Voluntary Greenhouse Gas Emissions Disclosure by Non-Greenhouse Gas Registered Australian Companies: Determinants and Consequences

Abstract

This research investigates the determinants and consequences of voluntary greenhouse gas (GHG) disclosure by non-GHG registered companies in Australia. Initial specific characteristics of a volunteer, and his/her presupposed knowledge of an action, play a significant role in the decision of taking a voluntary action (James, 1890). Based on this rationale, and consistent with the disclosure literature (e.g., Aerts et al., 2008; Ling, 2007), determinants and consequences of voluntary GHG disclosure by companies are examined as two possible dimensions for GHG disclosure decisions.

This thesis is by publication and includes three papers. The first paper evaluates the determinants of GHG disclosure, using a number of firm-specific characteristics. The determinants are examined based on agency, legitimacy, stakeholder and voluntary disclosure theories. The second and third papers of this thesis examine the consequences of voluntary GHG disclosure on market-based and accounting-based performance, respectively. A GHG disclosure index was developed based on the requirements in the Australian *National Greenhouse and Energy Reporting Act 2007* and adapted from de Aguiar and Fearfull's (2010) GHG disclosure index. The level of GHG disclosure was scored via content analysis of the annual reports (2009 to 2011 financial years) of non-GHG registered companies. The content analysis was validated by using a test-retest procedure.

The first paper's findings highlight a positive association between GHG disclosure, firm size and board independence. Further, it finds that companies with newer equipment are more likely to engage in discretionary disclosure and that foreign listing status plays a significant role in the GHG disclosure decision, suggesting that companies tend to view shareholders' interests as a factor in determining GHG disclosure. The second paper indicates that a high level of debt cost in the previous year is a determinant for GHG disclosure. In the second paper, both linear regression and two-stage least squares regression analyses suggest that voluntary GHG disclosure is associated with a lower level of debt cost in the following year of disclosure. Also, it highlights that GHG disclosure has significant negative

relationships with the bid-ask spread and return volatility in the following year of disclosure. The third paper, using a matched-pair research design in addition to linear regression and two-stage least squares regression analyses, also suggests that GHG disclosure has positive relationships with return on assets in the following year of disclosure. However, it does not provide evidence that the level of return on assets in the previous year of disclosure is a significant determinant for GHG disclosure. The second and third papers provide some evidence about the positive economic consequences of voluntary GHG disclosure. Overall, the research findings are consistent with the predictions of a cost-benefit framework. The findings indicate that managers tend to apply a cost-benefit framework based on likely trade-off between costs and benefits of disclosure (Garcia-Meca et al., 2005; Verrecchia, 1983, 1990, 2001) when deciding to disclose GHG voluntarily. The research outcome indicates that companies bear the extra voluntary disclosure costs to achieve the perceived benefits of voluntary disclosure.

Overall, the thesis contributes to the GHG disclosure literature by responding to Simnett et al.'s (2009) call for research to apply a collection of archival data to examine the characteristics of companies reporting their GHG emissions. Understanding the underlying determinants for voluntary GHG disclosure may help stakeholders to appreciate the benefits and limitations of this disclosure. The thesis further contributes to the voluntary GHG disclosure literature by bridging the existing gap between the determinants and consequences of voluntary GHG disclosure. The findings could be implemented in the cost-benefit analysis of non-disclosing companies for future disclosure. The findings also highlight the value relevance of GHG disclosure in financial markets, which could help stakeholders in their decision-making process. Also, the content analysis of the annual reports provides some clarity in respect of the most common aspects of GHG disclosure (e.g., actions to tackle GHG emission) by non-GHG registered companies. It helps stakeholders to understand the nature, scope and quality of GHG disclosure.

Publications arising from the thesis

Published paper (included in Chapter two):

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Borghei, Z., Leung, P., & Guthrie, J. (2013). Voluntary greenhouse gas emission disclosure — Impact on accounting-based performance.

Conference papers (included in Chapters three and four, respectively):

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PBFEAM conference (2013), Melbourne Borghei, Z. & Leung, P. (2013). Voluntary greenhouse gas emission disclosure — Impact on market-based performance.

AFAANZ conference (2013), Perth Borghei, Z. & Leung, P. (2013). Voluntary greenhouse gas emission disclosure — Impact on accounting-based performance.

Certificate of originality

This thesis is submitted to Macquarie University in fulfilment of the requirements of the degree of Doctor of Philosophy. This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this university or any other institution.

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Chapter 1 Introduction

1.1 Background

In recent years climate change and its effect on global warming has been a much debated topic (Martin, 2007). Climate change may influence the basic elements of life, water, food and the environment (Stern, 2006). Water shortages, rising sea level, major declines in crops and the increasing intensity of droughts, forest fires, flooding and storms as the result of climate change threaten environmental sustainability. According to Stern (2006, p. vi), the estimated damage of not acting against climate change will be about 5% to 20% of global GDP.

Climate change issues and public concerns over perceived problems caused by climate change have led to the emergence of certain environmental regulations. The aim of these regulations is to limit factors causing global warming and therefore prevent the risk of catastrophic climate change (e.g., rising sea level and strong storms which severely damage physical infrastructures in societies (Cogan, 2006)). These regulations focus on the reduction of Greenhouse Gas (GHG) worldwide by adopting strategies, such as "carbon pricing" and "technological development" (Simnett et al., 2009).

A leading international agreement in relation to reduction of GHG was the Kyoto Protocol. According to this protocol, industrialised countries are mainly responsible for the current level of carbon emissions. Thirty-seven developed countries (during the first commitment period) agreed to limit and reduce their GHG emissions in two periods (2008–2012 and 2013–2020) (United Nations,

2013). In accordance with the GHG reduction targets of the Kyoto Protocol, different countries have set different policies and regulations to meet emissions reduction targets.

For instance, a regulatory disclosure requirement is the Canadian[1] mandatory GHG reporting regulation that requires facilities with 50 KT of carbon dioxide equivalent or higher in 2010 to disclose emissions information to Environment Canada (GHG Accounting, 2010). There are also several states in the United States[2] that require mandatory GHG reporting among certain industries. For example, from 2010, entities that emit more than 10,000 metric tons of GHG annually and vehicle fleets more than 2,500 metric tons of GHG yearly in Washington are mandated to report their emissions to The Climate Registry (Pew Centre on Global Climate Change, 2011).

The Australian Government legislated the *National Greenhouse and Energy Reporting (NGER) Act 2007*, mandating companies with GHG emission, energy consumption, or production above the specified thresholds to report their GHG, measured in $CO_{2\text{-}e}$ (carbon dioxide equivalents), as well as energy consumption and production data to the Australian Government. These companies are GHG registered with the Australian Greenhouse and Energy Data Officer.

The *NGER Act 2007* defines two levels of thresholds at which corporations should report GHG and energy consumption. These are: (1) facility thresholds; and (2) corporate thresholds. Facility thresholds are fixed over time at 25 KT (CO_2) and 100 TJ (energy), while corporate thresholds are variable over time with a

[1] In 2012, Canada withdrew from the Kyoto Protocol (United Nations, 2013).
[2] The United States did not ratify the Kyoto Protocol (United Nations, 2013).

decreasing trend during the first three years. For the first year of reporting (2008–09) under the *NGER Act*, the corporate threshold was 125KT (CO_2) and 500 TJ (energy). For the following year, it was 87.5 KT (CO_2) and 350 TJ (energy). If a group of a controlling corporation meets a facility or corporate threshold, GHG and energy data must be reported to the Australian Greenhouse and Energy Data Officer.

In the *NGER Act 2007*, three scopes are defined for each organisation. Scope 1 refers to direct (point-source) emissions from the sources of a company or sources controlled by a company (e.g., mining activity). Scope 2 refers to indirect emissions from the generation of electricity purchased and consumed by an organisation (e.g., the emission factors of scope 2 are physically produced by the burning of fuels at the power station). Scope 3 refers to other indirect emissions by the activities of a company, which are physically produced by other companies. As the Department of Climate Change and Energy Efficiency (2012) points out, the definition, methodologies and application of this scope is subject to debate.

Before the enactment of the *NGER Act 2007*, 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 in the world to introduce carbon rights legislation. It introduced the first emission trading scheme (ETS) in 1997, which became 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).

1.1.1 Corporates and climate change

In accordance with the rising awareness and increased regulations in relation to climate change issues, companies are under increasing pressure by different groups of stakeholders to disclose their GHG information and to take action to reduce GHG emissions (Kolk et al., 2008). Currently, the reduction of GHG emissions is one of several initiatives related to sustainability (Simnett et al., 2009; Hrasky, 2012).

Stakeholders (e.g., customers, suppliers, and employees) need GHG information to evaluate the level of carbon emission by companies, to investigate the probable regulatory and competitive risks of organisations and to assess how organisations control their GHG emissions (Bebbington & Larrinaga-Gonzalez, 2008). According to Freedman and Jaggi (2011) suppliers might be interested in information about the contribution of companies to global warming and in changes to the production process to reduce GHG emissions. It is reasonable to assume that customers would like to know about product changes and how a company complies with its social commitments towards global warming effects. Employees need to know how they are influenced by changes in the production process as a result of the application of GHG reduction strategies. Further, the community is interested to know how companies deal with GHG challenges, what reduction targets they plan for and how much progress they have made in implementing the plan. Therefore, it is argued that companies should be aware of and communicate their GHG information. It is perceived that an adequate degree of GHG reporting by companies is thus essential in providing such information to stakeholders.

1.1.2 Corporates' GHG reporting

The stated purpose of accounting is to provide useful information for sound economic decision making (IASB, 1989). Under the accounting conceptual framework companies should provide relevant information to a wide range of users and any significant information that could affect the "financial position, performance and changes in financial position" of an entity should be reported (IASB, 2010, p. 34).

The usefulness of financial statements will be improved by including comparable, verifiable, timely and understandable information (IASB, 2010). According to the conceptual framework of International Accounting Standards (IAS), relevance and faithful representation are two elements of useful information. Value relevance refers to the capability of making a difference in the decisions of users of financial statements. That is, to make a decision about investment in a company, analysts and investors require material information about the tangible and intangible assets of a company and a range of performance measures (Eccles et al., 2001).

The IAS may not keep pace with the advent of different dimensions in the economy (Eccles et al., 2001). For instance, in the earlier stages of clean air regulations (late 1860),[3] societies were less demanding on the enforcement of clean air legislation. Currently, societies pressure companies to behave in more socially responsible and accountable ways (Marshall & Macdonald, 2011). Action to reduce pollution may impact an organisation's financial position, performance and changes in financial position. In a carbon-constrained world the ability to hedge against "physical climate risk", "mitigating regulatory costs", "avoiding

[3] In late 1860s, the first clean air law passed in Pittsburgh (Jacobson, 2002, p. 85).

expensive litigation and other threats to corporate reputation", "managing climate risk in the supply chain", "investing capital in low-carbon assets" and "innovating around new technology and product opportunities" impact on the costs and revenue of companies (Lash & Wellington, 2007). However, despite the possible significant impact of carbon reduction strategies and disclosure on companies' financial performance, the IAS has not yet advanced significantly in this area.

The International Accounting Standards Committee Board (IASB) has been working on a project to develop requirements and guidance on carbon accounting (IASB, 2012). In May 2012, the IASB added Emission Trading Schemes as a research project to its agenda. Before this, the International Financial Reporting Interpretations Committee (IFRIC) issued IFRIC 3 in December 2004 to address accounting for the rights and obligations arising from the European Union Emission Trading Scheme (EU ETS) (IPSASB, 2013). IFRIC 3 had a limited scope and was withdrawn in less than a year to allow for the development of a more comprehensive approach to ETS accounting issues. Then, the IASB and the Financial Accounting Standards Board (FASB) conducted a joint project to develop a carbon mandatory reporting standard. The main focus of this standard was the recognition and measurement of the assets and liabilities of an emission trading scheme (IASB, 2012). This project was deferred in November 2010.

In the absence of the IAS and with increasing demand for relevant information, some organisations have chosen to provide additional information to their stakeholders via voluntary disclosure. Boesso (2002, p. 270) defines "voluntary disclosure" as that not explicitly required by an accounting standard or legislation. Voluntary disclosure should remain at "the total discretion of managers" (Boesso,

2002). Boesso (2002) argues that better information reporting reduces information asymmetry and improves relationships with investors, creditors, customers, suppliers, employees, managers and the other stakeholders. The reduction of information asymmetry ultimately smooths the progress of efficient allocation of scarce resources (Healy & Palepu, 2001).

A number of Australian companies disclose carbon information to communicate[4] their climate change strategies and reduction actions voluntarily, in the absence of an international carbon accounting standard and the presence of an increasing demand for climate change information. For instance, Ausenco publicly disclosed its GHG information and reduction strategies in its 2009 annual report, despite the fact that its level of total carbon dioxide equivalents is only about 16½ kilo tons, below the Australian *NGER Act 2007* reporting criteria. While there are other companies, similar to Ausenco, which disclose various levels of GHG information voluntarily, this research asks: what makes non-GHG registered[5] companies disclose a certain level of GHG information voluntarily. An answer to this question will provide decision makers a useful framework when deciding whether they should disclose GHG emission and at what level.

Previous studies in the voluntary GHG disclosure literature have examined several determinants of GHG disclosure. For instance, shareholder activism (e.g., Kolk et al., 2008; Reid & Toffel, 2009; Wegener, 2010; Cotter & Najah, 2012); industry (e.g., Wahyuni et al., 2009; Matsumura et al., 2011; Luo et al., 2012); and firm

[4] Companies disclose their GHG information in a variety of media including annual reports, sustainability reports, CDP questionnaires, media and web pages (Simnett et al., 2009).
[5] Non-GHG registered companies do not meet mandatory GHG reporting thresholds. Therefore, they are not registered with the Greenhouse and Energy Data Officer to release GHG information under the *NGER Act 2007*.

size (e.g., Freedman & Jaggi, 2005; Prado-Lorenzo et al., 2009; Reid & Toffel, 2009; Wahyuni et al., 2009; Wegener, 2010; Freedman & Jaggi, 2011; Cotter & Najah, 2012; Luo et al., 2012) are three commonly tested determinants for GHG disclosure. Several studies also identify geographical factors (such as, the ratification of the Kyoto protocol, the diversity of environmental regulations, the existence of common law, or the existence of emission trading schemes) (e.g., Freedman & Jaggi, 2005; Reid & Toffel, 2009; Luo et al., 2012; Freedman & Jaggi, 2011); and the existence of an environmental management system (e.g., Wahyuni et al., 2009) as the determinants of GHG disclosure. However, the samples of these studies are chosen from large companies, such as companies from the S&P500, Fortune 500 and Global 500. Large companies are not representative of all voluntary GHG disclosing companies. Generalising the conclusions of hypothesis tests from the sample of these studies to the whole population is not meaningful (Watt & Berg, 2002). Also, large companies are more likely to be subject to mandatory GHG regulations and the reason for their disclosure is more likely to be a regulation, rather than "managers' discretion". For example, BHP Billiton, a sample company, in Luo et al. (2012) is a GHG-registered company. Therefore, this study aims to contribute to the voluntary GHG disclosure literature by examining the association between several firm-specific characteristics of non-GHG registered companies and voluntary GHG disclosure, by using a comprehensive theoretical model (for further details regarding voluntary disclosure theories, see, Appendix 1).

Further, although there is literature on the determinants (firm-specific characteristics) of voluntary GHG disclosure, there are few studies that

specifically consider the consequences of voluntary GHG disclosure. This research gap is surprising given the importance of climate change risk for 83% of assets owners among investor networks in Europe, North America and Australia/New Zealand (IIGCC et al., 2011, p. 9) and the increasing economic significance of the carbon market, with a total value of $US176 billion traded globally at the end of 2011 (World Bank, 2012).

Several previous empirical studies on the consequences of voluntary GHG disclosure examine the association between GHG disclosure and firm value in the subject companies of the Carbon Disclosure Project (CDP)[6] questionnaire. For example, Griffin et al. (2010) find that the level of GHG emission is negatively associated with stock price. Similarly, Ziegler et al. (2009) examine the association between the level of companies' response to climate change and stock performance. However, this current study aims to contribute to the voluntary GHG disclosure literature by focusing on several aspects of market-based performance, such as bid-ask spread, return volatility, the cost of debt, and the cost of equity (finance costs).

Further, several studies (e.g., CDP, 2010; Kolk et al., 2008; Lash and Wellington, 2007) argue that companies that prepare GHG disclosure are expected to become more aware of the relation between their carbon footprints and their financial performance. A GHG disclosure strategy would lead companies to keep track and measure their carbon emissions. This strategy may help companies to identify the opportunities of cost savings through more efficient use of resources and

[6] The CDP is an independent non-profit entity that collects carbon emission-related data based on a questionnaire to accelerate solutions to climate change (CDP, 2011).

materials. It also could help companies to identify the operational efficiency improvements and the innovation opportunities in products and services. While these studies theoretically suggest that the implementation of "carbon management and reporting" may be associated with the costs and revenue of companies, this association has not been investigated empirically. This research gap is interesting given investors' growing concerns about the potential "financial risks" and "regulatory costs" related to carbon emissions as the result of internationally increasing economic significance in carbon markets (Coulton et al., 2012).

Therefore, this study aims to extend the current voluntary GHG disclosure literature by examining the association between voluntary GHG disclosure and the accounting-based measure of performance, such as, return on assets, return on equity and return on sales. Accounting-based performance refers to "overall profitability" as shown by return ratios (Golicic & Smith, 2013; Schultz et al., 2013).The accounting-based measures of performance aggregate the impact of possible costs and revenue change as a result of the implementation of "carbon management and reporting".

The remainder of this chapter is organised as follows. Section 1.2 presents the objectives of the research. Sections 1.3, 1.4 and 1.5 introduce the research questions, method and, the findings, respectively. Sections 1.6 and 1.7 provide the contributions of the research and the conclusion of the first chapter.

1.2 Objectives of the research

According to James (1890), to perform a voluntary action, initial specific characteristics of a volunteer and a presupposed knowledge of the action play a significant role in the decision to take the voluntary action. Based on the background discussed above, this thesis aims to develop further empirical evidence on the determinants and perceived consequences of voluntary GHG disclosure. In undertaking this task, we first consider what types of companies voluntarily disclose GHG information. In turn, this information provides an insight into the perceived benefits of GHG disclosure, especially by those non-GHG registered companies.

The prior voluntary disclosure literature identifies several determinants and consequences of voluntary disclosure decisions (details of the literature on voluntary disclosure is provided in Appendix 2). The empirical disclosure studies focused on a number of firm-specific characteristics as potential determinants of disclosure practices (Hackston & Milne, 1996). For example, studies have examined the effects of firm size, profitability, firm age, foreign listing status, ownership concentration, board independence and industry. The disclosure literature also identifies several perceived consequences of disclosure. For example, the perceived consequences are represented by the cost of capital estimates or return on assets or information asymmetry proxies, such as return volatility and bid-ask spreads (Guo et al., 2004 ; Shalev, 2009).

In the voluntary GHG disclosure literature, several previous studies (e.g., Luo et al., 2012; Prado-Lorenzo et al., 2009; Stanny and Ely, 2008) have examined the

determinants of voluntary disclosure in a GHG setting; however, their samples are chosen from large companies. Also, these large companies are more likely to be subject to mandatory GHG regulations. Thus, it is not clear if their disclosures were made with "managers' discretion", that is, a voluntary decision of the company irrespective of legislative requirements.

The first aim of this research is to identify empirically the determinants of voluntary GHG disclosure as they relate to firm-specific characteristics. Such characteristics are arguably prerequisites of the voluntary GHG disclosure decision. A comprehensive theoretical framework is used to ensure that key aspects of stakeholders' perspectives are considered.

Various studies have examined the association between GHG disclosure and firm value in the subject companies of the CDP questionnaire. For example, Kim and Lyon (2011) reviewed the financial impacts of institutional investor activism towards climate change by GHG emissions information disclosed in the CDP questionnaire. They argued that institutional investor activism towards carbon emissions can help the growth of shareholder value, when there is more awareness about carbon challenges. The available voluntary GHG studies on the economic consequences of GHG disclosure have, to date, relied on the CDP questionnaire, as a document for GHG disclosure. However, several researchers argue that the CDP questionnaire does not provide adequate information about GHG emissions (e.g., Kolk et al., 2008; Doran & Quinn, 2009; Andrew & Cortese, 2011). Also, companies that responded to the CDP questionnaire are mainly those subject to a variety of environmental regulations. For example, from the Global 500 companies responding to the CDP questionnaire in Luo et al. (2012) and Kim and

Lyon (2011), three Australian companies were included [Telstra Corporation, BHP Billiton, and Woolworths (PricewaterhouseCoopers, 2009)]. These companies voluntarily answer the detailed CDP questionnaire, while in Australia, they were mandated to release GHG information to the Greenhouse and Energy Data Officer under the *NGER Act 2007*.

The second research aim is to examine the impact of GHG disclosure on market-based performance. Bid-ask spread, return volatility and finance costs are used as the proxies of market-based performance. The aim of this study is to examine whether a lower level of information asymmetry as the result of voluntary GHG disclosure decreases bid-ask spread, return volatility and finance costs.

From a different perspective, several studies theoretically suggest that the implementation of "carbon management and reporting" may be associated with the improvement of financial performance (e.g., CDP, 2010; Kolk et al., 2008; Lash & Wellington, 2007). The authors argue that companies that prepare GHG disclosure are expected to be more aware of the relation between their carbon footprints and their financial performance. Therefore, a GHG disclosure strategy forces companies to keep track and measure their carbon emissions. This strategy may help companies to identify the opportunities of cost savings through more efficient use of resources and materials. Also, it could help companies to identify the operational efficiency improvements and innovation opportunities in products and services. Although a number of these studies theoretically predict that a GHG reduction strategy and the following GHG disclosure improves the accounting-based performance (e.g., return on assets, return on equity and return on sales) of a company, this association has not been investigated empirically. Therefore, the

third research aim of this thesis is to evaluate the impact of voluntary GHG disclosure on accounting-based performance.

Thus, the three aims of this thesis are:

(1) to revisit determinants (firm-specific characteristics) of voluntary GHG disclosure (first paper).
(2) *to examine the impact of voluntary GHG disclosure on market-based performance* (second paper).
(3) *to evaluate the impact of voluntary GHG disclosure on accounting-based performance* (third paper).

These questions are discussed in the following section in more detail.

1.3 Research questions

The focus of this thesis is to investigate the determinants and consequences of voluntary GHG disclosure by non-GHG registered Australian companies. To identify the effects of voluntary GHG disclosure, this research suggests that similar to prior voluntary disclosure literature, two factors may lead a company to disclose GHG information voluntarily, namely determinants (firm-specific characteristics) and perceived economic consequences of GHG disclosure. This research first examines whether voluntary GHG disclosure is influenced by firm-specific characteristics, such as firm size, leverage and ownership concentration. Then it empirically investigates whether GHG disclosure influences two aspects of financial performance, market-based and accounting-based performance, respectively.

Thus, the overall research question of this thesis is:

What are the determinants and consequences of voluntary GHG disclosure?

The overall research question is addressed in three chapters, in the form of three papers. Paper one, that is, Chapter 2, of this thesis, empirically identifies the key determinants of voluntary GHG disclosure by using a comprehensive theoretical model. The first specific research question is stated as follows:

(1) What are the key determinants of voluntary GHG disclosure?

Paper 2, that is Chapter three, identifies the relationship between GHG disclosure and several key market-based performance proxies by using a cost-benefit framework. The second specific research question is:

(2) What are the consequences of voluntary GHG disclosure on market-based performance?

In Chapter four of this thesis, that is, Paper 3, the impact of GHG disclosure on accounting-based performance using a cost-benefit framework is examined. The third specific research question of this thesis is:

(3) What are the consequences of voluntary GHG disclosure on accounting-based performance?

The next section considers the research method applied to examine the research questions.

1.4 Research method

Sample companies are selected from the ASX listed companies that are not subject to the *NGER Act 2007*, that is, as non-GHG registered companies, and

which disclose a level of GHG information in their annual reports. As at 29 February 2012, there were 2,317 ASX listed companies. Of these, 174 satisfy the criteria of being non-GHG registered but have disclosed voluntary information on GHG. These 174 companies formed the sample. The sample was hand-collected by searching for words, such as "Carbon", "Greenhouse" and "Climate Change" in the annual reports of the listed companies. The basis of selecting a company for the sample is by reviewing the information disclosed in the annual reports of these companies. Companies that disclose any specific information regarding GHG or climate change, such as targets, plans and strategies of a company on tackling climate change or any information about their emission numbers were chosen. Companies that mention explicitly in their reports that they are subject to the *NGER Act 2007*[7] or those on the list of NGER registered companies are excluded.[8] In cases in which the obligation of a company is not apparent, this company was contacted directly. Companies without operations in Australia were removed from the sample. Only a few sample companies also disclosed GHG information in their stand-alone sustainability reports.[9] For the purpose of the current research the annual report, a consistent, standard and common means of corporate environmental communication (Alrazi et al., 2011; de Villiers, & van Staden, 2011), was chosen.

Content analysis was used to assess the level of carbon disclosure in the annual reports. This analytical method is used for making replicable inferences from data

[7] Under the *Corporations Act 2001*, Australian companies are mandated to disclose whether they are subject to any particular environmental regulation in their annual reports.
[8] The first list of organisations subject to the *NGER Act 2007* was released on 26th February 2010.
[9] In this research, the availibility of sustainability reports of the sample companies are searched throughout the web pages of companies. Only about 2% of the sample companies prepared a stand-alone sustainability report.

to its context (Krippendorff, 2004). Content analysis is the most widely used method in the social and environmental disclosure literature, specifically for scoring the extent of disclosure (Alrazi et al., 2011; Guthrie & Mathews, 1985; Milne & Adler, 1999). To undertake content analysis a GHG disclosure index (see, Appendix 3) was developed based on the requirements of the *NGER Act 2007* and de Aguiar and Fearfull's (2010) GHG disclosure index (i.e., in accordance with GRI, 2002 and GRI, 2006 guidelines). Most researchers modify existing disclosure indices to meet their own perceived needs (Marston & Shrives, 1991). The GHG disclosure index adopted for this study was used to evaluate the level of GHG disclosure in the annual reports of non-GHG registered (with Greenhouse and Energy Data Officer) Australian companies for financial years 2009, 2010 and 2011[10]. The reliability of a disclosure index increases with well-specified decision categories and decision rules (Milne & Adler, 1999). This study's GHG disclosure index has specific decision rules and various categories such as: *disclosures on actions and targets to tackle GHG; GHG reduction achievements*; *GHG measures and verifications; GHG risk; GHG sources.*

Each disclosed item of the GHG disclosure index is analysed and scored for sample companies, based on zero for no disclosure, one for disclosure. At the end of scoring, the number of points a company has been awarded represents the level of disclosure (Gul & Leung, 2004; Meek et al., 1995). The double counting of the same issue is avoided (if a similar piece of information is disclosed twice in an

[10] The first year of reporting under the *NGER Act* was (2008–09). The initial object of this Act was to introduce a single national GHG reporting framework to underpin the introduction of an emissions trading scheme in year 2012. Therefore, to keep consistency annual reports of non-GHG registered companies for their voluntary GHG disclosure from financial year 2009 to 2011 are investigated in this thesis.

annual report, the second time of disclosure is ignored). Moreover, an interpretation of the implication of disclosure is considered (Cormier et al., 2005).

Also, in further analyses a binary GHG disclosure scale (similar to Cormier et al., 2005 and Williams, 2004) is used. The sample is split based on the level of voluntary GHG disclosure scores into two groups. Observations above the median GHG disclosure score are recorded as one (high disclosers), while those below the median are recorded as zero. This approach may reduce the possibility of measurement error of GHG disclosure scores.

A pilot study was undertaken to validate the viability and applicability of the scoring process and the disclosure measurement index. The annual reports of 25 companies that disclosed a level of GHG information in the 2008 financial year were randomly selected for the pilot study to avoid a possible data collection bias (Lombard et al., 2002). After the pilot study, a few changes (such as, wording changes and the exclusion of irrelevant items) were made to the original GHG disclosure index (see the final version of the disclosure index in Appendix 3).

Additionally, by the differentiation of "hard" to mimic disclosure items[11] such as *"carbon reduction achievement"*, from "soft" disclosure items such as *"targets to tackle climate change"*, the differences in the nature of GHG disclosure are captured (Clarkson et al., 2008). "Hard" to mimic disclosure items are verifiable and forward looking (e.g., *information about GHG sources; numbers; reporting*

[11] Similar to Clarkson et al. (2008). They categorised *"governance structure and manage systems", "credibility", "environmental performance indicators",* and *"environmental spending"* as "hard" to mimic environmental disclosure items. A company's disclosures of *"vision and environmental strategy", "environmental profile"* and *"environmental initiatives"* as they can be easily mimicked with no real environmental commitments were categorised as "soft" disclosure items.

method; verification; achievement). However, "soft" disclosures are statements that can be easily mimicked by companies (e.g., *general statements about aims of a company to reduce GHG emissions*) (Clarkson et al., 2008; Hutton et al., 2003). In this research, disclosure of information from several sub-categories of the GHG disclosure index are categorised as "hard" to mimic disclosure items, such as: *GHG sources; GHG numbers; reporting method; verification; GHG achievement; investment in carbon projects; redesign of process; product and services; utilisation; use of renewable energy and carbon.* Also, "soft" disclosure items arise from several sub-categories of the GHG disclosure index, such as: *targets to tackle GHG; education; support of green institutes and green actions (e.g., green power and earth hour); travel; carbon risk; and others opinions*.

The reliability of the content analysis is examined by using a test-retest of coding reports of a randomly selected sample of companies at a different time (3 month interval) by the same coder. The correlation of disclosure scores between different occasions is high and divergence is low. This highlights that GHG disclosure scores have good reliability (Milne & Adler, 1999).

To avoid possible type I error due to making multiple comparisons of treatment groups, we apply a single ANOVA test (Hair et al., 2006, p. 390). ANOVA demonstrates Analysis of variance between the defined specific categories of GHG disclosure, year and industry. ANOVA test results indicate that the level of GHG disclosure is significantly different within each industry.[12] In the first paper, industry effect is controlled directly as a determinant of disclosure. For the

[12] However, ANOVA test results present that the level of GHG disclosure is not significantly different within each year of the investigation.

empirical tests in the second and third paper, industry is not used as a control variable. A relative industry scaled disclosure score is constructed to control the effect of industry. The scaled GHG score is defined as the primary GHG disclosure score minus the company's average industry disclosure score (Eaton et al., 2007). This allows more meaningful comparisons between companies amongst different industries (Tauringana & Mangena, 2009).

Empirical models are designed in line with the previous financial and environmental disclosure studies (e.g., Clarkson et al., 2011; Dhaliwal et al., 2011; Guo et al., 2004). Multiple regression analyses were run in SPSS. To control for endogeneity and causality problems in papers two and three, two-stage least squares regression models are additionally used.

To further control possible self-selection and endogeneity problems, in paper three, this research employs a matched-pair sample. For each sample company that reports a level of GHG information, a matched company that does not disclose carbon information is considered. The matched pairs are similar in respect of industry, size, leverage and whether they are not subject to the *NGER Act 2007*. The GHG disclosure status of the sample companies represents GHG disclosure values in the matched-pair sample.

The variables' values are collected from the Datastream Advance database, Sirca, Thomson Reuters Tick History and the annual reports of the sample companies.

1.5 Findings

This thesis has five Chapters. This introductory chapter sets the background and the objectives of the research. It introduces the overall and specific research questions and method. The discussion in this Chapter also sets out the contributions of the research.

Chapter 2 presents the first paper of the thesis. In this chapter the determinants of voluntary GHG disclosure are examined. Chapter 3 introduces the second paper of this thesis, which considers the relationship between voluntary GHG disclosure and financial performance from the market aspect of performance. Chapter 4 is the third paper of the thesis and examines the relationship between voluntary GHG disclosure and financial performance from the accounting aspects of performance. Chapter 5 sets out the conclusion of the thesis, including the implications of the research for practice and future studies. A detailed review of the theoretical framework and the literature review are respectively included in appendixes 1 and 2. Appendix 3 includes the GHG disclosure index and decision rules for the scoring process.

1.6 Contributions of the research

This research makes several important contributions to the voluntary GHG disclosure literature. First, it considers whether companies are subject to the *NGER Act 2007* in the sample selection process. While much of the prior research uses GHG registered companies as the sample, no empirical study to date has considered non-GHG registered companies. As Boesso (2002) points out "voluntary disclosure" should remain at "the total discretion of managers".

Therefore, non-GHG registered companies' disclosure practice can be considered discretionary according to managers' preference.

Second, the content analysis of the annual reports provides some clarity in respect of the most common aspects of GHG disclosure (e.g., *actions to tackle GHG emission*) by non-GHG registered companies. This helps stakeholders to understand the type of carbon disclosure amongst non-GHG registered companies. Also, it helps stakeholders (e.g., shareholders, creditors, NGOs, governments, customers, suppliers, employees) to assess evidence of "green washing" and "symbolic disclosure" (Cormier et al., 2009; Hrasky, 2012). The content analysis of GHG disclosure in this research highlights the scope, extent and quality of GHG disclosure within the sample selected.

Third, although there is existing literature on the determinants (firm-specific characteristics) of voluntary GHG disclosure, there are few studies that specifically consider the consequences of voluntary GHG disclosure. This research gap is surprising given the increasing economic significance of the carbon market, with a total value of $US176 billion traded globally at the end of 2011 (World Bank, 2012). This study aims to bridge the existing gap between the determinants and consequences of voluntary GHG disclosure. That is, once the initial prerequisites for GHG disclosure are identified, the possible consequences of this voluntary action are examined.

Fourth, this study also considers whether the differences in the extent and nature of voluntary GHG disclosure can be explained by firm-specific characteristics stemming from common theories in voluntary disclosure studies. Understanding

the underlying determinants for voluntary GHG disclosure may help stakeholders understand the limitations of this disclosure.

Finally, this research responds specifically to Simnett et al.'s (2009) call for research to apply a collection of archival data to examine the characteristics of companies reporting their GHG emissions. Also, it responds to Cowan and Deegan's (2011) call for research to evaluate changes in voluntary emission disclosure practices by the introduction of the *NGER Act 2007*. Additionally, it responds to Bebbington and Larrinaga-Gonzalez's (2008) call to investigate the value relevance of disclosures on "carbon exposure" and "carbon management" in financial markets.

1.7 Conclusion

This chapter has outlined the foundations for this thesis including background, the objectives of the research, overall and specific research questions, the method used to analyse the data and the findings. In addition, the contributions of the research were outlined.

Chapter 2 Paper 1: An Empirical Analysis of the Theoretical Determinants of Voluntary Greenhouse Gas Disclosure in Australia

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Abstract

Based on a comprehensive theoretical framework, this paper investigates the determinants of voluntary GHG disclosure by non-GHG registered companies. Previous studies assessed the determinants of voluntary GHG disclosure by companies subject to mandatory GHG regulations. Also, it employs 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 voluntary GHG disclosure, firm size and board independence. Further, companies with newer equipment are more likely to engage in discretionary disclosure, and foreign listing status plays a significant role in the GHG disclosure decision, which suggests that companies tend to view shareholders' interests as a factor in determining GHG disclosure.

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

2.1 Introduction

Climate change issues and public concerns over perceived problems caused by climate change have led to the emergence of certain environmental regulations. These regulations focus on the reduction of GHG worldwide by adopting strategies such as "carbon pricing" and "technological development" (Simnett et al., 2009). One example of a regulatory disclosure requirement is the *NGER Act 2007*. This Act mandates companies with GHG emission, energy consumption or production above the specified thresholds[13] to report their GHG, measured in $CO_{2\text{-}e}$ (carbon dioxide equivalents), as well as energy consumption and production data, to the Australian Government[14]. However there are some companies that do not meet mandatory reporting criteria but disclose GHG information voluntarily. Of 2,317 Australian Stock Exchange (ASX) listed companies, 174 disclose different levels of GHG information despite not being subject to the *NGER Act 2007*. For instance, Ausenco publicly discloses its GHG information, despite its

[13] Two levels of thresholds are defined at which corporations need to report GHG and energy consumption: (1) facility thresholds; and (2) corporate thresholds. Facility thresholds are fixed over time at 25 KT (CO_2)and 100 TJ (energy), while corporate thresholds are variable over time with a decreasing trend during the first three years. For the first year of reporting (2008–09) under the *NGER Act*, the threshold was 125KT (CO_2) and 500 TJ (energy). For the following year, it was 87.5 KT (CO_2) and 350 TJ (energy). If a group of a controlling corporation meets a facility or corporate threshold, GHG and energy data must be reported to the Greenhouse and Energy Data Officer.

[14] Three scopes are defined in this regard for each organisation. The emissions from the first two scopes are subject to the Australian *NGER Act 2007*.Scope 1 refers to direct (point-source) emissions from the sources of a company or sources controlled by a company (e.g., mining activity). Scope 2 refers to indirect emissions from the generation of electricity purchased and consumed by an organisation (the emission factors of scope 2 are physicaly produced by the burning of fuels at the power station). Scope 3 refers to other indirect emissions by the activities of a company, but they are physically produced by other companies. As the Department of Climate Change and Energy Efficiency (2012) points out, the definition, methodologies and application of this scope is subject to discussions.

level of total carbon dioxide equivalents being only about 16½ kilo tons, below reporting criteria.

The voluntary disclosure literature can be categorised into three groups: voluntary financial disclosure; voluntary social disclosure; and voluntary GHG disclosure. As the financial disclosure literature gained momentum, social disclosure studies gradually started to develop. The growing literature of voluntary social disclosure examines several determinants of disclosure. This encompasses determinants identified in the financial disclosure literature, and a number of determinants linked to social responsibility concepts (e.g., Clarkson et al., 2008; O'Donovan, 2002; Patten, 1992). When climate change became a point of concern for society, a relatively new concept formed in the voluntary disclosure literature in respect of voluntary GHG disclosure.

Although several previous studies (e.g., Luo et al., 2012; Prado-Lorenzo et al., 2009; Stanny & Ely, 2008) look at the determinants of voluntary disclosure in relation to GHG, generalising 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 voluntary GHG disclosure. However, these samples are chosen from large companies, such as those on the Fortune 500, S&P500 and Global 500 (Berk, 1983). Further, these large companies are mostly subject to mandatory GHG reporting regulations and the reason for their disclosure is more likely to be regulation than discretion. Several researchers, such as Luo et al. (2012), choose the sample from companies that responded to the CDP questionnaire. They claim that respondents' behaviour is discretionary, as sample companies respond to the CDP questionnaire in a voluntary manner. However, companies that responded to

the CDP questionnaire are mainly companies subject to a variety of environmental regulations. For example, from the Global 500 companies responding to the CDP questionnaire, according to Luo et al. (2012), three Australian companies were included: Telstra Corporation; BHP Billiton; and Woolworths (PricewaterhouseCoopers, 2009). These companies voluntarily answered the detailed CDP questionnaire. Also, they are mandated to release GHG information to the Greenhouse and Energy Data Officer (GEDO) under the *NGER Act 2007*.

This study aims to empirically identify the key determinants of voluntary GHG disclosure using a comprehensive theoretical model. Its research question is:

What are the key determinants of voluntary GHG disclosure?

This study has broadened the use of theoretical proxies and examines the firm-specific characteristics associated with voluntary GHG disclosure to overcome the shortcomings in prior studies. It does not restrict sample merely to large companies or specific industries, instead it chooses the sample amongst the ASX listed companies that are not subject to the *NGER Act 2007* and that disclose a level of GHG information in their annual reports voluntarily. Further, the available studies on the determinants of voluntary GHG disclosure do not use a comprehensive theoretical framework. 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. A comprehensive theoretical framework is used to ensure that key aspects of stakeholders' perspectives are considered.

Legitimacy theory predicts that companies tend to disclose GHG information in order to legitimise their activities (e.g., Hrasky, 2012). Stakeholder theory suggests that, as stakeholders have different expectations (e.g., Deegan, 2002) about climate change, they may impose pressure on companies to release GHG information. On the other hand, voluntary GHG disclosure can be regarded as a means by which companies can reduce information asymmetry about GHG and subsequent agency costs (e.g., Richardson & Welker, 2001), thus supporting agency theory. Finally, voluntary disclosure theory predicts that companies with superior environmental performance tend to disclose more information to the public (e.g., Clarkson et al., 2008).

In order to examine the determinants of GHG disclosure, this study uses content analysis to investigate the annual reports of non-GHG registered (with GEDO) companies for their voluntary GHG disclosure from financial year 2009 to 2011 (300 company-year data for 151 sample companies). Its GHG disclosure index for content analysis is based on a modification of de Aguiar and Fearfull's (2010) GHG disclosure index according to the requirements in the *NGER Act 2007*. By the differentiation of "hard" to mimic disclosure items from "soft" disclosure items it controls the nature of disclosure, which makes the research design more rigorous.

In brief, the results of this study are as follows. It finds a positive association between the level of voluntary GHG disclosure, firm size and board independence, as predicted by legitimacy theory and agency theory. Further, companies with newer equipment are more likely to engage in discretionary disclosure, as predicted by voluntary disclosure theory. Also, it finds some

positive reaction to the foreign listing status proxy, which implies that sample companies respond to shareholder pressure. This research does not find any strong evidence to support industry and leverage as two determinants of voluntary GHG disclosure amongst the sample companies. One interpretation of this finding is that as these companies are not subject to the *NGER Act 2007*, they do not tend to seek legitimisation for their possibly good environmental performance. In other words, it can be inferred that well performed companies do not disclose for legitimisation, they disclose to acquire the perceived benefits of this information.[15]

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

The paper is organised as follows. First, research and theoretical determinants are developed, then the sample and methodology is described. Results are presented before the final section provides a summary and conclusions of this research.

[15] Disclosure could be used to overcome the legitimacy threat and to justify the operation, to distract the attention of society from adverse situations (Wilmshurst & Frost, 2000), and to present the conformity of the company to social norms and values.

2.2 Related research

The available studies about determinants of voluntary GHG disclosure were basically supported by stakeholder theory and legitimacy theory. For example, shareholder activism under the stakeholder theoretical framework is identified to be one external factor affecting the disclosure position of a company. Reid and Toffel (2009) show that shareholder resolutions filed against a company or against other companies in the same industry cause a growth in response rate to the CDP[16] questionnaire. Similarly, Wegener (2010) investigates that shareholder activism influences Canadian companies' decision to respond to the CDP questionnaire. Cotter and Najah (2012) also point out that powerful investors influence climate change disclosure via corporate communication channels. In the same way, Kolk et al. (2008) analyse FT500[17] companies' responses to the CDP questionnaire and argue that institutional investors have been successful in urging companies to disseminate detailed carbon information.

Industry and geographical factors (such as the ratification of the Kyoto Protocol,[18] the diversity of environmental regulations, the existence of common law, or the existence of emission trading schemes (ETS)) are other determinants of GHG voluntary disclosure. Industry is considered as a proxy for legitimacy theory in a number of GHG disclosure studies. That means companies in high polluting industries are more likely to disclose carbon information publicly. The studies of Wahyuni et al. (2009) and Luo et al. (2012) highlight a positive association

[16] 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.
[17] Financial Times 500
[18] The Kyoto Protocol is an agreement to the United Nations Framework Convention on climate change to tackle global warming.

between industry and GHG disclosure. Moreover, Matsumura et al. (2011) find that if 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 carbon disclosure. They highlight that companies from countries that confirmed the Protocol have a higher level of GHG disclosure. Further, multinational companies that have plants in countries that accepted the Protocol but with headquarters in non-ratified countries have a lower level of disclosure. In another study, Freedman and Jaggi (2011) 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[19] companies disseminate even less GHG disclosure than all the companies from other countries combined. In addition, they document that GHG disclosure is more frequent among Canadian and Japanese companies in comparison with European companies. Also, Reid and Toffel (2009) indicate that companies with head offices located in a region with proposed GHG regulations are more likely to release GHG information through the CDP questionnaire. In another study, Luo et al. (2012) reveal that carbon disclosure is more common among companies in countries that adopted ETS and companies in common law countries.

[19] India has ratified the Protocol but has not set any limits on GHG emissions (United Nations, 2013).

The existence of an environmental management system (EMS) is considered as the other determinant of voluntary GHG disclosure (Wahyuni et al., 2009). Wahyuni et al. (2009) investigate the voluntary GHG disclosure procedure of ASX300 companies in 2007 (before mandatory reporting under the *NGER Act 2007*) using a legitimacy theory framework. In a logistic regression analysis, they find that the existence of an EMS in a company, availability of a certified EMS, industry and firm size are the dominant determinants of GHG disclosure. They emphasise the voluntary phase of GHG reporting by their sample companies by analysing the years before the enactment of the *NGER Act 2007*. However, several companies in Australia were preparing carbon reports before the enactment of the *NGER Act 2007*, as they were subject to state ETS. For example, AGL Energy Limited is one sample company in Wahyuni et al.'s (2009) study that was subject to state regulations[20] before the enactment of NGER. Apparently, this study does not consider the effect of state regulations regarding tackling GHG problems before the introduction of NGER mandatory reporting in Australia.

In summary, previous studies assessed determinants of voluntary GHG disclosure by companies that were mainly subject to environmental regulations using a limited theoretical framework. This study chooses the sample from all the voluntarily disclosing companies and does not limit the sample to a specific listing status (e.g., ASX300) or a specific industry. Also, it applies a comprehensive approach by incorporating proxies for voluntary disclosure theory, agency theory

[20] 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 in the world that introduced carbon rights legislation. It set the first mandatory ETS in 1997, which became 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).

and resource-based theory, in addition to the stakeholder theory and legitimacy theory.

2.2.1 Theoretical determinants development

Voluntary social and environmental disclosure is difficult to explain and there are a number of theories (e.g., legitimacy theory, stakeholder theory, agency theory and voluntary disclosure theory) used to examine empirically such an exposure of information. There exists overlap between theories. In this study theories are considered together in order to explain why companies make the decision to disclose voluntary social and environmental information. This study employs a range of proxies for legitimacy, stakeholder, agency and voluntary disclosure theories to describe the determinants of voluntary GHG 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). In return, companies provide goods and services to society. As a result companies should always consider the unwritten social contract in their decision-making process (Mäkelä & Näsi, 2010). Moreover, one responsibility of companies is to consider the influences of their activities on all members of society (not only investors). Otherwise society would not legitimise the operation of the company and its survival will be threatened. Therefore, legitimacy is a necessary 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 (Deegan, 2002) (e.g., norms of society changes over time).

Currently, climate change and GHG emission are important issues. According to Stern (2006, i) the scientific evidence suggests that *"climate change presents very serious global risks, and it demands an urgent global response"*. GHG pollution can be seen as a threat to the legitimacy of a company. The development of awareness and concern in society about climate change may impact the response of a company in respect to GHG emissions. As companies are dependent on the expectations of society, if a legitimacy gap happens, it may 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 approach to communicate the activities of a company and the management perspectives to specific environmental, social and other corporate issues. Given the latest attention on how companies manage, describe, and evaluate their GHG, it is reasonable to expect that they try to legitimise their operations by voluntary disclosure (Wahyuni et al., 2009).[21] In an empirical study, Hrasky (2012), using ASX50 companies for 2005 and 2008, points out that the GHG disclosure of companies is consistent with "legitimation behaviour".

[21] Voluntary GHG disclosure amongst disclosing firms is not consistent (e.g., Schneider & Samkin, 2008) making comparability for investors difficult. For example, according to Andrew and Cortese (2011), GHG disclosure in the CDP questionnaire of Australasian companies in the metals and mining industry is not comparable because companies used a combination of methods for GHG reporting. Besides the inconsistency of the voluntary disclosure, there are a number of other shortcomings. First, as it is discretionary, mainly firms with a good story to tell will participate. Second, voluntary disclosure concentrates mostly on opportunities rather than risks and threats. Final, voluntary disclosure does not have an enforcement mechanism like mandatory disclosure.

On the other hand, as management has superior information to outsiders about the companies' operations, stakeholders demand information to monitor contracts with companies and to assess companies' valuation (Freedman & Jaggi, 2011). The 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, 1999). One value in current society is the management of GHG emissions. Stakeholders have different expectations in this regard. They pursue their informational needs through imposing pressure (directly or indirectly) on companies to release environmental information. Companies, through disclosure of information, provide a medium of communication to receive the support of stakeholders.

Investors demand information to monitor and evaluate companies' operations. As a result, companies will be motivated to disclose information voluntarily as disclosure may help them to obtain financial resources on the best terms and conditions (Gray et al., 1995). According to agency theory, 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 agency costs (Subramaniam, 2006). Voluntary GHG disclosure may therefore be used to reduce information asymmetry and the subsequent agency

costs in respect of GHG information. Also, according to resource-based theory, companies with greater financial resources are more likely to pursue environmental strategies and reporting (Russo & Fouts, 1997). In other words, environmental disclosure and financial success are interrelated (Clarkson et al., 2011).

According to voluntary disclosure theory, companies with good news to tell have incentives for disclosure. Amongst environmental disclosure studies, Clarkson et al. (2008) have employed voluntary disclosure theory to indicate that the purpose of voluntary environmental disclosure by companies is to promote superior environmental performance. Voluntary disclosure theory is also applicable in the GHG disclosure setting, in that companies reveal their superior GHG information and low GHG risk position to concerned stakeholders.

In order to examine the research question, this study uses a number of firm-specific characteristics as determinants of voluntary GHG disclosure, such as age of company, firm size, board independence, foreign listing status, ownership concentration, leverage and industry. Based on the disclosure literature, firm size is the most common determinant of voluntary disclosure in both financial and non-financial disclosure studies (e.g., Kim & Lyon, 2011). The current study considers whether firm size has the same positive association with voluntary GHG disclosure as it has with other types of voluntary disclosure. According to Kolk et al. (2008) preparation of carbon disclosure reports needs the allocation of resources. This would require a higher level of technical skills and resources than preparation of any other social performance reports; this is more available in large companies (resource-based theory). Also, large companies are more recognised by

governments and non-government organisations as polluters (The Canada Institute of the Woodrow Wilson International et al., 2008) and they disclose voluntary information to legitimise their operations (Haniffa & Cooke, 2005). For example, CDP, which is driven by powerful stakeholders, only requests infromation from large companies (Cotter & Najah, 2012). In summary, given the nature of GHG as described in the current paper, it is possible to suggest that larger companies would be more likely to disclose GHG information voluntarily. This study considers firm size as a possible proxy for voluntary GHG disclosure.

Age of company is another variable that has been examined as a determinant of environmental disclosure in several studies. Cormier and Magnan (1999) suggest that voluntary disclosure is negatively associated with age of company. 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 perceived benefits of their better environmental performance and to overcome competitors. This research investigates the impact of age of company on voluntary GHG decision based on voluntary disclosure theory.

The relationship of leverage 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 leveraged companies because debt holders are eager to be informed about issues affecting their debt contracts. Creditors currently employ the impacts of carbon risk in their debt contracts (e.g.,

see The Carbon Principles, 2009). Leverage as a possible determinant of GHG disclosure is considered in this study.

Several studies investigate the impact of foreign listing status of companies on disclosure. They explain the association between foreign listing status and the level of disclosure by emphasising the diversity of interests and the 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, this study examines whether foreign listing status influences the GHG disclosure decision. It assumes that companies listed on an international stock exchange are more likely to release GHG information than those companies listed only on the ASX in Australia.

The impact of board independence on the level of disclosure has been tested in several prior studies (e.g., Baek et al., 2009; Haniffa & Cooke, 2002; Muttakin & Subramaniam, 2013). They examine the influence of the composition of the board of directors (a proxy for corporate governance) on disclosure policy. It is important to consider the impact of board independence as a determinant of disclosure decision, because it is the board of directors and its committees that makes the final decision about disclosure policy (Haniffa & Cooke, 2002). The higher proportion of non-executive directors on the 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, the board possibly disseminates more information (Gompers, 1995), which ultimately

reduces agency costs. For the purpose of this paper, the impact of board independence on GHG disclosure decision is examined.

Companies disclose information based on the nature and norms of their industries (Gibbins et al., 1990). Companies in higher polluting industries adhere to a higher level of environmental disclosure to legitimise their activities due to political visibility (Gray et al., 1995; Patten, 2002). This study proposes that companies in carbon or energy intensive industries are more likely to disclose GHG information.

The relationship 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 shareholders. A company with a lower ownership concentration has a greater number of shareholders than a company with a higher ownership concentration. It might be expected that a company is under more pressure where there is a larger number of shareholders and therefore publishes additional information based on stakeholder theory (Cormier et al., 2005) to be responsive to the information demands of its shareholders. This study considers ownership concentration as another determinant of voluntary GHG disclosure.

2.3 Sample and methodology

2.3.1 Selection of sample

Boesso (2002, p. 270) defines “voluntary disclosure” as a disclosure that is not explicitly required by an accounting standard or legislation. Voluntary disclosure

should remain at "the total discretion of managers" (Boesso, 2002). However, amongst companies reporting their GHG information, there are several (e.g., Telstra Corporation, BHP Billiton, and Woolworths) that seem to be reporting GHG information voluntarily, while in fact they are subject to GHG regulations. Therefore, their disclosure practice cannot be considered as at the discretion of managers. To sum up, the companies with these disclosure patterns should be excluded from the sample of voluntary disclosure studies.

Among the Australian listed companies, there are several companies that do not meet mandatory national reporting (the *NGER Act 2007*) criteria, however, they disclose GHG information voluntarily. For instance, Ausenco publicly discloses its GHG information and reduction strategies in its 2009 annual report, despite the fact that its level of total carbon dioxide equivalents is only about 16½ kilo tons, below the Australian *NGER Act 2007*reporting criteria. The sample of this research includes all the listed companies in the ASX that publicly disclose their GHG information, and are not subject to the *NGER Act 2007* between 1 July 2008[22] and 30 June 2011. The sample is hand-collected by searching for words such as "Carbon", "Greenhouse", "Climate Change" and "CO_2" in all the annual reports of trading companies in the ASX between financial years 2009 and 2011. The basis of the sample selection is the review of information disclosed in the annual reports. Companies that disclose any specific information in respect of GHG or climate change, such as targets, plans and strategies of a company on tackling climate change or any information about their emission numbers were chosen. This study excludes those companies that mention explicitly in their

[22] The *NGER Act 2007* mandates companies to disclose greenhouse gas emissions, energy consumption and production from 1 July 2008.

annual reports that they are subject to the *NGER Act 2007*or those on the list of NGER registered companies. In cases where the obligation of a company is not clear, the company is contacted directly. It is also essential to exclude companies that do not have any operations in Australia.

The annual report is a primary and consistent means of corporate communication to a range of stakeholders, including shareholders, potential investors, suppliers and customers. For the purpose of the current paper, annual reports were chosen as the company document to address the research question. This study collects annual reports from Aspect Annual Reports Online. The number of companies releasing GHG information in their annual reports and not subject to the *NGER Act 2007*for the study period is 174 out of 2,317 companies listed on 29 February 2012. Among these, 23 companies are excluded from the sample, due to the fact that the financial variables have significant missing data or they do not have activity in Australia. The final sample was 151 companies and 300 company-year data.

Table 1, Panel A shows the industry distribution of the sample, based on Global Industry Classification Standard (GICS). The Materials and Energy industry has the largest proportion (16.33% and 14% respectively) of companies disclosing GHG information, while the Pharmaceuticals, Biotechnology and Life Sciences industry has the lowest proportion (0.33%). Table 1, Panel B presents the distribution of GHG disclosure by year. 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's (2011) study that

within the implication period of a regulation (whether the *NGER Act 2007* or the National Pollutant Inventory (NPI) the level of disclosure increases.

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 Science	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

2.3.2 Method

In order to examine the research question, this study uses content analysis to investigate the annual reports of non-GHG registered companies for their voluntary GHG 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). A number of researchers, for example, Clarkson et al. (2008), Freedman and Jaggi (2011), and Prado-Lorenzo et al. (2009), 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 the judgment of a researcher is involved in developing and applying a disclosure measurement index, the results may not be replicated (Healy & Palepu, 2001). Each disclosed item of the GHG disclosure index is analysed and scored for sample companies, based on zero for no disclosure, one for disclosure. At the end of scoring, the number of points a company has been awarded represents the level of disclosure. The double counting of the same issue is avoided (Kang & Gray, 2011). Moreover, an interpretation of the implication of disclosure is considered (Cormier et al., 2005). Although the content analysis of GHG disclosure includes a disclosure category about the level of GHG reduction, it does not necessarily reflect climate change abatement.

2.3.3 GHG disclosure index

Construction of a disclosure measurement index is one important factor of content analysis. It should be relevant to research questions and the user's aim for the index (Marston & Shrives, 1991). Researchers mostly adjust the existing disclosure indices to fulfil their research requirements (Marston & Shrives, 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 about GHG emissions has been growing in recent years (Freedman & Jaggi, 2011), there have been few consistent guidelines in respect of what companies should disclose. One of the proposed techniques of GHG disclosure is based on the use of protocols for measurement, reporting and verification such as the Global Reporting Initiative Guidelines

(GRI) (2013), International Organization for Standardization (ISO) (2006), and World Business Council for Sustainable Development and World Resources Institute (WBCSD & WRI) (2004).

In this thesis, the GHG disclosure index is based on a modification of de Aguiar and Fearfull's (2010) GHG disclosure index according to the requirements in the *NGER Act 2007*. De Aguiar and Fearfull's (2010) GHG index is in accordance with GRI (2002) and GRI (2006) Guidelines. GRI guidelines are an internationally accepted protocol, presenting principles for sustainability disclosure that contain energy consumption and production. The GRI principles break several principles down into greater 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 amongst global FT500 companies, 100% of Australian reporters include a GRI content index in the disclosure of their GHG. This is in line with the recommendations of the 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".

The GHG disclosure index used in this study includes a variety of categories, such as *disclosure on actions and targets to tackle GHG, GHG reduction achievements*, *GHG measures and verifications*. Additionally, by the

differentiation of "hard" to mimic disclosure items[23] such as *"carbon reduction achievement"*, from "soft" disclosure items such as *"targets to tackle climate change"*, the differences in the nature of GHG disclosure are captured (Clarkson et al., 2008).

2.3.4 Empirical model and variable definitions

In order to examine the research question, the following cross-sectional regression model is considered:

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

where voluntary GHG disclosure ($GHGDIS_{i,t}$), the dependent variable, refers to the attributes of GHG disclosure such as the extent of disclosure in time *t*. As endogeneity issues could potentially affect the results, a lead-lag approach to tackle these potential problems is used. Prior studies in the disclosure literature find several firm-specific characteristics as the determinants of voluntary disclosure under a legitimacy theory and stakeholder theory framework. This study examines the impacts of the following variables as firm-specific characteristics on voluntary GHG disclosure by a comprehensive theoretical framework: firm size (*SIZE*), age of company (*AGE*), leverage (*LEV*), foreign listing status (*EXCH*), board independence (*CORP*), industry (*IND*) and ownership concentration (*OWN*).

[23] Similar to Clarkson et al. (2008), who categorised *"governance structure and manage systems", "credibility", "environmental performance indicators",* and *"environmental spending"* as "hard" to mimic environmental disclosure items. A company's disclosures of *"vision and environmental strategy", "environmental profile"* and *"environmental initiatives"* can be easily mimicked with no real environmental commitments so were categorised as "soft" disclosure items.

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 company (*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. Foreign listing status (*EXCH*) is a dummy variable. It is equal to one if a company is listed in other stock exchanges in addition to the ASX and it is zero if not. The coefficient on the variable *EXCH* is expected to be positive. Board independence (*CORP*) is measured by the proportion of non-executive directors on the 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 company is operating in carbon or energy intensive industries and it is zero if not. Three industries are categorised as the most carbon or energy intensive industries (Coulton et al., 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.

This study obtains the independent variables' values from annual reports and the Datastream Advance database. A pilot study was undertaken to validate the viability and applicability of the scoring process and the disclosure measurement index. The annual reports of 25 companies that disclosed a level of GHG information in the 2008 financial year were randomly selected for the pilot study

to avoid a possible data collection bias (Lombard et al., 2002). After the pilot study, a few changes (such as wording changes and the exclusion of irrelevant items) were made to the original GHG disclosure index. Then, using the annual reports of the sample companies and disclosure index, the level of GHG disclosure is investigated.[24]

2.4 Results

2.4.1 Summary of GHG disclosure

As mentioned previously, the GHG disclosure index is based on a modified de Aguiar and Fearfull (2010) GHG disclosure index. According to the content analysis of annual reports, companies report a diverse level of GHG information numerically and verbally. Most GHG disclosures are supported by qualitative information of GHG items. Sample companies disclose different levels of GHG in their annual reports. For example, 52% and 22.33% of companies respectively disclose one and two items of GHG information voluntarily. The average level of GHG disclosure is around 2.17. About 8% of companies release six and above items of GHG information. Companies disclose GHG information in the annual reports mostly from the *"actions to tackle GHG"* phase (60.56%), followed by the *"targets to tackle GHG"* (21.12%) phase, and the least disclosed phase is the *"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

[24] The stability of the content analysis is examined by using a test-retest of coding reports of a randomly selected sample of companies on a different time (three month interval). The correlation of disclosure scores between different occasions is high and divergence is low. This shows that GHG disclosure scores have good reliability (Milne & Adler, 1999).

companies' disclosures are not showing a true picture of companies' GHG performance. These findings are consistent with the studies of Cowan and Deegan (2011) and Simnett et al. (2009) that find that voluntary emissions disclosures in the 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 score. Most of the 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 score. 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 is achieved. This is perhaps not surprising given the nature of achievements.

2.4.2 Descriptive statistics

As previously discussed, the dependent variable to be used in the current study is the level of voluntary GHG disclosure. Level of GHG disclosure is measured through the 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 voluntary GHG disclosure, and seven firm-specific variables as independent variables, are used. Table 2 reports descriptive statistics for the independent variables.

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

The average listing exchange status is only 0.07, suggesting that that most of the samples companies are only listed on the ASX. Also, on average, Industry is about 0.38, which indicates that most companies are in less carbon or energy intensive industries. The average Top20 (*OWN*) coefficient is 0.65. *AGE* has an average of 0.57. The mean of firm size is 369,274.1 ($,000) far from size Maximum and Minimum (7,036,000 and 2,213 $,000), thus the sample consists of a relatively extensive range of companies. The average leverage (*LEV*) is 22% of total assets. The average board independence (*CorporateGov*) is 0.50. For independent variable Age, there was ten company-year missing values for two groups of companies: 1- Companies reporting properties, plant and equipment based on fair value; 2- Companies not holding any properties, plant and equipment. To comply with multiple regression analysis assumption, size,

leverage and GHG disclosure scores are transformed 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.

Pearson correlations between variables used in the regression are presented 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*. There is no highly significant correlation between independent variables.

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)

2.4.3 Multiple regression analysis

Multiple regression analysis is conducted using SPSS to test the research question. Table 4 reports the results for determinants of the voluntary GHG disclosure model.

Table 4. Determinants of voluntary GHG 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		

As shown in Table 4, the adjusted R^2 for the models range from 40.7% to 23.1%. This is comparable to prior voluntary GHG disclosure studies (e.g., Freedman and Jaggi, 2011). As predicted, the estimated coefficients for *AGE* are positive and significant in total voluntary GHG disclosure and "hard" disclosure scores. 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 score, as well as for "hard" disclosure score versus "soft" disclosure score, leverage is positive but is statistically significant for the "soft" disclosure category only. One interpretation of this finding is that sample companies (which are not subject to the *NGER Act 2007*) are not under the pressure of creditors to disclose carbon information. Industry coefficients are insignificant in all models. This result could be because the sample implicitly includes companies with low GHG emission for the selection criteria of not being subject to the *NGER Act 2007*. This study finds that ownership concentration (Top20 Shareholders) and foreign listing status are insignificant in all three models at 95% significance level. These two independent variables for the total disclosure score are significant at 90% significance level. It suggests that companies, listing on the

other stock exchanges in addition to the ASX are more apt to voluntary GHG disclosure. This result may be due to the pressure imposed by a larger number of stakeholders. The coefficient for ownership concentration (Top 20 shareholders) is not in accordance with the prediction. However, it could be explained that as sample companies have apparently an acceptable environmental performance (because they are not subject to the *NGER Act 2007*), they disclose to receive the perceived benefits of disclosure. Consistent with agency theory, board independence proxy is positive and significant in all three models. The higher proportion of non-executive directors on the board provides an independent board. A more independent board attempts to reduce information asymmetry by reporting further information. In this way the independent board reduces the agency costs. Similar to the prediction, larger companies tend to disclose more information, which is supported by agency theory, resource-based theory and legitimacy theory. Larger companies have more resources (money, experts and systems) available for extra reporting (resource-based theory). In addition as larger companies are supposed to be under more scrutiny, they disclose to legitimise the operations.

2.4.4 Sensitivity analysis

A Logit regression model is run to investigate the consistency of results with the main results in Table 4. The sample is split with respect to voluntary GHG disclosure scores into two groups. Observations above the median GHG disclosure scores are recorded as one (high disclosers), while those below the median are recorded as zero. Again, the decision to provide voluntary GHG

disclosure is influenced by firm size, the combination of board and age of company.

2.5 Summary and conclusions

This study examines the key determinants of voluntary GHG disclosure by testing predictions from a comprehensive theoretical framework. In particular, it adds to the prior literature by focusing on voluntary GHG disclosure and by controlling the effect of "hard" to mimic GHG disclosure items and "soft" GHG disclosure items. The other strength of this research is that it avoids sample selection bias by not limiting the sample to merely large companies.

This study considers a number of firm-specific characteristics similar to prior studies, as the determinants of voluntary disclosure. Age of company, firm size, board independence, foreign listing status, ownership concentration, leverage and industry are the proxies for voluntary GHG disclosure. For unavailability of any consistent environmental performance measure of the sample companies, this study incorporates age of company (Clarkson et al., 2008).

The results are as follows. This research finds a positive and significant association between the level of voluntary GHG disclosure in the annual reports, board independence and firm size, which in general, support the application of agency theory and stakeholder theory. Further, companies with newer equipment are more likely to engage in discretionary disclosure, as predicted by voluntary disclosure theory. Finally, in contrast to industry and leverage variables, foreign listing status proxy appears to play a significant role in the GHG disclosure decision. This result can be explained by the fact that these companies voluntarily

disclose information to attract shareholders, though they are not subject to the *NGER Act 2007*. They disclose voluntary GHG information to acquire the possible benefits of communicating this information. This result could be supported by stakeholder theory. However, the findings do not support the hypothesis that companies in higher polluting industries adhere to a higher level of GHG disclosure to legitimise their activities due to political visibility.

A few caveats are worth noting. As a consistent environmental performance measure was not available for the sample companies, environmental performance is not controlled properly. Further, this study uses only annual reports as the GHG disclosure document. Also, about 6% of the sample companies report GHG information in the CDP questionnaire and media. However, it appears that companies that filled the CDP questionnaire disclose similar type of information in their annual reports (Cotter & Najah, 2012). Also, the sample of this study does not include any non-GHG registered companies that do not disclose GHG information. This might limit the generalizability of the conclusion.

Notwithstanding these caveats, this study offers many opportunities for future research. For example, according to the impact of industry and leverage proxies on voluntary GHG disclosure, it is suggested that perhaps well performed companies do not disclose for legitimisation, they disclose to acquire the perceived benefits of communicating this information. A study of perceived benefits of voluntary GHG disclosure may help us understand better the nature and relevance of GHG information. Further, as industry and leverage were not significant for companies not subject to the *NGER Act 2007*, it would be

worthwhile to investigate if this is similar with companies subject to the *NGER Act*, to investigate whether they seek legitimisation via GHG disclosure.

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Chapter 3 Paper 2: Voluntary Greenhouse Gas Emission Disclosure – Impact on Market-based Performance

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Abstract

Based on a cost-benefit framework, this study investigates the consequences of voluntary GHG disclosure by non-GHG registered Australian companies on market-based performance. Previous studies mostly assess the impact of GHG disclosure, using the CDP questionnaire, on market-based performance from a firm value perspective. This research employs a number of proxies for market-based performance, such as return volatility, bid-ask spread, and finance costs (the cost of debt and the cost of equity). The level of GHG disclosure is scored through the content analysis of the sample annual reports for the 2009 to 2011 financial years. The findings support that a high level of debt cost in the previous year is a determinant for voluntary GHG disclosure. Also, this study highlights that GHG disclosure has significant negative relationships with the bid-ask spread and return volatility in the following year of disclosure. Finally both linear regression and two-stage least squares regression analysis suggest that voluntary GHG disclosure is associated with a lower level of debt cost in the following year of disclosure.

Overall, the research results are consistent with predictions of the cost-benefit framework and indicate that companies bear the extra voluntary reporting costs to achieve the perceived benefits of disclosure.

Key words: GHG emission, voluntary disclosure, content analysis, market-based performance

3.1 Introduction

In the earlier stages of clean air regulations (late 1860),[25] societies were less demanding on the enforcement of clean air legislation. Currently, societies pressure companies to behave in more socially responsible and accountable ways (Marshall & Macdonald, 2011). Pollution reduction action could impact an organisation's financial position and performance and lead to changes in financial position. In a carbon-constrained world the ability to hedge against "physical climate risk", "mitigating regulatory costs", "avoiding expensive litigation and other threats to corporate reputation", "managing climate risk in the supply chain", "investing capital in low-carbon assets" and "innovating around new technology and product opportunities" may impact on the costs and revenue of companies (Lash & Wellington, 2007). However, despite the possible significant impact of GHG reduction strategies and its communication on companies' performance, IAS[26] has not yet advanced significantly in this area.

In the absence of the IAS and the presence of an increasing demand for relevant information, some organisations provide additional information to stakeholders via voluntary disclosure.[27] Boesso (2002) argues that better information reporting reduces information asymmetry and improves the relationship with investors, creditors, customers, suppliers, employees, managers and other stakeholders. The

[25] The first clean air law was passed in Pittsburgh in the late 1860s (Jacobson, 2002, p. 85).
[26] The IASB added Emission Trading Schemes as a research project to its agenda in May 2012 (IASB, 2012). Before that the IASB and the FASB were conducting a joint project to develop a carbon reporting standard. The main focus of this standard was on the recognition and measurement of the assets and liabilities of an emission trading scheme (i.e., finanicial accounting and reporting of GHG).
[27] Boesso (2002, p. 270) defines "voluntary disclosure" as a disclosure that is not explicitly required by an accounting standard or legislation.

reduction of information asymmetry ultimately smooths the progress of the efficient allocation of scarce resources (Healy & Palepu, 2001).

Several companies report a level of GHG information to respond to the information needs of stakeholders in the absence of an international carbon accounting standard. GHG disclosure is an approach to communicate the strategies and plans of a company in relation to climate change problems. Voluntary GHG disclosure may provide some economic benefits for the company (e.g., by reduction in information asymmetry and agency costs).

The existing literature on the consequences of voluntary GHG disclosure examined the association between GHG disclosure and firm value in the subject companies of the CDP questionnaire. For example, Kim and Lyon (2011) reviewed the financial impacts of institutional investor activism towards climate change by GHG emissions information disclosed in the CDP questionnaire. They argue that institutional investor activism towards carbon emissions can help the growth of shareholder value when there is more awareness about carbon challenges. But they could not provide any conclusive evidence that the participation in the CDP is the only reason for the increase in value. The available voluntary GHG studies have, to date, relied on the CDP questionnaire as a document for GHG disclosure. However, the CDP questionnaire is mostly applicable to large companies that are subject to several GHG regulations. In addition, several researchers argue that the CDP questionnaire does not provide adequate information about GHG emissions (e.g., Kolk et al., 2008; Doran & Quinn, 2009; Andrew & Cortese, 2011).

This study aims to identify the relationship between GHG disclosure and several aspects of market-based performance, such as, bid-ask spread, return volatility, the cost of debt, and the cost of equity (finance costs), by using a cost-benefit framework. This research evaluates the level of GHG disclosure from annual reports. Also, the sample is not limited to large companies.

In order to examine the research hypotheses, content analysis is used. The level of GHG disclosure in the annual reports of non-GHG registered (with Greenhouse and Energy Data Officer) Australian companies from 2009 to 2011 is coded based on a developed GHG disclosure index. In addition, by the differentiation of "hard" to mimic disclosure items, such as *"carbon reduction achievement"*, from "soft" disclosure items, such as *"targets to tackle climate change"*, the differences in the nature of GHG disclosure are captured.

Briefly, this study finds that a high cost of debt in the year prior to disclosure is a determinant of GHG disclosure. Consistent with the cost-benefit framework, companies with a high cost of debt are more likely to bear the extra reporting cost to achieve the perceived benefits of voluntary GHG disclosure. The perceived benefits of voluntary GHG disclosure could be a reduction in information asymmetry and a subsequent possible reduction in finance costs. Also, the findings suggest that GHG disclosure has significant negative relationships with bid-ask spread and return volatility in the following year of disclosure. This research also provides evidence that GHG disclosing companies achieved a lower level of cost of debt in the next year of disclosure.

Understanding the impact of voluntary GHG disclosure on market-based performance is important given the increasing economic significance of the carbon market, with a total value of $ US176 billion traded globally at the end of 2011 (World Bank, 2012). This paper provides an insight regarding the incentives of disclosure for non-disclosed companies. It is useful for non-disclosing companies to evaluate the perceived benefits of voluntary GHG disclosure. Further, this study responds to Bebbington and Larrinaga-Gonzalez's (2008) call to investigate the value relevance of disclosures on "carbon exposure" and "carbon management" in financial markets.

The remainder of the paper is organised as follows. The second section presents related research. The third section discusses the research theory and hypotheses development. Section four describes the sample and methodology. Section five presents the results. A summary and conclusions of the research are outlined in the final section.

3.2 Related research

Despite the rising significance of GHG information, there are limited studies available about how the disclosure of climate change information in capital markets influences market-based performance. For example, Delmas and Nairn-Birch (2010) examine the association between the level of carbon emissions and financial performance amongst 1100 US companies for the 2004–2008 period. They find that total carbon footprint has a negative impact on Tobin's Q. The negative relationship is described by the discount of future expected cash flows in an uncertain environment. Similarly, Matsumura et al. (2011), reviewing the CDP

questionnaire of S&P500 companies, find that there is a negative association between total carbon footprint and firm value. Also, Chapple et al. (2013) indicate that the market penalises the most carbon intensive companies, by between 7% and 10% of market capitalisation. Further, Griffin et al. (2010) examine investors' interest in companies' GHG emission disclosures. They highlight that the level of GHG emission is negatively associated with stock price, supporting the notion that investors care about companies' GHG information. They also conduct an event study and provide evidence that the market responds significantly at the time of GHG disclosure. Similarly, Bose et al. (2013), using observations from 33 countries, find that the relationship between GHG emissions and market value is significantly negative. Also, in an event study through the CDP questionnaire, Kim and Lyon (2011) suggest that institutional investor activism towards carbon issues can increase shareholder value when there is more consciousness about climate change. However, they could not find any systematic evidence of the growth in value because of the participation of a company in the CDP alone. Ziegler et al. (2009) also examine the association between the level of companies' response to climate change and stock performance. They show that a higher level of corporate activities about climate change in regions and periods with less pressure to tackle climate change challenges, may cause negative abnormal returns. However in regions and periods with more ambitious climate policies, companies would have positive abnormal returns for their responses to climate change. They state that the relationship between carbon management efforts and financial performance depends on the stringency of carbon regulation. A cost and benefit analysis is therefore a relevant mechanism for decision making.

In summary, previous studies assess the consequences of voluntary GHG disclosure on the market-based performance of companies mostly through CDP questionnaire disclosure. However, the majority of companies that respond to the CDP questionnaire are large companies subject to several GHG regulations. For example, three Australian companies, BHP Billiton, Woolworths, and Telstra Corporation (PricewaterhouseCoopers, 2009), voluntarily respond to the detailed CDP questionnaire. Also, they have to report GHG information to the Greenhouse and Energy Data Officer. Second, despite a growth in the quantity of GHG disclosure in the CDP questionnaire, the quality and informational value of this disclosure is still low (Doran & Quinn, 2009). Similarly, Kolk et al. (2008), based on the characteristics of data provided, show that the level of carbon disclosure via the CDP is not valuable for the investors, NGOs or policy makers. This study chooses annual reports, a consistent means of corporate communication, as the source of GHG disclosure. Further, it avoids sample selection bias by not limiting the sample to large companies. Most important of all, it applies a more comprehensive approach by focusing on several aspects of market-based performance.

3.3 Research theory and hypotheses development

Voluntary disclosure reduces information asymmetry (Eaton et al., 2007). The reduction of information asymmetry enhances the liquidity of stocks, reduces estimation risks and decreases the cost of capital (Dhaliwal et al., 2011). It is also likely that the content of disclosed information helps a better assessment of uncertainties about the future performance of a company. That is, voluntary disclosure improves investors' understanding of the company, which in turn may

decrease the cost of capital (Merton, 1987). According to agency theory, inadequate disclosure can increase information asymmetry. Lack of information may cause investors to undervalue companies and to become less willing to trade (Dhaliwal et al., 2011). This may lead to illiquidity and may cause an increase in bid-ask spread, transaction costs and finance costs (Verrecchia, 2001).

In addition to information asymmetry, the beneficial role of voluntary social disclosure may be described from a different angle, that is, the direct influence of social disclosure on the financial market through investors' preference for the socially responsible investment. Socially responsible companies also benefit from a higher number of possible green clients, a lower likelihood of potential litigation risks and a likely less pollution cleaning costs (Dhaliwal et al., 2011). Socially concerned investors are happy to pay a premium to invest in socially responsible companies (Richardson & Welker, 2001). Socially responsible companies are more legitimate in the eyes of investors. Capital markets award them with lower finance costs (Sharfman & Fernando, 2008).

Allocating resources for voluntary disclosure is a critical decision. A cost-benefit framework provides an explanatory framework for additional disclosure beyond the requirements. This framework explains that voluntary disclosure occurs when the benefits of disclosure outweigh its costs. The possible benefits of voluntary GHG disclosure from a market perspective could be the reduction of information asymmetry, the reduction of agency cost, lower finance cost, increased liquidity and decreased estimation risk. Measurement, verification, collation and publishing

of GHG information are considered definite costs of GHG reporting.[28] According to Leuz and Wysocki (2008), quantifying the costs of reporting is not easy, especially when considering opportunity costs (e.g., managerial time). To the best of my understanding no study directly controls for the effect of reporting costs on disclosure decision. Several researchers use firm size as a proxy for resource-based theory. They assume that larger companies are most likely to have the required human and financial resources, and therefore are more likely to undertake additional reporting.

The development of hypotheses for this research proceeded in two stages. The first hypothesis relates to the possible impact of the level of finance costs on voluntary GHG disclosure decision (determinant of disclosure). The second set of hypotheses relates to the possible impact of voluntary GHG disclosure on market-based performance proxies, such as, finance costs, bid-ask spread and return volatility (consequence of disclosure).

Determinants of voluntary GHG disclosure

Prior studies (e.g., Dhaliwal et al., 2011) highlighted that companies with a high cost of capital in the previous year are more likely to release corporate social responsibility (CSR) information in the current year. This is because disclosing companies assume that voluntary disclosure reduces the uncertainties about the future performance of their companies. It also may enhance the understandings of investors in respect of CSR issues, which in turn may help a better assessment of investment risks. Therefore, according to the cost-benefit framework companies

[28] As the sample firms are not subject to the *NGER Act 2007* for the low level of GHG emission,the possible legitimacy costs are not controlled in this research.

with high level of finance costs in comparison with companies with low level of finance costs might be more likely to be involved in GHG disclosure. Although voluntary disclosure is costly for all companies, the companies with high level of finance costs may be more motivated for voluntary disclosure. As, in a relative scale they are more likely to benefit from the future reduction of information asymmetry, the reduction of agency cost, lower finance cost, increased liquidity and decreased estimation risk. Therefore, the first hypothesis is as follows: a probable reduction in finance costs provides an incentive for companies to disclose GHG information.

H1: Voluntary GHG disclosure is positively associated with the finance costs in the previous year.

Consequences of voluntary GHG disclosure

In addition to investigating the financial determinants of voluntary GHG disclosure, our study analyses the financial consequences of voluntary GHG disclosure. Our study investigates the impact of GHG disclosure on market-based performance by applying a cost-benefit framework. Bid-ask spread, return volatility and finance costs are used as the proxies of market-based performance. If according to cost-benefit framework the reduction in finance costs motivates companies to disclose GHG information, we should observe an improvement in market-based performance, including finance costs, for disclosing companies in future. Therefore, this study hypothesises that a higher level of GHG disclosures causes a reduction in information asymmetry, and a lower level of information asymmetry as the result of voluntary GHG disclosure decreases bid-ask spread, return volatility and finance costs. To avoid potential endogeneity, this study uses

a lead-lag approach in the regression models. Also, to provide additional evidence of the robustness of our results, the set of variables used for the determinant of voluntary GHG disclosure model are employed to attain the fitted values of GHG disclosure proxy in two-stage least squares regression analyses.

The following hypotheses are subsequently developed:

H2: *Voluntary GHG disclosure is associated with a subsequently lower bid-ask spread.*

H3: *Voluntary GHG disclosure is associated with a subsequently lower return volatility.*

H4: *Voluntary GHG disclosure is associated with subsequently lower finance costs.*

3.4 Sample and methodology

3.4.1 Selection of sample

The perceived stringency of carbon regulation is a driving factor for voluntary GHG disclosure (Ziegler et al., 2009). GHG regulation at a national level was introduced in 2007 in Australia. The sample was chosen to include Australian companies not subject to the Australian *NGER Act 2007*; however, they disclose GHG information voluntarily in their annual reports. The sample includes all Australian Stock Exchange (ASX) listed companies that disclose GHG information, despite not being mandated by the *NGER Act 2007* to report GHG information between 1 July 2008 and 30 June 2011.

The GHG disclosure source in this study is annual reports, because they are consistent means of corporate communication. Annual reports are retrieved from Aspect Annual Reports Online. Of 2,317 companies listed on 29 February 2012, 174 disclose GHG information in the annual reports, despite not being subject to the *NGER Act 2007*. Of these 174 sample companies, 38 are excluded from the analysis because they do not operate in Australia or the data have major elements missing, making the final sample consist of 136 companies.

Figure 1 presents the distribution of the sample, based on the Global Industry Classification Standard (GICS). According to Coulton et al. (2012), 44% and 45% of GHG-registered companies in 2010 and 2011 are companies in the "Materials" and "Energy" industries. Consistent with the GHG registered companies, Figure 1 indicates that the non-GHG registered companies in the "Materials" and "Energy" industries make up the largest proportion of the sample (17.1% and 13.9% respectively). This could be because a company is more likely to release the same information that the peer companies in the same industry disclose (Matsumura et al., 2011).While the "Pharmaceuticals, Biotechnology & Life Sciences" industry has the lowest proportion (0.4%).

Figure 1: Sample distribution by industry

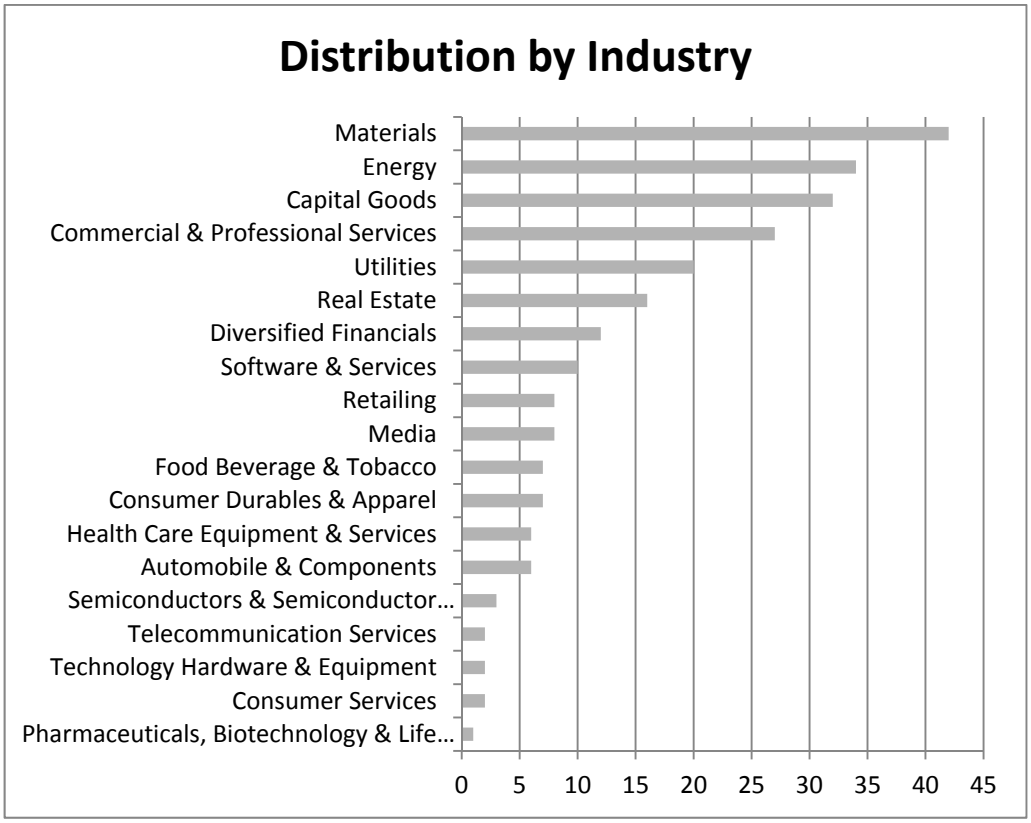
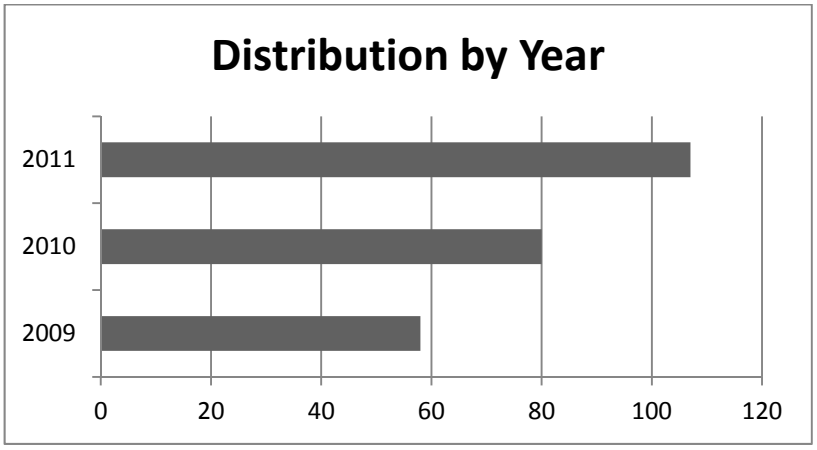


Figure 2 demonstrates the year distribution of sample. Similar to Cowan and Deegan (2011), the number of voluntary emission disclosure increases when environmental legislation is being established. There are 58 companies disclosing GHG information in 2009, increasing to 107 companies in 2011.

Figure 2: Sample distribution by year



3.4.2 Method

Content analysis is used to estimate the extent and nature of GHG disclosure by non-GHG registered companies. The GHG disclosure index for content analysis has different categories, such as: *disclosures on actions and targets to tackle GHG; GHG reduction achievements; GHG measures and verifications*. Reliability of disclosure index increases by well-specified decision categories and decision rules (Guthrie & Abeysekera, 2010; Guthrie et al., 2004; Milne & Adler, 1999). Each disclosed item of the GHG disclosure index is analysed and scored for sample companies, based on zero for no disclosure, one for disclosure. The number of points a company is awarded represents the level of disclosure.

The differences in the nature of GHG disclosure are captured by the differentiation of "hard" to mimic disclosure items from "soft" disclosure items. Disclosure of information about *GHG sources; GHG numbers; reporting method; verification; GHG achievement; investment in carbon projects; redesign of process; product and services; utilisation; use of renewable energy; and carbon sequestration* are included in the "hard" to mimic disclosure category of disclosure. *Targets to tackle GHG; education; support of green institutes and green actions (e.g., green power and earth hour); travel; carbon risk; and others opinions* are considered as "soft" disclosure items.

The level of disclosure is scored based on the number of disclosed items within the range of the GHG disclosure index. An ANOVA test is run to examine if the level of GHG disclosure is significantly different among industries. This study finds that the level of GHG disclosure is significantly different between

industries.[29] Therefore, a relative industry scaled disclosure score is constructed to control the effect of industry. The scaled GHG score is defined by the primary GHG disclosure score minus the company's average industry disclosure score (Eaton et al., 2007). This allows more meaningful comparisons between companies amongst different industries (Tauringana & Mangena, 2009).

3.4.3 Empirical models and variable definitions

In order to examine the first hypothesis, the following cross-sectional regression models are used:

$$GHGD_{i,t} = \beta_0 + \beta_1 COD_{i,t-1} + \beta_2 SIZE_{i,t-1} + \beta_3 CORP_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 LIST_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 AGE_{i,t-1} + \beta_8 VOLU_{i,t-1} + \varepsilon \quad (2)$$

$$GHGD_{i,t} = \beta_0 + \beta_1 COE_{i,t-1} + \beta_2 SIZE_{i,t-1} + \beta_3 CORP_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 LIST_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 AGE_{i,t-1} + \beta_8 VOLU_{i,t-1} + \varepsilon \quad (3)$$

where $GHGD_{i,t}$, the dependent variable, is the industry scaled level of voluntary GHG disclosure at year t. The independent variables $COD_{i,t-1}$ and $COE_{i,t-1}$ are the cost of debt and the cost of equity at year t-1. The models contain a number of control variables similar to previous disclosure studies, such as: *SIZE; CORP; LEV; LIST; ROA; AGE;* and *VOLU*[30]. These variables are respectively firm size (book value), board independence, leverage, foreign listing status, return on

[29] However, ANOVA test results present that the level of GHG disclosure is not significantly different within each year of the investigation.

[30] In our earlier regression models, we controled the effect of industry, year and the interaction between them as control variables. However, their coefficients were insignificant and the level of adjusted R2 reduced significantly by their inclusion.

assets, age of company and trading volume. This research uses a lead-lag approach to tackle potential endogeneity issues.

The level of GHG disclosure is obtained from the content analysis of annual reports. It is expected that the level of GHG disclosure in the current year increases in accordance with the level of debt cost and equity cost in the previous year. Positive coefficient on $COD_{i,t-1}$ and $COE_{i,t-1}$ would support hypothesis 1.

Firm size (*SIZE*), the total asset value at the end of financial year is the measure of *SIZE*. The coefficient on the variable *SIZE* is expected to be positive. It has been argued in the literature that large companies are more likely to be able to afford the extra reporting cost of voluntary disclosure and also to be under greater pressure by stakeholders for voluntary disclosure. Board independence (*CORP*) is represented by the proportion of non-executive directors on the board at the end of financial year. The coefficient on the variable *CORP* is expected to be positive. An independent board would probably release more information in the presence of information asymmetry. Leverage (*LEV*) is measured by total debt divided by total assets at the end of the financial year. The coefficient on the variable *LEV* is expected to be positive. Companies with high levels of debt could be under greater pressure from creditors to disclose information. Foreign listing status (*LIST*) is a binary variable. It is equal to one if a company is listed on other stock exchanges in addition to the ASX and zero if not. The coefficient on the variable *LIST* is expected to be positive, as the diversity of interests and power of stakeholders in different countries increases the likelihood of voluntary disclosure. Return on assets (*ROA*) is measured as operating income divided by beginning period operating assets. The coefficient on the variable *ROA* is expected to be

positive, as companies with a better financial performance and more resources are more likely to undertake extra reporting. Age of company (*AGE*) is calculated as 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. It is assumed that companies with newer equipment may have superior environmental performance and probably tend to disclose a higher level of environmental disclosure (Clarkson et al., 2008). Volume (*VOLU*) is the mean percentage of shares traded (i.e., daily traded shares divided by total shares outstanding) over a one-year period.

In order to examine the remaining hypotheses, the following cross-sectional regression models are used:

$$\text{Log}(SPREAD)^{31}=\beta_0+\ \beta_1 GHGD+\ \beta_2\ \text{Log}(MSIZE)+\ \beta_3\ \text{Log}(VOLA)+\ \beta_4\ \text{Log}(VOLU)\ +\varepsilon \quad (4)$$

$$\text{Log}(VOLA)=\beta_0+\beta_1 GHGD+\beta_2\ \text{Log}(MSIZE)+\beta_3\ \text{Log}(VOLU)\ +\varepsilon \quad (5)$$

$$\Delta\%COD_{i,t+1},\ \Delta\%COE_{i,t+1}=\beta_0+\beta_1 GHGD_{i,t}+\beta_2\Delta MSIZE_{i,t}+\beta_3\Delta LEV_{i,t}+\beta_4\Delta MB_{i,t}\ +\beta_5\Delta BETA_{i,t}+\beta_6\Delta VOLU_{i,t}+\ \varepsilon \quad (6)$$

where, *SPREAD*, *VOLA,* $\Delta\%COD_{i,t+1}$ and $\Delta\%COE_{i,t+1}$, the dependent variables, are respectively bid-ask spread, return volatility, the percentage change in the cost of debt and in the cost of equity from year *t* to time *t*+1. The independent variable *GHGD* is the industry scaled level of GHG disclosure at year *t.* The models contain a number of control variables similar to previous studies (Guo et al., 2004;

[31] A logarithm format in equations (4) and (5) is adopted following the bid-ask and volatility models of Guo et al. (2004) and Glosten and Milgrom (1985).

Dhaliwal et al., 2011), such as: *MSIZE; VOLA; VOLU; LEV; MB;* and *BETA*. These variables are respectively firm size (market value), return volatility, trading volume, leverage, market to book ratio and beta. A lead-lag approach is used to tackle potential endogeneity issues. Moreover, the change format in the cost of finance models can improve the power of the model and reduce the likelihood of potential endogeneity between dependent and independent variables. Accordingly, the control variables adopt the change form as well. To further control for endogeneity and causality problems this study employs multiple two-stage least squares (2SLS) estimations. This research uses the set of variables listed in the disclosure equations (2) and (3) as instruments to attain the fitted values of GHG disclosure proxy in the finance costs models. Using 2SLS estimation leads to the consistency of parameter estimates because fitted values of GHG disclosure are uncorrelated with the error term in the finance costs models.

SPREAD, bid-ask spread, is measured as the mean daily relative bid-ask spread over a six-month period following GHG disclosure. Relative Bid-Ask Spread is the absolute difference between the closing bid and ask prices on the ASX market, scaled by the mean of the bid and ask. Return volatility (*VOLA*) is the standard deviation of daily stock returns over a one-year period after GHG disclosure[32]. The percentage change in the cost of debt ($\Delta\%COD_{i,t+1}$) is the percentage change of debt cost from year t to t+1. The cost of debt is measured by the interest expense divided by average debt (short and long term) during a year. The percentage change in the cost of equity ($\Delta\%COE_{i,t+1}$) is the percentage change of cost of equity from year t to t+1. The cost of equity is calculated by using the

[32] This research measures the variables of bid-ask spread, volume, and volatility similar to of Guo et al. (2004) and Leuz and Verrecchia (2000).

Capital Asset Pricing Model (CAPM).[33] Firm size (*MSIZE*) is the total market value of equity at the time of GHG disclosure.

It is expected that bid-ask spread, return volatility and the percentage change in the cost of debt and in the cost of equity decreases with the higher level of GHG disclosure. Negative coefficients on *GHGD* would support hypotheses 2 to 4.

According to prior empirical studies bid-ask spread and return volatility, dependent variables, are negatively associated with firm size (*MSIZE*) and trading volume (*VOLU*). It is also expected that bid-ask spread is positively associated with return volatility (*VOLA*) (e.g., Glosten & Harris, 1988; Guo et al., 2004; Leuz & Verrecchia, 2000).

The control variables in the sixth model are derived from prior studies (e.g., Dhaliwal et al., 2011). It is expected that finance costs (the cost of equity or the cost of debt) are negatively associated with firm size, market to book value (*MB*) and trading volume. Similar to prior literature (e.g., Dhaliwal et al., 2011), it is also expected that risk factors such as *BETA* and Leverage (*LEV*) have positive coefficients in the sixth model.

The variables' values are collected from the Datastream Advance database, Sirca, Thomson Reuters Tick History and annual reports. There is a number of missing values for variables in each model, which makes the final sample of each hypothesis unequal. The viability and applicability of the disclosure index and the

[33] The EPS forecasts of the sample companies for the period of study were not available to apply the other available models for the cost of equity measure.

scoring process are tested in a pilot study. Then the level of GHG disclosure is evaluated by coding the annual reports based on the disclosure index[34].

3.5 Results

3.5.1 Summary of GHG disclosures

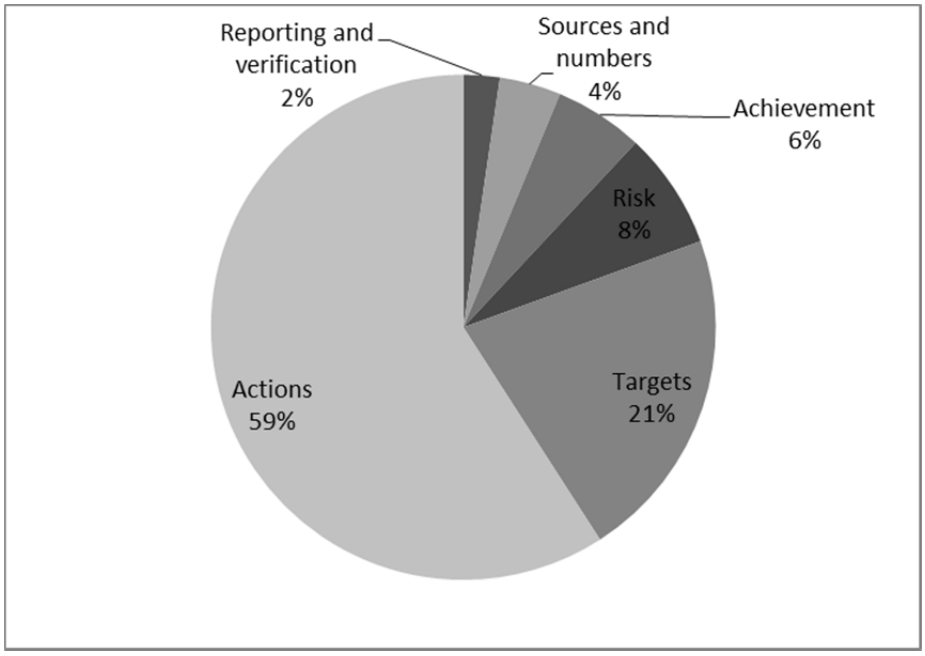
The annual reports of sample companies are coded based on the GHG disclosure index. Companies report GHG information at different levels. For example, 50.2% of the sample companies only disclose from one category of the GHG disclosure index. The average GHG disclosure level is about 2.18. Approximately 8.4% of companies report six or more items of GHG information.

Figure 3 demonstrates the distribution of the categories of GHG index among sample companies. The two most common categories of disclosure are *"actions to tackle GHG"* (59%), followed by *"targets to tackle GHG"* (21%), and the least common is *"reporting and verification"* (2%). About 6% of the total disclosure score is from the *"GHG reduction achievement"* phase of disclosure.

A more detailed analysis shows that *"emission reduction consultancy services and design of low carbon footprint products"* (27%) and *"energy conservation"* (15%) are the most disclosed items within the category of *"actions to tackle GHG"* (69.2%). Half of disclosure from *"targets to tackle GHG"* category is due to reporting about *"using energy and other resources efficiently*". "*Granted awards"* have the lowest contribution (only four cases among sample companies) under the *"GHG reduction achievement"* category.

[34] A test-retest (3 month interval) is run to examine the stability of the content analysis of a randomly selected sample firms. The correlation of scores in different periods is high and discrepancy is low. This result indicates that GHG scores are reliable (Milne & Adler, 1999).

Figure 3: Distribution of the categories of GHG index



3.5.2 Descriptive statistics

The dependent variables to be used in the current study are the level of voluntary GHG disclosure, bid-ask spread, return volatility and the percentage change in the cost of debt and the cost of equity from year *t* to time *t*+1. A number of independent and control variables are employed in the multiple regression analyses. Table 5 presents descriptive statistics for the independent and control variables.

Table 5: Descriptive statistics

Variable	Minimum	Maximum	Mean	Std. Deviation
%COD	0.04	13.38	4.74	2.87
%COE	6.54	13.53	9.23	1.49
SIZE (Thousand)	2,515	7,036,000	524,188	1,095,380
CORP	0.13	0.86	0.51	0.14
LIST	-	1.00	0.06	0.24
AGE	0.25	1.00	0.59	0.20
ROA	- 0.17	0.34	0.04	0.10
MSIZE (Thousand)	2,767	151,060,893	1,929,915	12,908,420
VOLA	0.01	5.98	1.50	1.35
VOLU	0.01	0.62	0.06	0.08
SoftGHGD	-	6.00	0.88	0.90
TotalGHGD	1.00	9.00	2.18	1.69
HardGHGD	-	6.00	1.25	1.24
ΔBETA	- 0.49	0.12	- 0.15	0.14
ΔMB	- 5.77	5.81	- 0.06	1.67
ΔLEV	- 0.31	0.68	0.07	0.16
ΔMSIZE	- 2.19	3.06	- 0.01	0.81

The average cost of debt in the previous year is 4.74%. The sample includes companies that differ widely in size. Average *SIZE* is 524,188 (thousand dollars), with a range between *SIZE* Maximum and Minimum (7,036,000 and 2,515 thousand dollars) that indicates the inclusiveness of the sample. This is similar for *MSIZE*. Average board independence (*CORP*) is 0.51. The low average of listing exchange status (0.06) indicates that the majority of the sample companies are only listed on the ASX. As discussed previously, sample companies disclose

different levels of GHG information in their annual reports. On average they disclose 2.18 pieces of GHG information voluntarily. The level of trading volume on average is 0.06. To fulfil multiple regression analysis requirements, trading volume and firm size are transformed to their natural logarithm. Departure from normality is not significant case for any of the variables.

Table 6 demonstrates Pearson correlations between variables. The correlations for determinant variables are shown in panel A. In this panel, *LnSIZE* has the largest (0.524) significant correlation with *TotalGHGD* (dependent variable in the first model). The Pearson correlations between the dependent variable and both independent and control variables (except for the cost of equity and leverage) in the first model are positive and significantly similar to the assumptions. Panel B provides Pearson correlations for the market-based performance measures. Bid-ask spread and volatility measures are negatively and significantly correlated to *TotalGHGD* in accordance with the hypotheses. None of the independent or control variables in both panels are highly correlated to each other.

Table 6: Pearson correlations

Panel A: Pearson correlations for determinants

Variables	TotalGHGD	SoftGHGD	HardGHGD	AGE	ROA	LnSIZE	CORP	LEV	LnVOLU	%DOB	%COE	LIST
TotalGHGD	1.000	.590**	.802**	.268*	0.015	.524**	.304**	-0.097	0.100	.362**	-0.025	0.067
SoftGHGD	.590**	1.000	0.018	.263*	-0.009	.368**	0.182	-0.128	0.175	.238*	-0.020	0.031
HardGHGD	.802**	0.018	1.000	0.133	0.020	.371**	.232*	-0.035	0.014	.230*	-0.044	0.065
AGE	.268*	.263*	0.133	1.000	-0.124	0.097	.225*	-.398**	.235*	0.103	0.047	.255*
ROA	0.015	-0.009	0.020	-0.124	1.000	.358**	0.072	0.127	0.037	0.083	0.083	-0.039
LnSIZE	.524**	.368**	.371**	0.097	.358**	1.000	.492**	0.041	.293**	.393**	0.008	0.197
CORP	.304**	0.182	.232*	.225*	0.072	.492**	1.000	-0.140	.227*	.304**	0.056	0.064
LEV	-0.097	-0.128	-0.035	-.398**	0.127	0.041	-0.140	1.000	-.362**	-0.074	0.092	0.059
LnVOLU	0.100	0.175	0.014	.235*	0.037	.293**	.227*	-.362**	1.000	0.056	-0.027	0.098
%COD	.362**	.238*	.230*	0.103	0.083	.393**	.304**	-0.074	0.056	1.000	0.149	0.021
%COE	-0.025	-0.020	-0.044	0.047	0.083	0.008	0.056	0.092	-0.027	0.149	1.000	-0.024
LIST	0.067	0.031	0.065	.255*	-0.039	0.197	0.064	0.059	0.098	0.021	-0.024	1.000

Panel B: Pearson correlations for market-based performance proxies

Variables	SPREAD	MSIZE	VOLU	VOLA	TotalGHGD	%ΔCOE	%ΔDOB	ΔLEV	ΔMB	ΔVOLU	ΔBETA
SPREAD	1.000	-.179**	-0.021	.540**	-.293**						
MSIZE	-.179**	1.000	-0.004	-0.111	.331**						
VOLU	-0.021	-0.004	1.000	0.105	-0.072						
VOLA	.540**	-0.111	0.105	1.000	-.252**						
TotalGHGD	-.293**	.331**	-0.072	-.252**	1.000	-0.119	0.118	.413**	0.019	0.105	-0.058
%ΔCOE					-0.119	1.000	0.046	-0.042	.337**	0.058	.532**
%ΔCOD					0.118	0.046	1.000	0.216	-0.050	0.129	0.106
ΔLEV					.413**	-0.042	0.216	1.000	0.114	0.102	-0.027
ΔMB					0.019	.337**	-0.050	0.114	1.000	-0.002	-0.056
ΔVOLU					0.105	0.058	0.129	0.102	-0.002	1.000	-0.212
ΔBETA					-0.058	.532**	0.106	-0.027	-0.056	-0.212	1

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

3.5.3 Multiple regression analysis

SPSS is used to examine the research hypotheses. The following tables demonstrate the results of multiple regression analyses for the determinants of voluntary GHG disclosure models and for the impact of GHG disclosure on the market-based performance models.

Panel A in Table 7 indicates the result of regression on the first determinant model of voluntary GHG disclosure. Models are significant in all three levels of disclosure. *AGE, LnSIZE* and *CORP*, control variables, have positive and significant coefficients in the total GHG disclosure model. This indicates that companies with newer equipment, larger amount of assets and a more independent board are more likely to disclose GHG information voluntarily. As predicted, the estimated coefficient for the independent variable, $\%COD_{,t\text{-}1}$, is positive and significant in the total GHG disclosure model. The sample companies with a high

level of debt cost in the previous year are more likely to disclose GHG in the current year. This result is consistent with the first hypothesis that a possible reduction in finance costs could be a determinant for GHG disclosure in accordance with the cost-benefit framework. Also, $\%COD_{,t-1}$, is positive and significant in the soft GHG disclosure model. We can interpret that the sample companies with a high level of debt cost in the previous year of disclosure are more likely to incorporate "symbolic" actions rather than "behavioural management" actions. In this way, they may seek to generate signals to maximize the social status of their companies that may cause a reduction in future finance costs.

Table 7: Determinants of voluntary GHG disclosure

Panel A: Cost of debt (t-1) and GHG 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	-5.181	-5.982	0.000	-2.496	-3.896	0.000	-2.315	-4.446	0.000
ROA	-0.512	-0.973	0.332	-0.150	-0.386	0.700	-0.309	-0.976	0.330
LEV	-0.352	-0.575	0.566	-0.487	-1.075	0.284	0.401	1.090	0.277
AGE	1.374	2.085	0.039	0.689	1.414	0.159	0.730	1.844	0.067
LIST	0.273	0.560	0.576	0.137	0.380	0.705	0.215	0.733	0.464
LnVOLU	-0.022	-0.172	0.864	-0.060	-0.634	0.527	0.083	1.089	0.278
LnSIZE	0.245	2.927	0.004	0.117	1.891	0.060	0.093	1.860	0.065
CORP	2.205	2.371	0.019	1.331	1.935	0.055	0.782	1.399	0.164
%COD	0.096	2.050	0.042	0.038	1.085	0.280	0.051	1.797	0.074
Adjusted R Square	0.210			0.090			0.121		
F-stat	6.960			3.214			4.076		
Panel B: Cost of equity (t-1) and GHG 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	-5.162	-4.509	0.000	-2.225	-2.652	0.009	-2.364	-3.443	0.001
ROA	-0.615	-1.159	0.248	-0.178	-0.457	0.648	-0.366	-1.150	0.252
LEV	-0.397	-0.642	0.522	-0.499	-1.101	0.273	0.376	1.013	0.312
AGE	1.380	2.065	0.040	0.709	1.448	0.149	0.730	1.821	0.070
LIST	0.366	0.744	0.458	0.163	0.452	0.652	0.267	0.903	0.368
LnVOLU	-0.054	-0.421	0.674	-0.076	-0.811	0.418	0.067	0.872	0.384
LnSIZE	0.288	3.511	0.001	0.135	2.249	0.026	0.116	2.358	0.019
CORP	2.557	2.766	0.006	1.454	2.147	0.033	0.971	1.751	0.082
%COE	-0.027	-0.312	0.756	-0.041	-0.651	0.516	-0.007	-0.142	0.887
Adjusted R Square	0.191			0.086			0.104		
F-stat	6.297			3.106			3.607		

Panel B in Table 7 indicates the result of regression on the second determinant model of voluntary GHG disclosure. Models are significant in all the three levels of disclosure. Again, *AGE, LnSIZE* and *CORP*, control variables, have positive and significant coefficients in the total GHG disclosure model. The independent

variable, $\%COE_{,t-1}$, is not significant in any of the disclosure models. This research could not provide evidence that a high level of equity cost in the previous year of disclosure is a determinant for voluntary GHG disclosure.[35]

Table 8 presents the first market-based performance measure in consequence models, bid-ask spread. The levels of adjusted R^2 are about 59% to 61%. Control variables are significant in all the disclosure models. As predicted there is a negative coefficient for *LgMSIZE* (firm size) and *LgVOLU* (trading volume) and a positive coefficient for *LgVOLA* (return volatility). These results are in accordance with the findings of prior papers (e.g., Guo et al., 2004). The independent variable, the level of GHG disclosure, is negative and significant for total GHG disclosure and "hard" to mimic disclosure items models. Similar to the second hypothesis the GHG disclosure is associated with a lower level of bid-ask spread in the following months of disclosure. This result is consistent with agency theory. The reduction of information asymmetry reduces uncertainties in financial markets which finally impacts on convergence of stock pricing.

Table 8: GHG disclosure and bid-ask spread

	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	0.798	4.794	0.000	0.864	5.347	0.000	0.926	5.606	0.000
LgMSIZE	-0.288	-7.637	0.000	-0.297	-7.995	0.000	-0.315	-8.388	0.000
LgVOLA	0.503	5.385	0.000	0.520	5.545	0.000	0.498	5.182	0.000
LgVOLU	-0.125	-3.201	0.002	-0.138	-3.483	0.001	-0.118	-2.936	0.004
GHGD	-0.055	-3.079	0.002	-0.066	-2.916	0.004	-0.035	-1.135	0.258
Adjusted R Square	0.610			0.608			0.588		
F-stat	60.046			59.444			54.981		

[35] The interaction effects of environmental performance (*Age*) and a number of control variables (*COD, COE, SIZE, ROA* and *LEV*) are controlled in the further analysis. For example, it is controlled whether the better environmental performance in companies with the higher cost of debt/equity, the higher GHG disclosure. However, the investigated interaction effects are not significant in the determinant regression models.

Table 9 provides findings of the regression analysis between the second proxy of market-based performance, return volatility, and GHG disclosure. Again, firm size (*LgMSIZE*) is negative and statistically significant, which is similar to the prior voluntary disclosure literature and prediction. GHG disclosure coefficients are also negative and significant in all the disclosure models. It indicates that similar to bid-ask spread, an increased extent of GHG disclosure reduces the volatility of return, consistent with the third hypothesis. This result is in accordance with agency theory.

Table 9: GHG disclosure and return volatility

	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	-0.336	-2.680	0.008	-0.303	-2.416	0.016	-0.248	-2.069	0.040
LgVOLU	-0.009	-0.151	0.880	-0.013	-0.221	0.825	0.004	0.064	0.949
LgMSIZE	-0.198	-9.048	0.000	-0.205	-9.468	0.000	-0.214	-10.313	0.000
GHGD	-0.038	-2.760	0.006	-0.038	-2.104	0.036	-0.043	-2.044	0.042
Adjusted R Square	0.337			0.328			0.327		
F-stat	42.297			40.723			40.601		

Table 10 provides the findings for the last hypothesis. Panel A presents the association between GHG disclosure and changes in the cost of debt in the following year of disclosure. As predicted in the total disclosure model, there is a negative and significant association between voluntary GHG disclosure and changes in the cost of debt. The coefficient of disclosure in the "hard" to mimic disclosure model is also significant at 90% significance level. These results are consistent with the last hypothesis that voluntary GHG disclosure could decrease finance costs in the subsequent year of disclosure. To interpret the economic implication of this finding, the coefficient of each variable and the estimate of mean at 95% confidence interval are transferred to equation (6). This research highlights that one item of GHG disclosure could cause a 0.024% reduction in the cost of debt in the following year of disclosure.

Table 10: GHG disclosure and cost of finance

Panel A: GHG disclosure and cost of debt (t+1)									
	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	-0.111	-0.352	0.726	-0.097	-0.307	0.759	-0.071	-0.222	0.824
ΔLEV	3.373	3.073	0.002	3.228	2.941	0.004	2.992	2.756	0.006
ΔMB	0.179	1.259	0.210	0.193	1.342	0.181	0.169	1.174	0.242
ΔVOLU	0.267	1.392	0.166	0.284	1.473	0.143	0.246	1.268	0.207
ΔBETA	2.552	1.494	0.137	2.571	1.497	0.136	2.631	1.527	0.129
ΔMSIZE	-0.859	-2.881	0.004	-0.851	-2.840	0.005	-0.884	-2.938	0.004
GHGD	-0.229	-2.328	0.021	-0.276	-1.915	0.057	-0.285	-1.651	0.101
Adjusted R Square	0.103			0.094			0.089		
F-stat	4.415			4.089			3.913		
Panel B: GHG disclosure and cost of equity (t+1)									
	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	0.042	0.479	0.633	0.044	0.494	0.622	0.045	0.507	0.613
ΔLEV	0.150	0.487	0.627	0.133	0.434	0.665	0.123	0.410	0.682
ΔMB	0.064	1.599	0.112	0.064	1.606	0.110	0.063	1.583	0.115
ΔVOLU	0.024	0.453	0.651	0.025	0.467	0.641	0.023	0.434	0.665
ΔBETA	2.756	5.772	0.000	2.757	5.770	0.000	2.760	5.773	0.000
ΔMSIZE	0.136	1.631	0.105	0.136	1.636	0.104	0.135	1.614	0.108
GHGD	-0.014	-0.518	0.605	-0.012	-0.290	0.772	-0.013	-0.282	0.779
Adjusted R Square	0.197			0.196			0.196		
F-stat	8.307			8.267			8.266		

Panel B in Table 10 shows the result of the association between GHG disclosure and changes in the cost of equity in the following year of disclosure. Although the coefficients for independent variable in all the disclosure models are negative (similar to the prediction), they are not significant. This study could not provide evidence that voluntary GHG disclosure could decrease the cost of equity in the following year of disclosure.

3.5.4 Sensitivity analysis

To examine the consistency of the findings, this research employs Logit regression models. Sample companies are divided according to the level of GHG scores into two groups. Value one is considered for companies with high disclosure scores (above the median GHG disclosure score), and zero is used for companies below the median GHG disclosure score. Logit regression findings are very similar to the above discussed results.

Also, this study enhances the analysis by employing two-stage least squares regressions to deal with any other possible[36] endogeneity and causality problems. Findings are similar to those of the primary results.

3.6 Summary and conclusions

This research investigates the impact of finance costs on the GHG disclosure decision. Also, it examines the influence of voluntary GHG disclosure on market-based performance. It improves on the voluntary GHG disclosure literature by focusing on several aspects of market-based performance. The other strength of the research is for capturing both the differences in extent and nature of disclosure. Also, it reduces the sample selection problems by choosing the all voluntarily disclosing companies, independent of size and industry.

The effect of the level of finance costs (the cost of debt and the cost of equity) on GHG disclosure is analysed by using a cost-benefit framework. Bid-ask spread, return volatility and finance costs as proxies of market-based performance are employed. It is assumed that GHG disclosure reduces information asymmetry in the following months of disclosure. As a result of reduced uncertainties and estimation errors in the financial markets, the level of bid-ask spread, return volatility and finance costs decreases.

The results are as follows. This research finds a positive and significant association between the level of voluntary GHG disclosure and the cost of debt in the previous year. In general, it supports that the high level of cost of debt in the previous year is a determinant of GHG disclosure, consistent with the cost-benefit

[36] In the main models a lead-lag approach and changes format to control possible endogeneity issues are used.

framework. That is, companies with higher level of debt costs are more likely to bear the extra reporting costs in hope of achieving the perceived benefits of GHG disclosure (e.g., reduction in the cost of debt). Further, GHG disclosure is negatively related to bid-ask spread and return volatility. As predicted by agency theory, inadequate disclosure can increase information asymmetry. Extra reporting reduces the likelihood of companies' undervaluation, extensive return volatility and wide bid-ask spread. This research also finds voluntary GHG disclosure is associated with a lower level of debt cost in the following year of disclosure consistent with the cost-benefit framework.

Using only annual reports as the GHG disclosure document is a limitation of this research. About 6% of the sample companies also disclose GHG information in the CDP questionnaire and media. Also, the sample of this study does not include any non-GHG registered companies that do not disclose GHG information. This might limit the generalizability of the conclusion.

Notwithstanding these limitations, the results of this study suggest that GHG disclosure could positively influence market-based performance of companies. This result could be implemented in the cost-benefit analysis of non-disclosing companies for future disclosure. Also, this study highlights the value relevance of GHG disclosure in financial markets by the significant influence of GHG disclosure on the return volatility and bid-ask spread.

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Chapter 4 Paper 3: Voluntary Greenhouse Gas Emission Disclosure – Impact on Accounting-Based Performance

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Abstract

Using a cost-benefit framework, this research empirically examines the impact of voluntary GHG disclosure by non-GHG registered Australian companies on accounting-based performance. Previous studies suggest that the implementation of "carbon management and reporting" may be associated with the improvement of accounting-based performance by the identification of cost savings opportunities or the introduction of innovation opportunities in products and services (e.g., CDP, 2010; Kolk et al., 2008; Lash & Wellington, 2007). This study applies several proxies of accounting-based performance, such as, return on assets, return on equity and return on sales, to empirically examine the association between voluntary GHG disclosure and accounting-based performance. The level of GHG disclosure is scored through content analysis of the annual reports of sample organisations for the financial years 2009 to 2011. This research highlights that GHG disclosure is positively associated with return on assets in the following year of disclosure. However, it could not provide evidence that a high level of financial performance in the previous year of disclosure is a determinant for the

GHG disclosure decision. To control for potential endogeneity and sample selection issues, this research also employs a binary measure of GHG disclosure in a matched-pair sample. Similarly, it finds that voluntary GHG disclosure is positively associated with return on assets in the subsequent year of disclosure. The findings are consistent with the predictions of the cost-benefit framework. It indicates that companies bear the extra voluntary disclosure costs in order to gain the perceived benefits of voluntary disclosure (e.g., the reduction of operational costs and the growth of revenues stemming from the improvement and innovation in products and services).

Key words: accounting-based performance, voluntary disclosure, GHG emission, content analysis, NGER

4.1 Introduction

Climate change issues and public concerns over perceived problems caused by climate change have led to the emergence of certain environmental regulations. The aim of these regulations is to limit factors causing global warming and therefore prevent the risk of catastrophic climate change (e.g., rising sea levels and severe weather events, see, Cogan, 2006). These regulations focus on the reduction of Greenhouse Gas (GHG) worldwide by adopting strategies such as "carbon pricing" and "technological development" (Simnett et al., 2009).

The Australian *NGER Act 2007* is one regulation that obliges companies with GHG emissions, energy consumption, or production above specified thresholds to report their GHG data to the Australian Government.

In accordance with increased regulation in relation to, and awareness of, climate change issues, companies are under increasing pressure by different groups of stakeholders to disclose their GHG information and to take action to reduce GHG emissions (Kolk et al., 2008). The implementation and communication of carbon reduction strategies may influence their approach to carbon risk management. Also, it may impact "the financial position, performance and changes in financial position" of companies. In a carbon-constrained world the ability to hedge against "physical climate risk", "mitigating regulatory costs", "avoiding expensive litigation and other threats to corporate reputation", "managing climate risk in the supply chain", "investing capital in low-carbon assets" and "innovating around new technology and product opportunities" would impact on the costs and revenue of companies (Lash & Wellington, 2007). However, there is yet no

International Accounting Standard (IAS) that requires the disclosure of GHG information. Despite the lack of an international carbon accounting standard, several companies disclose GHG information to communicate voluntarily their GHG reduction strategies and actions.

The existing empirical literature that examines the impact of GHG disclosure on accounting-based performance is limited. Several studies hypothesise that the implementation of "carbon management and reporting" may be associated with the improvement of financial performance in companies (e.g., CDP, 2010; Kolk et al., 2008; Lash & Wellington, 2007). They argue that companies that prepare GHG disclosure are expected to become more aware of the relation between their carbon footprints and their financial performance. A GHG disclosure strategy would make companies keep track of and assess their carbon emissions. This strategy may help companies to identify potential cost savings through more efficient use of resources and materials. Also, it could help companies to identify operational efficiency improvements and innovation opportunities in products and services. Although, several studies predict that a GHG reduction strategy and ensuing GHG disclosure improves the accounting-based performance of a company (e.g., return on assets; return on equity; return on sales), this association has not been investigated empirically. This research gap is interesting given the growing concerns of investors about the potential "financial risks" and "regulatory costs" related to carbon emissions, as the result of internationally increasing economic significance in carbon markets (Coulton et al., 2012).

The aim of this study is to examine the impact of GHG disclosure on accounting-based performance proxies using a cost-benefit framework. This research uses

several proxies of accounting-based performance and investigates the level of disclosed GHG information in the annual reports of companies. To avoid sample selection problems, it does not limit the sample to large companies.

Content analysis is used to assess the level of GHG disclosure in the annual reports. To undertake content analysis a GHG disclosure index (see Appendix 3) was developed based on the requirements in the *NGER Act 2007* and de Aguiar and Fearfull's (2010) GHG disclosure index (i.e., in accordance with GRI, 2002 and GRI, 2006 guidelines). My GHG disclosure index was used to evaluate the level of GHG disclosure in the reports of non-GHG registered (with the Greenhouse and Energy Data Officer) Australian companies for financial year 2009, 2010 and 2011. The GHG disclosure index has specific decision rules for GHG disclosure scoring and various categories such as: *disclosures on actions and targets to tackle GHG; GHG reduction achievements*; *GHG measures and verifications.*

Each disclosed item of the GHG disclosure index is analysed and scored for sample companies, based on zero for no disclosure, one for disclosure. At the end of scoring, the number of points a company has been awarded represents the level of disclosure. The double counting of the same issue is avoided. Also, in further analyses a binary GHG disclosure scale is used. The sample is split based on the level of voluntary GHG disclosure scores into two groups. Observations above the median GHG disclosure score are recorded as one (high disclosers), while those below the median are recorded as zero. This approach may reduce the possibility of measurement error of GHG disclosure scores.

A pilot study was undertaken to validate the viability and applicability of the scoring process and the disclosure measurement index. The annual reports of 25 companies that disclosed a level of GHG information in the 2008 financial year were randomly selected for the pilot study to avoid a possible data collection bias (Lombard et al., 2002). After the pilot study, a few changes (such as, wording changes, and the exclusion of irrelevant items) were made to the original GHG disclosure index.

Additionally, by the differentiation of "hard" to mimic disclosure items[37] such as *"carbon reduction achievement"*, from "soft" disclosure items such as *"targets to tackle climate change"*, the differences in the nature of GHG disclosure are captured (Clarkson et al., 2008). "Hard" to mimic disclosure items are verifiable and forward-looking (e.g., information about GHG sources, numbers, reporting method, verification, achievement). However, "soft" disclosures are statements that can be easily mimicked by companies (e.g., general statements about aims of a company to reduce GHG emissions) (Clarkson et al., 2008; Hutton et al., 2003). In this research, *disclosure of information about GHG sources, GHG numbers, reporting method, verification, GHG achievement, investment in carbon projects, redesign of process, product and services, utilisation, use of renewable energy* and *carbon sequestration* are categorised as "hard" to mimic disclosure items of the GHG disclosure index. *Targets to tackle GHG, education, support of green*

[37] Similar to Clarkson et al. (2008). They categorised *"governance structure and manage systems", "credibility", "environmental performance indicators",* and *"environmental spending"* as "hard" to mimic environmental disclosure items. A company's disclosures of *"vision and environmental strategy", "environmental profile"* and *"environmental initiatives"* can be easily mimicked with no real environmental commitments and so were categorised as "soft" disclosure items.

institutes and green actions (e.g., green power and earth hour), travel, carbon risk and *others opinions* are considered as "soft" disclosure items.

The reliability of the content analysis is examined by using a test-retest of coding reports of a randomly selected sample of companies on a different time (three month interval) by the same coder. The correlation of disclosure scores between different occasions is high and divergence is low.

ANOVA test results indicate that the level of GHG disclosure is significantly different within each industry.[38] For the empirical tests, industry is not used as a control variable. A relative industry scaled disclosure score is constructed to control the effect of industry. The scaled GHG score is defined as the primary GHG disclosure score minus the company's average industry disclosure score. This allows more meaningful comparisons between companies amongst different industries.

Empirical models are designed in line with the previous financial and environmental disclosure studies (e.g., Clarkson et al., 2011). Multiple regression analyses are run in SPSS. To control for endogeneity and causality, two-stage least squares regression models are used.

To further control for possible self-selection and endogeneity, this research employs a matched-pair sample. For each sample company that reports a level of GHG information, a matched company that does not disclose GHG information is considered. The matched pairs are similar in respect of industry, size, leverage and whether they are not subject to the *NGER Act 2007*. The GHG disclosure status of

[38] However, the ANOVA test result presents that the level of GHG disclosure is not significantly different within each year of the investigation.

the sample companies represents GHG disclosure values in the matched-pair sample.

The variables' values are collected from the Datastream Advance database, Sirca, Thomson Reuters Tick History and the annual reports of the sample companies.

In brief, this research highlights that there is a positive association between the GHG disclosure (independent variable) and return on assets (dependent variable) in the following year of disclosure. Also, it finds a similar result in the matched-pair sample. GHG disclosing companies achieve a higher level of return on assets in the subsequent year of disclosure. Consistent with the cost-benefit framework, companies bear the extra reporting cost in order to gain benefits from the voluntary reporting process.

It is important to find out the accounting-based impact of voluntary GHG disclosure, as it provides empirical evidence in regards to any possible relationship between accounting-based performance and GHG disclosure. Further, this study gives non-GHG disclosing companies insights into the incentives for voluntary GHG disclosure.

The rest of the paper is organised as follows. The second section describes the related research and hypotheses development. The third section discusses the sample and methodology. The fourth section presents the results. A summary and conclusions of the research are outlined in the final section.

4.2 Related research and hypotheses development

Despite the significance of climate change issues, there are not many empirical studies available about how "carbon management and reporting" impact on accounting-based performance. The available studies examined the consequence of voluntary GHG disclosure from a market-based aspect of financial performance. These studies examine the value relevance of voluntary GHG disclosure. For example, Ziegler et al. (2009) find that there is a relationship between the level of GHG disclosure and return (stock performance). They demonstrate that a higher level of GHG disclosure in periods and regions where there is less pressure on GHG issues causes negative abnormal returns. However, companies with a proactive response to climate change issues in periods and regions where there are more climate change considerations achieve positive abnormal returns. Griffin et al. (2010) examine the association between the level of carbon emission and stock value from a market-based performance perspective. They find a negative association between the level of GHG emissions and stock performance. In an event study, they highlight that market significantly and negatively responds to the GHG disclosure (intensity). They provide evidence that investors care about GHG disclosure. Matsumura et al. (2011) similarly show a negative relation between the firm value of S&P500 companies and the total carbon footprint disclosed in the Carbon Disclosure Project (CDP) questionnaire. Delmas and Nairn-Birch (2010) also find a negative impact between the total carbon footprint and Tobin's Q.

On the other hand, since the 1970 several studies in the environmental accounting and environmental management literature have analysed whether the

implementation of environmental strategies and subsequent disclosure improves accounting-based performance (e.g., Clarkson et al., 2008; Hart et al., 1996)[39]. According to Ambec and Lanoie (2008) the use of environmental plans and strategies could help to recognise operational inefficiencies. The implementation of these strategies ultimately would reduce levels of material, energy and labour costs. They could also positively impact on the revenue elements of accounting-based performance. For example, a company with strategic environmental plans is more likely to advertise its point of difference in relation to environmental matters, possibly providing access to different markets.

Several studies provide empirical findings to support these ideas and they examine whether it pays to be green (e.g., Al-tuwaijri et al., 2004; Hart et al., 1996; Pogutz & Russo 2009; Clarkson et al., 2011). For example, Clarkson et al. (2011) apply longitudinal data from the four most polluting industries to analyse whether the implementation of a proactive environmental strategy in a company leads to a subsequent financial improvement. They find that companies with superior environmental performance have better financial performance (e.g., profitability; cash flow; Tobin's Q). Pogutz and Russo (2009) also demonstrate that good environmental performance positively affects finanical performance (e.g., Tobin's Q; return on assets; return on equity; return on sales). Moreover,

[39] In the literature two perspectives describe whether "it pays to be green". The first perspective (as disscussed) refers to the positive impact of the improved environmental performance on the economic performance (e.g., Cronin et al., 2011). According to the second viewpoint, the development of environmental strategies resources to be allocated, which causes a significant cost rise. As a result, managers' attention would be distracted from the main goal of business, which is the maximisation of profit (Friedman, 1970).

Earnhart and Lizal (2011) show that the lower level of air pollutants prompts a better financial performance by lowering costs.[40]

Currently, the CDP (2010) and a number of researchers use a similar approach to advocate the beneficial role of "carbon management and reporting". For example, Kolk et al. (2008) argue that the preparation process for a GHG report would increase the awareness of the relationship between carbon footprints and the financial performance of companies. A GHG disclosure strategy makes companies keep track and assess[41] their level of GHG emissions. This strategy could help companies to identify the opportunities of cost savings through more efficient use of resources and materials. For example, BP, which has implemented GHG reductions targets, claims to have saved $650 million by reducing energy waste (The Natural Edge Project, 2005). A GHG management and disclosure strategy may cause an improvement in the operational performance of a company through the identification of the opportunities of cost savings, the possibilities of reduction in potential business risk and the innovation opportunities for products and services (Lash & Wellington, 2007).

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[40] The findings vary. A number of studeis find that it pays to be green (as discussed). However, several studies show no significant or a negative relationship between environmental performance and financial performance (e.g., Cordeiro & Sarkis, 1997; Jaggi & Freedman, 1992). For instance, Link and Naveh (2006) find that better environmental performance, as a result of the implementation of ISO 14001 does not nessesarily cause better financial performance. Delmas and Nairn-Birch (2010) also find that the total carbon footprint has a positive impact on the return of assets (ROA) of about 1,000 US firms. The equivocal relationship between environmental performance and financial performance could due to inconsistency in the measurement of variables or the ignorance of major control variables (e.g., the degree of environmental regulation).

[41] The measurement process of environmental impact alone reveals a number of ignored issues and it leads to enormous opportunities. According to Porter and Linde (1999) *"A large producer of organic chemicals ... hired a consultant to explore waste reduction opportunities in its 40 waste streams. A careful audit uncovered 497 different waste streams. The company had been wrong by a factor of more than ten"* for the estimation of its waste streams.

In summary, the existing studies on the perceived economic consequences of GHG disclosure examine the market-based aspects of financial performance. Although several studies predict that a GHG reduction strategy and disclosure improves the accounting-based performance of a company (e.g., Kolk et al., 2008), this association has not been investigated empirically. This research examines the impact of GHG disclosure on accounting-based performance. It applies a comprehensive approach by using several proxies of accounting-based performance, such as, return on assets, return on equity and return on sales.

The allocation of resources for a voluntary disclosure is a controversial decision. A cost-benefit framework can be used to demonstrate the logic for additional reporting beyond the requirements of regulation. The cost-benefit framework is based on economic principles and competitive analysis. It explains the discretionary approach of trade-off between the costs and the benefits of disclosure (Garcia-Meca et al., 2005; Verrecchia, 1983, 1990, 2001). As reporting information is costly, providing extra information occurs when its benefits outweigh its costs. As discussed previously, the possible benefits of voluntary GHG disclosure strategy from an accounting perspective could be the reduction of operational costs (e.g., energy and material costs) and the growth of revenues stemming from the improvement and innovation in products and services. The preparation process of GHG disclosure is the cost of GHG reporting.[42]

If according to cost-benefit framework the the reduction of operational costs and the growth of revenues stemming from the innovation in products and services

[42] As the sample firms are not subject to the *NGER Act 2007* for the low level of GHG emission, the possible legitimacy costs are not controlled in this research.

motivates companies to disclose GHG information, we should observe an improvement in accounting-based performance, for disclosing companies in future. Therefore, the main hypothesis (*H2*) examines the impact of GHG disclosure on accounting-based performance in the subsequent year of disclosure by using a cost-benefit framework. Return on assets (ROA), return on equity (ROE) and return on sales (ROS) are applied as the proxies of accounting-based performance. It is assumed that companies with more verifiable and forward-looking GHG disclosure items and a higher level of GHG disclosure would achieve higher accounting returns in the year following disclosure. A robust GHG disclosure strategy could provide the identification of cost savings opportunities or the introduction of innovation opportunities, which ultimately would increase net income.

Consistent with prior literature (e.g., Clarkson et al., 2011), it is also important to control the causality effect of accounting-based performance in the previous year on GHG disclosure. According to resource-based theory, companies with greater financial resources and returns are more likely to pursue environmental strategies and reporting (Russo & Fouts, 1997). In other words, environmental disclosure and financial success are interrelated (Clarkson et al., 2011). Thus, companies with better accounting-based performance are more likely to be involved in voluntary GHG disclosure. Therefore, The other hypothesis (*H1*) predicts that a high level of return in the previous year could be a determinant of GHG reporting. This research examines if the sample companies with a higher level of profitability are more likely to disclose GHG voluntarily.

A lead-lag method in the model is used to avoid potential endogeneity. The following hypotheses are subsequently developed:

H1: Voluntary GHG disclosure is positively associated with the accounting-based performance in the previous year.

H2: Accounting-based performance is positively associated with voluntary GHG disclosure.

4.3 Sample and methodology

4.3.1 Selection of sample

Voluntary GHG disclosure is more common in areas with more ambitious climate policies (Reid & Toffel, 2009). The existence of a GHG regulation is a driving factor for voluntary GHG disclosure (Ziegler et al., 2009). Australia introduced GHG regulation at a national level in 2007. The sample is chosen from Australian listed companies that are not mandated to disclose GHG information by the *NGER Act 2007*; however, they have chosen to voluntarily report GHG information in their annual reports. All the Australian Stock Exchange (ASX) listed companies that report GHG information, despite not being subject to the *NGER Act 2007* between financial year 2009 and financial year 2011, form the sample.

This research uses annual reports as the source of GHG disclosure because they are a consistent means of communication. It collects annual reports from the Aspect Annual Reports Online database. Of 2,317 ASX listed companies on 29 February 2012, 174 report GHG information in their annual reports for the study period while they are not subject to the *NGER Act 2007*. Of the 174 sample

companies, 28 are not considered in the study because their reports are missing significant data or the companies do not have any activities in Australia.

Table 11 shows the year distribution of the sample. Consistent with the findings of Cowan and Deegan (2011), there is a growing trend in the number of companies disclosing GHG information. The level of disclosure rises from 70 companies in 2009 to 126 companies in 2011.

Table 11: Sample distribution by year

Year	Frequency	Percent
2009	70	24.1
2010	94	32.4
2011	126	43.4
Total	290	100

Table 12 demonstrates the sample distribution by industry on the basis of the Global Industry Classification Standard (GICS). Consistent with predictions, the "Materials" and "Energy" industries have the largest proportion of companies in the sample (respectively 15.9% and 14.1%).

Table 12: Sample distribution by industry

Industry	Frequency	Percent
Pharmaceuticals, Biotechnology & Life Sciences	1.0	0.3
Telecommunication Services	1.0	0.3
Consumer Services	3.0	1.0
Semiconductors & Semiconductor Equipment	3.0	1.0
Technology Hardware & Equipment	3.0	1.0
Automobile & Components	6.0	2.1
Health Care Equipment & Services	6.0	2.1
Consumer Durables & Apparel	7.0	2.4
Food Beverage & Tobacco	7.0	2.4
Media	9.0	3.1
Retailing	9.0	3.1
Software & Services	15.0	5.2
Diversified Financials	16.0	5.5
Real Estate	20.0	6.9
Utilities	23.0	7.9
Capital Goods	37.0	12.8
Commercial & Professional Services	37.0	12.8
Energy	41.0	14.1
Materials	46.0	15.9
Total	290	100

4.3.2 Method

Content analysis is employed to evaluate the GHG disclosure of non-GHG registered companies. A GHG disclosure index (see Appendix 3) is the tool for content analysis. The GHG disclosure index is based on the requirements of the *NGER Act 2007* and the GRI (2002) and GRI (2006) guidelines. This GHG index has different aspects of GHG disclosure (e.g., "*GHG reduction achievement", "GHG assurance", and "actions to tackle climate change"*). Each disclosed item of the GHG disclosure index is analysed and scored for sample companies, based on zero for no disclosure, one for disclosure. At the end of scoring, the number of points a company has been awarded represents the level of disclosure. The differences in the nature of GHG disclosure are controlled by evaluating the context of disclosed items. This research differentiates the statements that could be easily mimicked by companies (e.g., *"the initiative to use energy and other resources efficiently"*) from verifiable forward-looking statements (e.g., *"the*

*company reduced its carbon emissions, with Scope 1 and 2 emissions of 7.5 kilo tonn*es"). On the basis of the number of disclosed items (within the range of GHG disclosure index) this research estimates the level of disclosure. To investigate whether the level of GHG disclosure is significantly different among different industries, an ANOVA test is run. The findings show that the level of GHG disclosure is significantly different within each industry.[43] Therefore, a scaled score for the level of GHG disclosure is used. The primary GHG disclosure score is deducted by the average industry GHG disclosure score to get the scaled GHG score.

To further control self-selection issues and possible endogeneity, this research uses a matched-pair sample. For each sample company that discloses a level of GHG information, it considers a matched company that does not report GHG information. The matched pairs are similar in respect of industry, size, leverage and whether or not they are subject to the *NGER Act 2007*.

4.4 Empirical models and variable definitions

In order to investigate the first hypothesis, this research employs the following cross-sectional regression model:

$$GHGD_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \beta_2 AGE_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 EV_{i,t-1} + \beta_6 CAPIN_{i,t-1} + \varepsilon \quad (7)$$

where, $GHGD_{i,t,}$ dependent variable, is the industry scaled level of voluntary GHG disclosure. It is equal to GHG disclosure status in the matched-pair sample. The

[43] However, the ANOVA test result presents that the level of GHG disclosure is not significantly different within each year of the investigation.

independent variable $ROA_{i,t-1}$ *is* return on assets ratio at year *t*-1. The model includes a number of control variables, such as: *AGE, SIZE, LEV, EV,* and *CAPIN*[44] similar to Clarkson et al. (2011). These variables are respectively age of company, firm size, leverage, enterprise value and capital intensity. A lead-lag method to tackle potential endogeneity issues is applied.

First, the GHG disclosure score is investigated through content analysis of the sample annual reports. In the matched-pair sample GHG disclosure is equal to one for disclosing companies and equal to zero for non-disclosing matched companies. It is predicted that companies with a higher level of return on assets in the previous year of GHG disclosure are more likely to disclose GHG information. These companies probably could afford the extra reporting cost beyond the requirements (resource-based theory). Positive coefficient on $ROA_{i,t-1}$ would support the first hypothesis.

Return on assets (ROA) is measured as total operating income divided by average total assets. It is expected that companies with newer equipment possibly have a superior environmental performance (Clarkson et al., 2008). *AGE* is measured as a ratio of net properties, plant and equipment divided by the gross properties, plant and equipment at the end of the financial period. Firm size is equal to the total asset at the end of the financial year. According to the disclosure literature, voluntary disclosure is more common among larger companies (e.g., Clarkson et al., 2011). Leverage, *LEV*, is defined as total debt divided by total assets at the end

[44] In our earlier regression models, we controled the effect of industry, year and the interaction between them as control variables. However, their coefficients were insignificant and the level of adjusted R^2 reduced significantly by their inclusion.

of the financial year. Highly leveraged companies possibly are under greater pressure by debtors to release information. *EV*, enterprise value, is measured as market capitalisation plus debt and preferred shares, divided by beginning of period total assets. *CAPIN,* capital intensity, is measured as capital expenditures divided by beginning of period total assets. Companies with a higher level of *CAPIN* are expected to have newer equipment and might have a better environmental performance (Clarkson et al., 2011). It is expected that the coefficients of all control variables are positive.

In order to examine the second hypothesis, the following cross-sectional regression models are used:

$$\Delta ROA_{i,t+1}=\beta_0+ \beta_1 GHGD_{i,t}+ \beta_2 \Delta ROA_{i,t}+ \beta_3 \Delta GRTH_{i,t}+ \beta_4 \Delta Size_{i,t} + \beta_5 \Delta EV_{i,t} + \beta_6 \Delta RDIN_{i,t} + \varepsilon \quad (8)$$

$$\Delta ROE_{i,t+1}=\beta_0+ \beta_1 GHGD_{i,t}+ \beta_2 \Delta ROE_{i,t}+ \beta_3 \Delta GRTH_{i,t}+ \beta_4 \Delta Size_{i,t} + \beta_5 \Delta EV_{i,t} + \beta_6 \Delta RDIN_{i,t} + \varepsilon \quad (9)$$

$$\Delta ROS_{i,t+1}=\beta_0+ \beta_1 GHGD_{i,t}+ \beta_2 \Delta ROS_{i,t}+ \beta_3 \Delta GRTH_{i,t}+ \beta_4 \Delta Size_{i,t} + \beta_5 \Delta EV_{i,t} + \beta_6 \Delta RDIN_{i,t} + \varepsilon \quad (10)$$

where, $\Delta ROA_{i,t+1}$, $\Delta ROE_{i,t+1}$ *and* $\Delta ROS_{i,t+1}$ dependent variables, are respectively changes in return on assets, return on equity and return on sales from year t+1 to t. The independent variable is $GHGD_{i,t}$. The models include a number of control variables, such as: $\Delta ROA_{i,t}$, $\Delta ROE_{i,t}$, $\Delta ROS_{i,t}$, $\Delta GRTH_{i,t}$, $\Delta Size_{i,t}$, $\Delta EV_{i,t}$ and $\Delta RDIN_{i,t}$, similar to Clarkson et al. (2011). These variables are respectively changes in return on asset, return on equity and return on sales, sales growth, firm size, enterprise value and research and development (R&D) intensity from year t-

1 to *t*. A lead-lag method is applied to tackle potential endogeneity issues. Further, the change format in the models could reduce the possibility of potential endogeneity problems and increase the power of models. To control for endogeneity and self-selection, a matched-pair sample is used.

Return on equity (ROE) is equal to total net income (available to shareholders) divided by average total equity. Return on sales (ROS) is measured by total operating income divided by total revenue. *RDIN*, R&D intensity, is measured as R&D expenses divided by the beginning of period total assets. *GRTH*, sales growth, is measured by change in sales divided by the beginning of period sales.

It is expected that the changes in accounting-based performance measures in the following year of GHG disclosure (*ROA, ROE* and *ROS*) increases. Positive coefficients on *GHGD* would support hypothesis 2. It is also expected that all the control variables have a positive coefficient.

The values for the variables are obtained from the annual reports of companies and the Datastream Advance database. In a pilot study the viability and applicability of the scoring process and the disclosure measurement index is tested. The level of GHG disclosure is estimated by scoring the sample annual reports based on the disclosure index.[45]

4.5 Results

4.5.1 Summary of GHG disclosures

[45] The stability of the content analysis is tested by running a test-retest of a randomly chosen sample of companies with three month intervals. The correlation of disclosure scores on the different occasions is high and divergence is low. This indicates that GHG disclosure scores have significant reliability (Milne & Adler, 1999).

A GHG disclosure index is used to estimate the level of GHG disclosure in the annual reports of the sample companies. Companies disclose a diverse level of GHG information. For example, 42.3% and 24.2% of the sample companies respectively disclose one and two pieces of GHG information voluntarily. The average level of GHG disclosure is about 2.128. About 8.2% of the companies release between six to nine pieces of GHG information. GHG disclosures are mostly qualitative data. The "*Actions to tackle GHG"* (59.91%), followed by *"targets to tackle GHG"* (19.83%) phases of the disclosure index are the two most common categories of disclosure. The least reported phase is "*GHG measurement and verification"* (2.16%). Only 6.25% of the total disclosure score relates to the "*achievement"* category of the GHG disclosure.

Items such as the *"design of low carbon footprint products and emission reduction consultancy services"* (23.38%) and "e*nergy conservation"* (16.91%), as well as the "*support of green actions"* (8.99%) are the most reported items within the "*actions to tackle GHG"* phase of disclosure. Half of the disclosure in *"targets to tackle GHG"* category*,* the second most reported category of GHG, is about "*using energy and other resources efficiently"*. About 30.61% of the "*targets to tackle GHG"* phase of disclosure is in regards to "*the initiatives to reduce carbon footprint"*.

4.5.2 Descriptive statistics

The dependent variables are the level of voluntary GHG disclosure, return on assets, return on equity and return on sales. The independent variables are the return on assets in the previous year of GHG disclosure and the level of GHG disclosure at the current year. In the multiple regression analyses, this research considers a number of control variables, such as age of company, firm size, leverage, enterprise value, capital intensity, sales growth and R&D intensity. Table 13 shows the descriptive statistics for the independent and control variables.

Table 13: Descriptive statistics

Variable	Minimum	Maximum	Mean	Std. Deviation
$\Delta ROA_{i,t}$	- 0.30	0.34	- 0.00	0.08
$\Delta Size_{i,t}$	- 7.81	2.23	0.04	0.61
$\Delta GRTH_{i,t}$	- 1.92	16.47	0.14	1.45
$\Delta RDIN_{i,t}$	- 0.58	0.11	- 0.03	0.10
$\Delta EV_{i,t}$	- 2.73	3.32	- 0.08	0.75
EV	0.31	5.30	1.41	1.11
SIZE	2,213	5,606,900	325,198	731,466
AGE	0.15	0.88	0.56	0.17
CAPIN	0.01	0.84	0.11	0.15
LEV	0.01	0.65	0.21	0.16
TotalGHGD	1.00	9.00	2.13	1.70
SoftGHGD	-	6.00	0.85	0.90
HardGHGD	-	6.00	1.23	1.20
ROA	- 0.14	0.27	0.04	0.09

The average return on assets in the previous year of GHG disclosure is 0.04. Average *AGE* highlights that sample companies have a medium age. The average of firm size is 325,198 (thousand $), very different from *SIZE* minimum and maximum (2,213 and 5,606,900 thousand $). The average level of GHG disclosure is about 2.13. Sample companies disclose from at least one category of disclosure index and at most from nine categories. The mean *LEV*, 0.21, shows that on average sample companies are not highly dependent on debts. Firm size, enterprise value and capital intensity measures are transformed to natural

logarithm of these variables to meet multiple regression analysis normality assumptions. Departure from normality is not significant for any of the variables.

Table 14 presents the Pearson correlations between variables. In panel A, it demonstrates the correlations for determinant proxies. It highlights that *GHGD* (the dependent variable in the first model) has the most significant relation with *LnSIZE* (0.360). Panel B presents the Pearson correlations for accounting-based performance variables. In accordance with the hypotheses, *GHGD* (the independent variable in the second model) is positively correlated with the dependent variables (*ROA*, *ROE*, *ROS*), but not significantly. This table provides evidence that the independent and control variables in both panels are not highly correlated to each other.

Table 14: Pearson correlations

Panel A: Pearson correlations for determinants

Variables	AGE	LEV	ROA	LnEV	LnSIZE	LnCAPIN	HardGHGD	TotalGHGD	SoftGHGD
AGE	1.00	-0.07	-.210**	0.09	0.01	-0.05	0.11	0.12	0.04
LEV	-0.07	1.00	.370**	-0.09	.371**	-.325**	0.09	.126*	0.09
ROA	-.210**	.370**	1.00	.247**	.337**	-.197**	0.08	.144*	0.10
LnEV	0.09	-0.09	.247**	1.00	-0.07	.242**	0.07	0.02	-0.04
LnSIZE	0.01	.371**	.337**	-0.07	1.00	-.179**	.249**	.360**	.268**
LnCAPIN	-0.05	-.325**	-.197**	.242**	-.179**	1.00	-0.03	-0.01	0.04
HardGHGD	0.11	0.09	0.08	0.07	.249**	-0.03	1.00	.795**	0.08
TotalGHGD	0.12	.126*	.144*	0.02	.360**	-0.01	.795**	1.00	.643**
SoftGHGD	0.04	0.09	0.10	-0.04	.268**	0.04	0.08	.643**	1.00

Panel B: Pearson correlations for accounting-based performance proxies

Variables	$\Delta ROA_{i,t+1}$	$\Delta ROA_{i,t}$	$\Delta Size_{i,t}$	$\Delta EV_{i,t}$	$\Delta RDIN_{i,t}$	$\Delta GRTH_{i,t}$	TotalGHGD	$\Delta ROE_{i,t}$	$\Delta ROS_{i,t}$	$\Delta ROE_{i,t+1}$	$\Delta ROS_{i,t+1}$
$\Delta ROA_{i,t+1}$	1.0	.679**	0.1	0.0	0.1	-0.1	.169*				
$\Delta ROA_{i,t}$	.679**	1.0	0.0	-0.1	.503**	-.180*	0.1				
$\Delta Size_{i,t}$	0.1	0.0	1.0	-0.1	-.555**	0.0	0.0	-.244**	-0.1	-.241**	0.0
$\Delta EV_{i,t}$	0.0	-0.1	-0.1	1.0	.404**	0.0	0.0	-0.1	-0.1	-0.1	-.158*
$\Delta RDIN_{i,t}$	0.1	.503**	-.555**	.404**	1.0	-0.2	0.2	.361*	.372*	0.0	-0.1
$\Delta GRTH_{i,t}$	-0.1	-.180*	0.0	0.0	-0.2	1.0	-0.1	.155*	-0.1	-0.1	0.1
TotalGHGD	.169*	0.1	0.0	0.0	0.2	-0.1	1.0	0.0	0.0	0.1	0.0
$\Delta ROE_{i,t}$			-.244**	-0.1	.361*	.155*	0.0	1.0	.206**	.402**	0.1
$\Delta ROS_{i,t}$			-0.1	-0.1	.372*	-0.1	0.0	.206**	1.0	0.1	.552**
$\Delta ROE_{i,t+1}$			-.241**	-0.1	0.0	-0.1	0.1	.402**	0.1	1.0	.319**
$\Delta ROS_{i,t+1}$			0.0	-.158*	-0.1	0.1	0.0	0.1	.552**	.319**	1.0

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

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

4.5.3 Multiple regression analysis

SPSS software is used to test the multiple regression analyses. The following tables indicate the results of analyses for determinant and accounting-based performance models.

Table 15 shows the result of the first hypothesis. It provides evidence regarding the impact of the return on assets in the previous year of disclosure on GHG disclosure decision (determinant factor). Contrary to the prediction of H1, the estimated coefficient for ROA is not significant for any of the disclosure models. Therefore, the findings do not support the first hypothesis. In other words, this research could not provide evidence that a high level of financial performance in the year prior to disclosure is a determinant of GHG disclosure.[46]

Table 15: Determinants of voluntary GHG 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	-3.757	-5.970	0.000	-2.082	-4.377	0.000	-1.374	-3.695	0.000
LnEV	0.034	0.250	0.803	0.129	1.271	0.205	-0.075	-0.942	0.347
LnCAPIN	0.083	1.038	0.300	0.006	0.096	0.924	0.074	1.563	0.119
LnSIZE	0.298	5.878	0.000	0.154	4.006	0.000	0.127	4.232	0.000
ROA	0.950	0.755	0.451	-0.027	-0.028	0.977	0.509	0.685	0.494
LEV	0.020	0.032	0.975	0.063	0.135	0.892	0.027	0.074	0.941
AGE	1.089	1.973	0.050	0.617	1.478	0.141	0.278	0.852	0.395
Adjusted R Square	0.128			0.057			0.063		
F-stat	8.041			3.922			4.251		

Table 16 demonstrates the analysis of the second model in respect of the level of voluntary GHG disclosure and accounting-based performance. Panel A presents the consequence of GHG disclosure on return on assets ratio. The adjusted R^2 in this panel ranges from 0.454 to 0.447, which is comparable to prior disclosure studies (e.g., Guo et al., 2004). All control variables have the expected direction

[46] The interaction effects between environmental performance (*AGE*) and *ROA, LEV* and *SIZE* are also examined. For example, I investigate whether a better environmental performance for companies with the higher return on assets is associated with GHG disclosure. The findings show no significant interaction effect in the determinant regression models.

except for changes in R&D. The coefficients of $\Delta ROA_{i,t,}$ and $\Delta EV_{i,t}$ are significant. As predicted in the second hypothesis, the level of GHG disclosure is positive and significant for "hard" to mimic disclosure items and total GHG disclosure models at 90% significance level. This result indicates that a more verifiable and forward-looking nature of GHG disclosure and a higher level of GHG disclosure is associated with a higher level of return on assets in the subsequent year. This result is consistent with the cost-benefit framework. Despite the cost of providing extra reporting, companies that implement carbon management strategies and disclosure achieve a better accounting-based performance.

Table 16: Voluntary GHG disclosure and accounting-based performance

Panel A : GHG voluntary disclosure and return on asset (ROA)									
	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	0.055	10.176	0.000	0.056	10.250	0.000	0.056	10.184	0.000
$\Delta ROA_{i,t}$	0.982	15.256	0.000	0.987	15.347	0.000	0.987	15.264	0.000
$\Delta Size_{i,t}$	0.006	0.741	0.459	0.005	0.657	0.512	0.007	0.854	0.394
$\Delta RDIN_{i,t}$	-0.039	-0.360	0.719	-0.034	-0.316	0.752	-0.026	-0.238	0.812
$\Delta EV_{i,t}$	0.013	1.871	0.062	0.013	1.882	0.061	0.012	1.818	0.070
$\Delta GRTH_{i,t}$	0.002	0.365	0.716	0.001	0.292	0.771	0.001	0.274	0.784
GHGD	0.007	1.884	0.061	0.008	1.755	0.080	0.002	0.418	0.676
Adjusted R Square	0.454			0.453			0.447		
F-stat	40.987			40.843			39.949		
Panel B: GHG voluntary disclosure and return on equity (ROE)									
	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	-0.015	-1.110	0.268	-0.014	-0.994	0.321	-0.013	-0.978	0.329
$\Delta EV_{i,t}$	-0.023	-1.350	0.178	-0.023	-1.331	0.184	-0.023	-1.378	0.169
$\Delta RDINi,t$	-0.064	-0.235	0.814	-0.051	-0.185	0.854	-0.030	-0.110	0.912
GHGD	0.015	1.588	0.113	0.016	1.400	0.163	0.001	0.051	0.960
$\Delta ROE_{i,t}$	0.355	6.480	0.000	0.356	6.498	0.000	0.355	6.454	0.000
$\Delta Size_{i,t}$	-0.032	-1.588	0.113	-0.033	-1.643	0.101	-0.030	-1.502	0.134
$\Delta GRTH_{i,t}$	0.017	1.658	0.098	0.017	1.617	0.107	0.016	1.588	0.114
Adjusted R Square	0.144			0.142			0.136		
F-stat	9.093			8.982			8.597		
Panel C: GHG voluntary disclosure and return on sale (ROS)									
	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	-0.003	-0.735	0.463	-0.003	-0.725	0.469	-0.003	-0.762	0.446
$\Delta Size_{i,t}$	0.001	0.198	0.843	0.001	0.186	0.852	0.002	0.267	0.790
GHGD	0.001	0.304	0.761	0.001	0.270	0.787	0.004	0.958	0.339
$\Delta EV_{i,t}$	-0.007	-1.282	0.201	-0.007	-1.281	0.201	-0.007	-1.279	0.202
$\Delta RDIN_{i,t}$	-0.020	-0.235	0.814	-0.019	-0.227	0.821	-0.021	-0.251	0.802
$\Delta ROS_{i,t}$	0.335	9.791	0.000	0.335	9.803	0.000	0.332	9.683	0.000
$\Delta GRTH_{i,t}$	0.006	1.936	0.054	0.006	1.954	0.052	0.006	1.926	0.055
Adjusted R Square	0.247			0.247			0.249		
F-stat	16.783			16.778			16.969		

Panel B and C includes the second and third proxy of the accounting-based performance measure, return on equity and return on sales. Although the levels of *F*-stat and adjusted R^2 in panels B and C are satisfactory, the coefficients of GHGD are not significant. The findings do not support the second and third proxy of accounting-based performance. This research cannot provide any evidence that voluntary GHG disclosure is positively associated with return on equity and return on sales in the subsequent year of disclosure.

Potential self-selection issues and endogeneity are controlled further in a matched-pair sample. For each sample company that discloses a level of GHG information, this research finds a matched company. The matched company is not subject to the *NGER Act 2007* and it does not report any GHG information in the company reports. The matched-pairs are from the same industries and they have rather similar size and leverage. Table 17 shows the mean statistics of variables for the matched-pairs. *GHG* highlights the GHG disclosure status of the sample companies in the matched-pair sample.

Table 17: The mean statistics for the matched-pair sample on the basis of GHG disclosure status

GHG	SIZE	EV	AGE	CAPIN	LEV	ROA
0	313,155.37	1.16	0.51	0.12	0.21	0.023
1	325,197.68	1.41	0.57	0.11	0.21	0.038
Total	319,176.52	1.28	0.54	0.11	0.21	0.030

Table 18 demonstrates a comparison of average *ROA* for the matched-pairs sample in three subsequent years. The patterns for before and after the GHG disclosure period are both in the same direction, predicted by the first and second hypotheses. It shows that the average *ROA* for disclosing companies in year *t*-1 is 3.8%, the corresponding figure for non-disclosing companies is 2.3%, and the

difference in the average is 1.5%, which is significant. Therefore, the pattern is in line with the statement that companies with a higher level of return on assets are more likely to disclose GHG information voluntarily (resource-based theory). The statistics on this table also highlights that the *ROA* differences between pairs are significantly higher (1.8%) for both year *t* and *t*+1. These findings imply that disclosing companies achieve a higher level of *ROA* in the subsequent years of disclosure, consistent with the second hypothesis.

Table 18: Mean statistics of ROA for the matched-pairs sample in three years

GHG	t-1	t	t+1
1	0.038	0.046	0.048
0	0.023	0.028	0.030
Diff	0.015	0.018	0.018
Sig.	0.002	0.006	0.004

Table 19 presents the findings of binary regression for GHG determinants model within the matched-pair sample. The results of -2 log likelihood and Hosmer and Lemeshow tests imply a model fit in the binary regression analysis. Similar to the previous findings, *ROA* coefficient is not significant. The matched-pair sample could not provide evidence that a high level of return on assets in the previous year of disclosure is a determinant of GHG disclosure.

Table 19: Determinants of voluntary GHG disclosure in the matched-pair sample

	Coefficient	Sig.
AGE	1.662	0.002
LEV	- 0.624	0.294
ROA	1.401	0.179
LnSIZE	0.093	0.088
LnCAPIN	- 0.078	0.281
LnEv	0.319	0.031
Intercept	- 2.089	0.001
-2 Log likelihood	780.352	
Hosmer and Lemeshow Test	0.158	

Table 20 shows the findings of the second model in the matched-pair sample. Panel A presents the consequence of GHG disclosure on return on assets ratio. The matched-pair sample provides stronger evidence than the primary findings regarding the consequence of voluntary GHG disclosure on *ROA*. It indicates that

Table 20: Voluntary GHG disclosure and accounting-based performance in the matched-pair sample

Panel A : GHG voluntary disclosure and return on asset (ROA)			
	Total GHG disclosure score		
	Coefficient	t-stat	Sig.
Intercept	0.038	8.699	0.000
GHG	0.016	2.692	0.007
$\Delta ROA_{i,t}$	0.982	25.122	0.000
$\Delta GRTH_{i,t}$	0.000	0.520	0.604
$\Delta Size_{i,t}$	0.001	0.211	0.833
$\Delta EV_{i,t}$	0.003	0.787	0.432
$\Delta RDIN_{i,t}$	0.028	0.394	0.694
Adjusted R	0.525		
F-stat	107.623		
Panel B: GHG voluntary disclosure and return on equity (ROE)			
	Total GHG disclosure score		
	Coefficient	t-stat	Sig.
Intercept	-0.015	-1.341	0.181
GHG	0.003	0.206	0.837
$\Delta GRTH_{i,t}$	0.000	0.547	0.584
$\Delta Size_{i,t}$	-0.041	-2.617	0.009
$\Delta EV_{i,t}$	0.000	-0.037	0.971
$\Delta RDIN_{i,t}$	-0.263	-1.392	0.165
$\Delta ROE_{i,t}$	0.326	8.904	0.000
Adjusted R	0.136		
F-stat	16.179		
Panel C: GHG voluntary disclosure and return on sale (ROS)			
	Total GHG disclosure score		
	Coefficient	t-stat	Sig.
Intercept	-0.007	-0.369	0.713
GHG	0.000	0.012	0.990
$\Delta GRTH_{i,t}$	-0.001	-0.942	0.351
$\Delta Size_{i,t}$	-0.011	-0.358	0.722
$\Delta EV_{i,t}$	-0.017	-0.873	0.387
$\Delta RDIN_{i,t}$	-0.135	-0.870	0.388
$\Delta ROS_{i,t}$	0.310	3.423	0.001
Adjusted R	0.118		
F-stat	2.334		

GHG disclosing companies have a higher level of *ROA* in the subsequent year of disclosure at 95% significance level. This suggests that companies with carbon management and voluntary disclosure would achieve the perceived benefits of disclosure. Panel B and C includes return on equity and return on sales in the matched-pair sample. Although the coefficients of GHG are positive in both models, they are not significant. Consistent with the previous findings, the analyses do not support the second and third proxy of accounting-based performance. This research cannot provide any evidence that voluntary GHG disclosure is positively associated with return on equity and return on sales in the subsequent year of disclosure.

4.5.4 Sensitivity analysis

This research runs multiple regression analyses with binary scores of GHG disclosure to investigate the consistency of the findings. The sample is split with respect to its voluntary GHG disclosure scores into two groups. The GHG disclosure score above the median value is recorded as one and the rest as zero. The logistic regression analysis findings are very similar to the discussed findings. To control for endogeneity and causality problems further, this research also ran multiple two-stage least squares (2SLS) estimation. It uses the set of variables listed in the disclosure equation (7) as instruments to attain the fitted values of GHG disclosure proxy. Its findings are similar.

4.6 Summary and conclusions

This research analyses the influence of return on assets in the previous year on disclosure decision. Also, it investigates the impact of voluntary GHG disclosure

on accounting-based performance. The research contributes to the voluntary GHG disclosure literature by focusing on several aspects of accounting-based performance. The differences in the nature of GHG disclosure are controlled by differentiation of the "hard" to mimic GHG disclosure items from the "soft" GHG disclosure items. This research contains samples with several possible industry-sizes to increase external validity. Also, it employs a matched-pair sample to control for potential sample selection and endogeneity issues.

This study investigates the impact of return on assets ratio in the previous year on GHG disclosure by using a cost-benefit framework. It also examines the impact of GHG disclosure on accounting-based measures, return on asset, return on equity and return on sales in the subsequent year of disclosure. It hypothesises that a high level of return on assets in the year prior to GHG disclosure could be a determinant for GHG disclosure decision. Also, it hypothesises that voluntary carbon management strategies and disclosure by the introduction of cost savings opportunities or the identification of innovation opportunities impact on accounting-based performance positively. Thus, voluntary GHG disclosure would increase the accounting-based ratios in the subsequent year of disclosure.

The findings are as follows. This study finds a positive and significant association between the level of "hard" to mimic GHG disclosure items and return on assets in the subsequent year of disclosure. Similarly, it finds that there is a positive association between the total level of GHG disclosure and return on assets. That is, companies with more verifiable and forward-looking GHG disclosure items and a higher level of GHG disclosure achieve the accounting-based benefits of GHG disclosure. Also, it finds a similar result in the matched-pair sample. The

GHG disclosure status of a company has a positive and significant association with return on assets in the subsequent year of disclosure. As predicted by the cost-benefit framework, companies bear the extra reporting cost to achieve the perceived benefits of disclosure. In contrary to the hypothesis this research could not find support for the association between return on assets in the previous year and GHG disclosure (first hypothesis) at 95% significance level. That is, companies with a higher level of return on assets do not necessarily disclose extra information about their carbon emissions and reduction strategies.

Use of only annual reports as the source of GHG disclosure appears to be a caveat of this study. Around 6% of the sample companies also disclose GHG information in the CDP questionnaire and media. Also, there is a risk in the selection of pairs in the matched-pair sample. There is a possibility that a pair is selected that has implemented carbon management strategies but is not reporting them. As long as the primary sample provides consistent findings with the matched-pair sample, this threat is not significant.

Notwithstanding these limitations, this research provides evidence that GHG disclosure is positively associated with return on assets. This finding could be used in the disclosure analysis of non-disclosing companies.

This study opens many research opportunities. For example, a case study is suggested to evaluate the detailed possible impact of the GHG disclosure decision in practice. The case study could examine how the implementation of a GHG disclosure strategy impacts on the reduction of energy, materials and other

operational costs. Also, it can investigate how this strategy influences the innovation opportunities in products, services or operational processes.

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Chapter 5 Conclusion

The findings of this research are diverse. Briefly this research provides evidence that larger companies and companies with a more independent board are more likely to disclose GHG information voluntarily. Also companies with newer equipment are more likely to engage in discretionary disclosure. The foreign listing status of companies plays a significant role in the GHG disclosure decision. A high level of debt cost in the previous year is also a determinant for voluntary GHG disclosure. However, this research could not provide evidence that the level of return on assets in the previous year of disclosure and leverage are the two significant determinants of voluntary GHG disclosure. Further, this research highlights that GHG disclosure has significant negative relationships with the bid-ask spread and return volatility in the following year of disclosure. Also, voluntary GHG disclosure is associated with the level of debt cost in the year following disclosure.

The research findings are consistent with the predictions of the cost-benefit framework. The findings indicate that managers tend to apply a cost-benefit framework based on likely trade-off between costs and benefits of disclosure (Garcia-Meca et al., 2005; Verrecchia, 1983, 1990, 2001) when deciding whether to voluntarily disclose GHG information. The research outcome highlights that companies bear the extra voluntary disclosure costs to achieve the perceived benefits of voluntary disclosure. In addition to the discussion of these outcomes and research objectives in more details, this Chapter provides the limitations,

contributions and implications of the research. Also, it identifies areas for further research.

5.1 Research objectives

Climate change issues and public concerns over perceived problems caused by climate change have led to certain types of environmental regulations. In Australia, the government legislated the *NGER Act 2007* to respond to these climate change issues. This Act mandates companies with greenhouse gas emissions, energy consumption, or production above specified thresholds to report their GHG, measured in $CO_{2\text{-}e}$ (carbon dioxide equivalents), as well as energy consumption and production data to the Australian Government (Australian Government, 2013).

In accordance with rising regulations and awareness about climate change issues, companies should be more likely to implement climate change strategic reduction plans (Kolk et al., 2008). Action to reduce pollution could impact companies' financial position and performance. In a carbon-constrained world the ability to hedge against "physical climate risk", "mitigating regulatory costs", "avoiding expensive litigation and other threats to corporate reputation", "managing climate risk in the supply chain", "investing capital in low-carbon assets" and "innovating around new technology and product opportunities" may impact on the costs and revenue of companies (Lash & Wellington, 2007). However, despite the possible significant impact of carbon reduction strategies and their disclosure on

companies' financial performance, International Accounting Standards (IAS)[47] has not yet advanced significantly in this area.

In the absence of an international carbon accounting standard and the presence of an increasing demand for climate change information, a number of non-GHG registered Australian companies (those not subject to the *NGER Act 2007*) disclose GHG information to communicate their climate change strategies and reduction actions voluntarily. An aim of this research was to empirically identify the key determinants and consequences of voluntary GHG disclosure amongst non-GHG registered Australian companies.

While much of the prior research uses GHG registered companies as the sample (e.g., Luo et al., 2012), no empirical study to date has considered non-GHG registered companies. As Boesso (2002) points out "voluntary disclosure" should remain at "the total discretion of managers". Therefore, non-GHG registered companies' disclosure practice can be considered as discretionary.

Further, although there is literature on the determinants (firm-specific characteristics) of voluntary GHG disclosure, there are few studies that specifically consider the consequences of voluntary GHG disclosure. This research gap is surprising given the increasing economic significance of the carbon market, with a total value of $US176 billion traded globally at the end of 2011 (World Bank, 2012). This study aimed to bridge the existing gap between

[47]The IASB added Emission Trading Schemes as a research project to its agenda in May 2012 (IASB, 2012). Before that the IASB and the FASB were conducting a joint project to develop a carbon reporting standard. The main focus of this standard was the recognition and measurement of the assets and liabilities of an emission trading scheme (i.e., finanicial accounting and reporting of GHG).

the determinants and consequences of voluntary GHG disclosure in annual reports. That is, once the initial prerequisites for GHG disclosure were identified, one would be able to examine the possible consequences of this voluntary action. Accordingly, this research contributed to the voluntary GHG disclosure literature by examining the determinants and consequences of voluntary GHG disclosure.

The aim of this thesis was to investigate the determinants and consequences of voluntary GHG disclosure for all Australian listed companies not subject to the *NGER Act 2007* from financial year 2009 to 2011. Content analysis was used and a GHG disclosure index for content analysis of annual reports was developed. This index is based on the requirements in the *NGER Act 2007* and de Aguiar and Fearfull's (2010) GHG disclosure index (i.e., in accordance with GRI, 2002 and GRI, 2006 guidelines). My GHG disclosure index was used to evaluate the level of carbon disclosure. The differences in the nature of GHG disclosure are captured by the differentiation of "hard" to mimic disclosure items from "soft" disclosure items.

Empirical models were designed in line with the previous financial and environmental disclosure studies and prior voluntary disclosure theoretical frameworks. Multiple regression analyses were run in SPSS. To control for endogeneity and causality in papers two and three, two-stage least squares regression models were additionally used. To further control for possible self-selection and endogeneity, in paper three, this thesis employed a matched-pair sample. For each sample company that reports a level of GHG information, a matched company that does not disclose GHG information was considered. The matched pairs were similar in case of industry, size, leverage and whether or not

they were subject to the *NGER Act 2007*. The GHG disclosure status of the sample companies represented GHG disclosure values in the matched-pair sample.

5.2 Outcomes of the research

There are several research outcomes resulting from the research undertaken in my PhD study. The following two subsections present the research outcomes of three specific research questions in respect of the determinants and consequences of voluntary GHG disclosure.

5.2.1 RQ1: Determinants of voluntary GHG disclosure (Paper one)

The first paper examines the determinants of voluntary GHG disclosure by testing predictions from a comprehensive theoretical framework. It considers several firm-specific characteristics similar to prior disclosure studies, as the determinants of voluntary disclosure. Age of company, firm size, board independence, foreign listing status, ownership concentration, leverage and industry are firm-specific characteristics examined as the determinants of voluntary GHG disclosure.

The results of the first paper highlight a positive and significant association between the level of voluntary GHG disclosure in the annual reports, board independence and firm size, which in general, support the application of agency theory and stakeholder theory. Further, it indicates that companies with newer equipment are more likely to engage in discretionary disclosure, as predicted by voluntary disclosure theory. Finally, in contrast to industry and leverage variables, foreign listing status appears to play a significant role in the GHG disclosure decision. The findings indicate that sample companies voluntarily disclose

information, though they are not subject to the *NGER Act 2007*. They disclose voluntary GHG information to acquire the possible benefits of communicating this information.

The findings of the first paper respond to the first specific research question that firm-specific characteristics would increase the likelihood of voluntary GHG disclosure. Consistent with prior voluntary disclosure studies, firm size is one of the major determinants of GHG disclosure. This finding is in line with the resource-based theory. The preparation of carbon disclosure requires resource allocation and a high level of technical skills, which would probably be available in a large company. Further, large companies are more recognised as polluters by governments and non-government organisations (The Canada Institute of the Woodrow Wilson International et al., 2008). Large companies disclose voluntary information to legitimise their operations (Haniffa & Cooke, 2005). Finally, larger companies are more likely to have a higher number of shareholders and a higher level of agency costs (Chow, 1982). Voluntary disclosure could help them to respond to the information interest of their shareholders and to reduce possible agency costs.

The findings of the first paper also suggest that the degree of board independence is a determinant of voluntary GHG disclosure based on agency theory. Age of company based on voluntary disclosure theory is the other determinant of voluntary GHG disclosure. Sample companies with newer equipment have a higher level of GHG disclosure. In this way, according to voluntary disclosure theory, they probably achieve the perceived benefits of communicating their environmental status. Further, the foreign listing status of a company plays a

significant role in the GHG disclosure decision based on stakeholder theory. The findings of this research indicate that companies listed on the international stock exchanges are more likely to disclose carbon information than those companies listed only on the ASX. Table 21 presents a summary of findings of the analysis of GHG disclosure determinants.

The second paper of this thesis provides empirical evidence to support the positive effect of voluntary GHG disclosure on the reduction of information asymmetry and the subsequent agency costs.

Table 21: Summary of findings – RQ1

Predictor	Predicted Sign	Dependent Variable (t)		
		Total GHG disclosure score	Hard GHG disclosure score	Soft GHG disclosure score
Independent and control variables relating to determinants of voluntary GHG disclosure (t-1)				
Firm Size	+	**S (+)**	**S (+)**	**S (+)**
Board Independence	+	**S (+)**	**S (+)**	**S (+)**
Age	+	**S (+)**	**S (+)**	NS
Ownership Concentration	+ (-)	**S (+)**	NS	NS
Listing Status	+	**S (+)**	NS	NS
Industry	+	NS	NS	NS
Leverage	+	NS	NS	**S (+)**
Return on Assets	+	NS	NS	NS
Trading Volume	-	NS	NS	NS
Cost of Debt	+	**S (+)**	NS	NS
Cost of Equity	+	NS	NS	NS
Enterprise Value	+	NS	NS	NS
Capital Intensity	+	NS	NS	NS

NS - Not Significant
S - Significant (at 90% level)

5.2.2 RQ2&3: Consequences of voluntary GHG disclosure on financial performance (Papers two and three)

The second and third papers investigate the relationship between voluntary GHG disclosure and financial performance (market-based and accounting-based performance, respectively). More specifically, the second paper investigates the impact of finance cost in the previous year on the GHG disclosure decision (as a determinant). It analyses the effect of the level of finance costs in the previous year (both the cost of debt and the cost of equity) on GHG disclosure by using a cost-benefit framework. Also, it examines the influence of voluntary GHG disclosure on the market-based performance in the year following disclosure (as a consequence). It employs bid-ask spread, return volatility and finance costs as proxies of market-based performance. It assumes that GHG disclosure reduces information asymmetry in the months following disclosure. As a result of reduced uncertainties and estimation errors in the financial markets, the level of bid-ask spread, return volatility and finance cost decreases.

The second paper demonstrates a positive and significant association between the level of voluntary GHG disclosure and the cost of debt in the previous year. In general, it supports that the high level of cost of debt in the previous year is a determinant of GHG disclosure, consistent with the cost-benefit framework. That is, companies with higher level of debt costs are more likely to bear the extra reporting costs in hope of achieving the perceived benefits of GHG disclosure (e.g., possible reduction in finance costs) (The fourth row from bottom in Table 21 presents a summary of findings in this regard). Further, this research shows that companies with more verifiable and forward-looking GHG disclosure items

and a higher level of GHG disclosure are more likely to achieve a lower bid-ask spread and return volatility. As predicted by agency theory, inadequate disclosure can increase information asymmetry. Extra reporting reduces the likelihood of companies' undervaluation, extensive return volatility and wide bid-ask spread. Also, this study finds that voluntary GHG disclosure is associated with the level of debt cost in the following year of disclosure, consistent with the cost-benefit framework.

The findings in the second paper support the primary findings of the first paper of this thesis, in regards to the association between GHG disclosure, firm size and board independence. The first paper indicates firm size and board independence as two determinants of GHG disclosure. It suggests that larger companies would have larger number of shareholders and possibly a higher level of agency costs. Thus, they may disclose GHG voluntarily to reduce their agency costs. Also, it highlights that companies with a more independent board are more likely to disclose GHG information. This disclosure could be for the purpose of the reduction in agency costs. The findings of the second paper, by providing evidence for the positive consequence of voluntary GHG disclosure on the reduction of information asymmetry and agency cost, complement the primary findings and justifications in the first paper (Chapter two).

The third paper analyses the influence of return on assets in the previous year on the GHG disclosure decision. Also, it investigates the impact of voluntary GHG disclosure on accounting-based performance in the year following disclosure by using a cost-benefit framework. It evaluates the impact of GHG disclosure on return on asset, return on equity and return on sales in the subsequent year of

disclosure. It is hypothesised that a high level of return on assets in the year prior to GHG disclosure could be a determinant for the GHG disclosure decision (The sixth row from bottom in Table 21 presents a summary of findings in this regard). It is also hypothesised that voluntary carbon management strategies and reporting by companies for the introduction of cost savings opportunities or the identification of innovation opportunities impact on accounting-based performance positively. Thus, voluntary GHG management strategies and disclosure would increase the accounting-based ratios in the subsequent year of disclosure.

The third paper (Chapter four) highlights a positive and significant association between the level of verifiable and forward-looking GHG disclosure items and return on assets in the subsequent year of disclosure. Similarly, this study finds that there is a positive association between the total level of GHG disclosure and return on assets. That is, companies with more verifiable and forward-looking GHG disclosure items and a higher level of GHG disclosure achieve the accounting-based benefits of GHG disclosure. This research also demonstrates a similar result in the matched-pair sample. The GHG disclosure status of a company has a positive and significant association with return on assets in the subsequent year of disclosure. As predicted by the cost-benefit framework, companies bear the extra reporting cost to achieve the perceived benefits of disclosure. Table 22 demonstrates a summary of findings of the analysis of GHG disclosure consequences.

Table 22: Summary of findings – RQ2&3

Predictor	Predicted Sign	Independent Variable (t)		
		Total GHG disclosure score	Hard GHG disclosure score	Soft GHG disclosure score
Dependent variables relating to consequences of voluntary GHG disclosure (t+1)				
Bid-Ask Spread	-	**S (-)**	**S (-)**	NS
Return Volatility	-	**S (-)**	**S (-)**	**S (-)**
Cost of Debt	-	**S (-)**	**S (-)**	NS
Cost of Equity	-	NS	NS	NS
Return on Assets	+	**S (+)**	**S (+)**	NS
Return on Equity	+	NS	NS	NS
Return on Sale	+	NS	NS	NS

NS - Not Significant
S - Significant (at 90% level)

5.3 Limitations

The findings of this research need to be considered in light of several caveats. There are four limitations to this study. First, using only annual reports[48] as the source of GHG disclosure is a caveat of this research. Also, about 6% of the sample companies discloses GHG information in the CDP questionnaire and media. Disclosures in the CDP questionnaire and media may have significantly different information. However, it appears that companies that filled the CDP questionnaire disclose similar type of information in their annual reports (Cotter & Najah, 2012).

Second, there is a risk in the selection of pairs in the matched-pair sample. There is a possibility that a pair is selected that has implemented carbon management strategies but is not disclosing its GHG reduction strategies. As long as the

[48] Only a few sample companies also disclosed GHG information in their stand-alone sustainability reports.

primary sample provides consistent findings with the matched-pair sample, this threat is not significant.

Third, while this research uses samples with different possible industry-size to increase external validity, by limiting the sample to Australian listed companies, the generalisability of the results is reduced. National differences (e.g., differences in the capital markets, regulatory and business environments) are not controlled in this research.

Finally, the scope of this thesis focuses on the economic consequences rather than other consequences of GHG emission disclosures. There are many other ways to interpret the consequences of GHG disclosure (e.g., climate change and carbon abatement).

Given these limitations, the findings should be interpreted with caution.

5.4 Contributions

The findings of this research have five main contributions. A summary of these are provided in this section. First, this research considered whether companies are subject to the *NGER Act 2007* in the sample selection process. While much of the prior research has used GHG registered companies as the sample, no empirical study to date considered non-GHG registered companies. As Boesso (2002) points out "voluntary disclosure" should remain at "the total discretion of managers". Therefore, non-GHG registered companies' disclosure practice can be considered as at the discretion of managers.

Second, the content analysis of annual reports provides some clarity in respect of the most common aspects of GHG disclosure (e.g., *actions to tackle GHG emission*) by non-GHG registered companies. It helps stakeholders to understand the types of carbon disclosure amongst non-GHG registered companies. Also, it helps stakeholders to assess the evidence of "green washing" and "symbolic disclosure" (Cormier et al., 2009; Hrasky, 2012). The content analysis of GHG disclosure in this research is informative. It highlights the scope, extent and quality of GHG disclosure within the sample selected.

Third, although there is existing literature on the determinants (firm-specific characteristics) of voluntary GHG disclosure, there have been few studies that specifically considered the consequences of voluntary GHG disclosure. This study aimed to bridge the existing gap between the determinants and consequences of voluntary GHG disclosure. That is, once the initial prerequisites for GHG disclosure were identified, one would be able to examine the possible consequences of this voluntary action. Given the increasing economic significance of the carbon market, understanding why some non-GHG registered companies disclose GHG information could help stakeholders in their decision making. This result is useful for other companies interested in the cost-benefit trade-off associated with voluntary GHG disclosure. It helps non-disclosing companies to evaluate the perceived benefits of voluntary GHG disclosure.

Fourth, this study considered whether the differences in the extent and nature of voluntary GHG disclosure can be explained by firm-specific characteristics stemming from theories in voluntary disclosure studies. Understanding the

underlying determinants for voluntary GHG disclosure may help stakeholders to appreciate the benefits and limitations of this disclosure.

Finally, this research responded specifically to Simnett et al.'s (2009) call for research to apply a collection of archival data to examine the characteristics of companies reporting their GHG emissions. Also, it responded to Cowan and Deegan's (2011) call for research to evaluate changes in voluntary emission disclosure practices by the introduction of the *NGER Act 2007*. Additionally, it responded to Bebbington and Larrinaga-Gonzalez's (2008) call to investigate the value relevance of disclosures on "carbon exposure" and "carbon management" in financial markets.

5.5 Implications and further research

The findings of this research highlight several implications for practice and future research opportunities. First, the findings of this study suggest that GHG disclosure could influence market-based performance and return on assets of companies positively. These findings could be implemented in the cost-benefit analysis of non-disclosing companies for future disclosure. Also, this study highlights the value relevance of GHG disclosure in financial markets by the significant negative influence of GHG disclosure on the return volatility and bid-ask spread, which could help stakeholders in their decision making. Therefore, this study concludes that voluntary GHG disclosure by non-GHG registered companies might represent a win-win situation. As both disclosing companies and society benefit from carbon management and reporting. It has some positive economic consequences for disclosing companies. It also might help to achieve

climate change abatement, by making awareness about the level and type of GHG emissions, the very early stage of achieving emissions reduction.

Second, industry and leverage were not significant determinants of voluntary GHG disclosure for sample companies that are not subject to the *NGER Act 2007*. It would be worthwhile to investigate if this is similar with companies subject to the *NGER Act 2007*, and find out if they seek legitimisation via GHG disclosure.

Third, a case study is suggested to evaluate the detailed possible impact of GHG disclosure decisions in practice. The case study could examine how the implementation of a GHG disclosure strategy impacts the reduction of energy, materials and other operational costs. Also, it can investigate how this strategy influences innovation opportunities in products, services or operational process.

Fourth, while a number of possible consequences of voluntary GHG disclosure are examined in this research, a different possible consequence of voluntary GHG disclosure, the positive possible effect of climate change disclosure on corporate image (e.g., Simnett et al., 2009) is not tested. It is suggested that the "green image" of companies may convince customers to buy their products. Thus, a study might investigate this association. A study could examine whether voluntary GHG disclosure influences the corporate image positively.

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Appendix 1: Theoretical framework for voluntary GHG disclosure

Introduction

Companies disclose voluntary information to communicate with society. Several empirical studies investigate the determinants and consequences of voluntary disclosure on a variety of theoretical frameworks (e.g., legitimacy theory, stakeholder theory and cost-benefit framework). According to Deegan (2002) companies could have different incentives for voluntary social and environmental disclosure, such as: "Economic rationality" perspective, that means voluntary disclosure as a "right thing to do" would provide business financial advantages; tendency to comply with the requirements of different organisations, for example, financial institutes require several social and environmental information from borrowers as a process of their risk assessment; a desire to comply with the expectations of society; as a response to the threats of the legitimacy of a company, for example a negative environmental incident or a negative media report; to attract stakeholders, for example to attract investors to invest in a company; to comply with industry requirements; to stop the threat of mandatory disclosure regulations; to win specific disclosure awards.

In fact, several incentives could influence the disclosure decision of a company. These incentives could be interrelated and one of them might be a dominant driving factor. There is no "accepted" theory for voluntary disclosure and a

number of theoretical perspectives are used in disclosure studies (Deegan, 2002). For instance, one incentive for corporate social and environmental disclosure could be the possible reduction of finance costs. The possible reduction of finance costs as a consequence of voluntary disclosure could be explained by a cost-benefit framework. A cost-benefit framework explains the discretionary disclosure approach of managers to the trade-off between costs and benefits of disclosure (Garcia-Meca et al., 2005; Verrecchia, 1983, 1990, 2001) in that a company bears the extra reporting cost to achieve the possible reduction of finance cost. Also, the other incentive for voluntary disclosure in this company could be for the tendency to legitimise operations. Then, the disclosure decision could also be explained by legitimacy theory in this case.

One aspect of disclosure that attracts interest is the disclosure of information about climate change risks and opportunities. GHG information could be reported in annual reports, sustainability reports, the CDP questionnaire, media and companies' web pages (Simnett et al., 2009). Voluntary GHG disclosure communicates the GHG reduction strategies of a company and GHG reduction plans to tackle climate change problems. As a result, voluntary GHG disclosure might provide some economic benefits for the company or it might help the company to keep its legitimacy.

Social voluntary disclosure is difficult to explain and there are several theories (e.g., legitimacy theory, stakeholder theory and cost-benefit framework) which are used in the social disclosure literature. There is overlap between theories that construct disclosure theoretical frameworks (Mäkelä & Näsi, 2010). These theories are considered together in order to explain why companies make the

decision to disclose social or environmental information voluntarily (Mäkelä & Näsi, 2010). The following sections outline the most explored theories in the social and environmental disclosure literature: political economy theory, legitimacy theory, stakeholder theory, cost-benefit framework and agency theory.

Political economy theory

Political economy theory is systems-based. Based on a system-based theory a company is influenced by society and influences the society in which it operates (Gray et al., 1996). Hence, it is essential to study companies in their economic, political and social framework. In other words, economics, politics and society are inseparable. Economic issues cannot be examined meaningfully without considering institutional, political and social frameworks together (Mäkelä & Näsi, 2010). Gray et al. (1996) define the political economy theory as *"the social, political and economic framework"*. Political economy theory encompasses all the processes within an integrated social system — *"recruitment and socialization, authority and control patterns, conflict and tension resolution, role conflict, goal adaptation, management processes, technology of task accomplishment, and adaptation to environment"* (Wamsley & Zald, 1973). In summary, the political economy framework highlights the effect of external environment on the internal structure of a company.

According to Benson (1975), two basic types of scarce resources are fundamental in a political economy framework, namely, money and authority. Companies need an adequate supply of resources for their operations. Their survival and operations are based on their abilities to attain and utilise these scarce resources from the

external environment (Wamsley & Zald, 1973). The greater the dependency of a company on a resource, the higher degree of influence (from investors, customers and regulatory organisation) on the organisational policies and practices of the company (Hasenfeld, 2000).

As a main concern of management is the control of the company through the accessibility of adequate resources, supply managers may use social and environmental disclosure to construct, maintain and legitimise economic and political arrangements. This approach may be used to the extent that it helps the achievement of control (Gray et al., 1996). Thus, the several activities of companies (e.g., voluntary disclosure) could reflect the limitations imposed by those who manage the needed resources (Hasenfeld, 2000).

The political economy framework helps to clarify the role of social and environmental disclosure in the relationship between companies and society. It attempts to show the role of disclosure on the distribution of money and power in society (Cooper & Sherer, 1984). This framework enables researchers to consider societal issues that influence the operations and disclosure practices of companies (Deegan, 2002). According to political economy theory, disclosure is an economic, political and social document (Guthrie & Parker, 1990). It is used to make, maintain, and legitimise economic and political arrangements and ideological subjects to the interests of companies (Guthrie & Parker, 1990). Disclosure influences the perceptions of stakeholders about the company (Gray et al., 1996). Political economy theory is an integrative framework as it brings a number of various concerns relating to the social environment together (Benson, 1975). It clearly identifies the power conflicts that are present in society and

among diverse stakeholders. In fact, it clarifies the interrelationship between "structure of rule" (policy) and "a system for producing and exchanging goods and services" (economy) (Wamsley & Zald, 1973).

Legitimacy theory

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. As a result companies should always consider the unwritten social contract in their decision-making process (Mäkelä & Näsi, 2010). One responsibility of companies is to consider the influence of their operations on all members of society (not only investors). Otherwise society would not legitimise the operation of the company and its survival will be threatened. Therefore, legitimacy is necessary for the survival of companies.

The expectations of society are a set of norms and values, which when breached mean the loss of legitimacy (O'Donovan, 2002). Therefore, if a company operates in accordance with the norms and values of society, it can achieve legitimacy (Mäkelä & Näsi, 2010). Similarly, Deegan (2000, p. 253) defines legitimacy as the following:

> Organizations continually seek to ensure that they operate within the bounds and norms of their respective societies, that is, they attempt to ensure that their activities are perceived by outside parties as being legitimate.

Legitimacy, similar to money and power in the political economy framework, is a needed resource for the survival of companies. This resource is dynamic and changes over time. A company that was legitimate before might not be legitimate currently for several reasons. First, it is likely that what was acceptable to society earlier, is no longer satisfactory (the expectations of society change) (Deegan, 2002). For example, before the 1960s the norms and values of society was focused on economic performance, however, during the 1960s and 1970s the expectations of society changed to corporate social performance (Patten, 1992). Second, legitimacy could be influenced by the strategies and operations of companies. For example, the occurrence of an environmental disaster could destroy the reputation and the legitimacy of a company (Deegan et al., 2002).

Companies attempt to manage legitimacy because it could help them to guarantee accessibility to resources, such as capital, labour and customers (Neu et al., 1998). It would also allow them to prevent adverse regulatory activities. Generally, it forestalls disruptive actions by stakeholders (e.g., boycotts of products).

According to legitimacy theory, management uses different strategies and corrective actions when it recognises that the operation of a company has departed from the expectation of society (Mäkelä & Näsi, 2010; Deegan, 2002). Otherwise, the existing legitimacy gap threatens the ongoing operations. A variety of strategies are used to fill the legitimacy gap. According to Lindblom (1994), to overcome the legitimacy threat and to justify its operations, a company's management might inform stakeholders about future performance improvement plans. Also, management might try to change the viewpoints of stakeholders. Further, it might divert the attention of stakeholders from the problem.

Disclosure of information is considered as an approach to communicate the activities of a company and the management perspectives in regards with specific environmental, social and other corporate issues. In other words, the disclosure mechanism could present the conformity of the company to social norms and values. Newson and Deegan (2002) emphasise that changes alone in a company cannot construct legitimacy. It is essential that stakeholders be informed about changes. Therefore, the disclosure of information plays a dominant role. According to legitimacy theory, disclosure is a means to manage political and social pressures (Lindblom, 1994). By using voluntary disclosure, a company informs stakeholders that it meets the norms and values of society (Freedman & Jaggi, 2005). Disclosure could also distract the attention of society from adverse situations (Wilmshurst & Frost, 2000).

Thus, legitimacy theory is a key theory in the social and environmental disclosure literature. As such, disclosure is a way to legitimise and to justify the operation of a company (Cormier et al., 2005; Gray et al., 1995; Haniffa & Cooke, 2005). Not only do companies report information voluntarily to achieve their own economic benefits (cost-benefit perspective), but also they attempt to transfer their perspective of social responsibility to society (Choi, 1999).

Currently, GHG emission could be seen as a threat to the legitimacy of a company. Companies are dependent on the expectations of society. If a legitimacy gap happens, it could have irreversible economic impact 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. Given the current significance of climate change, it is not inconceivable to suggest that companies need to legitimise their GHG emissions status by voluntary GHG disclosure. Therefore, it is argued that voluntary GHG disclosure could be explained by legitimacy theory. Detailed GHG disclosure might be employed to legitimise the operation of a company and to construct public image (Neu et al., 1998). In an empirical study, Hrasky (2012), using ASX50 companies for 2005 and 2008, points out that GHG disclosure by companies is consistent with "legitimation behaviour".

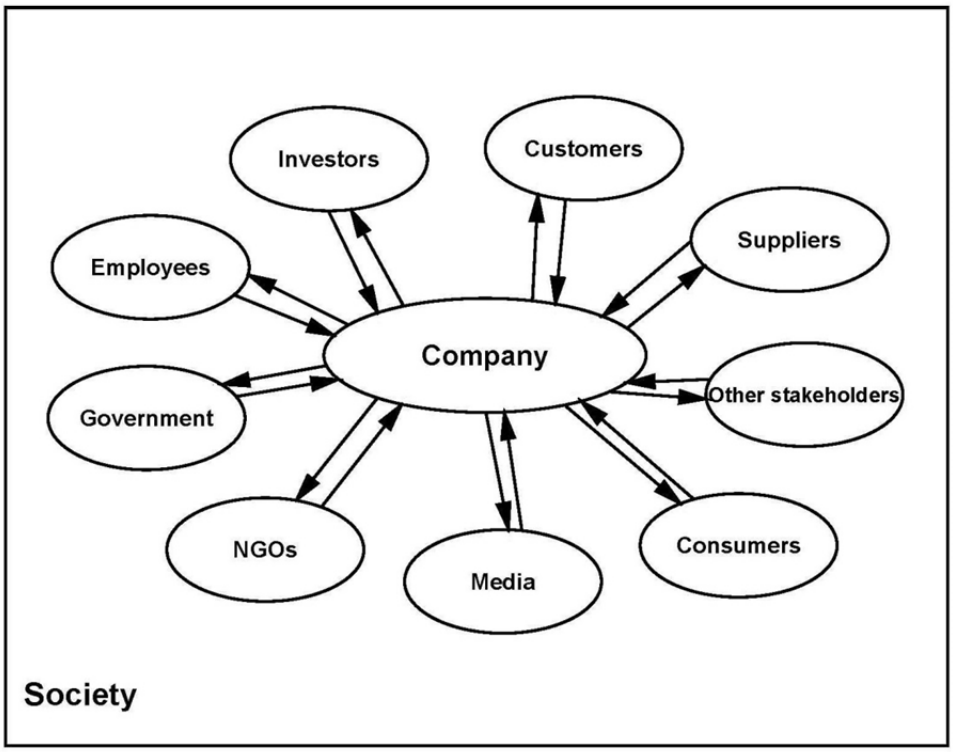
Stakeholder theory

Stakeholder theory 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 et al., 1999). Stakeholders are any groups or individuals who can influence or can be influenced by a company (Freeman, 1984). It means in addition to investors, customers, suppliers and employees companies are also accountable to governments, competitors, consumers, NGOs, media and other stakeholders (Freeman, 1984). Figure 4 illustrates the relationship of a company with its stakeholders in society.

Generally, managers attempt to improve the relationship with their stakeholders (Deegan, 2002). Their efforts are extensive when they deal with important stakeholders. Based on stakeholder theory, the requests of stakeholders will be managed in order to enhance benefits to companies (Deegan, 2002). In other words, stakeholder theory suggests that managers apply particular strategies in

order to respond to the needs of diverse stakeholders (Freeman, 1984). In these strategies managers consider stakeholder and attempt to minimise costs and to maximise benefits of representative groups.

Figure 4: The relationship of a company with stakeholders in society



The existence of a company is aligned with meeting the expectations of different stakeholders. Information is an essential factor that companies use to deal with stakeholders and to obtain their approval and support (Deegan, 2002). As obtaining approval requires a dialogue between a company and its stakeholders (Van der Laan Smith et al., 2005), voluntary disclosure helps to communicate with various stakeholders and to gain their supports (Gray et al., 1995).

Managers release information strategically (Deegan, 2002). Their motivation in disclosing information is to present that they are complying with the expectations of stakeholders. It means that disclosure is not necessarily based on perceived

responsibilities. In fact, companies meet the needs of stakeholders to achieve their own desired results (e.g., profitability, growth, stability, maintenance of the organisation) (Donaldson & Preston, 1995).

Currently, stakeholders have different expectations about the environment. They pursue their needs through imposing pressure on companies to disclose environmental information. Environmental disclosures could demonstrate the needs of stakeholders in respect to environmental information (Freedman & Jaggi, 2005). According to the social accounting literature, a variety of stakeholders benefit from social disclosure. Voluntary disclosure is not limited to capital providers.

Stakeholder theory, like legitimacy theory, is a constituent of political economy theory and based on a system-based theory. Stakeholder theory, in contrast to legitimacy theory, explicitly states that various groups in society have unequal power to influence the operations of a company (Deegan, 2002). Stakeholder theory does not go beyond "input/compensation relationships" between a company and its stakeholders (Mäkelä & Näsi, 2010). For example, stakeholder theory cannot explain different disclosure practices among companies in the same industries and operating in the same geographic areas (Freedman & Jaggi, 2005). For this reason, legitimacy theory is needed to provide deeper analysis.

In summary, stakeholder theory as a constituent of political economy theory that can be used to explain some aspects of voluntary GHG disclosure.

Cost-benefit framework

The cost-benefit framework is based on economic principles and competitive analysis. It explains the discretionary disclosure approach of managers by trade-off between costs and benefits of disclosure (Garcia-Meca et al., 2005; Verrecchia, 1983, 1990, 2001). As reporting information is costly (Admati & Pfeiderer, 2000), providing additional information beyond requirements occurs when the benefits of disclosure outweigh its costs. According to Collis and Montgomery (1995) the allocation of internal resources to external users is a critical strategic decision. Chu and Spires (2008) point out that *"Cost-benefit theories of decision strategy choice provide a conceptual foundation for studying human decision behaviour. Central to cost-benefit theories are decision makers' perceptions of the efficacy and effort of various decision strategies"*. The cost-benefit framework could provide a logic for voluntary disclosure behaviour.

A number of researchers use the cost-benefit framework in the disclosure literature (e.g., Li et al., 1997; Depoers, 2000). For example, Li et al. (1997) examine the determinants of voluntary disclosure of environmental liabilities by companies. They suggest that companies strategically release environmental liabilities. According to the literature, environmental disclosure is based on the overall disclosure policy that is determined by objective cost-benefit estimation (Cormier & Magnan, 1999).

In the investigation of the determinants and consequences of voluntary GHG disclosure, this research suggests that GHG reporting is an economic decision. Managers assess the various costs and benefits of a voluntary disclosure action. If

the benefits of disclosure outweigh the costs, a company may participate in a voluntary disclosure. The costs of disclosure are reporting costs and proprietary costs in the disclosure literature. The proprietary costs of GHG disclosure could be the increased attention of regulators on the carbon emissions status of a company and the increased knowledge of environmental support groups about the carbon emissions of a company (Peters & Romi, 2009). The perceived benefits of voluntary disclosure might be the enhancement of corporate image (Simnett et al., 2009) and improved economic performance. Also, it might be the reduction of information asymmetry and agency costs.

Agency theory

Managers have superior information compared to outsiders about companies. Investors demand information to monitor companies and to assess the valuation of companies. As a result, companies might be motivated to disclose information that could help to obtain capital on the best terms and conditions (Gray et al., 1995). According to agency theory, information asymmetry causes agency costs (Jensen & Meckling, 1976). Companies may voluntarily choose to disclose information to reduce both information asymmetry (Kim & Verrecchia, 1994; Richardson & Welker, 2001) and agency costs.

Agency theory is used by several researchers in the disclosure literature to explain voluntary reporting practices. It suggests that disclosure is a means by which companies can reduce the conflict between owners (principals) and managers (agents), and thus, decrease agency costs (e.g., Lambert et al., 2007). Several studies also explain firm-specific factors, such as size, industry and leverage as

the determinants of voluntary disclosure, based on agency theory (e.g., Depoers, 2000; Jensen & Meckling, 1976; Leftwitch et al., 1981).

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Appendix 2: Literature review

Introduction

This appendix reviews the existing research on voluntary disclosure. In particular, it reviews the discussions on corporate reporting. It includes a review of studies about the consequences of voluntary disclosure on financial performance, accounting-based and market-based performance. Also, it reviews the voluntary disclosure literature in regards to the determinants (firm-specific characteristics) of voluntary disclosure.

Corporate reporting

The stated purpose of accounting is to provide useful information for sound economic decision making (IASB, 1989). Under the accounting conceptual framework companies should provide relevant information to a wide range of users and any significant information that could affect the "financial position, performance and changes in financial position" of an entity should be reported (IASB, 2010, p. 34).

The usefulness of financial statements will be improved by including comparable, verifiable, timely and understandable information (IASB, 2010). According to the conceptual framework of International Accounting Standards (IAS), relevance and faithful representation are two elements of useful information. Value relevance refers to the capability of making a difference in the decisions of users of financial statements. That is, to make a decision about investment in a company, analysts

and investors require material information about the tangible and intangible assets of a company and a range of performance measures (Eccles et al., 2001).

IAS may not keep pace with the advent of different dimensions in the economy (Eccles et al., 2001). For instance, in the earlier stages of clean air regulations (late 1860s)[49] societies were less demanding on the enforcement of clean air legislation. Currently, societies pressure companies to behave in more socially responsible and accountable ways (Marshall & Macdonald, 2011). Pollution reduction action could impact financial position, performance and changes in financial position. In a carbon-constrained world the ability to hedge against "physical climate risk", "mitigating regulatory costs", "avoiding expensive litigation and other threats to corporate reputation", "managing climate risk in the supply chain", "investing capital in low-carbon assets" and "innovating around new technology and product opportunities" may impact on the costs and revenue of companies (accounting-based performance) (Lash & Wellington, 2007). However, despite the possible significant impact of carbon reduction strategies and its disclosure on companies' financial performance, IAS have not yet advanced significantly in this area.

Currently, the International Accounting Standards Board (IASB) is working on a project to develop requirements and guidance on carbon accounting (IASB, 2012). In May 2012 the IASB added Emission Trading Schemes as a research project to its agenda. Before this, the International Financial Reporting Interpretations Committee (IFRIC) issued IFRIC 3 in December 2004 to address the accounting for the rights and obligations arising from European Union Emissions Trading

[49] In late 1860s, the first clean air law passed in Pittsburgh (Jacobson, 2002, p. 85).

Schemes (EU ETS) (IPSASB, 2013). IFRIC 3 had a limited scope and it was withdrawn in less than a year to allow for the development of a more comprehensive approach to ETS accounting issues. Then, the IASB and the Financial Accounting Standards Board (FASB) conducted a joint project to develop a carbon mandatory reporting standard. The main focus of this standard was on the recognition and measurement of the assets and liabilities of an ETS (IASB, 2012). This project was deferred in November 2010.

In the absence of IAS and the presence of an increasing demand for relevant information, some organisations provide additional information to stakeholders via voluntary disclosure. Boesso (2002, p. 270) defines "voluntary disclosure" as a disclosure that is not explicitly required by an accounting standard or legislation. Voluntary disclosure should remain at "the total discretion of managers" (Boesso, 2002). Boesso (2002) argues that better information reporting reduces information asymmetry and improves the relationship with investors, creditors, customers, suppliers, employees, managers and other stakeholders. The reduction of information asymmetry ultimately smooths the progress of the efficient allocation of scarce resources (Healy & Palepu, 2001).

In accordance with more regulation and increasing awareness of climate change issues, companies are under increasing pressure from different groups of stakeholders to disclose their GHG information and to take action to reduce GHG emissions (Kolk et al., 2008). Currently, the reduction of GHG emissions is one of several initiatives for sustainability (Simnett et al., 2009). Therefore, companies should be accountable for their GHG emissions.

Stakeholders (e.g., customers, suppliers, and employees) need GHG information to evaluate the level of carbon emission by companies, to investigate the probable regulatory and competitive risks of organisations and to assess how organisations control their GHG emissions (Bebbington & Larrinaga-Gonzalez, 2008). According to Freedman and Jaggi (2011) suppliers might be interested in information about the contribution of companies to global warming and in the amendments of production processes to reduce GHG emissions. It is reasonable to assume that customers would like to know about product changes and how a company complies with its social commitments towards global warming effects. Employees need to know how they are influenced by changes in the production process as a result of the application of GHG reduction strategies. Further, the community is interested to know how companies deal with GHG challenges, what reduction targets they plan for and how much progress they have made in implementing the plan. Therefore, it is argued that companies should be aware of, and communicate, their GHG information. It is perceived that an adequate degree of GHG disclosure by companies is thus essential in providing such information to stakeholders.

In the absence of an international carbon accounting standard and the presence of an increasing demand for climate change information, a number of Australian companies disclose carbon information to communicate their climate change strategies and reduction actions voluntarily. For instance, Ausenco publicly discloses its GHG information and reduction strategies in its annual report, despite the fact that its level of total carbon dioxide equivalents is only about 16½ kilo tons, below the *NGER Act 2007* reporting criteria. While there are other

companies, similar to Ausenco, which disclose various levels of GHG information voluntarily, this research intends to seek answers to the next step of disclosure: what make non-GHG registered companies disclose a certain level of GHG information voluntarily. An answer to this question will provide decision makers with a useful framework when deciding whether they should disclose GHG emission and at what level.

The prior voluntary disclosure literature identifies several determinants and consequences of the voluntary disclosure decision on a cost-benefit framework, legitimacy theory, stakeholder theory, agency theory and voluntary disclosure theory. Empirical disclosure studies have focused on a number of firm-specific characteristics as potential determinants of disclosure practices (Hackston & Milne, 1996). For example, studies have examined the effects of firm size, profitability, age of company, foreign listing status, ownership concentration, board independence and industry. The disclosure literature also identifies several perceived consequences of disclosure. For example, the perceived consequences are represented by cost of capital estimates or information asymmetry proxies, such as return volatility, bid-ask spreads or return on assets (Guo et al., 2004; Shalev, 2009).

The following section outlines the findings of relevant research in the financial, social[50] (non-financial) and voluntary GHG disclosure literature in regards to the consequences of voluntary disclosure.

Consequences of voluntary disclosure

[50] Voluntary social disclosure relates to the exposure of information with regard to environmental, community, employee and consumer subjects (Gray et al., 1995).

Perceived economic benefits along with firm-specific characteristics are involved in a disclosure decision. Some economic consequences of voluntary disclosure have been examined in the disclosure literature, for example, the effect of voluntary disclosure on market-based performance. The next sections refer to the literature that examines the effects of voluntary (financial or non-financial) disclosure on the accounting-based performance of a company and the market-based performance of a company, separately.

Consequences of voluntary disclosure on accounting-based performance

In this section, first, the studies that investigate the impact of environmental performance on financial performance are reviewed. The research in this area uses a similar theoretical framework to the available studies that theoretically justify a possible association between voluntary GHG disclosure and the improvement in accounting-based performance. Then, the following section covers literature on the relationship between GHG voluntary disclosure and accounting-based performance.

"Does it pay to be green?"

Since 1970 several studies in the environmental accounting and the environmental management literature have analysed whether the implementation of environmental strategies and the subsequent disclosure improves accounting-based performance (e.g., Clarkson et al., 2008 and Hart et al., 1996). In the literature two perspectives describe whether "it pays to be green". The first perspective refers to the positive impact of the improved environmental performance on economic performance (e.g., Cronin et al., 2011). According to

Ambec and Lanoie (2008) the use of environmental plans and strategies may help to recognise operational inefficiencies. The implementation of these strategies ultimately would reduce the level of material cost, energy cost and labour cost. They could also positively impact on the revenue elements of accounting-based performance. For example, a company with strategic environmental plans is more likely to advertise its differentiation in terms of environment and to gain access to different markets. According to the second viewpoint, the development of environmental strategies needs the allocation of resources, which causes a significant cost rise. As a result, the attention of managers would be distracted from the main goal of business, which is the maximisation of profit (Friedman, 1970).

Emission reduction processes could influence economic performance both positively (e.g., enhanced efficiency and productivity) and negatively (the implementation costs of emission reduction strategy). The emission reduction process might influence revenue resources by the introduction of innovation in products, in services and in processes. It could have a positive impact on customer satisfaction, on access to certain markets and on a company's competitive position. As pollution is related to a waste of raw materials and resources (Lash & Wellington, 2007; Porter & Linde, 1995), pollution reduction targets and plans could cause a reduction in raw materials, energy or services costs. For instance, one positive impact of the implementation of ISO 14001[51] on the Flint Metal Centre of General Motors in Michigan caused a 61% reduction in energy use during the four-day Thanksgiving holidays in 2001 (compared with 1999), which

[51] ISO 14001 provides the requirements of an environmental management system (EMS), auditing, performance evaluation, labelling, life cycle assessment, and product standards.

meant a $250,000 saving. This saving was enough to cover the cost of the development of environmental management systems (Wecker-Seipke, 2002). Similarly, according to Kats (2003), the economic benefits of green buildings are more than ten times the extra cost associated with building green. Evidence for these financial advantages are a lower energy consumption rate, a lower environmental and emission cost and increased productivity. The implementation of emission reduction targets may also reduce the cost of labour by reducing the cost of illnesses, recruitment and absenteeism (Ambec & Lanoie, 2008; Maignan & Ferrell, 2001) and by attracting better candidates (Stigler, 1962). Emission reduction plans may improve the environmental performance of a company, possibly reducing litigation risk (Sharfman & Fernando, 2008). Also, the knowledge of how to reduce emissions in one segment can be transferred to all sections of a company. It even can be sold as pollution-control technology. It might generate a new source of revenue for the company.

Several studies provide empirical findings for the above discussion and they examine whether it pays to be green (e.g., Al-tuwaijri et al., 2004; Hart et al., 1996; Pogutz & Russo 2009). For example, Clarkson et al. (2011) apply longitudinal data from the four most polluting industries to analyse whether the implementation of a proactive environmental strategy in a company leads to a subsequent financial improvement. They find that companies with superior environmental performance have better financial performance (e.g., profitability; cash flow; Tobin's Q). Pogutz and Russo (2009) also demonstrate that good environmental performance positively affects finanical performance (e.g., Tobin's Q; return on assets; return on equity; return on sales). Moreover, Earnhart and

Lizal (2011) show that the lower level of air pollutants prompts a better financial performance by lowering costs[52].

Table 23 summarises several empirical studies that examine whether it pays to be green. As discussed the findings are extremely different. Several studies indicate that "it pays to be green" (e.g., Al-tuwaijri et al., 2004; Hart et al., 1996; King & Lenox, 2001; Klassen & McLaughlin, 1996; Pogutz & Russo, 2009; Russo & Fouts, 1997; Shane & Spicer, 1983). On the other hand, several studies show no significant or even a negative relationship between environmental performance and financial performance (e.g., Cordeiro & Sarkis, 1997; Gilley et al., 2000; Jaggi & Freedman, 1992). For example, Jacobs et al. (2010) examine the effects of two categories of environmental performance announcements on stock market reaction. They demonstrate that the market reacts positively only to certain types of environmental performance announcements, for example, to the announcement of ISO 14001 certification. For a number of other announcements this relationship is negative, for instance the announcement of voluntary emission reductions. Telle (2006) also examines the association between financial and environmental performance by including a number of unobserved variables in his panel regression analysis (a more robust approach compared to a pooled regression method). He could not find any significant relationship between financial and

[52] The findings vary. A number of studeis find that it pays to be green (as disscussed). However, several studies show no significant or a negative relationship between environmental performance and financial performance (e.g., Cordeiro & Sarkis, 1997; Jaggi & Freedman, 1992; Link & Naveh, 2006; Delmas & Nairn-Birch, 2010). For instance, Link and Naveh (2006) find that better environmental performance, as a result of the implementation of ISO 14001, does not nessesarily cause a better financial performance. Delmas and Nairn-Birch (2010) also find that the total carbon footprint has a positive impcat on the return of assets (ROA) of about 1000 US firms. The equivocal relationship between environmental performance and financial performance could be due to the inconsistency in the measurement of variables or the ignorance of major control variables (e.g., the degree of environmental regulation).

environmental performance. Also, Link and Naveh (2006) could not support this idea that better environmental performance, as a result of the implementation of ISO 14001, causes better financial performance. Further, Hassel et al. (2005), by a residual income valuation model, find that environmental performance has a negative impact on the market value of listed Swedish companies.

Table 23: A number of studies on whether it pays to be green?

Authors	Sample Companies	Methodology	Measure of Environmental Performance	Measure of Financial Performance	Result
Gilley et al., (2000)	All industries	Event study	The number of company environmental initiatives	Stock returns	No significant association
Link and Naveh (2006)	All industries	Survey	Announced environmental information	Annual gross profit margin, investment in R&D, sales, sales per employee and business with foreign organizations	No significant association
Cordeiro and Sarkis (1997)	All industries	Archival	Firm environmental proactivism	EPS forecasts	Negatively associated
Jaggi and Freedman (1992)	Pulp and paper industry	Archival	Announced environmental information	Price earning ratio, beta, net income, ROE, ROA, cash flows/equity, and cash flows/assets ratio	Negatively associated
Hassel et al., (2005)	All industries	Archival	Announced environmental information	Market value of firm	Negatively associated
Jacobs et al., (2010)	All industries	Event study	Announced environmental information and environmental awards	Stock returns	Both positively and negatively associated (depends on types of announcements)
Telle (2006)	Four polluted industries	Archival	Announced environmental information	ROS	Both positively and not significantly associated (respectively based on non-considering and considering unobserved variables)
Busch and Hoffmann (2011)	All industries	Archival and Survey	Announced environmental information (outcome-based measurement) and answered questionnaire information (process-based measurement)	ROA, ROE, Tobin's q	Positively associated (outcome-based measurement) and negatively associated (process-based measurement)
Shane and Spicer (1983)	Four polluted industries	Event study	Announced environmental activities	Share price fluctuation	Positively associated
Klassen and McLaughlin (1996)	All industries	Event study	Environmental awards	Share price fluctuation	Positively associated
Russo and Fouts (1997)	All industries	Archival	Announced environmental information	ROA	Positively associated
Al-tuwaijri et al., (2004)	All industries	Archival	Announced environmental information	Industry-adjusted annual return, market price per share	Positively associated
Pogutz and Russo (2009)	Eight polluted industries	Archival	Announced environmental information	ROA, ROE, ROS and Tobin's q	Positively associated
Clarkson et al., (2010)	Four polluted industries	Archival	Announced environmental information	ROA, CF and Tobin's q	Positively associated
Hart and Ahuja (1996)	All industries	Archival	Announced environmental information	ROA, ROE and ROS	Positively associated
King and Lenox (2001)	Manufacturing firms	Archival	Announced environmental information	Tobin's q	Positively associated
Earnhart and Lizal (2011)	All industries	Archival	Announced environmental information	Profit, Operating profit, costs and sales	Positively associated

The equivocal relationship between environmental performance and financial performance could be due to not considering a lag period, or the inconsistency in the measurement of variables or the ignorance of major control variables. Several studies examine the impact of environmental improvement on financial performance at the same time as the implementation of the enhanced environmental strategies. However, it takes some time for the environmental improvement process to influence financial performance. Moreover, researchers use different approaches to measure the dependent and independent variables. For example, the pollution performance index in Jaggi and Freedman (1992) is only related to water pollution while a number of other studies also consider air pollution. Also, Busch and Hoffmann (2012) use two different dimensions for corporate environmental performance: outcome-based dimension and process-based dimension. The outcome-based measurement refers to the carbon intensity of the sample companies and the process-based measurement focuses on the quality of the carbon management of a company. The findings show that corporate environmental performance is positively related to financial performance when it is defined by an outcome-based measurement. However, when it is represented by a process-based measurement, it is negatively associated with financial performance. In addition, the pollution performance measure may not represent the exact pollution performance because of the possibility of judgments involved in the definition of the contribution of each pollutant. Also, this ambiguous association could due to not controlling for the degree of environmental regulation.

Voluntary GHG disclosure and accounting-based performance

Similar to environmental accounting and management studies, several studies elaborate the beneficial role of "carbon management and reporting". For example, Kolk et al. (2008) argue that the preparation process for the GHG report may increase the awareness of the relationship between the carbon footprint and the financial performance among companies. A GHG disclosure strategy forces companies to keep track and evaluate[53] their level of GHG emissions. This strategy could help companies to identify the opportunities of cost savings through more efficient use of resources and materials. For example, BP, which has implemented GHG reductions targets, claims to have saved $650 million by reducing energy waste (The Natural Edge Project, 2005). A GHG management and disclosure strategy may cause an improvement in the operational performance of a company through the identification of the opportunities of cost savings, through the possibilities of reduction in potential business risk and through innovation opportunities for products and services (Lash & Wellington, 2007). According to Young et al. (2009) companies in more emission-intensive industries that develop low-carbon products and green energy technologies would have competitive benefits.[54]

[53] The measurement process of environmental impact alone reveals a number of issues that have been ignored and presents enormous opportunities. According to Porter and Linde (1999) *"A large producer of organic chemicals, ..., hired a consultant to explore waste reduction opportunities in its 40 waste streams. A careful audit uncovered 497 different waste streams. The company had been wrong by a factor of more than ten"* for the estimation of its waste streams.

[54] The direct (scope1) GHG emission is only about 14% of total supply chain emission. The largest portion of GHG emission comes from supply chain sources (scope 2 and 3) (Mathews et al., 2008). A number of firms consider stategies for greening their supply chain. Thus, non-innovative firms might lose their market share.

Although, several studies predict that carbon management and reporting could improve the financial performance of a company, this association has not been investigated empirically.

Financial and social voluntary disclosure and accounting-based performance

There are a number of empirical studies in both financial and social disclosure that investigate the role of disclosure on financial performance based on a cost-benefit framework. A number of these studies examine the consequence of voluntary disclosure on market-based performance (Eaton et al., 2007; Guo et al., 2004; Healy et al., 1999; Petersen & Plenborg, 2006; Poshakwalea & Courtis, 2005). For example, they show that a higher level of disclosure causes an enhanced liquidity (e.g., Healy et al., 1999), an improved company valuation (e.g., Core, 2001), a reduced bid-ask spread (e.g., Guo et al., 2004) and a reduced cost of capital (e.g., Eaton et al., 2007). These studies are reviewed in the next section of this appendix. Several other studies reflect the impact of voluntary disclosure on accounting-based performance. These studies consider the direct and indirect costs of disclosure and the potential growth of revenue as the consequences of disclosure.

Allocating resources for voluntary disclosure is a critical decision. A cost-benefit framework provides an explanatory framework for additional disclosure beyond the requirements. This framework explains that voluntary disclosure occurs when the benefits of disclosure outweigh its costs. The possible benefits of voluntary GHG disclosure from a market perspective could be the reduction of information asymmetry, the reduction of agency cost, lower finance cost, increased liquidity

and decreased estimation risk. Measurement, verification, collation and publishing of information are considered as the definite cost of reporting. According to Leuz and Wysocki (2008), quantifying the costs of reporting is not easy, especially at the time of considering opportunity costs (e.g., managerial time). To the best of my understanding no study directly controls the effect of reporting costs on the disclosure decision. Several researchers use firm size as a proxy for resource-based theory. The assumption is that larger companies possibly have the required human and financial resources, and therefore are more likely to undertake additional reporting.

The indirect cost of disclosure is considered as proprietary costs. It is argued that companies consider proprietary costs in the disclosure decision process (Verrecchia, 1983). If stakeholders make strategic use of voluntary disclosure to their advantage, a proprietary cost could be imposed to a company. For example, based on a competitive market point of view, higher disclosure damages companies' competitive position because competitors use disclosed information to develop their competitive strategies (Mautz & May, 1978). A competitive threat may not be the only obstacle to disclosure. According to Leuz and Wysocki (2008) the greater transparency provided by voluntary disclosure might impose additional costs to the existing financing relationships, especially with creditors. Moreover, Dobler (2008) suggests the threat of rising litigation as another indirect cost of disclosure.

There are a number of indirect benefits for voluntary disclosure. For example, voluntary disclosure may deter the entry of potential competitors. Also, it can help to overcome competitors by revealing good news (Darrough & Stoughton, 1990).

Entwistle (1999) shows that R&D disclosure makes other companies modify their products. Voluntary disclosure might reduce the expected litigation costs and risks (e.g., Healy & Palepu, 2001). In addition non-voluntary disclosure practice might be interpreted as bad news by stakeholders (Depoers, 2000; Garcia-Meca et al., 2005; Guo et al., 2004) or as poor environmental performance (Verrecchia, 1983). Another positive indirect benefit of voluntary disclosure might be the enhancement of corporate image. An improved corporate image could develop performance (Gilley et al., 2000).

Consequences of voluntary disclosure on market-based performance

This section reviews studies in regard to the consequences of voluntary financial and social disclosure on market-based performance. Also, it includes relevant literature regarding the consequences of GHG disclosure on market-based performance.

Consequences of voluntary financial disclosure on market-based performance

A number of consequences of voluntary financial disclosure on financial market elements have been revealed so far. As investors and creditors require information for valuation, companies are motivated to disclose information voluntarily. Reporting a well-developed level of information can help investors and creditors analyse an entity more accurately (Levinsohn, 2001). Foster (2003), a former member of the FASB, states that more disclosure of information is equal to less ambiguity. People pay more for certainty. Several studies also suggest that voluntary disclosure decreases the risk of undervaluation (Healy & Palepu, 1995,

2001). Voluntary disclosure improves the market price of securities (Core, 2001; Hossain et al., 1994).

Also a higher degree of disclosure causes a lower cost of capital. Survey evidence shows that 44% and 39% of managers respectively strongly agreed with the positive impact of voluntary disclosure on liquidity and the reduction of cost of capital (Graham et al., 2005). Sletten (2012) finds that the reduction of stock price and the subsequent augmentation of equity cost are two incentives to disclosing information voluntarily. Voluntary disclosure helps companies to finance on the best terms and conditions (Gray et al., 1995). Better terms and conditions of finance contracts implies a reduced finance cost and thus, better market-based performance. In an empirical study, Hossain et al. (1994) point out that companies that issue public debt or equity in the international capital markets disclose extent wider variety of information to develop their chances of finance. Similarly, the findings of Frankel et al. (1995) confirm that companies raise the level of voluntary disclosure to obtain capital at a lower cost in future. Also, Cheng et al. (2011) point out that better stakeholder engagement and transparency about CSR performance are important elements in reducing capital constraints.

Several studies show that voluntary disclosure reduces the cost of capital and the estimation risk (e.g., Botosan, 1997; Eaton et al., 2007; Francis et al., 2005; Petersen & Plenborg, 2006; Poshakwalea & Courtis, 2005; Richardson & Welker, 2001; Sengupta, 1998). Researchers assume that companies tend to disclose voluntary information to influence the perception of investors in financial markets. They suggest that investors consider a risk premium for the existing information asymmetry, which causes a higher finance cost. Companies disclose

voluntary information to reduce information asymmetry and the subsequent agency cost in the cost of capital for the incomplete information (Petersen & Plenborg, 2006).

Several studies examine the consequence of voluntary disclosure on the cost of capital indirectly. They show the impact of voluntary disclosure in the reduction of information asymmetry based on a number of market-based proxies, such as, bid-ask spread, return volatility, and liquidity. Guo et al. (2004) and a number of other researchers have identified that the level of bid-ask spread decreases by disclosure of relevant information (Coller & Yohn, 1997; Diamond & Verrecchia, 1991). Voluntary disclosure also causes a higher liquidity of shares (Healy et al., 1999; Verrecchia, 2001). Also, it decreases information asymmetry to improve the chance of financing in capital markets (Healy & Palepu, 2001). Another benefit of voluntary disclosure in the capital markets is the reduction of return volatility (Guo et al., 2004). Further, Healy and Palepu (1995) present that voluntary disclosure reduces the dispersion of analyst forecasts about company performance.

Consequences of voluntary social disclosure on market-based performance

Currently social responsibility is becoming a significant phenomenon. Around 58% of institutional investors mentioned that they consider both economic factors and social factors[55] in the investment decision (Longstreth & Rosenbloom, 1973).[56] Non-financial information, like financial information, is useful in the

[55] Social factors encompass information about community, corporate governance, diversity, employee relations, environment, human rights and products.

[56] A small number of surveys have a different finding. They show that social responsibility information is not significant for an investment decision (e.g., Firth, 1978). Also several other

evaluation of future performance and cash flows (Dhaliwal et al., 2011). A socially responsible company with a good environmental image could simply develop relations with external stakeholders (e.g., shareholders, bankers, customers) and could mitigate risks (Reinhardt, 1999). The primary focus in this section is to review the literature about the impact of voluntary disclosure on the reduction of cost of capital and the reduction in information asymmetry.

There are a number of studies that find a positive impact of social disclosure on market-based performance, such as price/earnings ratio, stock price returns and analysts' forecasts dispersion.[57] For example, Bowman (1973) argues that social disclosure could have a positive impact on the price/earnings ratio. Anderson and Frankle (1980) suggest that investors consider a premium for the companies that provide non-financial disclosures. Non-financial disclosure is important for the users of annual reports and they seek this kind of information at the time of decision making (Deegan & Rankin, 1997). Anderson and Frankle (1980) also compare market values of socially disclosing companies with non-disclosing matched companies. They show that social disclosure positively affects monthly returns. Vanstraelen et al. (2003) supports the effect of non-financial disclosure on the reduction of dispersion in analysts' forecasts. Similarly, Aerts et al. (2008) find that the environmental disclosure causes less dispersion in the forecasts of analysts.

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surveys emphasise the value relevance of the environmental disclosure dimension of social disclosure for investment decision making (e.g., Deegan & Rankin, 1997).

[57] On the other hand, there are several studies that indicate that social and environmental disclosures do not significantly affect market-based performance. For example, Milne and Chan (1999), in an experimental study, find that only a small number of participants alter their investment decisions for social disclosure. Similarly, Mahapatra (1984) finds that investors do not reward firms for their social responsible attitudes. Belkaoui and Karpic (1989) also could not indicate any significant association between environmental disclosure and firm returns. These mixed results might be due to the lack of a single conceptual framework.

Two scenarios explain the market response to social disclosure. First, voluntary disclosure reduces information asymmetry (Eaton et al., 2007). The reduction of information asymmetry enhances the liquidity of stocks, reduces estimation risks and decreases the cost of capital (e.g., Dhaliwal et al., 2011). It is also likely that the content of disclosed information helps a better assessment of uncertainties about the future performance of a company. In other words, voluntary disclosure improves investors' understanding of the company, which in turn may decrease the cost of capital (Merton, 1987). According to agency theory, inadequate disclosure can increase information asymmetry. Lack of information may cause investors to undervalue companies and to become less willing to trade (Dhaliwal et al., 2011). This may lead to illiquidity and may cause an increase in bid-ask spread, transaction costs and finance costs (Verrecchia, 2001).

Second, the beneficial role of voluntary social disclosure could be described from a different angle. This angle refers to the direct influence of social disclosure on financial markets through investors' preference for the socially responsible investment. Socially responsible companies also benefit from a higher number of possible green clients, a lower likelihood of litigation risks and less possible pollution cleaning costs (Dhaliwal et al., 2011). Socially concerned investors are happy to pay a premium to invest in socially responsible companies (Richardson & Welker, 2001). Socially responsible companies are more legitimate in the eyes of investors. Capital markets award them with lower finance costs (Sharfman & Fernando, 2008).

Several studies examine the association between environmental performance and financial performance. They provide evidence that a socially responsible company

has less undesirable risk. Socially responsible companies achieve a greater firm value (Luo & Bhattacharya, 2006). According to Ambec and Lanoie (2008) stock markets respond significantly to good or bad information. Environmentally friendly actions make the access to financial markets easier by attracting investors (Cronin et al., 2011). Spicer (1978) shows that better pollution control is related to higher profitability, lower total risk, lower systematic risk and a higher price/earnings ratio in the pulp and paper industry. Moreover, Sharfman and Fernando (2008) find that financial markets reward companies that develop environmental strategies to control their environmental risks. These companies face a reduction in the cost of equity.[58]

Consequences of voluntary social disclosure on cost of capital

Recently banks have considered the social performance of their clients. They investigate the social responsibility aspects of projects beside their economic implications (Ambec & Lanoie, 2008). A company with a better social image may find it easier to borrow. For example, according to Young et al. (2009), five of the international leading commercial and investment banks apply the Carbon Principles[59] to limit climate risks in financing electricity generation projects. It means that environmental concerns in these projects could increase the cost of finance or even make lenders avoid the finance of high-emitting generation projects. Shareholders also consider the environmental performance of companies

[58] All the studies in this area could not find a significant and positive association between environmental performance and financial performance (e.g., Mathur & Mathur, 2000). The mixed result is possibly because of the ignorance of a lag preiod, the inconsistency in the measurement of variables, or the disregard for a number of major contorl variables.

[59] Carbon Principles introduce several procedures that help the evaluation of carbon risk in financing electric power projects for banks (The Carbon Principles, 2009).

(Ambec & Lanoie, 2008). The environmental concerns of both bankers and shareholders could influence the cost of capital.

Recently, several studies in the social disclosure literature have examined the association between social disclosure and the cost of capital. These empirical studies present conflicting evidence on the association between voluntary social disclosure and the cost of equity capital. Plumlee et al. (2010) examine whether quality voluntary environmental disclosure reduces the cost of equity capital. They suggest that institutional investors require more transparency about social performance. Thus, high quality voluntary social reporting leads to a lower level of capital cost. Dhaliwal et al. (2011) also investigate the impact of voluntary social disclosure on the reduction of cost of equity and vice versa. They find that companies with a greater level of cost of equity are more likely to release CSR reports. Moreover, they provide evidence that disclosing companies with a superior social performance have a lower cost of equity in comparison with non-disclosing companies. The reduction of information asymmetry, the investor preference, or an interaction between these two, explains the impact of social disclosure on the cost of capital. Social disclosure reduces the cost of capital by the mitigation of estimation error. Social disclosure also could reduce the cost of capital directly by investor preference. Green investors prefer to buy stocks that fulfil their social objectives even if these stocks have a lower return in comparison with “dirty” stocks (Richardson & Welker, 2001; Richardson et al., 1999).

On the other hand, Clarkson et al. (2010) find that voluntary environmental disclosure has no impact on the evaluation of environmental risk and future cash flow. Environmental disclosure does not influence the cost of equity or firm value.

Similarly, Cahan et al. (2012) suggest that CSR activities are on average uninformative.

Richardson and Welker (2001) provide evidence that social disclosure is positively related to the cost of capital. They examine the impact of voluntary financial and social disclosure on the cost of capital for Canadian companies. They highlight that there is an adverse relationship between financial disclosure and the cost of capital. However, their findings show that there is a significant positive association between social disclosure and the cost of capital.

The conflicting findings in this area could be due to not considering the conceptual framework of voluntary disclosure. Clarkson et al. (2010), in contrast to Plumlee et al. (2010) and Richardson and Welker (2001), controls the impact of environmental performance by data available from the Environmental Protection Agency. Clarkson et al. (2010) argue that as there is a positive association between environmental performance and the cost of equity capital, it is essential to control the effect of environmental performance at the time of the investigation of the relationship between social disclosure and the cost of equity capital. However, it is hypothesised that voluntary social disclosure reduces the cost of capital for the provided relevant information (which helps the reduction in information asymmetry or which provides useful information for socially responsible investors). If the environmental performance data are already available from the Environmental Protection Agency, voluntary environmental disclosure by companies means repeated disclosure of information. In other words, environmental disclosure is not timely. In fact, there is no information asymmetry and voluntary environmental disclosure is not useful for decision

makers (because it has already been published by Environmental Protection Agency). Then it is natural to find that voluntary environmental disclosure has no impact on the cost of equity or firm value. Similarly, Richardson and Welker (2001) emphasise that:

> ... the lack of strong empirical findings on the relationship between disclosure and cost of capital may be an artifact of the markets and information set that are used in empirical tests. If there is little variation in the information disclosed due to effective regulatory interventions, or if analysts routinely generate information independently of the companies' own disclosures, then the power of empirical tests will be significantly reduced.

To overcome this problem Clarkson et al. (2010) mention that environmental disclosure encompasses future environmental liability in addition to the released information by Environmental Protection Agency. Based on the existing accounting conceptual framework, material financial risks (contingent liability) are mandated to be disclosed in annual reports. If there is a possibility of future environmental liability, it has to be released. The disclosure of contingent liability would not be considered as a voluntary disclosure.

Consequences of voluntary GHG disclosure on market-based performance

Climate change reporting could provide relevant information about carbon risks and opportunities for investors. It is likely that GHG disclosure reduces information asymmetry and provides relevant information for green investors. GHG disclosure could reduce estimation risks, bid-ask spread, return volatility and the cost of capital.

Despite the rising significance of GHG information, there are limited studies available about how climate change information disclosure in capital markets

influences market-based performance. For example, Delmas and Nairn-Birch (2010) examine the association between the level of carbon emissions and financial performance amongst 1100 US companies for the 2004–2008 period. They find that total carbon footprint has a negative impact on Tobin's Q. The negative relationship is described by the discount of future expected cash flows in an uncertain environment. Similarly, Matsumura et al. (2011), reviewing the CDP questionnaire of S&P500 companies, find that there is a negative association between total carbon footprint and firm value. Also, Chapple et al. (2013) indicate that the market penalises the most carbon intensive companies, by between 7% and 10% of market capitalisation. Further, Griffin et al. (2010) examine the interest of investors in companies' GHG emission disclosures. They highlight that the level of GHG emission is negatively associated with stock price, supporting the notion that investors care about the GHG information of companies. They also conduct an event study and provide evidence that the market responds significantly at the time of GHG disclosure. Similarly, Bose et al. (2013), using observations from 33 countries, find that the relationship between GHG emissions and market value is significantly negative. In an event study through the CDP questionnaire, Kim and Lyon (2011) suggest that institutional investor activism towards carbon issues can increase shareholder value when there is more consciousness about climate change. However, they could not find any systematic evidence of the growth in value because of the participation of a company in the CDP alone. Ziegler et al. (2009) also examine the association between the level of response of companies to climate change and stock performance. They show that a higher level of corporate activities about climate change in regions and periods

with less pressure to tackle climate change challenges may cause negative abnormal returns. However, in regions and periods with more ambitious climate policies, companies would have positive abnormal returns for their responses to climate change. They state that the relationship between carbon management efforts and financial performance depends on the stringency of carbon regulation. A cost benefit analysis is therefore a relevant mechanism for decision making.

In summary, previous studies assess the consequence of voluntary GHG disclosure on the market-based performance of companies mostly through the CDP questionnaire disclosure. However, the majority of companies that respond to the CDP questionnaire are large companies subject to several GHG regulations. For example, three large Australian companies, BHP Billiton, Woolworths and Telstra Corporation (PricewaterhouseCoopers, 2009), voluntarily respond to the detailed CDP questionnaire. Also, they have to report GHG information to the Greenhouse and Energy Data Officer. Second, despite a growth in the quantity of GHG disclosure in the CDP questionnaire, the quality and informational value of this disclosure is still low (Doran and Quinn, 2009). For example, Kolk et al. (2008), based on the characteristics of data provided in the CDP questionnaires, suggest that the level of carbon disclosure is not valuable for investors, NGOs or policy makers. This study chooses annual reports as the source of GHG disclosure as they are more consistent among companies. Further, it avoids sample selection bias by not limiting the sample to large companies. Most important of all, it applies a more comprehensive approach by focusing on several aspects of market-based performance.

To this point, a number of consequences of voluntary disclosure of voluntary disclosure applied in prior voluntary financial, social and the GHG disclosure literature are reviewed. The next section addresses several determinants of voluntary disclosure (firm-specific characteristics) of voluntary disclosure.

Determinants of voluntary disclosure (firm-specific characteristics) and voluntary disclosure

Information asymmetry evolves in both financial and non-financial aspects of corporate activities. One type of voluntary disclosure refers to the disclosure of specific financial information, such as R&D spending by each segment within a company. The other type contains voluntary disclosure of non-monetary information, such as: corporate environmental performance; targets; and strategies. A review of accounting literature in the field of determinants (firm-specific characteristics) of voluntary (financial, social and GHG information) disclosure is discussed in the following sections.

Determinants of voluntary disclosure (firm-specific characteristics) and voluntary financial disclosure

In this section, the voluntary financial disclosure literature, which focuses on firm-specific characteristics, is reviewed. Several disclosure studies examine the association between firm-specific characteristics and voluntary financial disclosure. The most frequently tested determinants in these studies are firm size, ownership concentration, board independence, leverage and foreign listing status.

Firm size[60] has been shown to be positively related to voluntary financial disclosure (Archambault & Archambault, 2003; Chavent et al., 2006; Cooke, 1989, 1991; Depoers, 2000; Eng & Mak, 2003; Haniffa & Cooke, 2002; Hossain et al., 1994; Meek et al., 1995; Robb et al., 2001; Vanstraelen et al., 2003; Zarzeski, 1996). For example, using sales as a proxy for size, Chavent et al. (2006) highlight that the extent of disclosure on provisions is positively related to firm size. This positive relation is explained in a variety of ways. For example, Chow (1982) suggests that larger companies have more agency costs because of the likelihood of having more outside shareholders and creditors. Therefore, they disclose information to reduce agency cost (Jensen & Meckling, 1976; Watson et al., 2002). Moreover, larger companies are more likely to be at the centre of public attention (Cormier et al., 2005; Patten, 1991). They might be under greater pressure from stakeholders. It is also argued that as the cost of providing detailed information is high, larger companies are more likely to afford extra reporting costs. Therefore, the possibility of voluntary disclosure is higher amongst larger companies (Depoers, 2000).

Ownership concentration is negatively associated with disclosure. This suggests that a company with widely held shares discloses more information (Archambault & Archambault, 2003; Baek et al., 2009; Eng & Mak, 2003; Haniffa & Cooke, 2002; Hossain et al., 1994; Luo et al., 2006). Again, the objective of reduction in agency costs explains this association. Companies with less ownership concentration are under greater scrutiny by shareholders. A company with a lower ownership concentration has a greater number of shareholders than a company

[60] The total book value of assets, market capitalisation value, sales revenue, or the number of shareholders are different applied proxies for firm size.

with a high ownership concentration. It might be expected that a company is under more pressure where there is a larger number of shareholders. This company publishes additional information based on stakeholder theory (Cormier et al., 2005) to be responsive to the information demands of its shareholders.

The impact of board independence on the level of disclosure has been tested in several prior studies (e.g., Baek et al., 2009; Haniffa & Cooke, 2002; Muttakin & Subramaniam, 2013). They examine the influence of the composition of the board directors (a proxy for corporate governance) on disclosure policy. The 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 the board causes more effective monitoring of the actions of executive directors (Fama & Jensen, 1983) and provides an independent board. In this case, in the presence of information asymmetry, the board possibly wants to disseminate more information (Gompers, 1995), which ultimately reduces agency costs.

Leverage is one of the firm-specific characteristics, the relationship of which 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 as a result of greater pressure by creditors of highly leveraged companies because debt holders are eager to be informed about issues that impact their debt contracts. Several studies (e.g., Hossain et al., 1994; Meek et al., 1995) do not find leverage to be a significant determinant of disclosure.

Several studies investigate the impact of foreign listing status of companies on disclosure. They explain the association between foreign listing status and the level of disclosure by emphasising 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.

So far the most commonly examined determinants in financial disclosure studies have been outlined. As the financial disclosure literature has gained momentum, social disclosure studies gradually started to develop. The growing literature of voluntary social disclosure examines several determinants of disclosure. They encompass determinants identified in the financial disclosure literature, and a number of determinants related to social responsibility concepts. The next section outlines relevant studies regarding determinants of social voluntary disclosure.

Determinants of voluntary disclosure (firm-specific characteristics) and voluntary social disclosure

As mentioned earlier, information asymmetry develops in both the financial and non-financial aspects of the operations of a company. Relevant literature regarding the impact of firm-specific factors on voluntary financial disclosure was discussed in the previous section. This section refers to the review of firm-specific determinants in the social disclosure literature. The non-financial disclosure literature applies quite similar determinants to those of the financial disclosure literature. Also, it includes a number of determinants that are closely related to social issues. A number of determinants that have been investigated specifically

in the voluntary social disclosure literature are introduced in the following paragraphs.

Several studies use an environmental disaster to show the impact of a tendency to legitimisation on the growth of environmental disclosure. For example, Patten (1992) tests the impact of the Exxon Valdez oil spill on the environmental disclosures of petroleum companies other than Exxon. The findings indicate that this environmental disaster has caused a significant growth in the level of environmental reporting among other companies in the same industry. Similarly, Summerhays and de Villiers (2012) point out that the six largest oil companies at the time of the Gulf of Mexico oil spill increased their environmental disclosures. Some other studies use archival information, or conduct an experiment to examine the effect of tendency to legitimisation on environmental disclosure. For instance, O'Donovan (2002) provides evidence about the relationship between disclosure and attaining, sustaining and fixing legitimacy by the development of a quasi-experimental method among three Australian companies.

Support for examining industry-sensitivity as a specific determinant of social disclosure comes from several studies (Adams et al., 1998; Choi, 1999; Hackston & Milne, 1996; Newson & Deegan, 2002). Companies disclose information based on the nature and norms of their industries (Gibbins et al., 1990). Companies in more polluted industries adhere to a higher level of environmental disclosure to legitimise their activities due to political visibility (Gray et al., 1995; Patten, 2002).

Media coverage is another hypothesised determinant in a number of social disclosure studies. It has been identified that a higher level of media attention leads to a higher level of environmental disclosure (Brown & Deegan, 1998; Cormier & Magnan, 2003). Deegan et al. (2002) study the trend of BHP Ltd's social disclosure from 1983 to 1997. Their findings indicate that in response to a negative media release, the company reported positive social information. This could be explained by legitimacy theory. Samkin and Schneider (2010) argue that in the light of extensive negative media publicity, the informal reporting disclosures are used "to gain, maintain and repair the organisational legitimacy".

The higher information costs shareholders bear to obtain the additional information has been shown to be positively related to the greater likelihood of environmental disclosure (Cormier & Magnan, 1999; Cormier & Magnan, 2003; Cormier et al., 2005). Competitive market forces may motivate mangers to disclose their environmental information voluntarily because in the absence of disclosure by companies, stakeholders may look for information from other sources that could not be reliable and therefore could be considered unfavourable by companies (Freedman & Jaggi, 2011). In addition, obtaining information from externalities is costly. In other words, investors eventually impose this cost on the non-disclosing companies (Johnston, 2005).

The other frequently tested determinant in social disclosure is social and environmental performance. Polluters tend to have both litigation and reputational risks (Kolk et al., 2008; Lash & Wellington, 2007). The findings of research about the impact of environmental performance on disclosure are mixed. Several studies provide evidence of a positive association between these two factors (e.g., Al-

tuwaijri et al., 2004; Clarkson et al., 2008; Patten, 2002). For example, Clarkson et al. (2008) highlight that companies with better environmental performance are more likely to report environmental information. On the other hand, several studies in this area show a negative or zero significant association between environmental performance and disclosure. For instance, Patten (2002) tests the relationship between environmental disclosure and environmental performance. His findings highlight that environmental disclosure and environmental performance are negatively related. Cormier et al. (2011) also indicate that there is a significant negative association between environmental performance of Canadian companies and their environmental disclosure. Wiseman (1982) could not find any significant relationship between environmental performance and the Wiseman environmental disclosure index.

Age of company is another variable that has been examined as a determinant of environmental disclosure in several studies. Cormier and Magnan (1999) suggest that voluntary disclosure is negatively associated with age of company. 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 perceived benefits of their better environmental performance and to overcome competitors.

Determinants of voluntary disclosure (firm-specific characteristics) and voluntary GHG disclosure

Because of the perceived significance of climate change, several companies disclose their GHG information voluntarily. As a result, a new concept is defined

in the voluntary disclosure literature, that is, voluntary GHG disclosure. Table 24 summarises a comprehensive review of the previous literature on the determinants of voluntary GHG disclosure.

The available studies about determinants of voluntary GHG disclosure are supported by stakeholder theory and legitimacy theory. For example, shareholder activism under a stakeholder theoretical framework is identified to be one external factor affecting the disclosure position of a company. Reid and Toffel (2009) show that shareholder resolutions filed against a company or against other companies in the same industry cause a growth in response rate to the CDP questionnaire. Similarly, Wegener (2010) investigates that shareholder activism influences the decision by Canadian companies to respond to the CDP questionnaire. Cotter and Najah (2012) also point out the impact of powerful investors on climate change disclosure via corporate communication channels. In the same way, Kolk et al.(2008) analyse the responses of FT500[61] companies to the CDP questionnaire, and argue that institutional investors have been successful in urging companies to disseminate detailed carbon information.

Industry and geographical factors (such as ratification of the Kyoto Protocol, the diversity of environmental regulations, the existence of common law or the existence of ETS) are other determinants of GHG disclosure. Industry is considered as a proxy for legitimacy theory in a number of GHG disclosure studies. Industry is considered as a proxy for legitimacy theory in a number of GHG disclosure studies. That means companies in highly polluted industries are more likely to disclose carbon information publicly. Wahyuni et al. (2009) and

[61] Financial Times 500

Luo et al. (2012) highlight a positive association between industry and GHG disclosure. Moreover, Matsumura et al. (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 carbon disclosure. They show that companies from countries that confirmed the Protocol have a higher level of GHG disclosure. Further, multinational companies that have plants in countries that accepted the Protocol but have their headquarters 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 US, EU, Japanese, Canadian, and Indian companies. Freedman and Jaggi (2011) also highlight that Indian[62] companies disseminate even less GHG disclosure than all the companies from other countries. In addition, they document that GHG disclosure is more frequent among Canadian and Japanese companies in comparison with European companies. Also, Reid and Toffel (2009) indicate that companies head offices located in a region with proposed GHG regulations are more likely to release GHG information through the CDP questionnaire. In another study, Luo et al. (2012) reveal that carbon disclosure is more common among companies in countries that adopted ETS and companies in common law countries.

[62] India has ratified the Protocol but has not set any limits on GHG emissions (United Nations, 2013).

The existence of environmental management systems (EMS) is considered as the other determinant of voluntary GHG disclosure (Wahyuni et al., 2009). Wahyuni et al. (2009) investigate the voluntary GHG disclosure procedure of ASX300 companies in 2007 (before the execution of mandatory reporting under the *NGER Act 2007*) using a legitimacy theory framework. Using a logistic regression analysis, they find that the existence of an EMS in a company, availability of a certified EMS, industry and firm size are the dominant determinants of voluntary GHG disclosure. They emphasised the voluntary phase of GHG disclosure by their sample companies by analysing the years before the enactment of the *NGER Act 2007*. However, several companies in Australia have been preparing carbon reports before the enactment of the *NGER Act 2007*, as they were subject to state ETS. For example, AGL Energy Limited is one sample company in Wahyuni et al.'s (2009) study that is a large polluter and is subject to state regulations[63] prior to the enactment of the Act. 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.'s (2009) assumption of a discretionary phase of GHG disclosure was not met.

In summary, previous studies assessing determinants of voluntary GHG disclosure by companies that were mainly subject to environmental regulations used a limited theoretical framework. This study chooses the sample from all the voluntarily disclosing companies and does not limit the sample to a specific listing

[63] 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 in the world that introduced carbon rights legislation. It set the first mandatory ETS 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).

status (e.g., ASX300) or a specific industry. Also, it applies a comprehensive approach by incorporating proxies for voluntary disclosure theory, agency theory and resource-based theory, in addition to stakeholder theory and legitimacy theory.

Table 24: Studies on the determinants of GHG voluntary disclosure

Authors	Sample Companies	Disclosure Approach	Reason for Disclosure	Methodology	Determinants of Disclosure
Stanny and Ely (2008)	S&P500	CDP	Social pressure Institutional investors	Logistic regression	Size Previous disclosure Foreign sales
Prado-Lorenzo et al., (2009)	Fortune500	Web-based data	Social pressure Information asymmetry	Content analysis regression	Size Market capitalization
Freedman and Jaggi (2011)	Forbes Magazine list of 2000 largest firms	CDP	Geographical position	Content analysis regression	Ratifying GHG Protocol Size
Wahyuni, Rankin and Windsor (2009)	ASX300	Annual, sustainability reports and web-based data	Social pressure	Logistic regression	Existence of an EMS Certified EMS Industry Size
Cotter and Najah (2011)	G500	Annual, sustainability reports and web-based data	Institutional investors	Content analysis regression	Powerful investors Size
Luo, Lan and Tang (2010)	Global500	CDP	Geographical position Regulatory pressure	Logistic regression	Existence of ETS or a common low Size Industry
Peters and Romi (2009)	Large firms responding to CDP	CDP	Geographical position	Logistic regression	Environmental regulation Market-based financial systems
Wegener (2010)	Canadian firms answering CDP questionnaire	CDP	Social pressure Information asymmetry	Logistic regression	Shareholder activism Low cost publicity Litigation risk Size
Kolk, Levy, and Pinkse (2008)	FT500	CDP	Institutional investors	Descriptive research	Powerful investors
Stanny (2010)	S&P500	CDP	Social pressure	Logistic regression	Previous disclosure
Reid and Toffel (2009)	S&P500	CDP	Social pressure Geographical position	Logistic regression	Shareholder activism Regulatory threats Size
Freedman and Jaggi (2005)	Fortune500	Annual, sustainability reports and web-based data	Geographical position	Content analysis regression	Ratifying GHG Protocol Size
Matsumura, Prakash and Vera-Muñoz (2011)	S&P500	CDP	Superior nvironmental performance and Industry peers disclosure	Logistic regression	Environmental proactive actions Peer pressure

Although several previous studies (e.g., Stanny & Ely, 2008; Prado-Lorenzo et al., 2009; Luo et al., 2012) look at the determinants of voluntary disclosure in a GHG setting, generalising 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 voluntary GHG disclosure. However, these samples are chosen from the largest companies in the world, such as companies in Fortune 500, S&P500 and Global 500 (Berk, 1983). Further, these large companies are mostly subject to mandatory GHG reporting regulations and the reason for their disclosure is more likely to be regulation rather than discretion. Several researchers, such as, Luo et al. (2012) choose their sample from companies that responded to the CDP questionnaire. They claim that respondents' behaviour is discretionary, as sample companies respond to the CDP questionnaire in a voluntary manner. However, companies that responded to the CDP questionnaire are mainly companies that are subject to a variety of environmental regulations. For example, from the Global 500 companies responding to the CDP questionnaire, in Luo et al. (2012), three Australian companies were included: Telstra Corporation, BHP Billiton and Woolworths (PricewaterhouseCoopers, 2009). These companies voluntarily answered the detailed CDP questionnaire. Also, they are mandated to release GHG information to the Greenhouse and Energy Data Officer (GEDO) under the *NGER Act 2007*. According to part 4, section 24(1) of the *NGER Act 2007*:

> The Greenhouse and Energy Data Officer must publish on a website, by 28 February in a financial year, totals of:
>
> (a) greenhouse gas emissions; and
> (b) energy production; and
> (c) energy consumption;

> reported in relation to a registered corporation's group for the previous financial year.

Further, the available studies on the determinants of voluntary GHG 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. This research considers a range of proxies to support voluntary disclosure theory and agency theory, in addition to legitimacy theory and stakeholder theory.

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APPENDIX 3: GHG disclosure index

[Adapted mostly from de 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 a 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 product or service of the entity across all related stages of the life cycle (production, delivery, use and disposal)

A5. The amount of direct GHG (scope1) per facilities of the business

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

A6. The amount of indirect GHG (scope2) per facilities of the business

A7. The amount of other indirect GHG (scope3) per facilities of the business

A8. The amount of supply chain GHG per business

The total amount of emissions produced by the supply chain of a company, is indexed

A9.The sources of GHG

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

A10. The sources of GHG by the products and services of the business

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 company GHG position will be considered as one otherwise zero.

B1. The method used for estimation of GHG

The *NGER Act 2007* 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 the GHG emissions status of a company

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 achievement of targets in a financial year

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

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 energy extensive 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 planed actions, which should be reflected under ‘targets’ category.
- The disclosure is being indexed only for actions made by the company.

Other

- GHG Disclosures that were not possible to be categorised in any specific categories cited previously.