agency theory has been used by several researchers in the disclosure literature to explain voluntary reporting practices. They suggest that disclosure is a means by which companies can reduce the conflict between owners (principals) and managers (agents), and subsequently decrease the agency costs. GHG voluntary disclosure may therefore be used to reduce information asymmetry and the subsequent agency costs in regards with strategies of firms to tackle carbon issues.

According to voluntary disclosure theory, firms having good news to tell have incentives for disclosure. In the environmental disclosure studies Clarkson, Li, Richardson, and Vasvari (2008) have employed voluntary disclosure theory to indicate that voluntary environmental disclosure of firms is for companies to promote their superior environmental performance. Voluntary disclosure theory is also applied in GHG disclosure setting, in that firms reveal their superior GHG information and low GHG risk position to concerned stakeholders.

In order to examine our research question, we use a number of firm specific characteristics as determinants of GHG voluntary disclosure such as age of firm, firm size, corporate governance, listing status, ownership concentration, leverage and industry. Based on disclosure literature, firm size is the most common determinant of voluntary disclosure in both financial and non-financial disclosure studies (e.g., Kim and Lyon (2010)). The current study considers whether firm size has the same positive association with GHG voluntary disclosure as it has with other types of voluntary disclosure. According to Kolk et al. (2008) preparation of carbon disclosure reports needs resources allocation. This would require a high level of technical skills and resources than preparation of any other social performance reports which is more available in large firms (resource-based theory). Also, large firms are more

recognized by governments and non-governmental organizations as large polluters and they disclose voluntary information to legitimize their operations (e.g., The Canada Institute of the Woodrow, Levy, & Jones (2008)). In summary, given the nature of GHG as described in the current paper, it is possible to suggest that larger companies would be more probable to disclose GHG information voluntarily. We consider firm size as a possible proxy for GHG voluntary disclosure.

Age of firm is another variable which has been examined as a determinant of environmental disclosure in a number of studies. Cormier and Magnan (1999) claim that disclosure practice is negatively associated with age of firm. According to Clarkson et al. (2008) it is assumed that companies with newer equipment possibly have superior environmental performance. Therefore, these companies tend to disclose a higher level of environmental disclosure to obtain the benefits of their better environmental performance and to overcome competitors. We investigate the impact of age of firm on voluntary GHG decision based on the voluntary disclosure theory.

Leverage is one of the firm-specific characteristic that its relationship with voluntary disclosure has been tested in prior studies. For example, Choi (1999) finds that voluntary environmental disclosure is more common among companies with a higher level of leverage. This could be a result of greater pressure by creditors of highly leverage companies because debt holders are eager to be informed about issues affecting their debt contracts. Creditors today employ the impacts of carbon risk in their debt contracts (e.g., see The Carbon Principles (2009)), thus it is necessary to consider leverage as a determinant of GHG disclosure in this study.

A number of studies investigate the effects of foreign listing status of companies on disclosure. They explain the association between listing status and the level of disclosure by emphasizing on the diversity of interests and power of stakeholders in different countries (Haniffa & Cooke, 2005). Voluntary disclosure may be an approach to satisfy the information needs of stakeholders in various capital markets. GHG disclosure is one particular area of interests that might be considered in diverse capital markets. Stakeholders in these markets may expect companies to release their carbon information. Therefore, in this study we examine whether listing status influences on the GHG disclosure decision. We assume that corporations listed on international stock exchange have more tendencies to release GHG information than those corporations which are listed only on ASX in Australia.

The impact of corporate governance on the level of disclosure has been tested in several prior studies (e.g., Baek, Johnson, and Kim (2009) and Haniffa and Cooke (2002)). They examine the influence of board of directors' composition (a proxy for corporate governance) on disclosure policy. Consideration of this potential association as a determinant of disclosure decision is important, because it is the board of directors and its committees who make the final decision about disclosure policy (Haniffa & Cooke, 2002). The higher proportion of non-executive directors on board causes more effective monitoring of executive directors' actions (Fama & Jensen, 1983) and provides an independent board. In this case, in the presence of information asymmetry, board possibly adheres to disseminate more information (Gompers, 1995) which ultimately reduces agency costs. For the purpose of current paper, we examine the impact of corporate governance on GHG disclosure decision.

Companies disclose information based on the nature and norms of their industries (Gibbins, Richardson, & Waterhouse, 1990). Companies in more polluted industries adhere to a higher level of environmental disclosure to legitimize their activities due to political visibility (Gray, et al., 1995; Patten, 2002). Consequently, it is proposed that firms in greater carbon dioxide emitter and energy-intensive industries are more likely to disclose GHG emission information.

The relation between ownership concentration and disclosure has been empirically tested in both financial and non-financial disclosure studies (e.g., Baek et al. (2009)). These studies point out that those companies with less ownership concentration are under greater scrutiny by stockholders. It could be inferred that a firm with a lower ownership concentration has a greater number of stockholders than a company with a high ownership concentration. Subsequently, it might be expected that a company is under more pressure where there is larger number of stockholders. In order to be responsive to its stockholders' information demand, it publishes additional information under a stakeholder theory (Cormier, et al., 2005). We consider ownership concentration as another proxy for GHG voluntary disclosure.

3. Sample and methodology

3.1 Selection of sample

According to Boesso (2002), the term voluntary disclosure refers to reporting that are not required by accounting standards. Under the accounting conceptual framework companies should provide relevant information to a wide range of users and any significant information that is likely to affect the "financial position, performance and

changes in financial position” of an entity should be reported. In fact, the current accounting standards may not keep pace with the advent of new dimensions in the economy (e.g., possible carbon information needs) (Eccles, Herz, Keegan, & Phillips, 2001). However, based on the accounting standards and accounting conceptual framework companies have to report their contingent liabilities (e.g., carbon monetary risks). Among firms reporting their GHG information there are several organizations which seems to be exposing GHG information voluntarily, while in fact they are meeting an accounting standard or conceptual requirement by their disclosure (e.g., contingent carbon liability). Therefore, their disclosure practice cannot be considered as a discretionary manner, although for the period concerned, there was no explicit carbon standard available in accounting standards. Moreover, a number of companies may release GHG information in their company reports while they are obliged by a regulation other than accounting standards to provide such information. This may suggest that compliance with other regulations is not considered as a discretionary decision. To sum up, the companies with the above explained disclosure patterns are excluded from the sample of voluntary disclosure studies.

Existence of GHG regulation seems to be a driving factor for GHG voluntary disclosure. As regulation increases awareness in society (Kingiri, 2011), it may influence social norms and stakeholder perspectives. As discussed before, the diversity of environmental regulations, the existence of ETS and a common law are different determinants of GHG disclosure. Australia is a country that has introduced GHG regulation at national level and has not applied ETS (at the time of this research). That is carbon emissions do not have a price in Australia (at the research time). Other countries mandating GHG reporting such as Europe and New Zealand are one step ahead. They have been employing ETS for a while, which may have caused less tendency for voluntary disclosure. Therefore, we choose our sample from Australian corporations.

Among Australian listed corporations, there are a number of companies which do not meet mandatory national reporting (NGER Act 2007) criteria, however, they disclose GHG information voluntarily. For instance, as discussed before, Ausenco publicly releases its GHG information, despite the fact that its level of total carbon dioxide equivalents is only about 16½ kilo tons (in 2009), below reporting criteria. The sample of this research includes all companies listed in ASX which publicly disclose their GHG information, which are not subject to NGER Act 2007 between July 1, 2008 (Note 9) and June 30, 2011. The sample is hand-collected by searching for words such as “Carbon”, “Greenhouse”, “Climate Change” and “CO₂” in all annual reports of trading companies in ASX between financial year 2009 and 2011. Then for example, if there is any information about company’s targets, plans, actions and strategies on tackling climate change or any information about their emission numbers, this company is chosen. We exclude those firms which mention explicitly in their annual reports that they are subject to NGER or the ones which were on the list of NGER registered companies. If there is a case which we could not recognize a firm’s obligation, we directly contact the firm. It is also essential to remove companies which do not have any operations in Australia.

Annual report is one primary and consistent means of corporate communication to a various set of stakeholders, including shareholders, potential investors, suppliers, customers and so on. Australian companies provide GHG information in their annual reports. Subsequently for the purpose of the current paper, annual reports (Note 10) were chosen as the company document to be used in order to address the research question.

We collect annual reports issued by Australian listed companies from Aspect Annual Reports Online. The number of corporations releasing GHG information in their annual reports and not being subject to NGER Act for the study period is 174 out of 2317 corporations listed on 29 February 2012. 23 companies of these 174 selected listed firms are excluded from the sample, as they did not have operation in Australia or because of missing data. The final sample was 151 corporations and 300 firm-year data.

Insert Table 1 here

, Panel A shows the industry distribution of sample, based on Global Industry Classification Standard (GICS) of annual reports and disclosing firms. The Materials and Energy industry have the largest proportion (16.33% and 14% respectively) of firms disclosing GHG information in Annual reports, while the Pharmaceuticals, Biotechnology and Life Sciences industry has the lowest proportion of disclosing firms (0.33%). Table 1, Panel B presents the distribution by year of annual reports and disclosing firms. Overall, there is a steadily increasing trend in the number of GHG disclosing companies from 71 in 2009 to 131 in 2011. This finding is consistent with Cowan and Deegan (2011) study that within the implication period of a regulation (whether NGER Act 2007 or NPI) the level of disclosure about emissions in annual reports increases.

3.2 Methodology

In order to examine our research question, we use content analysis to investigate the annual reports of non-registered companies for their GHG voluntary disclosure. This analytical technique is used for making replicable inferences. Content analysis is the most common research method used to investigate social and environmental disclosures (Guthrie & Mathews, 1985; Milne & Adler, 1999). Numerous research publications, for example Clarkson et al. (2008); Freedman and Jaggi (2011); Prado-Lorenzo et al. (2009) studies, have used content analysis as their research technique to estimate the level of voluntary disclosure.

In content analysis, researchers construct their own disclosure metrics. To the extent that researcher's judgment is involved in developing and applying disclosure measurement index, the results may not be replicated (Healy & Palepu, 2001). In this study, we use "frequency of issues mentioned" to capture GHG disclosure. Under "frequency of issues mentioned" method, first specific items are identified by researchers (disclosure index), then each item is analysed and scored for sample firms, based on zero for no disclosure, one for disclosure. At the end of scoring, the number of points a firm has been awarded represents the level of firm's disclosure. This technique avoids double counting of the same issue and it is the most dependable way of contents analysis (Kang, 2006). Moreover, this technique includes an interpretation of the implication of the disclosure (Cormier, Magnan, & Van Velthoven, 2005).

3.3 GHG disclosure index

Construction of a disclosure measurement index is one important element of content analysis. It should be relevant to research questions and the user's aim of the index (Marston & Shrides, 1991). Researchers mostly adjust existing disclosure indices to fulfil their research requirements (Marston & Shrides, 1991). For example, Patten (2002) modified the work of Wiseman(1982) to construct a suitable index for his research questions.

Although demands for more information on GHG has been growing in recent years from stakeholders (Freedman & Jaggi, 2011), there has been little consistent guidelines regarding what firms should disclose. One of the proposed techniques of GHG disclosure is based on the use of protocols for measurement, reporting and verification such as Global Reporting Initiative Guidelines (2013), International Organization for Standardization (ISO) (2006), and World Business Council for Sustainable Development and World Resources Institute (WBCSD and WRI) (2004).

Our GHG disclosure index (see Appendix 1) is based on a modification of e Aguiar and Fearfull (2010)'s GHG disclosure index according to the requirements in NGER 2007 Act to obtain a suitable index for the research questions. e Aguiar and Fearfull (2010) GHG index is in accordance with GRI (2002) and GRI (2006) Guidelines. GRI guidelines are the only internationally accepted protocol, presenting principles for sustainability disclosure that contains energy consumption and production. The GRI principles break several principles down into a higher level of detail. They also concentrate more on the voluntary disclosure aspects of reporting (Council of Australian Governments Experts Group on Streamlining Greenhouse and Energy Reporting, 2009). Further, CorporateRegister.com (2008) reports that among global FT500 companies, 100% of Australian reporters include a GRI content index in the disclosure of their GHG. This is in line with International Auditing and Assurance Standards Board (IAASB) (2004) in their *International Framework for Assurance Engagements* that accepted criteria are "those embodied in law or regulation, or issued by authorized or recognized bodies of experts that follow a transparent due process".

Our GHG disclosure index includes a verity of categories, such as: Disclosure on actions and targets to tackle GHG, GHG reduction achievements, and GHG measures and verifications. In addition to total GHG disclosure level, we also consider the effect of hard to mimic items (such as GHG achievement) and soft disclosure items (such as targets to tackle GHG) separately to differentiate the possible impact in each level of disclosure.

3.4 Empirical model and variable definitions

In order to examine our research question, we consider the following cross-sectional regression model:

$$GHGDIS_{i,t} = \beta_0 + \beta_1 SIZE_{i,t+1} + \beta_2 AGE_{i,t+1} + \beta_3 LEV_{i,t+1} + \beta_4 EXCH_{i,t+1} + \beta_5 CORP_{i,t+1} + \beta_6 IND_i + \beta_7 OWN_{i,t+1} + \varepsilon \quad (1)$$

Where GHG voluntary disclosure ($GHGDIS_{i,t}$), the dependant variable, refers to the attributes of GHG disclosure such as the extent of disclosure in time t. As endogeneity and self-selection issues could potentially affect our results, we use a lead-lag approach to tackle these potential problems. Prior studies in disclosure literature find several firm-specific characteristics as determinants of voluntary disclosure under a legitimacy theory and stakeholder theory framework. In this study, we examine the impacts of the following variables as firm-specific characteristics on GHG voluntary disclosure by a more comprehensive theoretical framework: firm size ($SIZE$), age of firm (AGE), leverage (LEV), listing status ($EXCH$), corporate governance ($CORP$), industry (IND), and ownership concentration (OWN).

Firm size (SIZE) is measured as the total asset value at the end of financial year. The coefficient on the variable SIZE is expected to be positive. Age of firm (AGE) is estimated as a ratio of net properties, plant and equipment divided by the gross properties, plant and equipment at the end of financial year. The coefficient on the variable AGE is expected to be positive. Leverage (LEV) is equal to total debt divided by total assets at the end of financial year. The coefficient on the variable LEV is expected to be positive. Listing status (EXCH) is a dummy variable. It is equal to one if a corporation is listed in other stock exchanges in addition to ASX and it is zero if not. The coefficient on the variable EXCH is expected to be positive. Corporate governance (CORP) is measured by the proportion of nonexecutive directors on board at the end of financial year. The coefficient on the variable CORP is expected to be positive. Industry (IND) is a dummy variable. It is equal to one if a firm is operating in superior carbon dioxide emitter or energy-intensive industries and it is zero if not. Three industries are categorized as the most carbon dioxide emitter or energy-intensive industries (Coulton, Geen, & Tao, 2012). These industries are Energy, Materials or Utilities. The coefficient on the variable IND is expected to be positive. Ownership (OWN) is defined as the percentage of ordinary shares held by the top 20 shareholders (Demsetz & Lehn, 1985). The coefficient on the variable OWN is expected to be negative.

We obtain independent variables values from firms' annual reports and Datastream Advance database. A few number of sample firms are at the first year of operation which means there is no value for their independent variables in the previous year. In this case, we use the same year values for determinants factors. In a pilot study the viability and applicability of the coding process and the disclosure measurement index is examined. Then using company reports of sample firms and disclosure index (see Appendix 1), we investigate the level of GHG disclosure (Note 11).

4. Results

4.1 Summary of GHG disclosure

As mentioned before, our GHG disclosure index (see Appendix 1) is based on a modified e Aguiar and Fearfull (2010)'s GHG disclosure index. According to annual reports' content analysis of sample firms, companies report a diverse level of GHG information numerically and verbally. Most GHG disclosures are supported by qualitative information of GHG items being disclosed. Sample firms disclose different levels of GHG in their annual reports. For example, 52% and 22.33% of companies respectively disclose one and two pieces of GHG information voluntarily. The average level of GHG disclosure is around 2.17. About 8% of companies release six and above pieces of GHG information. Companies disclose GHG information in the annual reports are mostly in the *Actions to Tackle GHG* phase (60.56%), followed by the *Targets to Tackle GHG* (21.12%) phase, and the least disclosed phase is *GHG measurement and verification* phase (2.02%). In general disclosure from the hard to mimic disclosure items of disclosure index is less common. The low level of reporting from hard to mimic items of disclosure may indicate that corporations' disclosures are not showing a true picture of firms GHG performance. These findings are consistent with Cowan and Deegan (2011) and Simnett et al. (2009) studies that voluntary emissions disclosures in annual reports are not a sufficient source of data for environmental performance assessment.

In particular, within the *Actions to Tackle GHG* phase (60.56%), internal items such as design of low carbon footprint products and emission reduction consultancy services (25.64%) and energy conservation (14.62%), as well as external items, such as support of green movements (9.49%) (e.g., Earth hour or Plant a tree), are the most disclosed items in the companies' annual report. The second most disclosed phase of GHG is the *Targets to Tackle GHG* which includes 21.12% of the total disclosure. Most of disclosure in the *Targets to Tackle GHG* phase is due to disclosures about using energy and other resources efficiently (50%) and about continuing to take initiatives to reduce carbon footprint (27.08%).

The *achievement* phase of the GHG disclosure constitutes only 5.43% of the total disclosure. Indeed, while companies are willing to disclose information on what their strategies and targets are for tackling climate change and what actions they are implementing in this area, they are less forthcoming in disclosing information on what are achieved. This is perhaps not surprising given the nature of achievements.

4.2 Descriptive statistics

As previously discussed, the dependent variable to be used in the current study is the level of GHG voluntary disclosure. Level of GHG is measured by content analysis of annual reports considering the GHG disclosure index and decision rules. For the purpose of the multiple regression analysis, the dependent variable, the level of GHG voluntary disclosure, and seven firm-specific variables as independent variables, are considered. Table 2 reports descriptive statistics for the independent variables.

Insert Table 2 here

The average listing exchange status is only 0.07. It presents that most of the samples firms are only listed on ASX. Also, on average, Industry is about 0.38 which indicates that most companies are in cleaner industries. The average Top20 (OWN) coefficient is 0.65. Age has an average of 0.57. The firm size's mean is 369,274.1 (thousand dollar) far from size Maximum and Minimum (7,036,000 and 2,213thousand dollar) thus our sample consists of relatively extensive firms. The average leverage (LEV) is 22% of total assets. The average corporate governance (CorporateGov) is 0.50. For independent variable Age, we have 10 firm-year missing value for two groups of companies: 1- Companies reporting the properties, plant and equipment based on fair value, 2- Companies not holding any properties, plant and equipment. To comply with multiple regression analysis assumption we transform size, leverage and GHG disclosure measures to natural logarithm of size (LnSize), squared leverage (SqrLev) and natural logarithm of GHG (LnGHG). In this way, departure from normality is not significant for any of the variables.

Insert Table 3 here

We present Pearson correlations between variables used in the regression in

Table 3. LnSize has the highest correlation with dependent variable (0.618). The Pearson correlation between ListingStatus and LnGHG is not significant. The correlation direction is opposite to the assumptions for the association between Top20, Industry and LnGHG.

4.3 Multiple Regression Analysis

Multiple regression analysis is conducted using SPSS to test the research question.

Table 4 reports the results for determinants of GHG voluntary disclosure model.

Insert Table 4 here

As shown in table 4, the adjusted R^2 for the models range from 40.7% to 23.1%. This is comparable to prior GHG voluntary disclosure studies (e.g., Freedman and Jaggi (2011)). As predicted, the estimated coefficients for our GHG performance proxy (AGE) are positive and significant for total GHG voluntary disclosure and Hard disclosure measures. This result is consistent with voluntary disclosure theory. Companies with superior environmental performance and significant environmental achievements disclose more information about their environmental impact voluntarily. The predicted sign of leverage is similar to prior disclosure literature and intuition. For the total disclosure as well as hard disclosure versus soft disclosure, leverage is positive but is statistically significant for the soft disclosure category only. One interpretation of this finding is that sample firms (companies not subject to NGER Act 2007) are not under the pressure of creditors for disclosure of carbon information. Industry coefficients are insignificant in all models. This result could be for the fact that our sample implicitly includes firms with low GHG emission for the selection criteria of not being subject to NGER Act 2007. We find that the ownership concentration (Top20 Shareholders) and listing status insignificant in all three models at 95% significance level. These two independent variables for the total disclosure are significant at 90% significance level. It suggests that firms listing on the other stock exchanges in addition to ASX are more apt to GHG voluntary disclosure. This result may be due to the pressure imposed by a larger number of stakeholders to release environmental information. The coefficient for ownership concentration (Top 20 shareholders) is not in accordance with our prediction. However, it could be explained that as sample firms have apparently an acceptable environmental performance (for not being subject to NGER Act 2007), they disclose to receive the benefits of disclosure. Consistent with agency theory, corporate governance proxy is positive and significant in all three models. The higher proportion of non-executive directors on board provides an independent board. As coefficients for corporate governance determinant support, a more independent board adheres to reduce information asymmetry by reporting further information. In this way the independent board reduces the agency costs. Similar to our prediction, larger companies tend to disclose more information which is supported by agency theory, resource based theory and legitimacy theory. Larger firms have more resources (money, experts and systems) available for extra reporting according to resource based theory. In addition as larger firms are supposed to be under more scrutiny, they disclose to legitimize the operations.

4.4 Sensitivity analysis

We run a Logit regression model to investigate the consistency of results with the main results in

Table 4. We split our sample with respect to their GHG voluntary disclosure measures into two groups. Observations above the median GHG disclosure measure are scored as one (high disclosers), while those below the median are scored as zero. Again the decision to provide GHG voluntary disclosure is influenced by firm size, the combination of board and firm age.

5. Summary and conclusions

We examine the determinants of GHG voluntary disclosure by testing predictions from a comprehensive theoretical framework. Especially, we improve on the prior literature by focusing on truly voluntary GHG disclosure and by controlling the effect of hard to mimic GHG disclosure items and Soft GHG disclosure items. The other strength of our research is for avoiding sample selection bias by not limiting our sample to merely large corporations.

We consider a number of firm-specific characteristics similar to prior studies, as determinants of voluntary disclosure. Age of firm, firm size, corporate governance, listing status, ownership concentration, leverage and industry are our proxies for GHG voluntary disclosure. For unavailability of any consistent GHG performance measure of sample firms, we adopt Clarkson et al. (2008) assumption and choose age of firm as a proxy for environmental performance.

Our results are as follows. We find a positive and significant association between the level of GHG voluntary disclosure in annual reports, corporate governance and firm size, which in general, support the application of agency theory and stakeholder theory. Further, firms with superior GHG performance are more likely to engage in discretionary disclosure, as predicted by voluntary disclosure theory. Finally, in contrary to industry and leverage variables, listing status proxy appear to play a significant role in GHG disclosure decision. This result can be explained by the fact that these firms voluntarily disclose information due to their superior GHG performance though they are not subject to NGER Act 2007. They disclose voluntary GHG information to acquire the benefits of communicating good news.

A few caveats are worth noting. As a consistent GHG performance measure was not available for the sample firms, we adopt Clarkson et al. (2008) assumption that firms with newer equipment have superior environmental performance. Further, we use only annual reports as the GHG disclosure document to be consistent. Some sample firms also report GHG information in CSR reports, CDP questionnaire and web-paged documents.

Notwithstanding these caveats, we believe that our study opens many research opportunity. For example, according to the impact of industry and leverage proxies on GHG voluntary disclosure, we suggest that perhaps well performed firms do not disclose for legitimization, they disclose to acquire the benefits of communicating good news. Then a study of perceived benefits of GHG voluntary disclosure may help us understand better the nature and relevance of GHG information. Further, as industry and leverage were not significant for firms not subject to NGER Act 2007, it would be worthwhile to investigate if this is similar with firms subject to NGER Act, and find out if they seek for legitimisation via GHG disclosure.

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Notes

Note 1. Two levels of thresholds are defined at which corporations need to report GHG and energy consumption, (i) facility thresholds and (ii) corporate thresholds. Facility thresholds are fixed over time at 25 KT (CO₂) and 100 TJ (energy), while corporate thresholds are variable over time with a decreasing trend during the first three years. For 2008-2009 as the first reporting year, the threshold is equal to 125 KT and 500 TJ and for the following year, it is equal to 87.5 KT and 350 TJ. If a controlling corporation's group meets a facility or corporate threshold, GHG and energy data must be reported to Greenhouse and Energy Data Officer.

Note 2. Three scopes are defined in this regard for each company. The emissions from the first two scopes are subject to the Australian National Greenhouse and Energy Reporting Act 2007. Scope 1 refers to direct emissions from company's sources or sources controlled by company. Scope 2 refers to indirect emissions from consumption of electricity, heat, or steam, and scope 3 refers to other indirect emissions by company's activities, but they are physically produced by other companies.

Note 3. Disclosure could be used to overcome the legitimacy threat and justify the operation, distract society's attention from adverse situations (Wilmshurst and Frost, 2000), and to present the conformity of the company to social norms and values (good news).

Note 4. The CDP is an independent non-profit entity that collects the carbon emission-related data based on a questionnaire to accelerate solutions to climate change.

Note 5. Financial Times 500

Note 6. The Kyoto Protocol is an agreement to the United Nations Framework Convention on climate change for tackling global warming.

Note 7. India has ratified the Protocol but has not set any limits on GHG emissions.

Note 8. State governments in Australia set their own separate specific action plans and targets for GHG reductions policies. For example, the NSW government was the first government that introduced carbon rights legislation. It set the first mandatory ETS in the world in 1997 which turned to a mandatory scheme in 2003. Under this scheme, electricity retailers, such as AGL Energy Limited must meet mandatory annual GHG reduction targets (NSW Greenhouse Office, 2010).

Note 9. The NGER Act 2007 mandates companies to disclose greenhouse gas emissions, energy consumption and production from 1 July 2008.

Note 10. Our assumption is that annual reports are truthful and litigation threatens a lying firm.

Note 11. We examine the stability of our content analysis by using a test-retest of coding reports of a randomly selected sample of companies on a different time (3 month interval). The correlation of disclosure measures between different occasions is high and divergence is low. This shows that GHG disclosure measures have good reliability.

Table 1. Sample Distribution

Panel A: Distribution by Industry			
	Industries	Frequency	Percent
1	Automobile & Components	6	2.00
2	Capital Goods	38	12.67
3	Commercial & Professional Services	40	13.33
4	Consumer Durables & Apparel	7	2.33
5	Consumer Services	3	1.00
6	Diversified Financials	16	5.33
7	Energy	42	14.00
8	Food Beverage & Tobacco	7	2.33
9	Health Care Equipment & Services	6	2.00
10	Materials	49	16.33
11	Media	9	3.00
12	Pharmaceuticals, Biotechnology & Life Sciences	1	0.33
13	Real Estate	20	6.67
14	Retailing	9	3.00
15	Semiconductors & Semiconductor Equipment	3	1.00
16	Software & Services	15	5.00
17	Technology Hardware & Equipment	3	1.00
18	Telecommunication Services	3	1.00
19	Utilities	23	7.67
	Total	300	100
Panel B: Distribution by Year			
	Year	Frequency	Percent
	2009	71	23.67
	2010	98	32.67
	2011	131	43.67
	Total	300	100

Table 2. Descriptive statistics

Variable	N	Mean	Median	Minimum	Maximum	Std. Deviation
Listing Status	300	0.07	0	0	1	0.26
Industry	300	0.38	0	0	1	0.49
Top20	300	0.65	0.67	0.09	1	0.18
Age	290	0.57	0.57	0.04	1	0.21
size (Thousand)	300	369274.1	77083.0	2213.0	7036000.0	901490.9
Leverage	300	0.22	0.17	0.00	0.88	0.18
CorporateGov	300	0.50	0.50	0.13	0.86	0.14

Table 3. Pearson correlations

Variables	LnGHG	LnSize	CorporateGov	Age	Top20	ListingStatus	Industry	SqrLeverage
LnGHG	1	.618	.296	.282	.235	0.111	-.331	.333
LnSize	.618	1	.341	.318	.207	0.087	-.439	.474
CorporateGov	.296	.341	1	0.049	0.032	-0.001	-0.101	.171
Age	.282	.318	0.049	1	.126	0.053	0.022	0.075
Top20	.235	.207	0.032	.126	1	-0.053	-.309	.296
ListingStatus	0.111	0.087	-0.001	0.053	-0.053	1	0.108	-.126
Industry	-.331	-.439	-0.101	0.022	-.309	0.108	1	-.489
SqrLeverage	.333	.474	.171	0.075	.296	-.126	-.489	1

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

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

Table 4. Determinants of GHG voluntary disclosure

	Total GHG disclosure score			Hard GHG disclosure score			Soft GHG disclosure score		
	Coefficient	t-stat	Sig.	Coefficient	t-stat	Sig.	Coefficient	t-stat	Sig.
Intercept	-2.048	-8.487	0.000	-1.239	-4.881	0.000	-1.039	-4.788	0.000
LnSize	0.169	7.884	0.000	0.086	3.778	0.000	0.058	2.803	0.006
CorporateGov	0.543	2.404	0.017	0.545	2.306	0.022	0.590	2.544	0.012
Age	0.333	2.170	0.031	0.333	2.036	0.043	0.113	0.839	0.403
Top20	0.336	1.923	0.055	0.204	1.049	0.295	0.081	0.510	0.611
ListingStatus	0.208	1.787	0.075	-0.033	-0.274	0.785	0.085	0.887	0.376
Industry	-0.110	-1.494	0.136	-0.095	-1.192	0.235	0.043	0.637	0.525
SqrLeverage	0.079	0.449	0.654	0.095	0.506	0.614	0.389	2.399	0.018
Adjusted R Square	0.407			0.231			0.248		
F-stat	30.291			10.121			9.294		
N	300			213			177		

Appendix 1: GHG disclosure index

[Adapted from e Aguiar and Fearfull (2010)]

Company Name: _____

Year of report: _____

Date of coding: _____

Part A – GHG disclosures or GHG sources

- A. Any disclosed information about GHG amount will be considered as one otherwise zero or any disclosed information about GHG sources will be considered as one otherwise zero.**

A1. *The amount of total GHG per business*

The total amount of direct and indirect GHG produced by an business is presented

A2. *The amount of total direct GHG (scope1) per business*

The total amount emissions produced as a direct result of activities at all facilities is presented

A3. *The amount of total indirect GHG (scope2) per business*

For example, total GHG produced from the generation of purchased Energy

A4. *The amount of total other indirect GHG (scope3) per business*

The total amount of indirect emissions that are not mentioned in scope 2 is considered. For example, emissions connected to the entity's product or service across all related stages of the life cycle (production, delivery, use and disposal)

A5. *The amount of direct GHG (scope1) per business's facilities*

Total emissions produced as a direct result of activities at a facility is indexed

A6. *The amount of indirect GHG (scope2) per business's facilities*

A7. *The amount of other indirect GHG (scope3) per business's facilities*

A8. *The amount of supply chain GHG per business*

The total amount of emissions produced by a firm's supply chain is indexed

A9. *The sources of GHG*

The GHG sources covered by NGER act 2007 are "stationary energy, transport, waste, fugitive emissions, and industrial processes" which are outlined in report

A10. *The sources of GHG by business's products and services*

Part B – GHG measurement, verification or GHG opinions by stakeholders

- B. Any disclosed information about GHG measurement and reporting method will be considered as one otherwise zero, any disclosed information about GHG verification and audit will be considered as one otherwise zero or any disclosed information about stakeholders' opinions of a firm GHG position will be considered as one otherwise zero.**

B1. *The method used for estimation of GHG*

NGER outlines four methods for estimation of GHG for example one is Online System for Comprehensive Activity Reporting (OSCAR)

B2. *The business reporting about the verification process of emission measurement*

B3. *Opinions of external parties about company's GHG*

Part C – GHG achievement

- C. Any disclosed information about GHG achievement will be measured as one.**

C1. *The business disclosure of any information about the financial year's target achievement*

Part D – Disclosures on targets to tackle GHG**D. Any disclosed information about GHG targets will be measured as one.****D1. Targets to reduce GHG**

If a company has a current GHG reduction target which has been identified

D2. Targets to reduce direct and indirect emissions**D3. Targets by sources and types of GHG****D4. Targets driven by external businesses**

Targets on GHG established to comply with external initiatives to decrease GHG emission levels

Part E – Disclosures on actions to tackle GHG**E. Any disclosed information about GHG actions will be indexed as one.****E1. Use of new technologies****E2. Redesigning products/process/services**

Redesigning process/services/products to overcome GHG

E3. GHG certifications

For examples ISO certifications

E4. Energy conservation

Reductions on energy consumption

E5. Use of renewable energy

Use of energy from renewable sources such as solar, biofuels and wind

E6. Travel reductions

For instance reduction of staff travels

E7. Use of alternative types of transport

For example alternative sorts of transports are hybrid or electric cars

E8. Management plan and strategies to reduce global warming

Implementation of management programs or internal strategies to tackle GHG

E9. Employees incentives to activities associated with global warming**E10. Employee training****E11. Internal emissions trading**

Emissions trading to exchange emissions internally to the business

E12. Supply chain involvement**E13. Consumer training****E14. Research sponsorship****E15. Carbon sequestration**

Reservoir to eliminate GHG from the atmosphere

E16. Carbon offset

To purchase credits to compensate carbon emissions

E17. Product ban

For example to stop the use of light bulbs

E18. Others

Part F –GHG risk

F. Any disclosed information about GHG risk and commitment will be indexed as one otherwise zero.

F1. GHG risks/opportunities are identified at a company**Decision rules for GHG disclosure****General points**

- The information to be indexed is related to greenhouse gas emissions (GHG).
- If any piece of information has more than one possible category, the disclosure should be classified as the item most highlighted.
- Any repeated information should not be considered each time that it is mentioned.
- Graphs and pictures are considered within the coding.

Specific points**Emissions disclosures**

- Emissions information from the whole business and facilities.

Exception: Emissions information about a specific program, products, services or process, should be indexed under the ‘actions’ category.

- Information about emissions measurement.

Exception: Enhancements in emissions measurement initiated by specific program, process, services or products. This sort of disclosure should be measured as ‘actions’.

- Any graphs and tables which do not refer clearly to emissions data, should NOT be measured at ‘Emissions disclosure’.

Actions (part E)

- Only information about actions that is in operation at present (date of disclosure).
- Exception: It does not contain planned actions, which should be reflected under ‘targets’ category.
- The disclosure is being indexed only for actions made by the company.

Other

- Information that presents the opinions of professionals that do not work directly for the company that is being indexed
- GHG Disclosures that were not possible to be categorized in any specific categories cited previously.