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Voluntary disclosure of greenhouse gas emissions, corporate governance and earnings management: *Australian evidence*

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ABSTRACT

This study examines the impact of corporate governance mechanisms on greenhouse gas emission disclosure and the extent to which the disclosure of greenhouse gas emission information is associated with earnings management and the liquidity of firms' shares. The sample for this study is drawn from Australian publicly listed firms that voluntarily disclosed their greenhouse gas emission information through voluntary disclosure channels such as the Carbon Disclosure Project, annual reports, standalone sustainability reports, and corporate websites between 2006 and 2009. This study adopts the Carbon Disclosure Project 2010 scoring methodology to measure the quality of greenhouse gas emission disclosure. A content analysis was used to score the quality of voluntary disclosures in annual financial and sustainability reports, and the information provided on company websites.

In this thesis, two competing views: the stakeholder value maximisation view and the shareholder expense view are examined in relation to the impact of corporate governance mechanisms on greenhouse gas emission disclosures and the extent to which the disclosure of greenhouse gas emission information is associated with earnings management. The stakeholder value maximisation view predicts that firms engage in socially responsible initiatives such as greenhouse emission reduction strategies and targets associated with climate change to fulfil the legitimate interests of stakeholders. On the other hand, the shareholder expense view suggests that firms engage in socially responsible initiatives such as greenhouse gas emission reduction initiatives at the expense of shareholders.

This research contributes several new findings to the literature. Firstly, with regards to the relationship between corporate governance mechanisms and voluntary disclosure, this thesis has found that effective corporate governance mechanisms such as greater board independence, the absence of Chief Executive Officer duality, the presence of board gender diversity, decrease in directors' share ownership, increase in institutional ownership and smaller size of the audit committee drive voluntary greenhouse gas emission disclosure. These results suggest that firms with effective corporate governance mechanisms focus on the legitimate interests of a broader group of stakeholders with regards to climate change, particularly greenhouse gas emission mitigation targets. This is consistent with the stakeholder value maximisation view of firms which is based on stakeholder theory and legitimacy theory as opposed to the shareholder expense hypothesis which is based on agency theory. These results are robust to control for self-selection using the Heckman two-stage sample selection procedure. Our results are also robust to the exclusion of financial sector firms which arguably could be affected by the Global Financial Crisis.

Secondly, this research finds a weak negative relationship between voluntary disclosure of greenhouse gas emission disclosure and earnings management. This study has found only weak support for the stakeholder value maximisation view, suggesting that stakeholder-focused firms are less likely to engage in earnings management. In addition, Australian firms are trying to maintain a balance between the quality of greenhouse gas emission disclosure and the quality of financial reporting. As a result, they have difficulty satisfying multiple objectives simultaneously. These results are robust for endogeneity controls using the two-stage least squares method.

Thirdly, this study has found that the voluntary disclosure of greenhouse gas emission information by firms has an impact on the liquidity of that firm's shares. This suggests that firms that disclose more greenhouse gas emission information voluntarily experience improved liquidity of their shares. These results support the view of Balakrishnan et al. (2013) that managers' decisions to disclose more voluntary information could directly affect the liquidity of their firms' shares. Managers may shape the liquidity of their firms' shares by providing more greenhouse gas emission information voluntarily through the Carbon Disclosure Project and their corporate reporting channels.

Finally, larger and more visible firms tend to provide more information regarding climate change related due to social pressures. Firms with higher growth opportunities tend to provide less greenhouse gas emission information. Firm leverage and age are positively associated with the quality of greenhouse gas emission disclosure; indicating that longer-established firms with more leverage may disclose more the quality of greenhouse gas emissions in order to maintain their reputation among the stakeholders.

CERTIFICATION OF DISSERTATION

I certify that the ideas, analyses, results and conclusions reported in this thesis are entirely my own effort, except where otherwise acknowledged. I also certify that this work is original and has not previously been submitted for any other award except where otherwise acknowledged.

_____ _____

Signature of Candidate Date

Endorsement

_____ _____

Signature of Principal Supervisor Date

_____ _____

Signature of Associate Supervisor Date

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TABLE OF CONTENTS

ABSTRACT... i
ACKNOWLEDGEMENTS ... iv
TABLE OF CONTENTS ... v
LIST OF FIGURES ... ix
LIST OF TABELS ... ix
APPENDICES ... x
ABBREVIATIONS ... xi
PULBICATIONS ... xii

1. INTRODUCTION ... 1

1.1. Background ... 1
1.2. Research question ... 4
1.3. Contributions of the study ... 6
1.4. Methodology ... 7
1.5. Structure of the thesis ... 7

2. LITERATURE REVIEW ... 9

2.1. Introduction ... 9
2.2. An overview of Australian legislation on GHG reporting ... 9
2.3. Voluntary GHG emission disclosure medium ... 12
2.4. Voluntary disclosures of GHG emission information ... 14
2.5. GHG emission disclosure and firm value ... 16
2.5.1. Capital market effects ... 16
2.5.2. GHG emission disclosure and firm value ... 17
2.5.3. GHG emission disclosure and firm financial performance ... 18
2.6. Incentives for voluntary GHG emission information ... 19
2.6.1. Reduction in information asymmetry ... 20
2.6.2. Political costs avoidance ... 21
2.6.3. Good corporate governance ... 21
2.6.4. Competitive advantage ... 22
2.6.5. Compensation for earnings management ... 23
2.6.6. Stakeholders' demands ... 23
2.6.7. Increases in liquidity ... 24
2.7. Definitions of corporate governance ... 24
2.7.1. Corporate governance in Australia ... 25
2.8. Voluntary disclosure and corporate governance quality ... 26
2.8.1. Corporate governance and CSR ... 27
2.8.2. Corporate governance and environmental disclosure ... 28
2.8.3. Corporate governance and GHG emission disclosure ... 28

2.9. Voluntary disclosure and corporate governance in Australia 30
2.9.1. Board independence 32
2.9.2. CEO duality 34
2.9.3. Board gender diversity 35
2.9.4. Directors' share ownership 36
2.9.5. Institutional share ownership 37
2.9.6. Frequency of audit committee meetings 38
2.9.7. Size of audit committee 39

2.10. Voluntary disclosures and earnings management 39
2.10.1. CSR and earnings management 40
2.10.2. Environmental disclosure and earnings management 44
2.10.3. Voluntary disclosure, corporate governance and earnings management 49

2.11. Voluntary disclosure and liquidity 49

2.12. Research gap in the literature 52

3. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT 53

3.1. Introduction 53

3.2. Theoretical framework 53
3.2.1. Stakeholder theory 53
3.2.2. Agency theory 55
3.2.3. Legitimacy theory 56

3.3. Research question 57

3.4. Stakeholder value maximisation vs. shareholder expense views 57
3.4.1. Stakeholder value maximisation view 57
3.4.2. Shareholder expense view 59

3.5. Hypotheses development 60
3.5.1. Corporate governance and GHG disclosures 60
3.5.2. GHG disclosures and earnings management 62
3.5.3. GHG disclosures, corporate governance and earnings management 63
3.5.4. Liquidity and GHG disclosure 64

3.6. Conclusion 65

4. DATA AND METHODOLOGY 67

4.1. Introduction 67

4.2. Sample selections and exclusions 67

4.3. Data collection 68

4.4. Measurement of variables 69
4.4.1. Voluntary disclosure of GHG emission 69
4.4.2. Corporate governance variables 71
4.4.3. Earnings management calculations 73
4.4.4. Measures of stock liquidity 75
4.4.5. Control variables 78

4.5. Endogeneity and selection bias 80

4.5.1. Lag independent variables *80*
4.5.2. Year and industry dummy *80*
4.5.3. Use of a variety of control variables *80*
4.5.4. Two-stage least squares method *81*
4.5.5. Heckman two-stage estimation *81*

4.6. Data analysis techniques 81
4.6.1. Cross-sectional multiple regression model *81*

4.7. Conclusion 83

5. DESCRIPTIVE STATISTICS 85

5.1. Introduction 85

5.2. Sample disdribution by responses 85

5.3. Descriptive statistics for corporate governance and GHG disclosure 86

5.4. Earnings management and GHG emission disclosure 94

5.5. Voluntary disclosure of GHG emission and liquidity 95

5.6. Conclusion 98

6. DATA ANALYSIS AND RESULTS 99

6.1. Introduction 99

6.2. The impact of corporate governance on voluntary GHG emission disclosure 99
6.2.1. Correlation results for H1 (a) and (b) *99*
6.2.2. Voluntary GHG emission disclosure and corporate governance variables *102*
6.2.3. Long-term performance *108*
6.2.4. Year-by-year regression results *110*
6.2.5. Disclosure sub-scores and corporate governance *113*
6.2.6. Robustness analysis *115*

6.3. Voluntary GHG emission disclosure and earnings management 121
6.3.1. Correlation matrix *122*
6.3.2. Voluntary GHG emission disclosure and earnings management *124*
6.3.3. Year-by-year regression results *128*
6.3.4. Disclosure sub-scores and corporate governance *130*
6.3.5. GHG emission disclosure, corporate governance, and earnings management *131*
6.3.6. Robustness tests *134*

6.4. Stock market liquidity and voluntary disclosure of GHG information 138
6.4.1. Correlation results *138*
6.4.2. Stock liquidity and voluntary disclosure of GHG emissions *141*
6.4.3. Year-by-year regression results *143*
6.4.4. Market liquidity and sub-disclosures of GHG emission information *145*
6.4.5. Market liquidity,GHG emission information and corporate governance *146*
6.4.6. Conclusion *147*

7. CONCLUSIONS AND IMPLICATIONS 149

7.1. Introduction 149

7.2. Research questions 149
7.2.1. What are the impacts of corporate governance characteristics on voluntary GHG emission information disclosure? 149
7.2.2. What is the relationship between voluntary disclosures of GHG emission information and earnings management? 152
7.2.3. Do Australian firms with higher voluntary disclosure of GHG emission information have higher liquidity of the firms' shares? 153
7.3. The contributions of the study 153
7.3.1. Contributions to the literature 153
7.3.2. Contributions to the practice 154
7.4. The limitations of the study 154
7.5. Recommendations for future research 155
8. LIST OF REFERENCES 157
APPENDICES 179

LIST OF FIGURES

Figure 2.1 Total GHG emissions 11

Figure 2.2 Quality of Corporate Responsibility Reporting 13

LIST OF TABLES

Table 2.1 Sustainability disclosure and earnings management 46

Table 4.1 Total sample firms before exclusions 67

Table 4.2 Summary of sample selection and exclusions 68

Table 4.3 Definitions of variables 76

Table 5.1Sample distribution by responses and CDP reporting years 86

Table 5.2 Corporate governance and GHG emission disclosure decisions 87

Table 5.3 Quality of GHG information scores attained across years 89

Table 5.4: Quality of GHG emission disclosure by industries 90

Table 5.5 Corporate governance and quality GHG emission information 91

Table 5.6 Absolute value of discretionary accruals 94

Table 5.7 Amihud's illiquidity for disclosing and non-disclosing samples 95

Table 5.8 Amihud's illiquidity measure and disclosure quality 96

Table 5.9 Bid-ask spreads and disclosing and non-disclosing sample 97

Table 5.10 Bid-ask spreads and disclosure quality 98

Table 6.1 Correlation matrix (Pearson above diagonal and Spearman below diagonal) 101

Table 6.2 Decision to disclose GHG emission information and corporate governance 103

Table 6.3 Quality of GHG emission information and corporate governance 106

Table 6.4 Long-term performance 108

Table 6.5 Decision to Disclose GHG emission information and corporate governance by years 110

Table 6.6 Quality of GHG disclosure and corporate governance by years 112

Table 6.7 Sub-scores of disclosures and corporate governance 114

Table 6.8 Heckman two-stage sample selection model 116

Table 6.9 GHG emission disclosure and alternative corporate governance 119

Table 6.10 Regression results excluding financial sector 120

Table 6.11 Correlation between GHG disclosure and earnings management (Pearson above diagonal and Spearman below diagonal) 123
Table 6.12 Choice of GHG disclosure and earnings management..... 125
Table 6.13 Quality of GHG information disclosure and earnings management .. 126
Table 6.14 Choice of GHG disclosure and earnings management by years 128
Table 6.15 Quality of GHG emissions disclosure and earnings management by years..... 129
Table 6.16 Sub-scores of quality of GHG emissions information and earnings management..... 130
Table 6.17 GHG disclosure, corporate governance and earnings management... 132
Table 6.18 Quality of GHG, corporate governance and earnings management... 133
Table 6.19 Heckman two-stage and OLS two-stage 135
Table 6.20 Analysis of an alternative measure of corporate governance..... 137
Table 6.21 Correlation between liquidity and disclosure of GHG (Pearson above diagonal and Spearman below diagonal)..... 139
Table 6.22 Liquidity and disclosure of GHG information 141
Table 6.23 Liquidity and disclosure of GHG information by years..... 143
Table 6.24 Liquidity and sub-scores of GHG emission information disclosure .. 145
Table 6.25 Liquidity, disclosure and corporate governance 146

APPENDICES

Appendix 1: CDP 2010 scoring methodology……179
Appendix 2: Regression normality test……204

ABBREVIATIONS

AGE	Listing age
AMILOG	Logarithm of Amihud's illiquidity measure
AMT	Number of audit committee meetings
ASX	Australian Stock Exchange
ASXCGC	Australian Stock Exchange Corporate Governance Council
BHD	Blockholders Ownership
BIDLOG	Logarithm of bid-ask spread
CDP	Carbon Disclosure Project
CDLI	Carbon disclosure leadership Index
CEO	Chief Executive Officer
CRL	Cross-listing
CSP	Corporate Social Performance
CSR	Corporate Social Responsibility
DCA	Discretionary current accruals
DISC	Disclosure decisions
DIV	Board gender diversity
DUA	DEO duality
ETS	Emission Trading Scheme
GAAP	Generally accepted accounting principles
GHG	Greenhouse gas
GICS	Global industry classification standard
IND	Board independence
IPCC	Intergovernmental Panel on Climate Change
KPMG	KPMG international cooperative
LMV	Logarithm of market value
MAU	Size of audit committee
MSO	Directors' ownership
NDCA	Non-discretionary current accruals
NGER	The National Greenhouse Energy Reporting Act
NPI	National Pollution Inventory
OECD	Organisation for Economic Co-operation and Development
QUAL	Disclosure quality
ROA	Return on assets
SEC	Security Exchange Commission (US)
SWT	Switching from non-disclosing to disclosing, or vice versa
TBL	Triple Bottom Line
TCA	Total current accruals
TOB	Tobin's *q*
VOL	Volatility

LIST OF PAPERS PRESENTED AT INTERNATION CONFERENCES

1. Eswaran Velayutham, Chandrasekhar Krishnamurti and Ariful Hoque '*Internal corporate governance, environmental committee and environmental risks information: Australian evidence*' presented at World Business and Social Science Research Conference, 24-25 October 2013 at Novotel Hotel Bangkok on Siam Square, Thailand.

2. Eswaran Velayutham, Chandrasekhar Krishnamurti and Ariful Hoque "*The role of voluntary corporate governance mechanisms on environmental risk disclosure: Australian evidence"* presented at the 2014 Financial Markets & Corporate Governance Conference, 23-24 April 2014, at QUT Gardens Point Brisbane, Australia.

CHAPTER ONE

INTRODUCTION

1.1. Background

Extreme weather events around the world have increased public awareness about climate change. There is growing scientific evidence indicating that human-made greenhouse gas (GHG) emissions exacerbate global warming and business activities potentially inducing severe climate change (IPCC 2007; Liao, Luo & Tang 2014; Saka & Oshika 2014). Demands from a variety of stakeholders have resulted in firms disclosing climate change-related information, particularly GHG emission information. Climate change issues represent a vital part of a firm's corporate governance agenda for managing stakeholders' demands and enhancing organisational climate change-related legitimacy. Australia's per capita GHG emissions is not only the highest in the Organisation for Economic Co-operation and Development (OECD) countries but also among all developed countries (Garnaut 2008). Therefore, corporate decisions regarding GHG emissions disclosure by listed entities in the Australian stock exchange forms the focus of this study.

GHG emission information has emerged as an important dimension of corporate voluntary disclosure practice. Firms may engage in GHG emission disclosure to meet the needs of a diverse group of current and future stakeholders. Most importantly, institutional investors demand that firms disclose GHG emission information in order to assess the impact of climate change-related risks and opportunities on their investments. In this setting, firms have incentives to use sustainability disclosure as a competitive device as well as a strategy that can be used for image building. Firms with more concentrated focus on meeting stakeholders' expectation need to disclose more information regarding sustainability in order to honour their commitment to sustainability (Ullmann 1985).

Disclosure of climate change related information provides risks and opportunities for firms and gives corporate managers disclosure challenges (Aggarwal & Dow 2012). A broader group of stakeholders, namely, institutional investors, regulators, and public groups have been demanding disclosures of climate change related information particularly GHG emissions information from firms' operations. Firms that are disclosing sustainable information to the public have both advantages (opportunities) and disadvantages (risks). The opportunities of disclosing sustainable information are competitive advantage (Rankin, Windsor & Wahyuni 2011), positive image of firm (Lyon & Maxwell 2011), positive market responses (Griffin & Sun 2013), relevant information to investors (Dhaliwal et al. 2012), and reduction in cost of capital (Dhaliwal et al. 2011; El Ghoul et al. 2011). The risks of disclosures of such information are increasing operating cost (CERES 2011), reduction in market value (Aggarwal & Dow 2011), and engaging in earnings management (Prior, Surroca & Tribó 2008).

Firms can provide their GHG emission information through two channels: voluntary and mandatory disclosures. Voluntary disclosures of GHG emission information includes disclosures in GHG emission information in corporate reports such as annual reports, sustainability reports, participating in voluntary disclosure programs, and through press releases. Mandatory GHG emission disclosures include reporting GHG emission information as a result of regulatory requirements, for example, the introduction of the National Greenhouse Energy Reporting Act (the NGER Act) in Australia. GHG emission disclosures are a specific form of environmental disclosure that addresses business risks and opportunities, strategies to reduce GHG emissions and reporting information that is associated with climate change. Although Australian Government introduced the NGER Act on 29 September 2007, Australian firms were not required to report their GHG emission information until the 2009 financial year (Choi, Lee & Psaros 2013). GHG emission information reporting was mostly voluntarily before implementation of the NGER Act in Australia. Most importantly, this study focuses on a timeframe before implementation of the NGER Act that ensured that Australian firms provided GHG emission information through their reporting channels on a voluntary basis.

This thesis builds on three strands of prior research. Firstly, we build on prior research that suggests that firms may use their corporate governance mechanisms for managing stakeholders' demands and enhancing organisational legitimacy via monitoring GHG emissions and climate change risks and providing related information. Prior research suggests that effective corporate governance mechanisms are more likely to be associated with implementation of strategies that increase GHG emission disclosures in order to manage stakeholders' expectations concerning climate change risks and reduce legitimacy gap between the firm and its society (Khan, Muttakin & Siddiqui 2013; Peters & Romi 2014). In contrast, Prado-Lorenzo and Garcia-Sanchez (2010) argue that firms' corporate governance mechanisms do not play a monitoring role in disseminating GHG emission information. Rodrigue, Magnan and Cho (2013) find evidence to suggest that corporate governance mechanisms play only a symbolic role (rather than a substantive role) as a strategic driver of environmental activities. This creates a need to understand the role of corporate governance mechanisms in addressing climate change risks.

In the Australian context, using corporate governance quality as a composite measure, Rankin, Windsor and Wahyuni (2011) found that firms with higher corporate governance quality were more likely to disclose credible GHG emission information. Kohl and Schaefers (2012) argued that the composite measure of corporate governance quality is an inadequate proxy for corporate governance because of the possibility of ignoring important corporate governance characteristics. The impact of corporate governance on a manager's choice to disclose voluntary GHG emission information is limited and needs to be analysed further using a range of corporate governance mechanisms. This study adds new evidence by investigating the impact of specific corporate governance mechanisms on voluntary GHG emission disclosure.

The second strand of research pertains to the relation between voluntary GHG disclosure and earnings management. Stakeholders of a firm grant unwritten authority to the managers to do business as long as they are seen as good corporate citizens. If firms breach social responsibility, they will lose their license to operate (Brine, Brown & Hackett 2006). Socially responsible firms are less likely to engage in negative social activities which could damage their reputation and public trust because good corporate citizens are less likely to experience negative social events (Laksmana & Yang 2009). Kim, Park and Wier (2012) posit that managers may use sustainability disclosure as a reputational sign and constrain earnings management to maintain the reputation of the firm. Socially responsible firms have incentives to cultivate a long-term relationships with their stakeholders in order to gain competitive advantages (Choi, Lee & Park 2013) .

The separation of ownership and control creates a conflict between managers and shareholders that drives managers to pursue their personnel rent-seeking behaviour at the expense of shareholder interests. (Jensen & Meckling 1976). Salewski and Zülch (2014) argue that firms that engage in earnings management may use sustainability disclosure as a mean to cover up their opportunistic behaviour. Kim, Park and Wier (2012) argue that firms may buy a form of reputational insurance by providing more detailed sustainability information to the stakeholders, which gives them a license to manage earnings. Prior, Surroca and Tribó (2008) argue that managers disclose generous quantity of sustainability information as a tool to get support from major stakeholders when they engage in earnings management.

The existing literature provides conflicting findings on the link between earnings management and corporate social responsibility (CSR) disclosure (Choi, Lee & Park 2013; Kim, Park & Wier 2012; Prior, Surroca & Tribó 2008; Salewski & Zülch 2014). No empirical evidence on the link between earnings management and voluntary disclosure of GHG emission information is found in the existing literature. Australian firms may use GHG emission disclosure as either a strategic device or opportunistic purpose. In this juncture, corporate governance mechanisms may play a vital role to constrain or support engaging in earnings management. This study contributes to the literature by re-examining this issue in the context of Australian firms.

The third strand is the impact of voluntary disclosure of GHG information on a firms' stock liquidity. Information asymmetry creates agency problems between managers and outside investors, thereby impacting a firm's share trading. Voluntary disclosure of high quality information may reduce information asymmetry and firms with more voluntary disclosure and increased quality of information may experience greater liquidity, lower cost of transactions and more demand for the firms' shares (Cho, Lee & Pfeiffer 2013; Diamond & Verrecchia 1991). Balakrishnan et al. (2013) argue that managers actively shape their information environment by voluntarily disclosing more information and this effort improves liquidity of the firms' shares.

One of the benefits of voluntary disclosure is the increase in liquidity of a firm's shares. A greater quality information reduces the levels of adverse selection in the market, thereby increasing the liquidity of shares (Bardos 2011). Prior research suggests that better disclosure quality increases market liquidity (Healy, Hutton & Palepu 1999; Heflin, Shaw & Wild 2000). This study argues that voluntary disclosure of GHG emission information quality may impact the liquidity of a firm's shares. Currently there is no research on the link between voluntary disclosure of GHG emission information and stock market liquidity. Therefore, in this research, we shed light on the unexplored link between voluntary disclosure of GHG emission information and liquidity of firms' shares.

1.2. Research question

Shareholders are primarily concerned with financial performance of the firm. Non-investing stakeholders focus on issues related to environmental, social, and other issues (Rupley, Brown & Marshall 2012). Firms can use effective corporate governance mechanisms that induce managers to act in the best interest of stakeholders when there is a conflict between shareholders and non-investing stakeholders. Under effective corporate governance mechanisms, managers may use socially responsible engagement to resolve conflicts among stakeholders to maximise the shareholders' wealth (Harjoto & Jo 2011). Consistent with this view, socially responsible activities would be positively related to more effective corporate governance mechanisms.

Since risk management associated with climate change is a crucial aspect of a firm's strategic decision making and since corporate governance mechanisms play a crucial role in meeting stakeholder concerns, this thesis examines the role of corporate governance. Firms with good corporate governance are expected to improve voluntary disclosure of information and reduce opportunistic behaviour by management (Chen, Chen & Wei 2009; Lo, Wong & Firth 2010). Since corporate governance mechanisms are involved in monitoring and determining a firm's overall disclosure policy, it is expected that corporate governance mechanisms will enhance disclosure quality while constraining earnings management.

In the absence of effective corporate governance mechanisms, managers may disclose information voluntarily to a wide range of stakeholders to camouflage their opportunistic behaviour while they engage in earnings management. In addition, one of the capital market benefits of voluntary disclosures of GHG emissions is its impact on market liquidity. The main research question is: **What are the determinants of voluntary disclosure of GHG emission information and what is the impact of voluntary disclosure on the liquidity of a firm's shares?**

To answer this main question, several sub-research questions will be addressed.

1. What are the impacts on corporate governance attributes of the disclosure of voluntary GHG emission information?
2. What is the relationship between the voluntary disclosure of GHG emission information and earnings management and to what extent do corporate governance mechanisms affect the above relationship?
3. Do Australian firms with higher voluntary disclosure of GHG emission information have increased the liquidity of the firms' shares?

Since the theoretical framework to explain voluntary disclosure of GHG emission information of firms is limited, the issue is being explored by using two competing views based on existing theories. The first view, labelled as the stakeholder value maximisation view, posits that managers of the firms may provide transparent and credible GHG emission information to have a long-term relationship with stakeholders. The second view, termed the shareholder expense view, suggests that opportunistic managers are incentivised to disclose GHG information to favour other stakeholders at the expense of shareholders (Deng, Kang & Low 2013).

The objectives of this research are threefold. First, this study explores the impact of a firm's corporate governance mechanisms on voluntary disclosure of GHG emission information. Second, this research also examines the extent to which voluntary GHG emission disclosures are associated with earnings management with and without controls for corporate governance characteristics. Finally, this research investigates the effects of voluntary disclosure of GHG emission information on the liquidity of firms' shares.

A firm's information disclosure about its ability to manage the risks and opportunities associated with climate change is of interest to investors and others. GHG emissions, through human activities and natural processes, have been growing rapidly in this century. Human-induced GHG emissions are expected to generate risks of dangerous climate change. GHG emissions of carbon dioxide, namely (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (IPCC 2007), are thought to be the most relevant. Most GHGs are emitted from fossil fuel combustion and industrial processes. Recent studies indicate that investors have started incorporating firm's GHG emission information when making decisions about which companies to invest in (Chapple, Clarkson & Gold 2013; Griffin & Sun 2013; Matsumura, Prakash & Vera-Muñoz 2014).

This study is driven by four motivations. Firstly, many studies use multidimensional perspectives of CSR which makes it hard to reach concrete conclusions. Since the different types of CSR can cater to different stakeholders, it follows that the motivations of different aspects of CSR may be different. Moser and Martin (2012) suggest that when researchers develop and test research questions regarding the effects of CSR on other variables of interest, the different types of CSR should be examined separately. Therefore, the narrow aspect of sustainability disclosure, viz., GHG emission disclosure, is used in this study.

Secondly, GHG emission disclosures are specific environmental disclosures that address business risks and opportunities associated with climate change. Although the Australian Government introduced the NGER Act on 29 September 2007, Australian firms were not required to report their GHG emission information until the 2009 financial year (Choi, Lee & Psaros 2013). GHG emission information reporting was mostly voluntary prior to the implementation of the NGER Act in Australia. Interestingly, the ASX corporate Government Council proposed a series of recommendations to strengthen firms' corporate governance. Thus Australia had a relatively weak disclosure regime for GHG emissions while having a relatively strong corporate governance system. Therefore, Australia provides a unique institutional setting within which to examine the role of corporate governance mechanisms on voluntary GHG emission disclosures.

Thirdly, prior studies have examined various incentives and determinants of firms' voluntary disclosure of GHG emission information (Cotter & Najah 2012; Luo, Lan & Tang 2012; Matsumura, Prakash & Vera-Muñoz 2014; Prado-Lorenzo et al. 2009). Very little research has investigated the impact of corporate governance quality on voluntary GHG emission information in Australia (Rankin, Windsor & Wahyuni 2011). This research extends the literature by investigating the impact of a range of corporate governance characteristics on voluntary disclosure of GHG emission information and the relationship between voluntary disclosure of GHG emission information and earnings management controlling for corporate governance characteristics in Australia.

Finally, extant literature examines the association between different types of voluntary disclosures and liquidity. There is as yet no empirical study on the relationship between the voluntary disclosure of GHG emission information and liquidity in the literature. As far as the author is aware, this study is the first to investigate the impact of voluntary disclosure of GHG emission information on the liquidity of a firm's shares.

1.3. Contributions of the study

This study makes three key contributions to the literature. Firstly, existing research on the impact of corporate governance mechanisms on corporate sustainability reporting, particularly GHG emission disclosure, is limited. This empirical study examines the relationship between the extent and quality of voluntary disclosure of GHG emissions and a range of corporate governance mechanisms. Previous studies have investigated the impact of firm specific variables as well as industry specific variables on disclosure of GHG information ignoring a range of corporate governance attributes. This research will be useful to the Australian Stock Exchange Corporate Governance Council (ASXCGC) and other regulatory bodies in terms of identifying good corporate governance attributes that work in the Australian setting.

Secondly, this research extends the literature on voluntary disclosure and earnings management by investigating whether managers use voluntary disclosure of GHG emission ethically or opportunistically. By explicitly incorporating corporate governance mechanisms, this study is able to provide a nuanced view of the managerial motivation behind voluntary disclosure of GHG information. Finally, this research contributes to the literature by examining the impact of voluntary disclosure of GHG emission on liquidity. Previous studies indicate that voluntary disclosure can enhance transparency and quality of information, thereby improving the liquidity of firms' shares (Kim 2014).

1.4. Methodology

Voluntary disclosure of GHG emission information is measured in two ways. First, it is measured as a dummy variable based on firms' choice to voluntarily respond to the CDP annual questionnaires. Second, the quality of GHG emission disclosure is measured on the basis of a company's annual report, sustainability report, and corporate website using the CDP 2010 scoring methodology. Corporate governance characteristics were hand-collected from annual reports available from the DatAnalysis database. Discretionary accruals proxy for earnings management and the required accounting data were collected from DatAnalysis and FinAnalysis databases. Amihud's (2002) illiquidity measure and bid-ask spreads are proxies for liquidity of firms' shares and data for these variables were collected from the DataStream database.

This study addresses the potential endogeneity problem arising from a selection bias in analysing the relationship between corporate governance, voluntary disclosure of GHG emission information and earnings management in three ways. Firstly, this study incorporates lagged independent and control variables, addressing the simultaneity aspect of endogeneity. Secondly, this study incorporates year and industry dummies to deal with time-specific and industry related aspects of endogeneity. Finally, this thesis corrects potential selection bias using Heckman two-stage estimations to control for endogeneity.

1.5. Structure of the thesis

This thesis is structured as follows. Chapter 1 provides an introduction of the study. Chapter 2 reviews existing literature on voluntary disclosure of GHG emission information, corporate governance, earnings management, and stock market liquidity. Chapter 3 explains theories used in this research and develops the hypotheses. Chapter 4 describes the research methods of the study. Chapter 5 discusses descriptive statistics. Chapter 6 provides the empirical findings and discusses the results. Chapter 7 draws conclusions and provides recommendations and suggestions for future research.

Chapter 1: Introduction

This Chapter provides the background of the study, research questions and objectives of the study, motivations and methods of the study. Finally, this Chapter also provides the structure of the thesis.

Chapter 2: Literature review

This Chapter reviews existing literature related to this study. This section provides an overview of Australian legislations and voluntary initiatives on GHG emission reporting. It discusses the internal as well as external corporate reporting channels of GHG emission disclosure information. Further, this Chapter provides a discussion managerial motivation with respect to the decision to disclose voluntarily GHG emission information. The material provided in this Chapter helps one to understand the existing relationship between corporate governance mechanisms, voluntary GHG emission disclosure, earnings management and stock market liquidity.

Chapter 3: Theories and hypotheses development

This Chapter provides theoretical discussions on how corporate governance mechanisms and earnings management practices impact on GHG emission disclosure. Stakeholder theory, agency theory and legitimacy theory are used in this research. Further, this Chapter develops hypotheses based on two competing views, namely, the stakeholder value maximisation and shareholder expense views.

Chapter 4: Data and methodology

This Chapter provides details of sample selection and research methods used in this study. Then, our dependent, independent and control variables are described. Additionally, this Chapter addresses procedures to correct endogeneity and sample selection bias.

Chapter 5: Descriptive analysis

This Chapter explains in detail the descriptive statistics of dependent, independent and control variables. In this Chapter, descriptive statistics are provided for all variables for the full sample, disclosing and non-disclosing sub-samples, the CDP reporting years and industry classifications.

Chapter 6: Empirical findings and discussions

This Chapter reports on the empirical findings and provides discussions of the results. The empirical findings and discussions are divided into three main sections. Firstly, this study provides the empirical findings and discussions for the impact of corporate governance mechanisms on voluntary GHG emission disclosure. Secondly, this study conducts an analysis and discussion of the relationship between earnings management and voluntary disclosure of GHG emission information with and without controls for corporate governance mechanisms. Finally, this Chapter studies the effects of voluntary GHG emission disclosure on stock market liquidity.

Chapter 7: Summary and conclusions

This is the final Chapter of this thesis. This Chapter draws conclusions from the empirical findings provided in Chapter 6. Additionally, there is a discussion of the theoretical and practical implications of the research findings. This Chapter also lists the limitations of the study, and offers suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

Managers have a choice regarding whether or not to disclose GHG emission information, which can significantly impact upon a broad group of stakeholders. As a result, voluntary disclosure of GHG emission information has been a topic of interest for academics in terms of theoretical and empirical investigations over recent years. This literature review consists of three key sections. The first section reviews the existing literature on voluntary disclosure of GHG emission with regards to the Australian institutional setting, examines the incentives of GHG emission disclosure and evaluates the relationship between corporate governance mechanisms and voluntary disclosure of social and environmental information including GHG emissions. The second section reviews the relationship between earnings management and voluntary disclosure of GHG emission information with and without corporate governance mechanisms. The third section summarises the literature on the association between voluntary disclosure of GHG emission information and stock market liquidity.

2.2. An overview of Australian legislation on GHG reporting

Australian regulators, industry groups, and voluntary initiatives incentivise Australian firms to disclose environmental and GHG emission information voluntarily. Frost (2007, p. 193) postulates that *"while Australian regulators have not been active in introducing mandatory environmental reporting within the corporate annual report, there are several guidelines on the voluntary inclusion of environmental information in the annual report".* These reporting guidelines have been developed by Australian Government and industry groups such as New South Wales Environmental Protection Authority,1997; Victoria Public Accounts and Estimates Committee, 1998, 1999; Commonwealth of Australia, 2000; the Mineral Council of Australia code for Environmental management, 2000 (Choi, Lee & Psaros 2013; Frost 2007).

Additionally, a variety of other legislations and initiatives with regards to environmental and GHG emission information disclosure has also arisen. These include the section of 299(1)(f) of the Corporations Law, the Greenhouse Challenge Plus, the Kyoto Protocol, the National Pollution Inventory, the National Greenhouse and Energy Act, and carbon tax, which provide to impetus firms to disclose environmental information as well as GHG emissions and management strategies.

The introduction of section 299(1)(f) of the Corporations Law was the first statutory requirement for specific environmental reporting introduced in 1998 (PricewaterhouseCoopers 2005), which requires Australian company directors to disclose their company's environmental performance. Prior Australian studies on environmental and GHG emission disclosure note that there is an increase in voluntary environmental information in annual reports because of the introduction of section 299(1)(f) of the Corporations Law (Choi, Lee & Psaros 2013; Frost 2007). Section 299(1)(f) of the Corporations Act 2001 requires companies whose operations are subject to *"any particular and significant environmental regulation"* to include in its directors' report details of the entity's information in relation to such regulation over the financial year (Gibson & O'Donovan 2007).

Frost (2007) notes that there has been an increased level of environmental disclosure in annual reports due to the introduction of section 299(1)(f) of the Corporation Law and the firms disclosing environmental information have considerable variation in their reporting, most significantly, firms that breach environmental regulations avoid having to provide a stand-alone sustainability report. Choi, Lee and Psaros (2013) note that although introduction of section 299(1)(f) increases environmental disclosure among Australian firms, this legislation is ineffective and ambiguous from the perspective of Australian legal practitioners.

The Greenhouse Challenge Plus is a voluntary initiative, which may help Australian firms to disclose their GHG emission reduction strategies in their corporate reporting channels. It was a joint voluntary initiative between Australian Government and industry, which began in 1995. The objectives of this initiative are to (i) encourage abatement, (ii) improve GHG emission management, (iii) improve emissions measurement and monitoring, (iv) strengthen information sharing between government and industry (DepartmentoftheEnvironment 2009). More than 700 firms with excellent coverage of GHG emission in Australian industry participated in this program. To reduce GHG emissions, firms were encouraged to invest in new technologies, process, energy, efficiency improvement, and fuel switching. This program ceased on 1 July, 2009.

The Kyoto Protocol is an international agreement introduced under the United Nations Framework Convention on Climate Change in Kyoto, Japan in 1997 (DepartmentofClimateChange 2010). The objective of this agreement is to reduce human-induced GHG emissions of developed countries by at least 5 percent below 1990 levels during 2008 to 2012. Australia ratified the Kyoto Protocol on 3 December 2007 and its terms came into effect on 11 March 2008. Freedman and Jaggi (2011) note that the number of firms disclosing voluntary GHG emission information is higher in countries that have ratified the Kyoto Protocol. Australian Government proposed the GHG emission reporting Act after ratification of the Kyoto Protocol.

The National Pollution Inventory (NPI) is an Internet database designed for larger Australian facilities that are required to estimate and report annually their GHG emissions. Australian industrial facilities that exceed the thresholds for 93 NPI substances are legally required to report emissions to their state or territory environmental agency annually. Work and consultation on the NPI started in 1995 and in 1996 (DepartmentoftheEnvironment 2009). The objective of NPI is to inform the community which has a right to know about GHG emissions. Cowan and Deegan (2011) suggest that the NPI is a driver for GHG emission disclosure and previous Australian studies ignored to the existence of the NPI.

Many firms around the world are required by investors and regulators to report on their GHG emissions. For example, all firms listed on the main market of the London Stock Exchange are required to report their GHG emission levels in their annual reports staring from April 2013. The US firms are required to comply with their GHG emission disclosure obligation issued by Securities and Exchange Commission in February 2010 (Matisoff 2013). In Australia, the National Greenhouse and Energy Act (the NGER Act) was introduced in mid-2007. Firms satisfying a threshold level of emissions were required to report GHG emissions and energy use information starting from the 2009 financial year (Choi, Lee & Psaros 2013).

The NGER Act requires reporting its GHG emissions under Scope 1, 2 and 3. Scope 1 is direct GHG emissions from sources that is owned or controlled by the firm, e.g. emissions from combustion in owned or controlled boilers, furnaces and vehicles. Scope 2 accounts for GHG emissions from the generation of purchased electricity by the company. Scope 3 allows for the treatment of all other indirect emissions and it is an optional reporting category. It includes business related travel, disposal of waste to landfill and use of paper. Fig 2.1 is a pictorial depiction of GHG emissions under Scopes 1, 2, and 3.

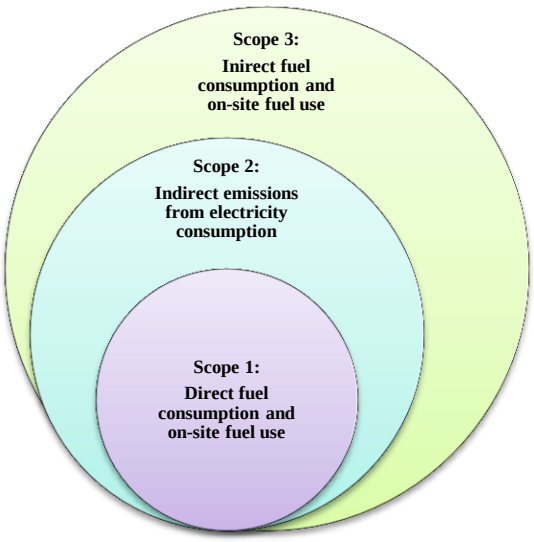

Figure 2.1 Total GHG emissions

The Australian Government enacted a legislation to introduce a carbon tax with effect from 1 July 2012. It was expected that the carbon tax would have a significant impact on the monitoring and reporting of GHG emissions by Australian entities (Choi, Lee & Psaros 2013). From a political perspective, the carbon tax became a very sensitive issue in Australia. The new Australian Government has decided to remove the carbon tax from 1 July 2014. For this purpose, the new Government, as promised, introduced the Clean Energy Legislation (Carbon Tax Repeal) Bill 2013 on 13th of November 2013 (ParliamentofAustralia 2013).

2.3. Voluntary GHG emission disclosure medium

A firm's first step in addressing climate change-related issues is to measure and report its GHG emissions, emission reduction strategies, and investments. Wade, Dargusch and Griffiths (2014) indicate that the majority of larger Australian firms have at least accomplished the first step towards best practice of GHG emission management. Firms can achieve competitive advantages by using better strategies in their management of GHG emission reduction initiatives and investments, which will help to assess their impact on their profitability (Wade, Dargusch & Griffiths 2014). Information about a firm's strategies and activities with regards to GHG emission reduction initiatives is important for the decisions of stakeholders (Liao, Luo & Tang 2014).

Australian firms have been disclosing their GHG emission disclosure voluntarily to the external reporting programs such as the CDP, and their corporate reporting channels such as annual reports, standalone sustainability reports, and corporate websites in addition to mandatory GHG emission disclosure. As such, Australian firms mainly use four reporting channels to disseminate their GHG emission information to their stakeholders. Firstly, Australian firms respond to the CDP questionnaire to disclose GHG emission information. The CDP is an independent not-for-profit organisation that surveys companies globally about their emissions and associated risks, opportunities, strategies in relation to climate change (Armstrong 2011). Since 2003, the CDP sends the world's largest firms a questionnaire on the risks and opportunities associated climate, GHG emissions, emission reduction plans, targets and strategies, emission intensity, and communication on behalf of 722 institutional investors with combined assets of US$87 trillion. Australian firms were requested to respond the CDP questionnaire since 2006. The CDP sends its questionnaire to the Australian firms in February and firms are required to respond to it by May each year.

Secondly, annual reports are another major channel for the communication of information from corporations to their stakeholders (Gibson & O'Donovan 2007), which have information about climate change related information; particularly a firm's strategies and activities of GHG emission reduction initiatives. Prior research on social and environmental disclosure suggests that corporate annual reports are major sources of social and environmental information provided by companies (Haque & Deegan 2010). The ASXCGC recommended that: *"one way to demonstrate good corporate governance is to use the annual report to disclose information to all legitimate stakeholders"* (Gibson & O'Donovan 2007, p. 944). GHG emission information in corporate annual report is seen as firms' effort to legitimise their activities by aligning their corporate goals with those of the society in which they are operating.

Thirdly, corporate responsibility reporting has traditionally been voluntary. However, government and regulatory bodies around the world are increasingly imposing mandatory reporting requirements (KPMG 2013). Currently, there is no legislated requirement for Australian firms to produce yearly sustainability reports (Wade, Dargusch & Griffiths 2014). Australian firms' corporate sustainability reporting rate has increased to 82 percent in 2013, particularly in annual reports. A majority of firms include corporate sustainability information in annual reports separately (KPMG 2013). According to Figure 2, the quality of corporate responsibility reporting in Australian firms is higher than that of American or Japanese firms. The quality of corporate responsibility reports have been measured by using seven criteria based on current guidelines: (i) strategy, risk and opportunities, (ii) materiality, (iii) targets and indicators, (iv) suppliers and the value chain, (v) stakeholder engagement, (vi) governance of corporate responsibility, and (vii) transparency and balance.

Source: KPMG International, The KPMG Survey of Corporate Responsibility Reporting 2013, December, 2013

Figure 2.2 Quality of Corporate Responsibility Reporting

The above figure indicates that Australian firms' sustainability reporting quality is lower than that of firms in Italy, Spain and UK but higher than firms in Germany, Switzerland, South Korea, Japan, USA and China/Hong Kong. Australian firms report their GHG emissions and their strategies and activities in relation to emission reduction initiatives voluntarily in their annual and sustainability reports in addition to formal reporting of GHG emissions to the Australian Government (Wade, Dargusch & Griffiths 2014).

Finally, corporate websites may be used as a medium to enhance the flow of voluntary disclosure to the stakeholders (Trabelsi, Debreceny & Lymer 2014). Patten and Crampton (2003) posit that there are indeed differences in the type of environmental information companies are choosing to disclose on their websites relative to annual reports. They further add that firms may use corporate websites to disclose their environmental information and attempt to legitimise their activities rather than for corporate accountability purposes. Villiers and van Staden (2011) note that managers choose to disclose their environmental information on their corporate websites and annual reports to satisfy different types of stakeholders. KPMG (2013, p. 68) states: *"today's businesses operate in the age of transparency, where the Internet and social media have created a global community of active and engaged stakeholders."*

2.4. Voluntary disclosures of GHG emission information

There has been a wide consensus that climate change caused by human-induced greenhouse gas emissions may impair output and productivity (Eyraud et al. 2011). Firms increasingly face climate change risk (CDP 2013) and it is a major concern for a broad group of stakeholders of firms (Busch & Hoffmann 2011). GHG disclosure represents '*proprietary non-financial information about the firm's exposure to climate-change risks, resulting from the firm's operations and related to future profitability over time'* (Peters & Romi 2014, p. 2). GHG emission disclosure refers to *"organisations' disclosure of information about emissions of carbon dioxide and other GHGs resulting from their operations, as well as the strategies they have in place to manage and reduce these emissions"* (Armstrong 2011, p. 29). GHG emission disclosure information has both information that relates to the risks and opportunities posed to business operations from climate change-related activities.

There is significant pressure on firms to disclose information about regulatory, physical, and other risks and opportunities associated with climate change, GHG emissions, GHG emission reduction plan, targets, and strategies, GHG emission intensity, and communication. GHG emissions are released as a result of manufacturing processes and the burning of fossil fuels. The GHG emission information includes details of emission and management of numerous items including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) sulfur hexafluoride (SF_6) and other fluorinated gases (Peters & Romi 2014).

Firm's climate change related information particularly GHG emission reduction initiatives are necessary for investors to use when making their investment decisions. Disclosing information on GHG emissions in the annual and sustainability reports, on the company's website, and participating in the voluntary reporting program could be used by the institutional investors and stakeholders to assess a company's risks and opportunities with regards to climate change. A broader group of stakeholders are demanding not only current emissions levels and quality but also future strategies to mitigate GHG emissions.

Most of the empirical research, using firm responses to CDP questionnaire on carbon disclosure, is limited either to the US market or a broad global context. Stanny and Ely (2008) investigate factors associated with US S&P500 firms' decisions to voluntarily disclose GHG emissions. They document that size, previous disclosures and foreign sales are positively associated with disclosures of GHG emissions. Stanny (2010) investigated voluntary disclosure of GHG emissions by US S&P500 firms that responded to the CDP. She provided support for legitimacy theory and found that the majority of firms responded to the questionnaire but did not disclose their emissions. Reid and Toffel (2009) examined the impact of regulatory threat and shareholder resolutions on disclosure of greenhouse gas emissions by US S&P500 firms that responded to the CDP and found a positive association between them.

Using the CDP data for FT 500 firms, Kolk, Levy and Pinkse (2008) examined the extent to which the CDP provided information on GHG emissions reductions to enable various interest groups of a firm to make decisions regarding a firm. They reported that using institutional investors, the CDP urged firms to disclose extensive information about GHG emissions. Peters and Romi (2009) investigated whether or not cross-country differences influenced the level of corporate GHG emission disclosures by firms that responded to the CDP in a global context. They found that the country of origin of a firm embodied certain characteristics that influenced the level of GHG emission disclosures.

Luo, Lan and Tang (2012) examined the impact of economic, regulatory, social and financial market factors by Global 500 companies reporting to the CDP on voluntary disclosure of GHG emissions. They find that larger firms that face direct economic consequences have a significant positive association on GHG emission disclosures. They suggested social or political pressure played an important role for larger companies with greater propensity to disclose more detailed information on GHG emissions. Cotter and Najah (2012) investigated the influence of institutional investors on the voluntary disclosure of information about climate change using Global 500 firms as a sample.

Armstrong (2011) argued that it was not necessary for companies to participate in a third-party voluntary reporting program, for example through the CDP, in order to externally report their GHG emission. They could do so by other means, such as on their corporate websites and in annual and sustainability reports. Managers choose to disclose voluntary environmental information for several reasons. Peters and Romi (2014) argued that sustainability officers and environmental committees in a firm have motivations to disclose more GHG emission information voluntarily. They found that the existence of a chief sustainability officer and an environmental committee were positively related to voluntary GHG emission disclosures.

Freedman and Jaggi (2011) argued that GHG disclosures were a function of GHG emissions, emission standards, environmental settings and disclosure requirements in the countries in which firms operate. They argued that firms from European Union countries, Canada and Japan, which have ratified the Kyoto Protocol, will have to meet certain emission standards and limits which will provide the basis for GHG emission disclosures. They document that there is a higher level of voluntary GHG emission disclosure by firms from countries such as European Union countries, Canada and Japan than firms in the United States which has not yet ratified the Protocol.

Aggarwal and Dow (2011) argued that when the board of directors created a committee that monitored GHG emission risks and opportunities, the risks and opportunities were less likely to be identified. They explained that board involvement was directed at managing disclosures of GHG emission information in order not to reduce firm value. The same finding was first identified by Prado-Lorenzo and Garcia-Sanchez (2010).

Aggarwal and Dow (2012) suggested that there were five factors that induced a firm to reduce GHG emissions. Firstly, reduction in GHG emissions at a firm level would lead to higher profits. Secondly, pressure from mandatory regulations convinced a firm to reduce GHG emissions at a firm level. Thirdly, buyers preferred to buy goods and services that had a lower carbon footprint. Fourthly, firms invested their money in cost-effective climate change mitigation equipment and machinery. The final factor was pressure from major shareholders; that is, institutional investors demanded a firm to disclose transparent climate change risk information such as GHG emission information. They further suggested that failure to respond effectively would reduce firm's value and increase the firm's cost of capital in this regard.

2.5. GHG emission disclosure and firm value

GHG emissions can have a significant impact on business activities, and few studies have so far examined the effects of GHG emissions disclosure on firm value (Saka & Oshika 2014). Although GHG emission disclosure-related research is still at an initial stage in the academic literature, the existing literature provides some insights into whether disclosure of GHG emission information enhances firm value. These capital market effects are relevant to our understanding of determinants of GHG emission disclosure and its consequences.

2.5.1. Capital market effects

The existing research has analysed the share market price reaction around the announcement of GHG emission disclosure and regulation. Griffin and Sun (2013) have examined shareholders' responses to a unique set of disclosures about climate change made by the US firms through CSR newswire service. They found that managers' voluntary GHG emission disclosure decisions produced positive returns for shareholders. In addition, their findings showed that shareholders of smaller companies with limited public information availability benefited the most from voluntary GHG emission disclosures, since in these settings investors have fewer other channels and less access to competing information.

Hsu and Wang (2013) examined market reaction around carbon emission disclosure announcements using a sample of firms with news coverage in Wall Street Journal during the period 1989-2008. They found that socially responsible action to tackle climate change is costly to the investors. Lee, Park and Klassen (2013) examined the relationship between climate change disclosure and shareholder value using a sample of Korean firms from 2008 to 2009, with data drawn from Korean newspapers. They found a negative association between the announcement of climate disclosure and shareholder wealth, suggesting that shareholders perceived climate change announcements as a bad news that were destroying shareholder wealth maximisation.

Griffin, Lont and Sun (2012) examined the relationship between voluntary GHG emission disclosures and company stock prices using the even study method. They found that GHG emission levels were associated negatively with stock price and that the relationship was stronger for carbon-intensive companies. They suggested that investors view GHG mission information as value relevant and consequential for stock price and hence, and were potentially useful for capital market decision making. Chapple, Clarkson and Gold (2013) investigated the capital market effects of the proposed Emission Trading Scheme (ETS) in an Australian setting. They find evidence that capital markets responded negatively to ETS announcements and the negative market responses are larger for firms that operated in carbon-intensive sectors.

2.5.2. GHG emission disclosure and firm value

Existing studies on the effects of GHG emission levels and disclosure of GHG emission information on firm values provide very little evidence. The levels or volume of GHG emissions have a negative impact on firm value whereas, disclosure of GHG emission information on emission mitigation initiatives have a positive impact on firm value. Matsumura, Prakash and Vera-Muñoz (2014) examined the impact of volume of GHG emissions and voluntary disclosure of GHG emission information on firm value using all the S&P500 firms. They find a negative association between volume of GHG emissions and firm value and a positive relation between managers' decision to disclose GHG emission information and firm value. Their findings indicate that the capital market penalise non-disclosing firms, which is an adverse signal about lack of commitment to reduce GHG emissions.

Saka and Oshika (2014) examined the impact of volume of GHG emissions and disclosure of GHG emission management information on firm value using a sample of 1,094 Japanese firms. For this study, the volume of GHG emissions and corporate GHG emission management disclosure were collected from Japanese Government mandatory reporting files and the CDP database respectively. Their results show that corporate GHG emission volume has a negative relation with firm value and voluntary disclosures of GHG emission information have a positive relationship with firm value. In addition, they found that the positive relation between the voluntary disclosure of GHG emission information and firm value was stronger when firms had a larger volume of GHG emissions.

Aggarwal and Dow (2011) examined the impact of GHG emission levels on firm value for a sample of over 600 larger firms from the US, Canada, and Europe. They find a negative association between volume of GHG emissions and firm value. They were unable to document that GHG mitigation actions add to firm value. Eccles, Serafeim and Krzus (2011) examine GHG emission information have an impact on capital market. They find that equity investors and analysts perceived GHG emissions disclosure as risky to a firm as it can potentially affect equity prices. More specifically, they found that investment analysts incorporate GHG emission information in their investment recommendations.

2.5.3. GHG emission disclosure and firm financial performance

Prior research investigated the effect of firms' financial performance on disclosure of GHG emission information. It is argued that more profitable firms allocate greater resources to engage in more socially responsible initiatives to meet stakeholder pressure. Therefore, it is expected that there would be a positive relationship between profitability and GHG emission disclosure. Prado-Lorenzo and Garcia-Sanchez (2010) found a positive association between profitability and GHG emission disclosure for the Global 500 firms. Ben-Amar and McIlkenny (2014) found a positive association between firms' profitability and managers' decision to disclose GHG emission information for Canadian firms. They found an insignificant relationship between firms' financial performance and GHG emission disclosure transparency for the same sample firms.

On the other hand, Liao, Luo and Tang (2014) found a negative relationship between firm profitability and GHG emission disclosure for UK firms, and the negative relationship is more severe for firms with carbon intensive industry. There were more recent studies, which find insignificant association between profitability and GHG emission disclosure, Rankin, Windsor and Wahyuni (2011) and Choi, Lee and Psaros (2013) for Australian firms, and Chu, Chatterjee and Brown (2013) for Chinese firms.

The announcement effects of GHG emission disclosure have both positive and negative market reactions, which indicate that investors perceive the GHG emission disclosure information as value relevant for their decision making. The findings from Matsumura, Prakash and Vera-Muñoz (2014) and Saka and Oshika (2014) suggest that disclosure of GHG emission information has a positive impact on firm value. On the other hand, the volume of GHG emissions has negative impact on firm value. The evidence on the effects of disclosure of GHG emission information on financial performance is mixed. Therefore, it is not yet clear that GHG emission information destroys or enhances firm value.

2.6. Incentives for voluntary GHG emission information

Corporate voluntary disclosure is defined as: "*disclosures in excess of requirements, representing free choices on the part of company managements to provide accounting and other information deemed relevant to the decisions needs of users of their annual reports"* (Meek, Roberts & Gray 1995, p. 555). Managers have several reasons for making voluntary disclosures. Prior research identified some of the incentives related to voluntary disclosures. Healy and Palepu (2001) identified six incentives or reasons that influence managers to make voluntary disclosures. These factors are capital market transactions, corporate control contests, stock compensation, litigation, proprietary costs and management talent signalling. An, Davey and Eggleton (2011) constructed a theoretical framework for explaining voluntary disclosures regarding intellectual capital and identified three motivations for voluntary intellectual capital disclosures by organisations. The motivations are: to reduce information asymmetry, to be accountable to all shareholders, and to show their quality by signalling firms' legitimacy and excellence to the society.

Deegan (2002) argued that there were a variety of motivations for managers to voluntarily disclose social and environmental information. They were (i) compliance with legal requirements, (ii) economic rationality considerations, (iii) a belief in an accountability to report, (iv) compliance with borrowing requirements, (v) meeting community expectations, (vi) threats to firm's legitimacy, (vii) manage powerful stakeholders, (viii) attract social investment fund, (ix) compliance with industry requirements and (x) win environmental awards.

Solomon and Lewis (2002) suggested that managers had four incentives to disclose environmental information voluntarily. These incentives are market, social, political and accountability incentives. Luo, Lan and Tang (2012) proposed four hypotheses in their research based on four motivations which were to induce managers to disclose voluntary GHG emissions information through the CDP. These hypotheses were economic, regulatory, social and financial market factors that motivated managers to disclose voluntary GHG information. Armstrong (2011) argued that firms face growing stakeholder pressure to disclose GHG emissions. She suggested that firms had four drivers which induced managers to disclose voluntary GHG emission information. They were institutional investors' pressure, supply-chain pressure, the desire to get ahead of the legislative curve and business development strategy.

Porter and Kramer (2006) identified four motives for companies engaging in social responsible disclosure: a moral obligation, firm's stewardship of the environment and the community, a license to operate, and reputation. Adams and Zutshi (2004) suggested that a firm could achieve four benefits if it acted in a socially and environmentally responsible manner: improved corporate image and relations with stakeholders, better recruitment and retention of employees, improved decision making and cost-savings, and improved financial returns.

Prado-Lorenzo and Garcia-Sanchez (2010) suggested that there were country and firm-level factors that induced managers to voluntarily disclose more detailed GHG emission information. Pressure from the general public and interest groups, the legal system of a country and a firm's corporate governance systems motivated firms to disseminate information on GHG emissions. They argued that the characteristics of board of directors such as board independence, CEO duality and the diversity of a board, as well as other country-level factors, played a significant role in encouraging the disclosure of GHG emissions information. This study has analysed the following incentives in relation voluntary GHG emission disclosures: reduction in information asymmetry, political costs avoidance, good corporate governance, competitive advantage, compensation for earnings management, stakeholders' demands and increases in stock liquidity.

2.6.1. Reduction in information asymmetry

One of the main incentives for firms to make voluntary disclosures is a reduction in information asymmetry. Managers of firms may disclose additional pieces of GHG emission information to investors in order to make their investment decisions. The separation of ownership and control of a firm can create an information asymmetry problem which can be reduced by making voluntary GHG emission disclosures. Managers have incentives to disclose more voluntary GHG emission information to reduce agency problems between managers and investors. Firms with superior environmental information have incentives to make more voluntary environmental disclosures (Clarkson et al. 2008). Dye (1985) suggested that firms with good news have incentives to disclose more information to differentiate themselves from firms with bad news in order to reduce information asymmetry. He predicted that high quality firms would disclose their information more completely so as to differentiate themselves from low quality firms.

Voluntary disclosures can be a critical device to moderate the information asymmetry between different types of shareholders (Allegrini & Greco 2013). These disclosures are mostly made at managers' discretion so that managers can choose how much importance they give to the disclosures. Villiers and van Staden (2011) argue that firms with bad environmental reputations use their annual reports to explain how they are managing these issues in order to reduce information asymmetry. They find that firms that have bad environmental reputations disclose more voluntary environmental information in their annual reports. Krishnamurti, Sevic and Sevic (2005) suggest that firms from emerging markets that issue American Depository Receipts (ADR) have incentives to make more voluntary disclosures to have a lower level of information asymmetry.

Lundholm and Van Winkle (2006) argued that primary goal of voluntary disclosure is to reduce information asymmetry between investors and managers. They noticed that there was conflict between these two parties when managers made decisions whether or not to disclose particular information to the investors. They concluded that voluntary disclosure could be employed as a means to reduce information asymmetry. Cho, Lee and Pfeiffer (2013) argued that firms were using good and bad CSR performance to mitigate information asymmetry between investors and the firm. They suggest that CSR performance played a positive role in mitigating the information asymmetry faced by investors.

Peters and Romi (2014) posited that information asymmetry between the managers and stakeholders of a firm provided incentives for voluntary disclosure decisions or actions to increase the quality of disclosure of the firm. Given that sustainability-focused governance mechanisms have incentives to provide quality GHG emission information in order to reduce information asymmetry between managers and stakeholders; firms can enhance their environmental legitimacy and use GHG emission disclosure as a strategic device for managing the firm's environmental reputation.

2.6.2. Political costs avoidance

The second incentive of voluntary disclosure is a reduction in political cost. Political cost theory argues that managers make more detailed environmental disclosures in order to avoid political cost (Healy & Palepu 2001; Watts & Zimmerman 1978). Voluntary environmental disclosures, such as GHG emissions disclosures made by a firm in relation to its positive or negative impact on its physical environment, may be a technique that can be used to reduce political cost. Firms will voluntarily disclose more environmental information in order to have a better relationship with the government and public sectors, that will lead to reduced political costs and to gaining some advantages such as subsidies, and positive outcomes in legal actions. As a result, political costs may avoid the shifting of a firm's wealth towards the public and political sectors. Villiers and van Staden (2011) predicted that firms with bad environmental reputations used their websites to explain how they were managing these issues in order to reduce political costs. They found that firms that had experienced environmental disasters were more likely to disclose more environmental related information on their websites.

2.6.3. Good corporate governance

The third incentive for firms to voluntarily disclose GHG emissions information is good corporate governance. Corporate governance is defined as the rules and practices that govern the relationship between managers, boards and shareholders that guides the extent and method of information disclosed by organisations (Jensen & Meckling 1976). The board of directors has fiduciary duty to protect the shareholders' wealth by managing long-term risks and opportunities. The key responsibility of the board of directors is to monitor what senior management is doing with regard to climate change. It is their duty to deal with GHG emission

information disclosure to manage the pressure emerging from different stakeholder groups. Therefore, board of directors were accountable to ensure transparency and quality of GHG emission information (CERES 2006). Haigh and Shapiro (2011) found that investors could assess a firm's corporate governance quality using GHG emission disclosure.

Firms that have good corporate governance are more likely to disclose GHG emissions information voluntarily in their reports and company website. Good corporate governance includes more independent directors on a board, having different people serving as the CEO and chairman of the board, an independent chairman on the board, female directors on the board, lower managerial share ownership, higher institutional shareholdings, more audit committee meetings in a financial year, and a smaller sized audit committee. These good corporate governance variables compelled managers to voluntarily disclose more GHG emissions information in their reporting channels.

A study by Peters and Romi (2014) argued that environmental committees took more proactive interest in disclosing greater levels of GHG emission information as part of the firms' overall strategy. In addition to that, they argued that the existence of sustainability officers would be associated with sustainability initiatives and monitoring; and therefore they are able to disclose more GHG emission information. Environmental committees and sustainability officers within the board of directors may encourage a company's board to disclose greater amounts of GHG emission information.

2.6.4. Competitive advantage

Rankin, Windsor and Wahyuni (2011) found that some proactive but pragmatic Australian firms were disclosing GHG emissions information voluntarily in order to gain a competitive advantage. Dye (1985) argues that higher quality firms disclosed more information to differentiate themselves from low quality firms. Porter and Kramer (2006) contended that social issues significantly affected the fundamental motives of a firm's competitiveness in the locations where it operated. Disclosing environment related information such as GHG emissions from a firm's operations may lead to gains in competitive advantage over a firm that was not disclosing such information. Disclosing GHG emission information may be a powerful tool to create a positive image of a firm that differentiated it from other firms and contributed to increase in social value. A firm can use the voluntary disclosure of GHG emission information as a strategic device to manage stakeholders' demands with regards to climate change related risks and opportunities (Peters & Romi 2014).

2.6.5. Compensation for earnings management

Another incentive for voluntary GHG emissions information is compensating the stakeholders through earnings management. Voluntary environmental information may be used as a compensation for engaging in earnings management. Prior, Surroca and Tribó (2008), Sun et al. (2010) and Cespa and Cestone (2007) argued that managers who engaged in earnings management may use voluntary environmental information as a device to divert stakeholders' attention to their socially responsible activities. Managers of these firms may therefore have incentives to compensate stakeholders through environmental information when they manage earnings opportunistically. Disclosing environmental information of a firm may help build a positive image among different interest groups. These positives can be used by a manager to get supports from all stakeholders. There may be a possibility to use these supports as a tool to distract stakeholders' attention for engaging earnings management. Prior, Surroca and Tribó (2008, p. 161) noted that: "*as a defense against stakeholder activism and vigilance, which could cost a manager his job and damage the firm's reputation, managers have incentives to compensate stakeholders through Corporate Social Responsibility (CSR) practice*".

In line with the above argument,Mallin, Michelon and Raggi (2013) contended that managers used CSR as an entrenchment strategy to gather support from stakeholders. Based on this entrenchment strategy, managers and stakeholders had very strong collaboration that could not be easily blocked by individual shareholders. Therefore, managers had incentives to improve corporate social performance while they had the intention to manipulate earnings.

2.6.6. Stakeholders' demands

Managers have another incentive to disclose GHG emission information through various channels to meet and fulfil the demands or needs of a diverse group of stakeholders. Huang and Kung (2010) posited that pressure from various stakeholders such as investors, customers employees, regulatory bodies, induced a firm to disclose environmental information. In a country where stakeholders were seen as legitimate, a greater level of interest in firms' activities meant that they were more likely to disclose CSR information (Dhaliwal et al. 2012). Moser and Martin (2012) argued that managers engaged in some CSR activities at the expense of shareholders in order to meet the demands of a larger group of stakeholders. Therefore, CSR activity would help to fulfil the demands of a larger group of stakeholders than by providing value-relevant information to shareholders. They defined "at the expense of shareholders" to mean the overall costs of CSR activity to the firm would exceed the benefits to the firm. To strengthen stakeholders' demands to disclose sustainable information requests, Kim, Park and Wier (2012) supported the premise that socially responsible firms that seek to make an investment on CSR activity in order to meet ethical expectations of stakeholders in society provide more transparent and reliable financial information to investors while simultaneously constraining opportunistic managers who engaged in earnings management.

2.6.7. Increases in liquidity

Healy and Palepu (2001) summarised three capital market consequences from voluntary disclosure, including improved stock liquidity, reduced cost of capital, and increased information intermediation. Managers' incentives to disclose more information voluntarily could affect liquidity. Most recently, researchers have analysed various aspects of disclosure quality in relation to stock market liquidity. They found that the quality of information disclosure improved stock market liquidity (Balakrishnan et al. 2013; Bardos 2011; Lang & Maffett 2011; Ng 2011). Balakrishnan et al. (2013) argued that when managers had a choice about whether or not to shape information through voluntary disclosure activity, such activity improved their liquidity. They find that liquidity improved as a result of voluntary disclosure. Lang and Maffett (2011) found evidence that firms with greater transparency in earnings management and accounting standards disclosure experienced greater market liquidity. Ng (2011) found that quality of information disclosure was associated with lower liquidity risks; which, in turn, lowered the cost of capital. In line with these findings, Bardos (2011) found that the quality of financial information improved firms' liquidity.

2.7. Definitions of corporate governance

Although corporate governance has been widely researched, there is no universally-acceptable corporate governance definition to address social responsibility issues. Cadbury (1992) defined corporate governance as: "*the system by which companies are directed and controlled".* Some researchers traditionally defined corporate governance as *"the defense of shareholders' interests"* (Tirole 2001). For example, Shleifer and Vishny (1997, p. 737) defined corporate governance as: *"the way in which suppliers of finance to corporations assure themselves of getting a return on their investment"* and La Porta et al. (2000, p. 4) as *" a set of mechanisms through which outside investors protect themselves against expropriation by managers and controlling shareholders".* The above definitions primarily focussed on the interests of shareholders whilst ignoring the interests of non-investing stakeholders.

On the other hand, others broaden their definition to include stakeholders. From a stakeholder perspective, Tirole (2001, p. 4) defines corporate governance as: *"the design of institutions that induce or force management to internalise the welfare of stakeholders".* OECD (2004, p. 11) defines corporate governance *"a set of relationships between a company's management, its board, its shareholders and other stakeholders".* This definition specifically focuses on inter-relationship with various stakeholders. Donnelly and Mulcahy (2008, p. 416) defined corporate governance as: *"a set of corporate governance mechanisms that is specially designed to monitor and ratify managerial decisions and to ensure the efficient operation of a corporation on behalf of its stakeholders."* This definition concentrates on monitoring managers on behalf of stakeholders. In the view of Solomon (2010, p. 6) corporate governance is: *"the system of checks and balances, both internal and external to companies, which ensures that companies discharge their accountability to all their stakeholders and act in a socially responsible way in all areas of their business activity".* This definition includes economic, social, and ethical responsibility of directors.

Corporate governance has shifted from shareholder-focused to stakeholder focused paradigm following recent financial scandals around the world. Given that, the corporate governance system of a firm may be biased either towards shareholders alone (shareholder-focused corporate governance) or towards a broader stakeholder groups (stakeholder-focused corporate governance) and this bias will have implications for a firm's disclosure practices. In shareholder-focused corporate governance, corporate directors and managers have fiduciary duties to run the firm for its shareholders only. Shareholder-focused corporate governance system focuses only on the issues that resolve agency conflicts among managers and owners. Consequently, shareholder-focused corporate governance concentrates on maximising shareholder value, rather than having a relationship with a variety group of stakeholders.

By contrast, in stakeholder-focused corporate governance, board members and managers may clearly consider a broader group of stakeholders when making decisions. (Devinney, Schwalbach & Williams 2013). Stakeholder-focused corporate governance is a set of corporate governance mechanisms that seek to maximise value for shareholders while satisfying the legitimate demands of stakeholders (Durden 2008). It concentrates on the issues that go beyond traditional view to touch upon corporate ethics, accountability, disclosure, and reporting for the interests of other stakeholders. *"Stakeholder-focused corporate governance leads to higher investor confidence, more stable earnings, and a better share price",* says Jim Roger, Chairman, President, and CEO of Duke Energy. Jim Roger proposes four aspects to be stakeholder-focused corporate governance: create sustainable stewardship, be thoughtful and sceptical, create an environment of engagement, and talk to others.

2.7.1. Corporate governance in Australia

The ASX formed its Corporate Governance Council (CGC) in Australia in 2002 and published its "Principles of Good Governance and Best Practice Recommendations" in 2003. The ASX CGC defines corporate governance as: *"the system by which companies are directed and managed"* (ASXCGC 2003, p. 2). In addition, the ASXCGC revised its recommendations in 2007 and 2010. The Council revised its corporate governance as: *"the framework of rules, relationships, systems and processes within and by which authority is exercised and controlled in corporations"* (ASXCGC 2007, p. 3).

The ASXCGC developed 28 recommendations based on ten essential principles of good corporate governance (Gibson & O'Donovan 2007). A firm should (i) lay solid foundations for management and oversight, (ii) structure the board to add value, (iii) promote ethical and responsible decision-making, (iv) safeguard integrity in financial reporting, (v) make timely and balanced disclosure, (vi) respect the rights of the shareholders, (vii) recognise and manage risk, (viii) encourage enhanced performance, (ix) remunerate fairly and responsibly and (x) recognise the legitimate interests of stakeholders (ASXCGC 2007, p. 3).

The AXSCGC expects that Australian firms with good corporate governance should be structured as follows: (i) a majority of the board should be independent directors, (ii) the chairperson should be an independent director, (iii) the roles of chairperson and chief executive officer should not be exercised by the same individual, (iv) the board should establish an audit committee, which comprises only non-executive directors, a majority of whom are independent directors, (v) the board or appropriate board committee should establish policies on risk oversight and management, and (vi) establish and disclose a code of conduct to guide compliance with legal and other obligations to legitimate stakeholders (ASXCGC 2007, p. 3).

Australian firms adopt Anglo-based corporate governance mechanisms, which is market-based and primarily focus on interests of shareholders (Young & Thyil 2013). Although Australian firms follow Anglo-based corporate governance, over the past few years, stakeholder perspectives have increasingly been included in Australian corporate governance mechanisms (Young & Thyil 2013). According to Pham et al. (2012) *"Australian corporate system offers a unique environment for assessing the impact of corporate governance mechanisms"* (Pham, Suchard & Zein 2012, p. 84). There are significance institutional differences between Australia and countries such as UK and US with regards to stock market development, ownership concentration, and institutional shareholding. Overall, it is not clear if Australian firms' corporate governance mechanisms are on the whole shareholder-focussed or stakeholder-focussed.

Firstly, although Australian companies have corporate governance mechanisms that are similar in design to those in the UK and US, with regards to stock market development to GDP index, UK and US firms have higher values than those in Australia. Corporations in UK and US were much more active in corrective mechanisms against managerial entrenchment and corporate failure than Australia (Pham, Suchard & Zein 2012). Secondly, Australian firms have higher concentration of blockholders ownership and lower institutional shareholding as compared with UK and US firms (Pham, Suchard & Zein 2012). These differences in Australian firms provide a unique institutional setting within which to test the impact of corporate governance on voluntary disclosure of GHG emission information.

2.8. Voluntary disclosure and corporate governance quality

The Triple Bottom Line (TBL) reporting of financial, social and environmental issues has emerged since 1990s and since then, many firms have been disclosing separate standalone sustainability reports and additional complementary information in their annual reports voluntarily around the world (Gibson & O'Donovan 2007). Firms make use of the TBL reporting to legitimise their operations in terms of sustainability (Rao, Tilt & Lester 2012). Based on the prior literature, voluntary disclosure can be divided into four groups: financial voluntary disclosure, corporate sustainability voluntary disclosure, environmental voluntary disclosure and GHG emission voluntary disclosure.

A large body of research has extensively investigated the role of corporate governance mechanisms on the firm's voluntary financial disclosures (see for instance, Forker (1992), Klein (2002), Eng and Mak (2003), among others). In this strand, there are several empirical studies which seek to show relationships between corporate governance mechanisms and corporate disclosures such as CSR, environmental disclosure, and GHG emission disclosure. Firstly, this study summarises the literature on the link between corporate governance mechanisms and CSR. Secondly, this study reviews the literature on the relationship between environmental disclosure and corporate governance. Finally, the relationship between climate change disclosure particularly GHG emission disclosure and corporate governance are reviewed.

2.8.1. Corporate governance and CSR

A limited number of studies have empirically examined how corporate governance mechanisms influence CSR (Harjoto & Jo 2011; Jo & Harjoto 2012; Mallin, Michelon & Raggi 2013; Ntim & Soobaroyen 2013). Harjoto and Jo (2011) studied four competing hypotheses: namely conflict resolution, overinvestment, strategic choice, and product-signalling to examine the impact of corporate governance mechanisms on CSR. The conflict resolution hypothesis assumes that managers may use CSR to reduce conflict among various stakeholders. The overinvestment hypothesis predicts that firms with effective corporate governance mechanisms were less likely to engage in CSR; the strategic-choice hypothesis suggests that managers strategically use CSR to increase their job security; and finally, the product-signalling hypothesis proposes that there is no association between corporate governance mechanisms and CSR. They found that firms used corporate governance mechanisms and CSR in order to reduce conflict among stakeholders, which, in turn, tended to increase the firm's value.

Jo and Harjoto (2012) investigated the empirical association between corporate governance and CSR. They introduced two competing hypotheses: the conflict-resolution hypothesis based on stakeholder theory and the overinvestment hypothesis based on agency theory. They argued that there was a positive association between corporate governance and CSR according to the conflict-resolution hypothesis and a negative association according to the overinvestment hypothesis. In addition, if managers used effective corporate governance mechanisms together with CSR to resolve conflict among stakeholders, then there was a positive relationship between a firm's profitability and CSR according to the conflict-resolution hypothesis. Their results support the conflict-resolution hypothesis supporting stakeholder theory.

Mallin, Michelon and Raggi (2013) have divided corporate governance mechanisms into two broader perspectives: stakeholder-orientation corporate governance based on stakeholder theory and monitoring intensity of corporate governance based on agency theory. They found that stakeholder-orientation of corporate governance influenced CSR. Ntim and Soobaroyen (2013) investigated whether corporate governance mechanisms could influence the contributions of CSR to corporate financial performance. They find that board independence, board size, board diversity, government ownership were positively related to CSR, and blockholders' ownership and institutional ownership were both negatively related to CSR.

2.8.2. Corporate governance and environmental disclosure

The association between corporate governance and voluntary environmental disclosure is another issue that is broadly investigated in the existing literature. For example, Rupley, Brown and Marshall (2012) examined the relationship between corporate governance, media coverage and voluntary environmental disclosure using 127 US firms for the period of 2000 to 2005. They introduced multi-stakeholder governance mechanisms aspects with the quality of voluntary environmental disclosure. The variables of multi-stakeholder governance mechanisms included in their study were board independence, gender diversity, multiple directorships, separation of the CEO from the board chairman, and the existence of environmental committee. They found that board independence, gender diversity, and multiple directorships had a positive influence, whilst media coverage negatively impacted on the quality of the voluntary environmental disclosure.

Buniamin et al. (2008) investigated the relationships between a set of separate corporate governance variables: board independence, CEO duality, managerial share ownership, and board size, and levels of voluntary environmental disclosures in annual reports. They used content analysis of 243 companies listed in Malaysia. They found a positive association between board size and levels of voluntary environmental disclosure. They did not find an association between board independence, CEO duality, and managerial share ownership and levels of voluntary environmental disclosure in annual reports.

2.8.3. Corporate governance and GHG emission disclosure

Research on voluntary disclosure of GHG emission information is a very new concept and the relationship between corporate governance and voluntary disclosure of GHG emission information was rarely studied in the prior literature. The study by Prado-Lorenzo and Garcia-Sanchez (2010) is an exception and they focussed on voluntary disclosures of GHG emissions and corporate governance variables. They specifically examined the relationship between board independence, CEO duality and diversity, and levels of information disclosures about GHG emissions. They did not find a significant relationship between voluntary disclosure of GHG emissions and board independence. Moreover, a significant positive relationship between CEO duality and disclosures of GHG emissions disappeared when controlling for the intensity of GHG emissions. They found that boards of directors were more focused on creation of economic value than on the disclosure of GHG emission information.

Peters and Romi (2014) examined whether or not environmental corporate governance characteristics associated with voluntary GHG emission disclosure by using a sample of firms participating in the CDP from 2002 to 2006. They argued that environmental corporate governance participants view GHG emission disclosures as a potentially important strategic device for meeting the environmental information demands of stakeholders. To address this issue, they took two broad theoretical views: an economic perspective and an ethics-based perspective. The economic-based approach is that the firm makes GHG emission disclosure decisions

primarily focused on its investors due to economic pressure. Given that, the firm may analyse its costs and benefits with regards to decisions about voluntary disclosure decision of GHG emission information. On the other hand, the ethical-based approach views the firm's GHG emission disclosure decisions as a broader response to the demands of stakeholders. They focus on the relationship between voluntary GHG emission disclosure and environmental committee, the existence of a sustainability officer, the size of the environmental committee size the existence of sustainability officer as factors.

They found that the presence of an environmental committee, committee size, number of committee meetings, expertise of committee members, existence of a sustainability officer, and overlap between the environmental committee and audit committee was positively associated with the probability of GHG emission disclosure. In addition, they found that the presence of a sustainability officer and the level of expertise of the environmental committee were positively associated with GHG emission disclosure transparency, and the existence of a larger environmental committee was negatively associated with the transparency of GHG emission disclosures.

Ben-Amar and McIlkenny (2014) examined the relationship between board of directors' effectiveness and voluntary GHG emission disclosure using a sample of 200 publicly listed companies on the Toronto Stock Exchange for the period of 2008 to 2011. They measured voluntary disclosure of GHG emission information based primarily on CDP questionnaires. Board effectiveness is an index as a measure of the effectiveness of the board of directors used by the University of Toronto's Clarkson Centre of Business Ethics and Board Effectiveness. They found a positive relationship between board effectiveness and voluntary disclosure of GHG emission information in Canadian firms.

Liao, Luo and Tang (2014) examined the impact of corporate board's characteristics on the voluntary disclosure of GHG emissions in the form of a CDP questionnaire using a sample of 329 largest firms in the UK. They primarily focussed on three corporate governance variables such as gender diversity, board independence, and the presence of environmental committee. They argued using legitimacy and stakeholder theories that GHG emission reduction strategies and initiatives involving large investment had complex and vague consequences that may affect a variety of stakeholders. Therefore, an effective board may have power to address issues raised by various stakeholders. They have found that gender diversity, board independence and the presence of an environmental committee have an impact on voluntary disclosure of GHG emissions without considering endogeneity and selection bias issues.

2.9. Voluntary disclosure and corporate governance in Australia

Since climate change differentially impacts countries (Aggarwal & Dow 2012) the country of origin of a firm has an impact in determining the level of disclosure (Adams 2002). Therefore, research on the impact of corporate governance mechanisms on voluntary disclosure of GHG emission information using a single country may provide greater insights. As Australian listed firms have unique institutional background compared to the US and the UK, the above relationship may provide clear picture as far as Australian firms concerned. There are only a limited number of research studies in the Australian market.

Clarkson, Overell and Chapple (2011) claim that first Australian study that investigates environmental disclosure is the study by Deegan and Rankin (1996). Australian listed companies have had a tendency to disclose excessive amounts of positive environmental data (Cowan & Gadenne 2005). A content analysis was used in this study to investigate environmental disclosures in annual reports of the companies during the period 1998 to 2000. Gibson and O'Donovan (2007) using content analysis have documented that the percentage of environmental disclosures in annual reports has increased over a 21-year period (1983- 2003). Frost (2007) argued that while Australian regulators have not been active in introducing mandatory environmental reporting in annual reports, there has been some consideration of releasing a number of guidelines for voluntary environmental disclosures developed by the Australian government. He has noted that Australian firms have disclosed an increased amount of environmental information in annual reports and standalone sustainability reports. He found that voluntary reporting provides more consistent substantial information on environmental performance. Previous Australian studies on environmental disclosures have focused only on annual reports as a source of getting data about environmental disclosures.

Chan, Watson and Woodliff (2014) analysed the relationship between corporate governance quality and CSR disclosures using the annual reports from a sample of 222 Australian listed firms. They argue that firms with good corporate governance should theoretically be better corporate citizens and more socially and environmentally responsible than firms with poor corporate governance, therefore, they expected that there would be a strong positive association between corporate governance quality and voluntary disclosure of CSR. Their argument is based on stakeholder and legitimacy theories. Using Horwath ranks to test for corporate governance quality, they found that Australian firms with corporate governance quality were positively related with voluntary disclosure of CSR.

Recently, Rao, Tilt and Lester (2012) examined the association between corporate governance mechanisms and voluntary environmental disclosure using a sample of 96 large firms in Australia. They argued that characteristics such as board independence, board size, and female director on the board influence the voluntary disclosure of environmental information. They did find that board independence, female director on the board, and board size had positive influence on the voluntary disclosure of environmental information in Australia.

Rankin, Windsor & Wahyuni (2011) examined the relationship between voluntary GHG disclosures, internal organisational systems and private regulation that have guided GHG disclosures as evidence of reported corporate response to climate change. Institutional governance theory (Griffiths, Haigh & Rassias 2007) has been used to explain voluntary GHG reporting in the context of a market governance system in the absence of climate change public policy. They argued that the institutional environment would impact upon the quality of climate change governance, and encourage firms to be proactive in pursuing avenues to address climate change.

They construct a voluntary GHG emissions disclosure index from the GHG reporting standard measured based on ISO 14064-1 items for a sub-sample of 80 disclosing firms. Corporate governance quality is measured as a composite measure based on the Howarth reports. Their final sample of ASX firms consists of 187 firms including 80 firms that report GHG emissions information in their 2007 company reports. They found firms that voluntarily disclosed GHG emissions data had environmental management systems, higher corporate governance quality and publicly report to the CDP, tended to be larger and were in the energy and mining industrial sectors. They recommended that the extent and credibility of voluntary disclosure of GHG emissions were greater for firms that reported their GHG emission through the CDP.

Borghei-Ghomi and Leung (2013) investigated the determinants of GHG emission voluntary disclosure based on a sample of 151 Australian firms. They measured the GHG emission disclosure index using only annual reports of firms based on GRI guidelines. They included a single corporate governance variable, which is the proportion of non-executive directors on the board. They found a positive association between the proportion of non-executive directors on the board and voluntary disclosure of GHG emission information.

The above two Australian studies by Rankin, Windsor and Wahyuni (2011) and Borghei-Ghomi and Leung (2013) investigated the relationship between corporate governance and voluntary disclosure of GHG emission information in an Australian setting. Rankin, Windsor and Wahyuni (2011) adopt corporate governance quality ranked by the Howarth reports. Kohl and Schaefers (2012) argued that researches based on self-constructed or professionally prepared corporate governance quality, were more likely to be inadequate proxies for corporate governance for three reasons.

Firstly, there was the possibility of avoiding important corporate governance characteristics in their calculations. Secondly, the construction of corporate governance quality was necessarily biased to the extent that weights were more or less arbitrarily assigned to certain corporate governance variables. Finally, professional agencies have not delivered reliable and accurate corporate governance ratings (Sonnenfeld 2004). Sonnenfeld (2004, p. 108) criticises professional rating agencies' scoring of corporate governance effectiveness based solely on public records using simplistic checklists of standards or metrics based heavily upon myths, rather than genuine research. Beekes, Brown and Zhang (2014) noted that the Horwath corporate governance ratings focus on key features of corporate governance that were not all encompassing measures.

Additionally, a single corporate governance attribute does not give a full picture of a firm's corporate governance practices. A wide range of corporate governance attributes was needed to see the better corporate governance practices. This research gap between broad ranges of corporate governance attributes and voluntary disclosure of GHG emission information will be filled by this research.

It is argued that firms with better corporate governance quality disclose higher levels of voluntary information. In Australia, a few studies have documented the relationship between board characteristics and voluntary disclosures in annual reports. Beekes and Brown (2006) examine the association between corporate governance quality rating and disclosures of information in relation to price sensitive announcements using a sample of 250 Australian firms. They find that better corporate governance firms do make more informative disclosures. Lim, Matolcsy and Chow (2007) examined the association between board composition and voluntary disclosure in annual reports for 2001 by 181 Australian companies. Firstly, they found a positive association between board composition and voluntary disclosure of information. Secondly, they found a more positive association between board independence and forward-looking and strategic disclosures. The above studies did not examine the relationship between voluntary GHG emissions disclosures, corporate governance and earnings management.

One of the key purposes of this study is to provide an explanatory association between levels of voluntary disclosures and a set of separate corporate governance variables. A number of studies document the relationship between overall corporate governance quality and voluntary disclosure in annual reports in different markets with mixed findings (Akhtaruddin & Haron 2010; Baek, Johnson & Kim 2009; Chau & Gray 2010; Gul & Leung 2004; Ho & Wong 2001). This research, therefore, examines specific corporate governance variables (in the following sections) and their relationship to voluntary disclosure of GHG emissions.

2.9.1. Board independence

The board of directors is referred to as an internal governance mechanism that tends to ensure that the interest of shareholders and managers are closely monitored and controlled. Fama and Jensen (1983) posit that the board of directors is the internal governance mechanism accountable for observing actions by the top management. The role of the board of directors is to provide final approval of each firm's strategy, monitor and control senior executive's performance and their implementation strategy, approval of financial and other reports. The boards of directors generally consist of executive and non-executive directors. Executive directors are elected at shareholders' meetings and are employed by a firm. Non-executive directors are also elected by board and not employed by the firm. An executive director who has a relationship with firm other than his position as a non-executive director such as a substantial shareholder, as a management consultant or advisor, as a supplier or customer, will not be treated as an independent director. Independent non-executive directors have no other relationship with the firm other than as non-executive directors.

Corporate governance is deemed to be effective if the firm has a majority of independent directors who monitor and control senior management in order to reduce the self-serving actions of senior management executives and reduce information asymmetry by disclosing relevant information in their periodic reports and on their websites. The ASXCGC (2007) recommends that a majority of the board should be independent (Recommendation 2.1). When determining the independent status of a director the board should consider whether a director:

I. is a substantial shareholder of the company or an officer of, or otherwise associated directly with, a substantial shareholder of the company
II. is employed, or has previously been employed in an executive capacity by the company or another group member, and there has not been a period of at least three years between ceasing such employment and serving on the board
III. has within the last three years been a principal of a material professional adviser or a material consultant to the company or another group member; or an employee materially associated with the service provided
IV. is a material supplier or customer of the company or other group member, or an officer of or otherwise associated directly or indirectly with a material supplier or customer
V. has a material contractual relationship with the company or another group member other than as a director (extracted from the ASXCGC, 2007:17).

An independent director is a non-executive director who is not a member of management and who is free of any business or other relationship that could materially interfere with the independent exercise of their judgment (ASXCGC 2007) Fama and Jensen (1983) have argued that independent directors have incentives to develop their reputations as experts in monitoring managers because value of their human capital depends preliminary on their performance as internal managers in other organisation. They have further argued that independent directors can reduce the agency costs associated with the separation of ownership and control. Beasley (1996) has found that the existence of independent directors on the board reduces the likelihood of financial statement fraud. All non-executive directors on the board of directors are not independent directors. Non-executive directors can be classified as independent and grey directors. An independent director is a non-executive director who has no affiliation with the firm than the affiliation from being on the board of directors. A ‘grey director’ is not a current employee of the firm and has a potential source of violation of board independence because of their other affiliations with management (Beasley 1996)

Rupley, Brown and Marshall (2012) have argued that independent directors are on the boards to monitor, influence, and provide outside perspective to assist a firm in attaining their strategic goals. They have further argued that independent directors were more likely to disclose more transparent and quality environmental information. They found that a positive association existed between voluntary environmental disclosure and the board independence.

Independent directors can play a major role in making decision with regards to a firm's voluntary disclosure (Ajinkya, Bhojraj & Sengupta 2005). Recently, Ben-Amar and Zeghal (2011) examined the relationship between board independence and level of executive compensation disclosures for firms listed on Toronto Stock exchange. They argued that an independent board has the ability to monitor managers in disclosing higher levels of executive compensation information and package to motivate executives. They have found a positive association between board of directors' independence and executive compensation disclosure. More independent directors on a board are needed to monitor and control the actions of internal managers and limit inside members 'opportunistic behaviours' (Jensen & Meckling 1976). Earnings management creates information asymmetry between contracting parties, and it tends to decrease shareholders' wealth (Park & Shin 2004). Firms with more independent directors on the board are more likely to constrain earnings management (Peasnell, Pope & Young 2005; Xie, Davidson III & DaDalt 2003).

A number of studies found a significant positive association between the proportion of independent directors on the board and the levels of voluntary disclosure in annual reports (Chau & Gray 2010; Huafang & Jianguo 2007). On the other hand, Eng and Mak (2003), Gul and Leung (2004) Haniffa and Cooke (2005) found that the proportion of non-executive directors on the board has been negatively associated with the levels of voluntary disclosures. In addition, Barako, Hancock and Izan (2006a) and Ho and Wong (2001) did not find an association between board independence and voluntary disclosure.

2.9.2. CEO duality

The ASX recommends that the chairperson should be an independent director. The role of the chairman of the board is to lead board meetings, and supervise the process of recruiting and sacking, evaluating, compensating the CEO. These critical roles can only be performed by an independent chairperson (Jensen 1993). Subramaniam, McManus and Zhang (2009) argued that independent chairmen monitor the board and the CEO to keep their reputations. Since an independent chairman does not have any material relationship with the firm, he or she can lead the board very successfully. They found that a firm with an independent chairman induces the board to create a risk management committee. CEO duality is the practice of one person serving both as a firm's CEO and board chair (Peng, Zhang & Li 2007). Effective corporate governance does not allow an individual to serve as CEO and chair of the board of director. The CEO is a firm's chief strategist, who is in charge of initiating and implementing company-wide plans and policies, while the role of the chairperson is to ensure that the board works effectively in advising and monitoring the CEO (Chancharat, Krishnamurti & Tian 2012). Agency theory predicts that the power of CEO duality may reduce the intensity of monitoring. As a result, firms may disclose less information which leads to increase information asymmetry (Jensen & Meckling 1976). Chau and Gray (2010) argue that the CEO duality prevents him/her from running a firm effectively. The presence of an independent director on the board induces managers to release more voluntary information to the outsiders. They found a positive relationship between the existence of an independent chairman and levels of voluntary disclosure in their study.

Gul and Leung (2004) argued that since firms with concentrated power of CEO duality are less likely to be effective in monitoring management and disclosing a higher level of voluntary information, therefore, there might be a negative association between CEO duality and levels of voluntary disclosures. They reported that CEO duality is negatively associated with levels of voluntary disclosures. Forker (1992) found a negative association between CEO duality and disclosure of share options. In contrast, Ho and Wong (2001) and Barako, Hancock and Izan (2006a) did not find an association between levels of voluntary disclosures and CEO duality. This study expects to find a negative relationship between levels of voluntary disclosures of GHG emissions and CEO duality.

2.9.3. Board gender diversity

The ASXCGC (2014, p. 11) recommends (3.3) that '*companies should disclose in each annual report the measurable objectives for gender diversity set by the board in accordance with the diversity policy and progress with achieving them*'. Women and men have different motivations in social responsibility (Post, Rahman & Rubow 2011). In this context, the presence of women on the board of directors is expected to have an impact on social responsible disclosure. Since women on boards have more social empathic and caring qualities (i.e., female stereotypical behaviour), they are more socially responsible (Boulouta 2013).

Rupley, Brown and Marshall (2012) have argued that female directors on a board are more likely to disclose more environmental information to the public. They find that the gender diversity has an impact on voluntary environmental disclosure. Rao, Tilt and Lester (2012) argue that board diversity has an impact on the disclosure of environmental information. They found that women directors on boards are positively associated with voluntary environmental disclosure. Bear, Rahman and Post (2010) suggested that firms may use the number of women on the board as a signal to stakeholders that they are socially responsible firms. They find a positive association between the number of women on the board and community and diversity dimensions of CSR.

Fernandez-Feijoo, Romero and Ruiz (2012) investigated the board gender diversity and CSR and found that the board with three or more women members have disclosed more CSR information. Amran, Lee and Devi (2014) investigated the role of the board gender diversity in sustainability reporting quality in the Asia-Pacific region. They argue that the presence of female directors on the board was more likely to result in an enhancement in the quality of sustainability information. However, they found no relationship between the board gender diversity and quality of sustainability disclosure.

Liao, Luo and Tang (2014) argued that female directors on the board were more likely to be assigned and to accept roles that were related to sustainability development matters; therefore, the presence of women on the board would increase the voluntary disclosure of GHG emission information. They found a positive association between the proportion of women directors on the board and voluntary disclosure of GHG emission information for the UK firms. Prado-Lorenzo and Garcia-Sanchez (2010) argued that women members of the board of directors were more likely to disclose higher GHG emission information. However, they found no relationship between the board gender diversity and disclosure of GHG emission information. Overall, there is mixed evidence regarding the role of gender diversity on GHG emissions disclosure.

2.9.4. Directors' share ownership

Managerial share ownership is the percentage of ordinary shares owned by both executive and non-executive directors. Equity-based compensation is a corporate governance device that attempts to constrain managers' self-serving activities. Jensen (1986) has predicted that external directors have less incentives to constrain managers when they have low managerial share ownership. A few studies focus on the relationship between percentage of managerial share ownership and levels of voluntary disclosures and find mixed findings. Arcay et al. (2005) found a positive association in the relationship, while Akhtaruddin and Haron (2010) and Eng and Mak (2003) found a negative relationship between managerial share ownership and levels of voluntary disclosures. Agency theory predicts that a firm's top management should have a significant equity-based ownership in order to act on behalf of owners. It is believed that managers may disclose a greater amount of GHG emission information voluntarily to show that they work in the interest of shareholders.

Li and Qi (2008) examined managerial share ownership and voluntary disclosure for Chinese listed firms and found a positive association between the two variables. They argue that managers with high share ownership were more likely to disclose more voluntary information to avoid high agency costs. This was because managers were concerned about shareholders' benefit and stock options, and this may provide an incentive to managers for them to disclose more voluntary information. Therefore, based on theory, this research expects a positive relationship between levels of voluntary disclosures of GHG emissions and the percentages of managerial share ownership. The Corporation Act 2001 requires every director of a listed company to notify the ASX about holdings and changes to relevant interests in securities (ASIC 2008). Directors' shareholding is measured by ratio of directors' shareholding (direct, indirect, and beneficial holding) to total share outstanding (Koh 2005).

2.9.5. Institutional share ownership

Institutional share ownership is the percentage of ordinary shares held by institutional investors. Institutional investors include insurance companies (life and non-life), superannuation and pension funds, investment trusts (including investment trust), financial institutions (bank and bank nominee companies, finance companies, building societies and credit cooperatives), investment companies, and other nominee companies associated with the above categories of institutions (Koh 2003). Institutional investors demand GHG emission information to assess the risk and opportunities associated with climate change. Corporate directors, therefore, need to disclose such information voluntarily, even in the absence of any mandatory requirement industry-wide. Aggarwal and Dow (2011) found that institutional investors do not exert direct influence on decisions regarding adoption of GHG emission mitigation strategies at the firm level. Their pressures seem more dedicated at influencing public policy such as promoting GHG emission disclosure through the CDP.

Attig et al. (2012) argued that long-horizon institutional investors have greater efficiency and incentives to engage in effective monitoring. They found that institutional investors with long-term investment horizon played an efficient governance role to mitigate information asymmetry and agency problems as opposed to investors with a short-term horizon. Ismail and Rahman (2012) suggested that institutional investors are playing more effective roles in monitoring company's risk management disclosure compared to the board of directors.

Marshall, Brown and Plumlee (2011) examined the relationship between different types of intuitional investors and the quality of a firm's voluntary environmental disclosures. They argued that the types of institutional investors provide different levels of monitoring and controlling. They divide the institutional investor into two groups such as short-horizon institutional investors and long-horizon institutional investors. Long term institutional investors were more likely to engage with management whereas short-term institutional investors were less likely to engage in activities that influenced managerial decision making. They find that short-term institutional investors may limit the extent of voluntary disclosure of environmental information. They suggested that voluntary environmental disclosure was likely to be perceived as a long term issue.

Hsu and Koh (2005) suggest that long-term oriented institutional investors can act as a corporate governance mechanism to mitigate managerial rent-seeking activities. Voluntary disclosure reduces information asymmetries between management and outside investors and among different types of investors. This, in turn, improves liquidity in a firm's stock and makes it more attractive to institutional investors. Diamond and Verrecchia (1991) find a positive association between institutional shareholding and financial reporting quality. They recommended that disseminating more information can reduce information asymmetry between parities that also reduce risk associated with them.

Sharma (2004) argued that since Australian institutional investors have larger concentrated share ownership than the US they have more incentives in monitoring top management. She found a positive relation between the institutional shareholding and fraud. Institutional investors were more likely to use their shareholding to influence the board (Lau, Sinnadurai & Wright 2009). Koh (2003) suggested that institutional investors with high share ownership were more likely to use their power to monitor CEOs.

Institutional investors with substantial investment in a firm's ordinary shares have strong incentives to monitor firm management. Thus, managers may disclose more voluntary information to meet the expectations of larger institutional shareholders (Barako, Hancock & Izan 2006b). Institutional investors play an important role in inducing firms to disclose a great amount of GHG emissions information. Institutional investors facilitate climate change information through the CDP. Harmes (2011) suggested that institutional investors incorporate climate change information into their investment decision-making and promote climate change mitigation by switching their investments from poor to good climate performers by putting direct pressure on corporate managers.

Cotter and Najah (2012) found that the institutional investors positively influenced the disclosure of GHG emissions information. Bushee and Noe (2000) find that institutional investors were attracted to firms with greater levels of disclosure. Baek, Johnson and Kim (2009) found a positive association between voluntary disclosure and institutional share ownership. Donnelly and Mulcahy (2008) found an insignificant relationship between voluntary disclosures and institutional share ownership. This research expects that firms with higher institutional share ownership may experience more intensive monitoring. As a result, a firm with higher proportion of institutional share ownership may disclose more voluntary GHG emissions information.

2.9.6. Frequency of audit committee meetings

The ASXCGC (2007) recommended that the audit committee should meet often enough to undertake its role effectively. Abbott, Park and Parker (2000) argued that an audit committee that meets frequently was more likely to perform their duties effectively. Chung, Ho and Kim (2004) suggest that the presence of an audit committee serves as a means of mitigating agency cost, managerial opportunism, and improving disclosure quality. Xie, Davidson III and DaDalt (2003) argued that an audit committee that seldom met may be less likely to engage in a monitoring role. A more active committee that met more often should be in a better position to engage in a monitoring role. This research will use frequency of audit committee meetings as a proxy for the levels of audit committee activities. Previous studies find a positive association between frequency of audit committee meetings and levels of information disclosure (Allegrini & Greco 2013; Ho & Wong 2001; O'Sullivan, Percy & Stewart 2008). However, Forker (1992) does not find an association between disclosure and the presence of an audit committee.

2.9.7. Size of audit committee

The ASXCGC (2007) states that audit committee should have at least three members to do its duty. The maximum numbers of members of an audit committee is not limited by ASXCGC. Previous study between the size of audit committee and quality of its disclosure has produced mixed results. Some researchers argue that having larger audit committees tended to carry out its responsibilities more effectively; and therefore, this has an impact on disclosure quality. Pucheta-Martínez and De Fuentes (2007) argued that the more members there are in an audit committee, the more likely it is to put pressure on managers to disclose quality financial information. They found a positive association between the size of the audit committee and financial reporting quality. Felo, Krishnamurthy and Solieri (2003) argued that a larger audit committee is likely to spend adequate time and effort to ensure the quality of financial reporting. They found a positive association between the size of the audit committee and quality of financial disclosure.

Lin, Xiao and Tang (2008) argued that, since audit committees with more members were not necessarily functioning very effectively rather; they tended to spend their time and effort arguing on trivial matters. This may lead to ineffective decision making which has an impact on disclosure quality. Scarbrough, Rama and Raghunandan (1998) argued that an audit committee with skilled members was more likely associated with the objectives of audit functions. Karamanou and Vafeas (2005, p. 458) argued that: *"larger audit committees had a wider knowledge base on which to draw but were likely to suffer from process losses and diffusion of responsibility".* Beasley et al. (2009) found that audit committee members provided effective monitoring of financial reporting and acted as an active member of an audit committee.

2.10. Voluntary disclosures and earnings management

Earnings management studies *"examine whether managers act as if they believe users of financial reporting data can be misled into interpreting reported accounting earnings as equivalent to economic profitability"* (Fields, Lys & Vincent 2001, p. 279). The opportunities for earnings management arise because of the flexibility permitted by generally accepted accounting principles (GAAP). Earnings management is more likely to occur when managers have the motivation to mislead their financial statement users by exercising discretion over accounting choices or real activities manipulation in financial reporting.

Healy and Wahlen (1999, p. 368) argued that *"earnings management occurs when managers use judgment in the financial reporting and in structuring transactions to alter financial reports to either mislead some stakeholders about the underlying economic performance of the company, or to influence contractual outcomes that depend on reporting accounting numbers".* Schipper (1989, p. 92) define earnings management as *"a purposeful intervention in the external financial reporting process, with the intent to obtain some private gain".*

Managers have several incentives to distort the true financial performance of the firm. Managers' earnings management practice is associated with risks and costs. Prior research has identified several incentives for earnings management. Managers manage earnings to increase their compensation (Burns & Kedia 2006), increase equity price (Burghstahler, Hail & Leuz 2006), and reduce tax (Jones 1991). Although managers have various motivations for managing earnings, another motive is that managers manage earnings management while they engage in social responsible initiatives (Gargouri, Shabou & Francoeur 2010; Prior, Surroca & Tribó 2008; Salewski & Zülch 2014).

Zhou and Lobo (2001) note that: "*corporate disclosure and earnings management are both subject to managers' discretion; therefore, managers are likely to consider their interaction when exercising managerial discretion.*" Voluntary disclosure of GHG emissions may contain both positive and negative information as well as current emissions and future strategies related to a firm operation. Mangers may have incentives to create a positive image about firm's emission management. Decision to disclose voluntary GHG emission mostly depends on at managers' discretion. Mangers may create positive image regarding their GHG emission related activities sometimes referred to as 'greenwashing'. Greenwashing is defined by Lyon and Maxwell (2011, p. 9) as "selective disclosure of positive information about a company's environmental or social performance without full disclosure of negative information on these dimensions, so as to create an overly positive image."

2.10.1. CSR and earnings management

The relationship between earnings management and CSR disclosure can be analysed based on different perspectives such as whether or not the managers' incentives are ethical or opportunistic. It is expected that firms with a higher ethical orientation are more likely to report accurate and reliable financial information. Ethical managers believe that socially responsible firms prefer to have long-term relationship with their stakeholders and therefore these managers provide more value-relevant information to the stakeholders in order to make their decisions correctly (Choi, Lee & Park 2013). Kim, Park and Wier (2012) have argued that if managers engaged in sustainability disclosure focusing on the ethical commitment perspective, they were less likely to engage in earnings management; that would in turn to lead an accurate and high quality financial reporting. Under this theory, firms with high level of ethical commitment would provide high quality of financial reporting than firms with lower ethical commitment (Choi & Pae 2011). Socially responsible firms are less likely to engage in negative social activities which could damage their reputation and public trust because good corporate citizens are less likely to experience negative social events (Laksmana & Yang 2009). In addition, Brine, Brown and Hackett (2006) have stated that the stakeholders grant the firms an unwritten authority to do business. If firms fail to manage their responsibility to society, they will lose their license to operate. If managers are ethical then they disclose more reliable and transparent CSR information as well as financial information. There should be a negative relationship between CSR disclosure and earnings management. In supporting this view, previous research has found a significant negative association between sustainability disclosure and earnings management (Cho, Lee & Pfeiffer 2013; Heltzer 2011; Hong & Andersen 2011; Kim, Park & Wier 2012).

The separation of ownership and control creates a conflict between managers and shareholders that drives managers to pursue their personnel's rent-seeking behaviour at the expense of shareholder interests. (Jensen & Meckling 1976). Salewski and Zülch (2014) argue that firms that engage in earnings management may use sustainability disclosure as a means to cover up their opportunistic behaviour. If firms use sustainability disclosure as a means to cover up their de facto socially irresponsible behaviour, it may be actively engaged in earnings management. Kim, Park and Wier (2012) support this view by stating that firms may buy a form of reputational insurance by providing more sustainability information to the stakeholders, which gives them a license to manage earnings. Prior, Surroca and Tribó (2008) argue that managers disclose a generous amount of sustainability information as a tool to get support from major stakeholders of firms when they engage in earnings management. Managers believe that investing more on sustainability disclosure is worthwhile in order for them to meet the demands of a broad group of stakeholders when they engage in earnings management. This action leads to disclosure of sustainability information at the expense of shareholders. Managers of those firms destroy shareholders' value by making an investment decision based on sustainability disclosure.

If managers are opportunistic, then they use sustainability disclosure as a device to mask their opportunistic behaviour. There is a positive relationship between sustainability disclosure and earnings management. Recent researchers find a positive association between sustainability disclosure and earnings management (Prior, Surroca & Tribó 2008; Salewski & Zülch 2014).

Hong and Andersen (2011) investigated the relationship betwee CSR and earnings management using a sample of 8,078 US firm year observations. They proposed two conflicting arguments with respect to the association between CSR and earnings manahement. The first argument is based on ethical values and long-term profitability, where firms are relectant to engage in earnings manangement. The second argument is that firms use social responsibility as a license to operate when they engage in earnings management. They found that more socially responsible firms had less earnings management.

Kim, Park and Wier (2012) investigated whether or not socially responsible firms behaved in a responsible manner to constrain earnings management. Did firms disseminate transparent and reliable financial reporting to investors or were socially responsible firms disseminating transparent CSR to mislead stakeholders behind the appearance of transparency while engaging in earnings management? They argue that if managers engaged in CSR in a socially responsible manner, they were more likely to constrain earnings management and to make responsible operating decisions, thereby maintaining transparency in financial reporting. Therefore, a negative relationship will be observed between CSR and earnings management. On the other hand, if managers engage in CSR, managers of these firms are more likely to mislead stakeholders as to the value of the firms and financial performance. Therefore, a positive relationship will prevail between CSR and earnings management. They found that CSR firms were less likely to engage in earnings management. They also found evidence that top executives of the CSR firms were less likely to be involved in Security Exchange Commission (SEC) investigations. In addition to the ethical commitment point of view, Kim, Park and Wier (2012) offer

two more explanations with regards to the relationship between sustainability disclosure and earnings management. Firstly, to maintain the reputation of the firm, managers may use sustainability disclosure as a reputational signal and constrain earnings management. Secondly, firms with more economic slack are less likely to engage in earnings management and greater sustainability disclosure.

Prior, Surroca and Tribó (2008) examined the relationship between CSR and earnings management using 593 international industrial firms in the 2002 – 2004 period. They found a positive association between CSR and earnings management practices. Their study examines the relationships between voluntary disclosure of GHG emissions and earnings management without considering the moderating effect of corporate governance quality.

There are a few studies that document the relationship between CSR and earnings management with mixed findings. Chih, Shen and Kang (2008) examined the relationship between earnings management and CSR using four different hypotheses namely myopia avoidance hypothesis, predictable earnings hypothesis, multiple objectives hypothesis, and institutional hypothesis. The myopia avoidance hypothesis posits that a socially responsible firm will not hide unfavourable earnings realisations so that they will not engage in earnings management. The relationship between CSR and earnings management will be negative according to the myopia avoidance hypothesis. The predictable earnings hypothesis predicts that firms with a high degree of CSR may tend to smooth earnings to ensure that reported earnings are more predictable. Therefore, the relationship between CSR and earnings management will be positive. The multiple objectives hypothesis suggests that firms with high CSR may tend to manage earnings when managers try to serve all stakeholders in a firm. There will be a positive relationship between CSR and earnings management when they hold the multiple objectives hypothesis. The institutional hypothesis argues that there is no relationship between CSR and earnings management.

Chih, Shen and Kang (2008)measure earnings management using earnings smoothing, earnings aggressiveness, and earnings losses and decreased avoidance. They find a negative association between CSR and earnings smoothing and losses and decreases and a positive association between CSR earnings aggressiveness suggesting that multiple objectives hypotheses holds. Heltzer (2011) examined the relationship between earnings management and a sub-sample of CSR items using 2171 US firms. He found that firms with environmental concerns exhibited higher earnings management than other sampled firms.

Scholtens and Kang (2013) have investigated how earnings management is associated with CSR and investor protection using a sample of 139 firms in ten Asian countries for the period of 2004-2009. They argue that managers have incentives to disclose more CSR information to mitigate agency conflict between managers and shareholders. As a result, CSR disclosure may reduce the incentives to engage earnings management. Two different methods of earnings management, namely earnings smoothing and earnings aggressiveness, are used in their studies to measure earnings management. Moreover, they expect that there is an inverse relationship between CSR and earnings management. They find that firms with good CSR are engaged significantly less in earnings management.

Yip, van Staden and Cahan (2011) examined the relationship between CSR and earnings management and whether or not the relationship was mitigated by political cost considerations or by the firm's ethical predisposition using US listed firms from the food and oil and gas industries. They argued that the relationship between CSR and earnings management is affected by political environment. They found a negative relationship between CSR and earnings management for environmentally sensitive industries such as the oil and gas industry. In addition, they found a positive relationship between CSR disclosure and earnings management within the food industry.

Gargouri, Shabou and Francoeur (2010) examined the relationship between corporate social performance (CSP) and earnings management using a sample of 109 Canadian companies for the years 2004 and 2005. They found a positive association between the level of CSP and earnings management. Particularly, their findings show that environmental aspects of CSP were positively and significantly related with earnings management. They explained that such environmental activities contributed to significant costs that reduced financial performance, which appears to prompt managers to engage in earnings management.

Rahmawati and Dianita (2011) examined the relationship between earnings management, CSR and financial performance for firms listed in Indonesia Stock Exchange during the years 2006-2008. They argued that managers who had incentives to manage earnings are very proactive in their public disclosure advertise through CSR activities, especially for companies with strict supervision. Conversely, companies with low levels of earnings management had little incentive to get a public response by promoting CSR activities. Empirically, they found that engaging in earnings management had no influence on CSR activities.

Using Korean firms from 2002 to 2008, Choi, Lee and Park (2013) examined the relationship between CSR and earnings management with two different ownership models - concentrated and institutional shareholding. They argued that firms that focussed on the long-term perspective were more likely to provide transparent and quality CSR to investors, while constraining earnings management. Therefore, there would be negative association between CSR disclosure and earnings management. On the other hand, firms with managerial rent seeking behaviours were more likely to provide CSR activity for their opportunistic earnings management. A positive association between CSR and earnings management would therefore exist. They found support for the long-term perspective that a negative association exists between CSR disclosure and earnings management for all firms. Firms with highly concentrated ownership were using CSR as a tool to hide their managerial rent seeking activity. On the other hand, firms with higher levels of institutional investors' shareholdings had lower incentives to use CSR as tool for hiding their opportunistic actions.

Martínez-Ferrero, Garcia-Sanchez and Cuadrado-Ballesteros (2013) investigated the association between CSR and earnings management using a sample of 747 international listed non-financial firms for the period 2002-2010. Following Francis, Nanda and Olsson (2008), they proposed two opposing views on the relationship between CSR and earnings management - complementary and substitute relations. The complementary relationship viewpoint predicts that firms with good quality

financial information (less earnings management) have incentives to disclose all kinds of CSR information. On the other hand, the substitutive relationship model posits that firms' quality of financial reporting (more earnings management) and disclosed CSR information act as substitutes. They find that firms with high quality of financial information were more likely to report high quality sustainability information supporting a complementary relationship.

2.10.2. Environmental disclosure and earnings management

Previous research extensively investigated a broader discussion of how CSR impacts on earnings management and findings are mixed. One potential explanation of these mixed results is that a broader perspective of CSR measures comprised of different aspects. Brammer and Millington (2008) note CSR is a "multidimensional construct that encompasses a large and varied range of corporate behaviour in relation to its resources, processes, and outputs". Researchers will need to separate single component of CSR when developing and testing hypothesis with regards to CSR on other variables of interest (Moser & Martin 2012). Consequently, a border perspective of CSR may cause conflicting results on the association between CSR and earnings management (Litt, Sharma & Sharma 2014).

Patten and Trompeter (2003) examined the relationship between the level of pre-event environmental disclosure and the extent of earnings management in response to regulatory threat for a sample of 40 US chemical firms. They argued that managers believed environmental disclosure was an effective tool for reducing exposure to potential regulatory costs and decisions to manipulate earnings are tied to a larger corporate strategy for dealing with political pressures. They found a positive relationship between environmental disclosure and earnings management.

Litt, Sharma and Sharma (2014) investigated the association between environmental disclosure and earnings management using a sample of, 2095 US firms for the period 2004-2010. They source environmental disclosure data from KLD database. They argue that firms with environmental disclosures were associated with less earnings management based on an external monitoring theory and an internal corporate cultural theory. The external theory predicts that environmentally responsible firms were less likely to engage in earnings management because these firms are closely monitored by external stakeholders such as regulators, investors, society, and media. Internal culture theory implies that since environmentally responsible firms incorporate good corporate cultures, they encourage employees to act less out of self-interest. They have found that firms engaged in environmental initiatives were less likely to practice earnings management.

Sun et al. (2010) investigated the association between environmental disclosures and earnings management using a sample of 245 UK firms for the financial year ending in March 2007. They argued that managers' motivations with regards to voluntary environmental information acted as a signal to attract investors, enhancing their positive corporate image when they try to practice earnings management. They do not find a significant association between earnings management and corporate environmental disclosures. It is suspected that managers who engage in earnings management have incentives to disclose voluntarily generous amount of socially

responsible information such GHG emissions to get the grant support from environmental defence pressure groups. Prior research has supported this view (Cespa & Cestone 2007; Choi, Lee & Park 2013; Pagano & Volpin 2005; Prior, Surroca & Tribó 2008; Rahmawati & Dianita 2011; Sun et al. 2010). Sun et al. (2010) argued that managers had incentives to disclose voluntary environmental disclosures as a signal to attract existing and potential investors and to enhance positive corporate images when they attempted to engage in earnings management. Patten and Trompeter (2003) argued that managers had incentives to disclose environmental information that was an effective tool for reducing exposure to potential costs and decisions to manipulate earnings tied to a larger corporate strategy for dealing with political pressures. Based on the previous work on the relationship between social responsibility disclosures and earnings management, this research argues that firms may disclose higher quality of GHG emissions information in annual and sustainability reports and on their website as a consequence of earnings management. Therefore, it is expected that there will be a positive relationship between voluntary disclosure of GHG emission information and earnings management. The following table provides a brief description of previous research on the relationship between disclosure and earnings management.

Table 2.1 Sustainability disclosure and earnings management

Authors (year)	Sustainability Disclosure Measure	Earnings Management Measures	Sample Period (Size)	Country	Findings
Patten and Trompeter (2003)	Environmental disclosure	Discretionary accruals	1984 (40)	US	Positive realtionship
Chih, Shen and Kang (2008)	The FTSE4Good Global Index	Earnings smoothing, earnings aggressiveness, and earnings losses and avoidance	1993-2002 (1,653)	46 countries	Mixed relationship
Prior, Surroca and Tribó (2008)	CSR scores SiRi ProTM data	Performance adjusted modified Jones mode	2002-2004 (593)	26 countries	Positive relationship
Laksmana and Yang (2009)	Dummy variable takes one if a firm is one of the 100 Best Corporate Citizen (BCC) by Business Ethics Magazines	Earnings persistence, predictability, smoothness and accrual	2001-2002 (1,778)	USA	Negative relationship
Gargouri, Shabou and Francoeur (2010)	Corporate social performance as provided by Michael Jantzi Research Associates – Canadian Social Investment Database	Modified Jones discretionary accruals	2004-2005 (109)	Canada	Positive relationship
Sun et al. (2010)	Corporate environmental disclosure	Performance adjusted discretionary accruals	2007 (245)	UK	No relationship

Authors (year)	**Sustainability Disclosure Measure**	**Earnings Management Measures**	**Sample Period (Size)**	**Country**	**Findings**
Choi and Pae (2011)	Ethical commitment index	Discretionary accruals, accounting conservatism and accrual quality	1998-2008 (242)	Korea	Negative relationship
Heltzer (2011)	Dummy variable	Discretionary accruals by modified Jones model	2007 (2,171)	USA	Negative relationship
Hong and Andersen (2011)	CSR score using KLD data	Accrual and real earnings management	1995-2005 (8,078)	USA	Negative relationship
Rahmawati and Dianita (2011)	CSR score	Modified Jones discretionary accruals	2006-2008 (27)	Indonesia	No relationship
Kim, Park and Wier (2012)	CSR Score using KLD data	Discretionary accruals, activity-based earnings management and SEC investigation	1991-2009 (23,391)	USA	Negative relationship
Choi, Lee and Park (2013)	CSR rating by the Korean Economic Justice institute	Modified Jones discretionary accruals	2002-2008 (2,042)	Korea	Negative relationship
Pyo and Lee (2013)	Dummy variable takes 1 if a firm disclose CSR reports filed with GRI	Modified Jones discretionary accruals and Performance matched discretionary accruals	2004-2010 (4,198)	Korea	Negative relationship

Authors (year)	**Sustainability Disclosure Measure**	**Earnings Management Measures**	**Sample Period (Size)**	**Country**	**Findings**
Salewski and Zülch (2014)	CSR Score base on the Kirchhoff Consult AG 'Good Company Ranking'	Performance adjusted modified Jones mode (Kothari, Leone and Wasley (2005)	2005 to 2009 (258)	European Blue Chips	Positive relationship
Scholtens and Kang (2013)	the CSR score according to Asia Sustainability Research	Earnings smoothing and earnings aggressiveness	2009 (139)	10 countries	Negative relationship
Martínez-Ferrero, Garcia-Sanchez and Cuadrado-Ballesteros (2013)	An ordinal variable takes values between 0 and 3 if a firm disclose CSR reports with GRI guidelines	Modified Jones discretionary accruals and Performance adjusted modified Jones mode (Kothari, Leone and Wasley (2005)	2010-2010 (747)	25countries	Negative relationship
Litt, Sharma and Sharma (2014)	Environmental disclosure (KLD)	Performance adjusted modified Jones mode (Kothari, Leone and Wasley (2005)	2004-2006 (2,095)	USA	Negative relationship

2.10.3. Voluntary disclosure, corporate governance and earnings management

The role of effective corporate governance is to mitigate the opportunistic behaviour of managers, improve firms' reporting quality and increase firm value. Fama and Jensen (1983) stated that board of directors monitors each firm's management in order to protect shareholder interests. Managers have incentives to engage in self-serving managerial activities. Numerous researchers have found that managers can benefit from manipulating earnings for several reasons. Managers manipulate their earnings to capital market pressure (Healy & Wahlen 1999; Ho 2005) to increase their compensation (Cornett, Marcus & Tehranian 2008) and for job security, while Hazarika, Karpoff and Nahata (2012) indicate that board of directors have ability to act and discipline managers proactively who engage earnings manipulation for their self-interest. Several studies have found that an effective corporate governance mechanism can limit manager engage self-serving managerial activities (Dechow, Sloan & Sweeney 1996; Klein 2002).

Prior research on the relationship between voluntary disclosure GHG and earnings management ignores the influence of a firm's corporate governance variables such as moderating variables that can constrain the ability of managers to engage in earnings management. Until now, there is only one research that focused on the relationship between levels of disclosures of GHG emissions information, corporate governance and earnings management. Sun et al. (2010) investigated the association between corporate governance variables, corporate environmental disclosures and earnings management for the financial year ended on March 2007. They argued that managers had incentives to disclose voluntary environmental disclosures as a signal to attract existing and potential investors and to enhance a positive corporate image when they attempted to engage in earnings management. They did not find a significant association between earnings management and corporate environmental disclosures. However, they did find that the relationship between corporate environmental disclosures and earnings management was affected by dummy variables of board size and the total number of audit committee meetings.

2.11. Voluntary disclosure and liquidity

"Liquidity is believed to a cornerstone of the well-functioning capital market since it enhances the value of investors' assets and lowers the cost of capital of firms" (Ali, Zhongzhi & Trabelsi 2013). The link between voluntary disclosure and liquidity of firms' shares has received considerable attention in recent years (Balakrishnan et al. 2013; Cho, Lee & Pfeiffer 2013; Haggard, Martin & Pereira 2008). Voluntary disclosure is a channel by which firms can improve their information quality which in turn can enhance liquidly of firms' shares. Diamond and Verrecchia (1991) show that managers' choice of disclosing information voluntarily reduces information asymmetry between firms and investors which lowers the firms' cost of capital. Healy and Palepu (2001) provide a framework of managers' voluntary disclosure choice in a capital market setting. They identify that voluntary disclosure improves stock liquidity, reduces cost of capital, and enhances information intermediation. Previous studies find support for a positive relationship between voluntary disclosure and liquidity.

Stock market liquidity is affected by information asymmetry. Information asymmetry creates agency conflicts between managers and outside investors as well as between informed and uninformed investors. Chen et al. (2007) argue that firms with poor information quality and disclosure practices experience serious information asymmetry problems. Managers may use voluntary disclosure and increased information quality to mitigate information asymmetry and therefore experience a decrease in agency conflicts. This action in turn increases the firm's stock liquidity (Beyer et al. 2010; Cho, Lee & Pfeiffer 2013; Diamond & Verrecchia 1991).

Kim (2014) investigates that whether firms' voluntary commitment to disclose information affects the liquidity of the firm's shares. He finds a positive effect on the liquidity of these firms. Using CSR scores, Cho, Lee and Pfeiffer (2013) investigate whether CSR performance affect liquidity of firms' shares. They find that CSR is playing a positive role for investors reducing information asymmetry thereby enhancing liquidity. They further add to the existing literature by investigating the role of institutional ownership on the relationship between CSR and bid-ask spread and find that when there is a higher proportion of institutional ownership the degree of reduction in information asymmetry is reduced suggesting that informed investors may exploit CSR information advantages. Bardos (2011) investigates the relationship between liquidity and quality of financial information and find a positive relationship between quality of financial information and liquidity.

Managers may have incentives to disclose information voluntarily, which improve liquidity of firms' shares that raises that increase a firm's market value by lowering its cost of capital. Balakrishnan et al. (2013) examine whether managers have a choice to shape information voluntarily to improve their liquidity in order to increase firm value. They argue that managers may use voluntary disclosure of information as a means to influence the liquidity of their shares. They find that mangers can actively influence liquidity by providing information voluntarily. Agarwal et al. (2013) show that mandatory portfolio disclosure improves stock liquidity but imposes costs on informed investors.

Stock market liquidity is an economic outcome that is commonly required by many regulators through the policy of disclosure regulation. Dhaliwal et al. (2014) suggests that the quality of information disclosure can reduce non-diversifiable risk in four ways. Firstly, the quality of information disclosure reduces information asymmetry between stakeholders. As a result, investors show greater willingness to trade, which leads to increased liquidity of the firms' shares. Secondly, transparent disclosure lessens risks associated with estimation by investors. Thirdly, transparent disclosure reduces the monitoring cost. Finally, a higher level of disclosure increases investors' recognition, which will result in enhanced risk sharing.

Dhaliwal et al. (2014) argued that managers of stakeholder-oriented countries will be more responsive to the information demands of the stakeholder groups and will therefore provide high quality of information disclosure. They found that when a firm belongs to stakeholder-oriented country, the firm provides transparent and information of high quality and therefore enjoys lower cost of capital. Bischof and Daske (2013) argued that firms expect to have a positive liquidity change when they provide voluntary transparent risk disclosure as a commitment. They used firms' share liquidity to assess the economic consequences of increased risk disclosure.

Han, Tang and Yang (2014) proposed that voluntary disclosure has been suggested as the basis of regulatory requirement. This is generally believed to have positive implications for market liquidity and efficiency, which are two critical indicators of well-functioning capital markets and reduce risks faced by traders as a result of improved market liquidity. Huang, Hugon and Hui (2014) argued that a conservative disclosure policy will increase the liquidity of firms' shares and lower the cost of capital as it limits a manager's ability to disclose information opportunistically. They find that firms with conservative disclosure policy experience higher liquidity and lower cost of cost of capital in the presence of higher uncertainty and weak monitoring.

Several studies examined the relation between corporate governance and stock market liquidity (Bacidore & Sofianos 2002; Chung, Elder & Kim 2010; Kanagaretnam, Lobo & Whalen 2007; Lei, Lin & Wei 2013). Empirical studies argued that effective corporate governance mechanisms limit management information distortion and managerial actions based on self-interest. As a result of the improved financial and operational transparency, information asymmetries between insiders, outside investors as well as among investors are reduced. Since effective corporate governance is strongly related to quality and transparent information disclosure, it is believed to have greater level of stock market liquidity. On the other hand, poor corporate governance can result in the use of inside information for the self-benefit of management, manipulation of earnings and conflict of interest, which lead to lower liquidity of firms' shares. Chung, Elder and Kim (2010) investigated the effects of corporate governance mechanisms on stock market liquidity and they found that firms with effective corporate mechanisms exhibit greater liquidity of firms' shares that mitigate information asymmetry among stakeholders.

To the best of our knowledge, this research is the first to study the impact of voluntary disclosure of GHG emission information on stock liquidity.

2.12. Research gap in the literature

The existing literature on voluntary disclosures, corporate governance, earnings management and liquidity were surveyed. The relationship between a set of separate corporate governance variables, levels and quality of voluntary disclosures of GHG emissions, and earnings management is little researched, and in Australia still unexplored. In recent years, ASX Corporate Governance Council is committed to implementing good corporate governance practices. An investigation of the impact of corporate governance on the relationship between the levels and quality of voluntary disclosures of GHG emissions and earnings management appears not to be studied. In addition, this thesis tries to see the relationship between voluntary disclosure of GHG emission information and liquidity. The findings of this research could provide useful outcomes for institutional investors and regulators in Australia.

CHAPTER THREE

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

3.1. Introduction

This Chapter presents the theories and develops hypotheses used in this thesis. Section 3.2 describes theories which are relevant for this study. Section 3.3 lists research questions used in this research. Section 3.4 outlines the two competing views; stakeholder value maximisation and shareholder expense, which are relevant to our study. Section 3.5 contains the development of hypotheses. Finally, section 3.6 concludes the chapter.

3.2. Theoretical framework

No single theory can explain the relationship among corporate governance, GHG emission disclosure and earnings management. It is suggested here that multiple theories are needed to explain the inter-relationship of these factors. Liao, Luo and Tang (2014) argued that although agency theory and legitimacy theory have been applied to a GHG emission disclosure setting, they are insufficient to explain issues pertaining to voluntary disclosure of GHG emission information. Borghei-Ghomi and Leung (2013) have argued that prior studies on the determinants of voluntary GHG emission information disclosure did not use a comprehensive theoretical framework. In this study, consideration is given to stakeholder theory, agency theory and legitimacy theory to support the central arguments. Stakeholder theory suggests that a variety of stakeholder groups make demands on firms to disclose GHG emission information in order to assess firms' climate change strategies. Agency theory predicts that firms provide GHG emission information to mitigate information asymmetry and agency cost. Legitimacy theory posits that firms should disclose GHG emission information to legitimise their activities due to a social contract between the firm and its society. These theories are discussed more fully in the following subsections.

3.2.1. Stakeholder theory

Freeman (1984, p. 46) defined a 'stakeholder' as: *"any group or individual who can affect or is affected by the achievement of the organisation's objectives".* Stakeholder theory states that "managers should make decisions that take account of the interests of all the stakeholders in a firm" (Jensen 2010, p. 32). Stakeholders include all interested or concerned parties in an organisation including shareholders,

managers, employees, creditors, supplies, union, government agencies, and the society from which a business gets its resources. Stakeholder theory assumes that an organisation is a part of the broader social system in which a diverse group of stakeholders have different interests, so organisations should consider the multiple demands of a broader group of stakeholders in order to achieve its goals (Freeman 1984).

Donaldson and Preston (1995) unpacked the stakeholder theory into descriptive or managerial, instrumental, and normative aspects. "*The descriptive aspect of stakeholder theory describes and explains past, present, and future states of affairs of corporation and its stakeholders"* (Donaldson & Preston 1995, p. 71). The instrumental branch of this theory concentrates on stakeholders as well as conventional corporate objectives such as profitability (Donaldson & Preston 1995; Kaler 2003). The normative dimension of stakeholder theory states that companies should follow moral and philosophical guidelines with respect to its operations and management (Donaldson & Preston 1995; Kaler 2003). The instrumental aspect of stakeholder theory suggests that firms should engage in socially responsible activities not only for making profit for their shareholders but also for focusing on other stakeholders' interests (Carroll 1999; Donaldson & Preston 1995).

Environmental disclosure represents a form of fulfilment of the demands of a broader group of stakeholders (Ullmann 1985). Stakeholder theory suggests that the pressure from stakeholders induces a firm to be environmentally sustainable, because environmental disclosure is a means for firms to show social responsibility. Peters and Romi (2014) have argued that the firm's corporate governance mechanisms may facilitate the use of GHG emission disclosure as a vital strategic device for meeting the stakeholders' demands, given that firms may need to provide quality climate change-related information from firms' operations in order to help stakeholders' decision making process.

Stakeholder theory recommends that if firms try to operate in a socially responsible manner, they should consider a broader group of stakeholders' needs. Such firms should have corporate governance mechanisms which reflect shareholder orientation. Hence, corporate governance directs managers towards a wider range of stakeholders, which leads firms to focus on social responsibility. Since different stakeholders have different expectations from the firms, such firms should have good corporate governance that reconcile the interests of different stakeholder groups (Lai and Chen (2014). This theory postulates that firms should use effective corporate governance mechanisms in order to provide managers with incentives to socially engage in responsible activities and at the same time resolve conflicts among various stakeholders in order to maximise stakeholder wealth (Jo & Harjoto 2012; Lai & Chen 2014). The author therefore considers the instrumental aspects of stakeholder theory to be the most relevant for this study and suggests that corporate governance mechanisms are a means to align the firm with stakeholders' interests.

3.2.2. Agency theory

Agency theory mainly focuses on the agency relationship which is defined by (Jensen & Meckling 1976, p. 308) as *"a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent".* The agency relationship between the principals (shareholders) and the agent (management) are commonly refereed as a principal-agent relationship. The principal-agent relationship depends on the assumption that the principals and the agents are focusing on maximising their utility and may not be aligned. This assumption posits that both parties have their own interest and maximise their utility, which may lead to conflict between the two parties. The conflicts between the principals and the agents are regarded as an outcome of the agency problem.

Since managers run the day to day business operations of firms, they know the quality of the firm better than shareholders. In a situation where managers have more information regarding their firms than investors, there will be an information asymmetry which will lead to agency conflict. Therefore, voluntary disclosure of information in annual and sustainability reports and on the websites can be used as a tool to reduce the agency conflict between these two parties. Agency theory offers a framework connecting voluntary GHG emission disclosure to corporate governance mechanisms.

Agency theory suggests that there is a potential conflict of interest arising with the separation of ownership and control, when managers act on behalf of firm and investors (Fama & Jensen 1983; Jensen & Meckling 1976). The basic assumption of agency theory is that managers will act for their personal interest opportunistically. Agency theory predicts that corporate governance mechanisms such as board independence and the separation of the CEO and the Chairman can play an active role to solve the agency problem. In addition, rent-seeking managers may use socially responsible activities as a strategy to mask their opportunistic behaviour (Choi, Lee & Park 2013; Prior, Surroca & Tribó 2008). In this situation, agency theory proposes that effective corporate governance mechanisms of the firm may produce strong incentives to hamper managers from pursuing their personal motives at the expense of shareholders.

Ho and Wong (2001) have proposed that agency theory may act either in complementary or substitutable ways with regards to the role of corporate governance mechanisms in determining disclosure policy (Kelton & Yang 2008). Complementary agency theory predicts that effective corporate governance mechanisms strengthen a firm's internal control to reduce managerial opportunistic behaviour and information asymmetry. As a result, mangers will not withhold information for their personal interests under effective corporate governance mechanisms, and therefore tend to provide more quality information. On the other hand, according to substitute agency theory, a firm's corporate governance mechanisms may attempt to mitigate managerial opportunistic behaviour and information asymmetry resulting in a decrease in the need for more monitoring and disclosure (Ho & Wong 2001; Kelton & Yang 2008).

3.2.3. Legitimacy theory

Legitimacy theory is based on the notion of a social contract between a firm and the society in which it operates. Legitimacy is defined as: *"generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values beliefs and definition"* (Suchman 1995, p. 574). Organisational legitimacy implies that: *"organisations seek to establish congruence between the social values associated with or implied by their activities and the norms of acceptable behavior in the larger social system of which they are a part"* (Dowling & Pfeffer 1975, p. 122). Legitimacy theory assumes that there is a social contract between the firm and society. Therefore, firms should operate within bounds and norms of the society in which it operates.

Legitimacy theory holds that voluntary disclosures can be used as a tool to enforce social contracts. Firms may use voluntary environmental disclosures to obtain legitimacy by mitigating social and political pressures (Cho et al. 2012). According to Deegan (2009), legitimacy theory stresses that the firm must consider the right of the public at large, not merely of its investors. He further asserts that the failure to comply with social contract may lead to sanctions being imposed by society.

Legitimacy theory suggests that firms disclose social and environmental information in response to social, institutional and political pressures to legitimise their activities. Legitimacy gap exists when there is a threat to the entity's legitimacy. When an actual or potential disparity exists between organisational and social values, organisational legitimacy will be jeopardised giving rise to a legitimacy gap (Khan, Muttakin & Siddiqui 2013). O'Donovan (2000) has suggested that if a firm identifies a legitimacy gap, then that firm needs to assess its social values and attempt to correct the perception of the firms or existing social values by introducing different legitimacy strategies.

Organisations may adopt four strategies when firms are faced with threats to their legitimacy (Dowling & Pfeffer 1975; Gray, Kouhy & Lavers 1995; Lindblom 1994). Organisations may (i) educate and inform its relevant stakeholders about changes in its performance and activities, (ii) change the perception of the relevant stakeholders but not their actual behaviour, (iii) manipulate the perception of their stakeholders regarding the issue of concern by diverting their attention from one issue to another, and (iv) change external expectations of its performance. These strategies may be either proactive or reactive. It is proactive when a firm attempts to gain or maintain the support of community. On the other hand, it is reactive when a firm tries to repair its legitimacy threats (Lu & Abeysekera 2014).

Therefore, legitimacy theory predicts that managers are responsible to recognise the legitimacy gap and take necessary action to narrow the gap. In this situation, corporate governance mechanisms can play an effective role to reduce the legitimacy gap between organisation and society by pressuring managers to disclose high quality GHG emission information.

3.3. Research question

The main research question of this study is "**What are the determinants of voluntary disclosure of GHG emission information and what is the impact of voluntary disclosure on the liquidity of a firm's shares?"**

To answer this main question, the following sub-research questions will be addressed.

1. What are the impacts on corporate governance attributes of the disclosure of voluntary GHG emission information?
2. What is the relationship between the voluntary disclosure of GHG emission information and earnings management and to what extent do corporate governance mechanisms affect the above relationship?
3. Do Australian firms with higher voluntary disclosure of GHG emission information have increased the liquidity of the firms' shares?

3.4. Stakeholder value maximisation vs. shareholder expense views

This study investigates the relationship between corporate governance, voluntary disclosure of GHG emission information, earnings management based on managerial motivations under the stakeholder value maximisation and the shareholder expense views. Stakeholder theory and legitimacy theory are used in this research to develop the stakeholder value maximisation view whereas agency theory is the basis for supporting the shareholder expense view.

3.4.1. Stakeholder value maximisation view

The stakeholder value maximisation view implies that managers engage in socially responsible activities to fulfil the interests of other stakeholders in order to have positive effects on shareholder wealth (Deng, Kang & Low 2013). For example, firms that invest and report more on socially responsible activities may gain a strong reputation for keeping stakeholders commitment, subsequently stakeholders of these firms are more likely to have strong incentives to contribute resources and efforts to the firms in order to contribute to firms' long-term profitability (Carroll 1999; Deng, Kang & Low 2013; Freeman, Wicks & Parmar 2004).

Firms cannot maximise their value by ignoring stakeholders' interests. The long-term value maximisation of a firm depends on its ability to serve different stakeholder groups. According to Jensen (2010, p. 33) *"in order to maximise value, corporate managers must not only satisfy, but enlist the support of, all corporate stakeholders – customers, employees, managers, suppliers, local communities"*. He has further suggested that corporate managers should have an effective leadership role in creating and implementing sustainable projects to maximise their wealth for the long-term.

Firms may engage in voluntary disclosure information to legitimise their operations in terms of sustainability (Rao, Tilt & Lester 2012). Sustainability mostly relates to long-term profitability for shareholders by focusing on the interests of other stakeholders. Sustainability refers to: *"the corporate practice of creating long-term shareholder value by focusing corporate strategy around economic, environmental, and social endeavors which includes the management of GHG emissions"* (Peters & Romi 2014, p. 2).

This view may be applied to the relationship between corporate governance, voluntary disclosure of GHG emission and earnings management. The stakeholder value maximisation view may entail that managers' decision to provide high quality GHG emission information is more likely to be relevant to meet the needs of a diverse group of stakeholders in order to get their long-term support. As a result, firms may enjoy long-term profitability in the future. The quality of GHG emission and financial reporting can be seen as an outcome of firms' effective corporate governance effort that confirm firms' sustainability through better business practices and the promotion of accountability and transparency not only to shareholders but also to other stakeholders (Jo & Harjoto 2012). Firms with better corporate governance mechanisms are more likely to engage in more socially responsible agenda such as GHG emission reduction initiatives (Ntim & Soobaroyen 2013).

Stakeholder theory stresses that a firm should have a corporate governance system, which is stakeholder-focused. Under this corporate governance system, board members and managers may clearly consider a broader group of stakeholders when making decisions (Devinney, Schwalbach & Williams 2013). Stakeholder-focused corporate governance is a set of corporate governance mechanisms that seek to maximise value to shareholders while satisfying the legitimate demands of stakeholders (Durden 2008). It concentrates on the issues that go beyond traditional views to include corporate ethics, accountability, disclosure, and reporting in the interests of other stakeholders. Rupley, Brown and Marshall (2012) introduce a multi-stakeholder governance model and define it as "a broad range of monitoring mechanisms pressuring management to act in the best interests of shareholders and society". The stakeholder value maximisation view suggests that stakeholder-focused corporate governance mechanisms encourage managers to provide sustainability disclosure to meet the demands of a broader group of stakeholders as firms' ethical and social efforts and achieve the firm's goals.

The instrumental aspect of stakeholder theory proposes that firms should focus on socially responsible activities to meet the wider range of stakeholders' demands while making profit for their shareholders (Carroll 1999; Donaldson & Preston 1995). Focusing on a stakeholder approach to running firms' businesses is an equally good or even better way of achieving conventional corporate objectives (Kaler 2003). This is because firms conduct business with stakeholders on the basis of mutual trust and engage in socially responsible activities with sincere commitment which enables them to achieve competitive advantages (McWilliams & Siegel 2001). Consequently, firms can enjoy long-term profitability. In addition to the instrumental aspect of stakeholder theory, legitimacy theory postulates that firms can use effective corporate governance to narrow the legitimacy gap between organisation and society by forcing managers to disclose quality GHG emission information (Khan, Muttakin & Siddiqui 2013).

3.4.2. Shareholder expense view

The shareholder expense view proposes that managers involve in socially responsible activities to support other stakeholders at the expense of shareholders (Deng, Kang & Low 2013; Prior, Surroca & Tribó 2008; Salewski & Zülch 2014). For example, overconfident managers could make a decision to overinvest in socially responsible activities to build their reputations as good social citizens even though this may reduce firms' profitability and shareholder wealth. As a result, other stakeholders may benefit from the socially responsible activities the expense of shareholders. Moser and Martin (2012) have defined "at the expense of shareholders" by the costs of the socially responsible activity of a firm being greater than the benefits gained from such activity.

From a capital market perspective, voluntary GHG emission disclosure information is critical to the functioning of an efficient capital market. Prior research finds conflicting results regarding the announcement of climate change related information (Griffin & Sun 2013; Hsu & Wang 2013; Lee, Park & Klassen 2013). Hsu and Wang (2013) note that the socially responsibility initiatives such as GHG emission reduction initiatives to tackle climate change is costly to the investors. Lee, Park and Klassen (2013) have shown that a negative association between the announcement of climate disclosure and stock return suggesting that investors perceive climate change announcements as reducing shareholder value. From this point of view, voluntary GHG emission disclosure information destroys shareholder value.

The shareholder expense view argues mangers may engage in voluntary GHG emission information disclosure for their opportunistic purpose. Effective internal and external monitoring through various corporate governance mechanisms may diminish managerial incentives and opportunistic use of GHG emission information disclosure. As a result, effective corporate governance mechanisms limit managerial opportunistic use of voluntary disclosure of GHG emission information. Salewski and Zülch (2014, p. 2) concluded that: "*firms might engage in CSR reporting to cover up their de facto socially irresponsible behavior and that the decision to invest in and report about CSR may to some extent be driven by opportunism".*

Barnea and Rubin (2010) have argued that a firm's managers and blockholders have an interest to overinvest in CSR for their private interest of expanding their image as a good global citizen at the expense of shareholders. As a result, a firm's policy with respect to socially responsible activity can create a conflict between different types of shareholders. Salewski and Zülch (2014) posit the view that investing and reporting about socially responsible activities provides the impression of a transparent firm, while the firm is masking behind the transparency and engaging in unethical activities at the expense of shareholders. Moser and Martin (2012) have argued that traditional stakeholder theory does not assume that mangers intentionally invest and report socially responsible activity at the expense of shareholders. If managers involve in socially responsible activity to satisfy the needs of a variety of stakeholders, then, some socially responsible activities are undertaken at the expense of shareholders.

Based on agency theory, GHG emission mitigation strategies, activities and reporting constitutes a principal-agent conflict between managers and shareholders (Jensen & Meckling 1976). Overconfident managers sometimes make value destroying investments on GHG emission reduction initiatives to build their personal reputations as good global citizens (Jo & Harjoto 2012). Managers' choice of overinvestments on GHG emission reduction initiatives is possibly a waste of resources that destroys firm value. A range of good corporate governance mechanisms of a firm may prevent managers' opportunistic behaviour regarding GHG emission initiatives which may induce an inverse relationship between effective corporate governance mechanisms and voluntary GHG emission information.

According to prior research, managers use sustainability disclosure as a tool to get immense supports from their stakeholders, when they are engaged in earnings management at the expense of shareholders (Prior, Surroca & Tribó 2008). Thus a positive association between sustainability disclosure and earnings management may be driven by managers' decision to invest and report sustainability activities at the expense of shareholders often using their socially responsible decision to cover up value destroying earnings management (Salewski & Zülch 2014).

3.5. Hypotheses development

3.5.1. Corporate governance and GHG disclosures

The instrumental aspect of stakeholder theory proposes that firms should focus on socially responsible activities to meet the interests of stakeholders while making conventional corporate objectives (Carroll 1999; Donaldson & Preston 1995). As a result, firms may build trust with stakeholders by providing socially responsible activities in order to achieve corporate success. In this view, firms with good corporate governance act on behalf of wider range of stakeholders and persuade management to provide information associated with GHG emission initiatives. The literature on corporate governance suggests that good corporate mechanisms are associated with improved transparency and disclosure (Mallin 2002), and doing so mitigates information asymmetry between managers and stakeholders. Since the board and managers of socially responsible firms have a fiduciary duty to provide sustainable information to a broader group of stakeholders those firms are less likely to breach the implicit contract with the stakeholders. The extent and quality of voluntary disclosure of GHG emission information are seen as a firm's corporate governance efforts to meet the needs of stakeholders. From the stakeholder value maximisation point of view, effective corporate governance pressurises the managers to engage in socially responsible disclosure to fulfil the demands of a broader group of stakeholders and this activity in turn creates shareholder value. If managers use effective corporate governance mechanisms and voluntary disclosure of GHG emission information to align with stakeholders' interests, then voluntary disclosure of GHG emission information should be positively related to effective corporate governance mechanisms.

In addition to the instrumental aspect of stakeholder theory, legitimacy theory suggests that voluntary disclosure of GHG emission information can be disseminated by a firm to fill the legitimacy gap. Therefore, effective corporate governance mechanisms may be playing vital roles in mitigating the legitimacy gap by disclosing high quality GHG emission information to a broader group of stakeholders. Therefore, it is expected that effective corporate governance mechanisms pressure top management to disclose voluntary GHG emission information to reduce the legitimacy gap between organisation and society.

Stakeholder theory and legitimacy theory support the stakeholder value maximisation view and suggest that a range of internal and external effective corporate governance mechanisms should play a vital role in focusing on the demands of stakeholders and ensuring organisational legitimacy through voluntarily disclosing GHG emission information. Therefore, firms may use effective corporate governance mechanisms and GHG emission disclosure to align with the interests of various stakeholders and legitimise their activities.
Based on the stakeholder value maximisation view, the author posits the following hypothesis:

Hypothesis 1(a): There should be a positive association between effective corporate governance mechanisms and voluntary disclosure of GHG emission information.

In contrast to the above view, the shareholder expense view claims, based on agency theory, that the choice of GHG emission disclosure is a principal-agent conflict between managers and shareholders (Harjoto & Jo 2011; Jo & Harjoto 2012). This viewpoint proposes that firms with overconfident CEOs are more likely to overinvest in GHG emission reduction initiatives and information disclosure takes place due to managers' personal motives at the expense of shareholders. If managers are not closely monitored by effective corporate governance mechanisms, they prefer to act more out of their personal interest rather than the interest of a broader group of stakeholders. Effective corporate governance mechanisms should mitigate the managers' opportunity to act for their personal interest. Therefore, it is expected that there will be a negative association between effective corporate governance and voluntary disclosure of GHG emission information because various effective corporate governance mechanisms should reduce the managers' motivations and rent-seeking activities.

In accordance with the shareholder expense view, the following hypothesis is proposed:

Hypothesis 1(b): Voluntary disclosure of GHG emission information is inversely associated with effective corporate governance mechanisms.

3.5.2. GHG disclosures and earnings management

In supporting the stakeholder wealth maximisation point of view, previous research has found a negative relationship between different types of voluntary disclosures and earnings management (Balakrishnan et al. 2013; Dye 1988; Jo & Kim 2007; Schipper 1989; Trueman & Titman 1988). The claim is that firms that provide more transparent and reliable disclosures are less likely to engage in earnings management. With regards to the broader perspective of CSR disclosure, previous studies support the stakeholder wealth maximisation view and find similar findings. Chih, Shen and Kang (2008) have found that a socially responsible firm will not hide unfavourable earnings realisations so that they will not engage in earnings management. Kim, Park and Wier (2012) found that CSR firms were less likely to engage in earnings management. Scholtens and Kang (2013) found that firms with good CSR were engaged significantly less in earnings management. Yip, van Staden and Cahan (2011) found that firms that operated in environmentally sensitive industries were less likely to engage in earnings management. Using a sample of Korean firms, Choi, Lee and Park (2013) found evidence that supports this view.

From the stakeholder wealth maximisation point of view, if managers act in a socially responsible manner, a negative association between quality of GHG emission information and earnings management will be expected. Therefore, the following hypothesis is suggested:

Hypothesis 2(a): There will be a negative association between the extent and quality of GHG emission disclosure and earnings management.

Earnings management results from agency conflicts arising from the misalignment of interests between managers and shareholders, which lead managers to take care of their own interests at the expense of the shareholders (Beaudoin, Cianci & Tsakumis 2014; Jensen & Meckling 1976). One managerial incentive is to wear a coat as socially responsible managers in order to cloak their opportunistic behaviour, when they engage in earnings management. According to agency theory, managers might use firms' resources for their self-interest rather than for the interests of stakeholders. Such managers might practice GHG emission reduction initiatives and reporting to disguise their managerial opportunistic behaviour. The shareholder expense view posits that managers are motivated to disclose relevant information to the stakeholders in order to get their support while they engage in earnings management. Earnings management benefits managers and some stakeholders at the expense of shareholders. If managers use sustainability disclosures opportunistically for their private interests rather than for the interests of their stakeholders, shareholder value creation would be damaged by such activity.

Gargouri, Shabou and Francoeur (2010) have found a positive association between the level of corporate social performance and earnings management. Particularly, their findings show that environmental aspects of corporate social performance are positively and significantly related with earnings management. They explained that such environmental activities contributed to significant costs that reduce financial performance, which appeared to prompt managers to engage in earnings

management. Patten and Trompeter (2003) have argued that managers could use environmental disclosure as an effective tool for reducing exposure to potential regulatory costs; and that decisions to manipulate earnings are tied to a larger corporate strategy for dealing with political pressures.

Prior researchers have supported the shareholder expense view by analysing the relationship between social sustainability disclosures and earnings management. (Cespa & Cestone 2007; Choi, Lee & Park 2013; Pagano & Volpin 2005; Prior, Surroca & Tribó 2008; Rahmawati & Dianita 2011; Sun et al. 2010). Cespa and Cestone (2007) have argued that managers have incentives to disclose information related to sustainability when they engage in earnings management. Prior, Surroca and Tribó (2008) have argued that managers engaging in earnings management may use CSR as a powerful tool to get support from major stakeholders in order to protect their position against the disciplinary actions. Patten and Trompeter (2003) have argued that managers could use environmental information disclosures as well as earnings management practices to deal with the political pressure. Kim, Park and Wier (2012) have argued that managers may use CSR as a form of reputational insurance which can be used by the managers as a license to engage in earnings management.

The above studies on the relationship between social responsibility disclosures and earnings management support the shareholder expense view. Based on the shareholder expense view, we argue that manager' decisions to disclose GHG emissions information through the CDP, annual reports, and sustainability reports and on their corporate website is intended to camouflage their opportunistic behaviour. In addition to this, managers of these firms may wear the CSR cloak to disguise their crooked activity such as earnings management. Based on the shareholder expense view, it is expected that there will be a positive relationship between voluntary disclosure of GHG emission information and earnings management. Therefore, the following hypothesis is presented:

Hypothesis 2(b): There will be a positive association between the extent and quality of GHG emission disclosure and earnings management.

3.5.3. GHG disclosures, corporate governance and earnings management

The stakeholder value maximisation view posits that effective corporate governance mechanisms can serve as instruments to resolve conflicts among a broader group of stakeholders. In supporting the stakeholder wealth maximisation view, Jo and Harjoto (2012) have argued that managers use effective corporate governance mechanisms together with engagement in CSR activity to resolve conflict among stakeholders and this would be positively related with firm value. Therefore, it is believed that firms with effective corporate governance mechanisms encourage disclosure of high quality of GHG information; and at the same time constrain managers' engagement in earnings management. Consequently, this study expects that the negative association between GHG disclosure and earnings management will be further strengthened by effective corporate governance mechanisms.

Based on stakeholder value maximisation view, we hypothesis the following:

Hypothesis 2(c): The negative association between voluntary disclosure of GHG emission information and earnings management will be strengthened by the presence of effective corporate governance mechanisms.

In contrast to the stakeholder maximisation view, the shareholder expensive view states that managers have motivation to disclose more sustainability information to hide their opportunistic behaviour. Investing and reporting in social sustainability disclosure is affected by firms' effective corporate governance mechanisms. If managers are not monitored properly by effective corporate governance mechanisms, they may have a preference to engage in socially responsible activity that might be destroying shareholder value. Firms with effective corporate governance mechanisms are less likely invest in CSR activity in order to disguise their rent-seeking activities namely earnings management. Therefore, firms with effective corporate governance mechanisms have less motivation to invest and report more on GHG emission reduction activity to divert stakeholders' attention at the expense of shareholders (Choi, Lee & Park 2013). Managers who engage in both social responsible activities and earnings management at the expense of shareholders are engaging in unethical behaviour. Therefore, there will be a positive association between CSR and earnings management (Kim, Park & Wier 2012). Managers may decide to engage in CSR activities as a way to create a positive impression with stakeholders, and show that the firm is transparent; when in fact the firm hides behind the appearance of transparency while engaging in earnings management.

Based on shareholder expense view, the following hypothesis is suggested:

Hypothesis 2(d): The positive association between voluntary disclosure of GHG emission information and earnings management will be moderated by effective corporate governance mechanisms.

3.5.4. Liquidity and GHG disclosure

Voluntary disclosure influences stock market trading resulting in lower information asymmetry which in turn improves stock market liquidity. It is argued here that managers choose to disclose more information for various reasons that could affect stock liquidity directly. Firms seek to disclose GHG emission information to satisfy a wider range of stakeholders and such disclosures may impact on liquidity. Balakrishnan et al. (2013) find that increased voluntary disclosure has a beneficial effect on the liquidity of the firms' shares.

Managers' choice to disclose more information voluntarily has an effect on the liquidity. Most recently, researchers have analysed various aspects of disclosure quality in relation to stock market liquidity. They have found that the quality of information disclosure improves stock market liquidity (Balakrishnan et al. 2013; Bardos 2011; Lang & Maffett 2011; Ng 2011). Lang and Maffett (2011) found evidence that firms with greater transparency in earnings and accounting standards disclosure experienced greater market liquidity. Ng (2011) found that the quality of information disclosure was associated with lower liquidity risks that lead to lowering of the cost of capital. In line with these findings, Bardos (2011) found that the quality of financial information improves liquidity.

We therefore posit the following hypothesis.

Hypothesis 3: The voluntary disclosure of GHG emission information will improve the liquidity of a firm's shares, *ceteris paribus*.

3.6. Conclusion

This Chapter provides the theoretical frameworks that lead to the hypotheses developed. Stakeholder theory, agency theory and legitimacy theory were reviewed to examine the relationship between corporate governance, voluntary disclosure of GHG emission disclosure, and earnings management. In addition to that, two competing views - stakeholder value maximisation and shareholder expense view - were introduced in order to guide the hypotheses.

CHAPTER FOUR

DATA AND METHODOLOGY

4.1. Introduction

This Chapter presents the data and methodologies used in this research. Section 4.2 explains the sample selection and exclusions. Section 4.3 explains the data collection processes. Section 4.4 measures the variables used in this study. Section 4.5 deals with endogeneity and selection bias. Section 4.6 outlines the data analysis techniques used in this study to test its hypotheses. Finally, section 4.7 concludes the Chapter.

4.2. Sample selections and exclusions

The data for this study are the largest firms listed on the Australian Stock Exchange (ASX) which are asked by the CDP to voluntarily respond to its annual questionnaire for the reporting years from 2006 to 2009.

Table 4.1 Total sample firms before exclusions

Detail	CDP4	CDP5	CDP6	CDP7	Total
The CDP Reporting Year	2006	2007	2008	2009	
Answered Questionnaire (AQ)	55	58	96	104	313
Provided information (IN)	06	06	07	03	22
Declined to participate (DP)	20	13	28	18	79
Did not respond (NR)	19	23	70	75	187
Total	100	100	201	200	601

The CDP is an independent not-for-profit organisation that surveys the world's latest companies' information on the business risks and opportunities presented by climate change and GHG emissions (Green & Zhou 2013). This study uses the CDP databases for Australian firms from 2006 to 2009, which includes information for the years 2005 to 2008. This time periods cover voluntary disclosure made by large Australian firms before implementing of the mandatory GHG emission reporting Act. The CDP sends its questionnaire to the Australian firms each year in February and it is firms' choice to respond the CDP's questionnaire on or before May each year. The CDP publishes the information in September/November in each year. This study also uses Australian firms' Annual reports, sustainability reports, and corporate websites as other sources in addition to the CDP to measure quality of GHG emission information using the CDP 2010 scoring methodology.

The CDP sent its questionnaire only to the ASX100 firms in the reporting year 2006 and 2007 and then expanded its survey to include ASX200 firms in reporting years 2008 onwards. Table 4:1 provides details of the initial sample. Initially, this study identified a sample of 601 firm year observations from the CDP database for the reporting years 2006 to 2009. A total of 36 year firm observations were excluded from its initial sample for various reasons. Ten firm year observations were excluded due to lack of corporate governance data. Further, 8 more firm year observations were excluded due to non-availability of annual reports. Furthermore, 17 firm year observations were removed because of non-availability of financial and stock market data. One firm has been removed from sample due to delisting before the reporting date. The details of these exclusions are provided in Table 4.2. The final sample of this study is 565.

Table 4.2 Summary of sample selection and exclusions

Reason for sample exclusion	Numbers	Total
Initial sample of ASX CDP firms from 2006 to 2009		601
Less exclusions		
- Corporate governance data not available	10	
- Annual reports not available to score CDP	08	
- Financial data not available	17	
- Removed from sample due to delisting before reporting date	01	
- Total exclusions		36
- **Final sample**		**565**

4.3. Data collection

This study uses a sample frame of ASX largest listed firms that were selected by the CDP to respond to GHG emission questionnaire. This research uses two GHG emission disclosure variables such as managers' choice to respond to the GHG emission questionnaire and the quality of GHG emission disclosure. Managers' choice to respond to the CDP questionnaire is an indicator variable that can be obtained from the CDP database. The quality of GHG emission disclosure index is calculated using firms' annual reports, sustainability reports, and corporate websites. Annual financial reports are collected from the Morningstar DatAnalysis and Bureau van Dijk Electronic Publishing Osiris databases. The available sustainability reports are collected from Bureau van Electronic Publishing Osiris database, Global Reporting Initiative (GRI) website, and the particular company's website.

Data on corporate governance variables such as board independence, CEO duality, and board diversity for sampled ASX firms are hand-collected from annual reports obtained from the Morningstar DatAnalysis and Bureau van Electronic Publishing Osiris databases. Ownership variables such as directors' share ownership and institutional shareholding are hand-collected for sample firms from annual reports obtained from the Morningstar DatAnalysis and Bureau van Electronic Publishing Osiris databases. Directors' ownership is hand-collected from the directors' details in the annual reports and Institutional share ownership is hand-collected from Top20 shareholding list in the annual reports. The audit quality variables such as frequency of audit committee meetings and the size of the audit committee are hand-collected from the annual reports.

Financial data for earnings management calculation is collected from the Morningstar DatAnalysis and FinAnalysis. Industrial classification is based on data from the Morningstar DatAnalysis and the Thomson Financial DataStream. Trading data regarding the firms' shares viz., stock return, trading volume, and bid-ask prices are collected from the Thomson Financial DataStream. The data for the control variables are collected from the Morningstar DatAnalysis, Bureau van Electronic Publishing Osiris, and the Thomson Financial DataStream databases.

4.4. Measurement of variables

This section lists the different variables and describes how are they are measured below.

4.4.1. Voluntary disclosure of GHG emission

This study uses two proxies for voluntary disclosure of GHG emissions information viz., managers' choice to disclose GHG emission information and the quality or transparency of GHG emission disclosure.

Managers' choice of GHG emission disclosure (DISC)

Firstly, based on the CDP questionnaire response, a dummy variable will be used for the CDP responding firms and non-disclosing firms. Recent studies by (Matsumura, Prakash & Vera-Muñoz 2014) have used dummy variables based on responding and non-responding status of companies to the CDP questionnaires. The CDP is the largest repository of GHG emission disclosures in the world (Peters and Romi (2014).

Quality of GHG emission disclosure (QUAL)

Secondly, this thesis adopts the CDP 2010 scoring methodology to measure the quality of GHG emission information. Recent studies have used Carbon Disclosure Leadership Index (CDLI) based on the CDP 2010 methodology as a proxy for quality of GHG emissions disclosure (Cotter & Najah 2012; Griffin & Sun 2013; Prado-Lorenzo & Garcia-Sanchez 2010). The CDP uses the respondents' answered questions on information request to create a disclosure index called the CDLI. GHG emission information disclosure is considered as a part of environmental disclosures.

Australian firms' GHG emission disclosures may be released as a part of the annual report or as a stand-alone sustainability report or on its corporate website. The CDP 2010 scoring methodology to evaluate the quality of GHG emission disclosure score made by Australian firms. This methodology has been developed jointly by CDP and their global advisor PricewaterhouseCoopers (PwC). This methodology provides a detail scoring approach that can be used by researchers. Peters and Romi (2014) suggest that the CDP 2010 is the benchmark for GHG disclosure methodology. It includes different types of questions such as lead question and conditional questions. Further, it provides scales for scoring the extent of disclosure (Please see Appendix 1)

There are three reasons why this research adopts the CDP 2010 methodology to score the quality of GHG emission information disclosure. Firstly, this methodology specifically focuses on the quality of GHG emission disclosure rather than quantity of GHG emission information. Secondly, this methodology has been developed by a group of experts and confirmed with external validity. Finally, since previous researchers (Griffin & Sun 2013; Rankin, Windsor & Wahyuni 2011) identify the CDP as one of leading sources of quality GHG emission information disclosure, it is expected that its methodology will be more comprehensive. The calculated CDLI is based on firms' responses to its questionnaires, which are available for our sample companies.

This research analyses the quality of voluntary disclosure of GHG emission information made via annual reports, standalone sustainability reports, and corporate websites using content analysis. Content analysis is a 'systematic replicable technique for comprising many words of text into fewer content categories, based on explicit rules of coding' (Stemler 2001). Krippendorff (2004, p. 18) defines content analysis as *"a research technique for making replicable and valid inferences from text to the contexts of their use"*. This analysis involves constructing a qualitative data base by classifying or coding different aspects of a qualitative data set (Schwartz-Ziv & Weisbach 2013). It is the appropriate tool for evaluating the public disclosure of information (Jose & Lee 2007). Rather than using number of pages or words, this study selects the text and sentence in the sources to weight the score. The CDP 2010 methodology is integrated with content analysis and relevant each sentence is matched with quality of GHG emission disclosure indicators and scored as indicated in the methodology. If the same information is repeated in within or different sources this information is only considered once. Quality of GHG emission disclosure consists of variety of questions and weighted in different scales.

For this purpose, information on GHG emissions made in annual financial and/or sustainability reports will be analysed. In addition to those, any GHG emissions information disclosed on each company's website will be considered when scoring. A firm can communicate its climate-change related activities through various corporate channels. Emphasising the social impact of a firm's climate-change motives is an effective way to communicate to its stakeholders with regards to GHG emission disclosure. Annual reports (Chu, Chatterjee & Brown 2013; Rupley, Brown & Marshall 2012), stand-alone sustainability reports annual reports (Cotter & Najah 2012; Rupley, Brown & Marshall 2012), corporate websites (Jose & Lee 2007; Prado-Lorenzo et al. 2009) are dominant corporate communication channels which are analysed by previous research to assess the extent and quality of disclosure. These sources are solely voluntary and have both quantitative and qualitative nature of information related to climate change.

Sub-scores

The CDP scoring methodology is measured as the benchmark for the GHG emission disclosure information (Peters & Romi 2014). This study incorporates the CDP 2010 scoring methodology and measures the transparency or quality of GHG emission disclosure for the sample firms. The methodology for computing the overall score involves estimating scores based on five sub-categories of the quality of GHG emission disclosure scores. These are (i) governance (GOVE), (ii) risks and opportunities (RISK), (iii) strategy (STRA), (iv) GHG accounting, energy and fuel use, and trading GHGE), and (v) communications (COMM). (Please find attached Appendix 1 for further details).

4.4.2. Corporate governance variables

Recently, Jo and Harjoto (2012) examined the causal effect of corporate governance on CSR. Interestingly, lagged corporate governance variables positively affect firms' CSR after controlling for various firm characteristics. Consistent with prior research, this thesis uses lagged corporate governance variables as well as control variables as one of the techniques to correct for endogeneity bias. The corporate governance variables consist of board independence, CEO duality, percentage of shareholding by directors, female directors on the board, percentage of shareholding by institutional investors, number of audit committee meetings, and the size of the audit committee.

Board independence (IND)

Board independence is measured as a proportion of independent directors on the board. A board consists of both executive and non-executive directors. Among non-executive directors, those who have no material relationship with the firm and have less than five percent of shareholding are treated as independent directors. This data is hand-collected from the annual report.

CEO duality (DUA)

Managing Directors or CEOs of a firm also acting as chairpersons of the board is considered as CEO duality. CEO duality is a binary variable taking a value one if a firm's Managing Director or CEO holds the position of chairman of the board of directors. This data is hand-collected from the firm's annual report.

Board gender diversity (DIV)

Board gender diversity is measured by the presence of a woman director on the board. This variable is also is a binary variable which takes one if a firm has a woman director on the board. This data is also hand-collected from the directors' report section of the annual report.

Frequency of audit committee meetings (LAT)

Total number of audit committee meetings held during a financial year will be the proxy for frequency of audit committee meetings. This data is hand-collected from annual reports.

The size of audit committee (MAC)

The size of the audit committee is the number of members on the audit committee. This data is hand-collected from the directors' report section of the annual report.

Managerial share ownership (MSO)

Managerial share ownership is measured as the proportion of shareholding by both executive and non-executive directors. This data is collected from the directors' details section of the annual reports.

Institutional shareholding (INS)

Institutional shareholding is measured as a proportion of shares held by the institutional investors. This data is collected from the Top 20 shareholding section of the annual report. Institutions on the Top 20 shareholding list are selected and then added to get the total shareholding.

Effective corporate governance mechanisms

Firms' effective corporate governance mechanisms persuade managers to act in the best interest of stakeholders when there is a conflict between shareholders and non-investing stakeholders. Under effective corporate governance mechanisms, managers may use socially responsible initiatives to resolve conflicts among stakeholders (Harjoto & Jo 2011). In this study, effective corporate governance mechanisms consists of a greater board independence, the absence of CEO duality, the presence of board gender diversity, lower directors' ownership, higher institutional ownership and smaller size of the audit committee.

4.4.3. Earnings management calculations

This study uses accrual earnings management rather than real earnings management or cash flows because accruals are relatively easier to manipulate and less visible to stakeholders than cash flows (Choi & Pae 2011). This research measures earnings management as the absolute value of abnormal accruals, using the modified Jones accrual model and the performance-augmented discretionary accrual model. In addition to those two models, this study also uses the performance-matched modified Jones discretionary accrual model. This study employs two accruals measures viz., total accruals and total current accruals. Total accruals for firm i in year t are calculated as $TA_{i,t} = NPAT_{i,t} – NOCF_{i,t,}$ where where, $TA_{i,t}$ = firm i's total accruals in year *t*, $NPAT_{i,t}$ = firm i's net profit after tax in year t, and $NOCF_{i,t,=}$ firm's i's net operating cash flow in year t. Total current accrual for firm i in year t are measured as $TCA_{i,t} = (\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta STD_{i,t} - DEPN_{i,t})/A_{i,t-1}$ where, $TCA_{i,t}$ = firm i's total accruals in year *t*, $\Delta CA_{i,t}$ = the change in current assets from year t-1 to year t, $\Delta CL_{i,t}$ = the change in current liabilities from year t-1 to year t, $\Delta Cash_{i,t=}$ the change in cash and short-term investments from year t-1 to year t, $\Delta STD_{i,t}$ = firm i's change in short-term debts from year t-1 to year t, $DEPN_{i,t}$ = firm i's depreciation and amortization expense in year t, $A_{i,t-1}$ = firm i's book value of assets in year t-1.

4.4.3.1 Modified Jones model

In the modified Jones model (Dechow, Sloan & Sweeney 1996), total accruals are regressed on ΔREV minus the change in trade receivable (ΔTR), and gross property, plant, and equipment (PPE). The independent variables are deflated by lagged total assets in order to reduce heteroskedasticity.

$$\frac{\mathrm{TA_{i,t}}}{\mathrm{A_{i,t-1}}} = \alpha_0 \left(\frac{1}{\mathrm{A_{i,t-1}}}\right) + \alpha_1 \left(\frac{\Delta\mathrm{REV_{i,t}} - \Delta\mathrm{TR_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \alpha_2 \left(\frac{\mathrm{PPE_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \varepsilon_{i,t} \qquad (1)$$

Where,

$TCA_{i,t}$ = firm i's total current accruals in year *t*
$\Delta REV_{i,t}$ = firm i's change in revenues from year t-1 to year t
$\Delta TR_{i,t}$ = firm i's change in trade receivables from year t-1 to year t
$PPE_{i,t}$ = firm i's level of gross property, plant, and equipment in year *t*
$A_{i,t-1}$ = firm i's total assets in year *t-1*
$\varepsilon_{i,t}$ = firm i's residual in year *t*

This study estimates the first earnings management measure using equation (1). In estimating equation (1), this study uses the Global Industry Classification Standard (GICS) industry groups that contain twenty-four industries. While estimating equation (1), we exclude all firm-year observations that have fewer than ten observations in a GICS industry group for any specific year. Following Klein (2002), Hazarika, Karpoff and Nahata (2012), Kim, Park and Wier (2012), this thesis measures earnings management as the absolute value of residual $\varepsilon_{i,t}$ of firm *i* in year *t.*

4.4.3.2 Performance-augmented model

The second earnings management measure is performance-augmented discretionary accruals model (Kothari, Leone & Wasley 2005). In this model, return on assets is added as an explanatory variable to control firms' performance. Sun and Rath (2011) evaluate various discretionary accruals using a sample of ASX listed firms and find that performance-augmented discretionary accruals model tends to report more reliable estimation of discretionary accruals. Prior, Surroca and Tribó (2008) examined the relationship between CSR and earnings management using performance-augmented discretionary accruals and found a positive association between CSR and earnings management.

$$\frac{\mathrm{TCA_{i,t}}}{\mathrm{A_{i,t-1}}} = \alpha_0 \left(\frac{1}{\mathrm{A_{i,t-1}}}\right) + \alpha_1 \left(\frac{\Delta\mathrm{REV_{i,t}} - \Delta\mathrm{TR_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \alpha_2 \left(\frac{\mathrm{PPE_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \alpha_3(ROA_{i,t}) + \varepsilon_{i,t} \qquad (2)$$

The independent variables are defined as in the previous subsection. In addition, $\mathrm{ROA_{i,t}}$ = firm i's return on assets.

4.4.3.3 Performance-matched model

This research adopts performance-matched discretionary accruals model for robustness check. Researchers choose from a wide range of firm characteristics to match a sample such as return on assets, size, income, cash flow, industry and year. This study matches firms from the same industry (and year) that has the closet return on assets (ROA). Kothari, Leone and Wasley (2005) suggested that discretionary accruals estimated using the Jones (1991) modified model tended to be the best specified measures of discretionary accruals across a wide variety of simulated conditions. The discretionary accruals for a matched firm were obtained by employing the following regression model of modified Johns model.

$$\frac{\mathrm{TCA_{im,t}}}{\mathrm{A_{im,t-1}}} = \alpha_0 \left(\frac{1}{\mathrm{A_{im,t-1}}}\right) + \alpha_1 \left(\frac{\Delta\mathrm{REV_{im,t}} - \Delta\mathrm{TR_{im,t}}}{\mathrm{A_{im,t-1}}}\right) + \alpha_2 \left(\frac{\mathrm{PPE_{mi,t}}}{\mathrm{A_{mi,t-1}}}\right) + ROA + \varepsilon_{im,t} \qquad (3)$$

Where,
$\mathrm{TCA_{im,t}}$ = mathed firm im's total current accruals from year t-1 to year t, $\Delta\mathrm{REV_{im,t}}$ = matched firm im's change in revenues from year t-1 to year t, $\Delta\mathrm{TR_{im,t}}$ = matched firm im's change in trade receivables from year t-1 to year t, $\mathrm{PPE_{im,t}}$ = matched firm im's level of gross property, plant, and equipment in year t, $\mathrm{A_{it-1}}$ = matched firm im's total assets in year t-1, $\mathrm{ROA_{im,t}}$ = firm im's return on assets and $\varepsilon_{im,t}$ = matched firm im's error term in year *t.*

The discretionary accrual of the matched firm im is the absolute value of residual $\varepsilon_{im,t}$ of a matched firm im in year *t* and is obtained from equation (3). Performance-matched discretionary accruals are computed as the absolute value of the residual $\varepsilon_{i,t}$ minus the matched firm's absolute value of residual $\varepsilon_{im,t}$.

4.4.4. Measures of stock liquidity

Amihud's illiquidity and bid-ask spreads are the two main measurements that proxy for stock liquidity. These two proxies are widely used in the literatures. This thesis collects announcements of voluntary information of GHG emission from the annual report release date. The quality of GHG emission information is measured based on the annual reports, sustainability reports and company websites. The annual reports and release dates of annual reports are available from the DatAnalysis database. The study uses annual report release date as an announcement date.

Amihud's illiquidity (AMILOG)

This study uses Amihud's (2002) illiquidity measure which is calculated using following equation:

$$\text{AMILOG} = \sqrt{[1000{,}000 * |r_{i,t}| / (p_{i,t} * \text{vol}_{i,t})]} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

This study takes the square root of the ratio of absolute stock return to dollar volume. Then, the average of these daily illiquidity measures over the periods (Quarter year, half a year, three quarter year, and one year) are computed and the natural log of the value is taken. A lower value of Amihud's illiquidity measure indicates greater liquidity. Investors can trade stocks with lower AMILOG with a minimal effect on prices.

Table 4.3 Definitions of variables

Variables	Predicted signs	Description
Managers' choice of GHG emission Disclosure (DISC)		DISC is an indicator variable equal to one if the firm discloses its GHG emission information to the CDP and permits public accessible.
Quality of GHG emission disclosure (QUAL)		Quality of GHG emission information disclosure measured based on the CDP 2010 scoring methodology using firms' annual reports, standalone sustainability reports and corporate websites.
Amihud's (2002) Illiquidity (AMILOG)		AMILOG is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and takes log of the value.
Bid-ask spread (BIDLOG)		BIDLOG is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and takes log of the value.
Earnings management proxies (AUG/MJM/MAT/MTC)	+/-	The absolute value of discretionary accruals calculated using the modified Jones model with ROA (AUG), the modified Jones model (MJM), the performance-matched modified Jones model (MAT), and the performance-matched modified Jones model adjusted with ROA (MTC).

Variables	Predicted signs	Description
Board Independence (IND)	+	Proportion of independent directors on the board.
CEO Duality (DUA)	-	An indicator variable that equals to one if the CEO has a role as a chairman of the board, and zero otherwise.
Board diversity (DIV)	+	An indicator variable that equals to one if woman director/s on the board, and zero otherwise.
Frequency of audit committee meetings (LAT)	+	Number of audit committee meetings in a financial year
The size of the audit committee (MAC)	-	Number of directors in an audit committee.
Directors' share ownership (MSO)	-	Proportion of shares held by all directors on the board.
Institutional share ownership (INS)	+	Proportion of shares held by institutional investors calculated from Top20 shareholding list.
Size (LMV/LTA)	+	The logarithm of market value of equity and total assets respectively.
Tobin's *q* (TOB)	+/-	Tobin's *q* is measured as the market value of common equity plus book value of preferred stock plus book value of long-term debt and current liabilities, all scaled by book value of total assets.
Return on asset (ROA)	+	The reported net profit after tax divided by total assets.
Leverage (LEV)	+	LEV is the debt ratio calculated total debt divided by total assets.
Listing age (AGE)		Number of years since a stock is listed on Australian stock exchange
Stock return volatility (VOL)	-	VOL is the volatility calculated as standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2.
Cross-listing (CRL)	+	CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise.

Bid-ask spreads (BIDLOG)

This study used the daily closing ask price and bid price to measure bid-ask spread. Bid-ask spreads are calculated as follow:

$$BIDLOG = (Ask\ price_{i,t} - Bid\ price_{i,t}) / [(Ask\ price_{i,t} + Bid\ price_{i,t})/2] \quad (5)$$

The calculated value is multiplied by 100. Then, this study takes an average of daily bid-ask spreads over different periods (Quarter year, half a year, three quarter year, and one year). Negative bid-ask spreads are excluded from the calculations. A Lower bid-ask spread denotes greater liquidity.

4.4.5. Control variables

Control variables are included to ensure that associations between dependent variable and explanatory variables of interest remain robust to inclusion of other variables which are expected to have an impact. The control variables include in this study are firm size (LMV), Tobin's *q* (TOB), profitability (ROA), financial leverage (LEV), listing age (AGE) and stock return volatility (VOL).

Firm size (LMV)

Larger firms have greater visibility and more stakeholders and more likely to be subject to stakeholders' scrutiny, and therefore, will disclose more GHG emission information to get their support for their continuous operations (Lu & Abeysekera 2014). Empirical studies provide evidence that the firm size has an impact on the likelihood and quality of GHG emission disclosure (Matsumura, Prakash & Vera-Muñoz 2014; Peters & Romi 2014; Prado-Lorenzo & Garcia-Sanchez 2010; Rankin, Windsor & Wahyuni 2011). Firm size is measured as the natural logarithm of the book value of total assets. It is expected that larger firms are more likely to disclose more voluntary information on GHG emissions because of relatively higher public attention to these companies.

Tobin's *q* (TOB)

Researchers generally use Tobin's *q* to control for growth opportunities of the firm. Peters and Romi (2014) argue that firms with fewer discretionary resources are less likely to disclose GHG emission information during high growth periods.On the other hand, there is a possibility that growth firms are more likely to disclose GHG emission information in order to mitigate information asymmetry between the firms and investors during this stage. Tobin's *q* is measured as the market value of common equity plus book value of preferred stock plus book value of long-term debt and current liabilities, scaled by book value of total assets (Peters & Romi 2014).

Profitability (ROA)

Firm economic performance may be related to its ability to meet costly programs related to social demands (Ullmann, 1985). Firms with more profitability are more likely to meet societal expectations of accountability. Profitability is measured as the reported net profit after tax divided by the book value of the total assets (ROA). Prado-Lorenzo et al. (2009) found that profitability had a negative relationship with disclosure of information on GHG emissions. Smith, Yahya and Amiruddin (2007) examined the relationship between environmental disclosures in annual reports for listed companies in Malaysia and ROA and found a negative association between these two variables. Another study by Prado-Lorenzo and Garcia-Sanchez (2010) found a positive relationship. Moreover, Gamerschlag, Moeller and Verbeeten (2011) found a positive relation between voluntary environmental disclosure and return on investment. This study expects to find a positive association between levels of voluntary disclosures of GHG emissions and profitability.

Leverage (LEV)

Leverage is measured by dividing total debt by total assets. Luo, Lan and Tang (2012) and Prado-Lorenzo and Garcia-Sanchez (2010) found a positive relationship between leverage of a firm and levels of voluntary disclosures of GHG emissions. In addition, Cotter and Najah (2012) found a positive association between leverage and levels of voluntary disclosures (only for non-responding CDP firms). Therefore, LEV is expected to have a positive association with levels of GHG emission disclosures.

Listing age (AGE)

Listing age is defined as the number of years a firm's stock has been listed on a particular stock exchange (Chen et al. 2011). Haniffa and Cooke (2002) argue that newly listed firms need to disclose more information to the investors to reduce scepticism and boost confidence among them. However, they find no evidence in support of their proposition. Recently, Li, Mangena and Pike (2012) found evidence that younger listed firms are more likely to provide intellectual capital disclosure to mitigate information asymmetry and lower the cost of capital. On the other hand, since GHG emission disclosure have distinct economic consequences and determinants, mature firms need to disclose more GHG emission information than younger firms to the investors to maintain their reputation and visibility. Therefore, this thesis expects to find a positive association between listing age and GHG emission disclosure.

Stock return volatility (VOL)

Stock return volatility is measured as the standard deviation of adjusted daily stock returns prior to annual report announcement date. Firms with a tendency to disclose more information voluntarily have lower information asymmetry and therefore lower stock price volatility. We include stock return volatility to control for the firm-level tendency to voluntarily disclose more information. Therefore, the relationship between voluntary disclosure of GHG emission and stock return volatility is expected to be negative.

Cross-listing (CRL)

When a firm is listed on two or more stock market exchanges, it is considered to be cross-listed. Cross-listed firms face greater visibility and more scrutiny by a range of stakeholders (Peters & Romi 2014). Cross-listed Australian firms may face greater pressure to participate and provide GHG emission information to their investors and external monitoring regulators. Peters and Romi (2014) show that US firms disclosing GHG emission information are more likely to be cross listed.

4.5. Endogeneity and selection bias

Potential endogeneity problems may also mask the actual relationship between corporate governance, voluntary disclosure of GHG emission information and earnings management. Endogeneity is defined as: *"a correlation between the explanatory variables and the error term in a regression"* (Roberts & Whited 2012, p. 6). Endogeneity could be due to omitted variables, simultaneity or measurement error. This study adopts four techniques to minimise the possibility of endogeneity problem and selection bias.

4.5.1. Lag independent variables

Prior researchers use lagged independent variables to minimise the endogeneity problem. For example, Jo and Harjoto (2012) use lagged corporate governance variables to see the effect of corporate governance on CSR and find that while the lag of CSR does not affect corporate governance variables, the lag of corporate governance variables positively affects firms' CSR after controlling for various firm characteristics. To address endogeneity problem, Peters and Romi (2014) incorporate lagged independent variables for their study on the relationship between corporate governance mechanisms and voluntary GHG emission disclosure information for US firms. Following prior work, we use lagged independent variables wherever possible.

4.5.2. Year and industry dummy

This study controls for year and industry fixed effects as a further control for the endogeneity problem. Industries are defined based on the GICS industry sectors. Prior researchers use year and industry dummy variables to control possible time and industry effects (Lee, Lee & Nagarajan 2014).

4.5.3. Use of a variety of control variables

Coles, Lemmon and Meschke (2012) suggest that one of the solutions to address the endogeneity is to use a variety of control variables to solve for the omitted variable problem. This study uses firm size, profitability, firm growth, firm age, leverage and volatility as control variables in addition to our main independent variables.

4.5.4. Two-stage least squares method

The two-state least squares method is one of the most powerful and versatile tools, which allows for consistent estimation of simultaneous equations with endogenous predictors (Antonakis et al. 2012). In this method, firstly, the dependent (endogenous) variable is regressed on their independent and control variables, and predicted value is extracted. Secondly, the calculated predicted value is used as the dependent variable in the second stage regression.

4.5.5. Heckman two-stage estimation

Heckman sample selection technique is a two-step estimation procedure, which corrects non-randomly selected sample (Heckman 1979). Corporate decisions are not made at random but are intentionally made by their managers to self-select into their desired choices (Li & Prabhala 2007). When analysing firms choice to disclose voluntary GHG emission information, there is a potential self-selection bias (Lourenço et al. 2014). Peters and Romi (2014) have suggested that Heckman two-stage model can be used to correct the potential selection bias. Therefore, we use Heckman two-stage regression model. In the first stage, disclosure choice will be analysed using a probit model. Then, the inverse Mill's ratio (IMR) will be calculated using the first stage regression. The inverse Mill's ratios will be added in the second stage as an explanatory variable (Lourenço et al. 2014; Matsumura, Prakash & Vera-Muñoz 2014; Peters & Romi 2014). Further, Lennox, Francis and Wang (2012) suggest that the selection model will be improved if researchers exclude some of the independent variables from first stage in the second stage.

4.6. Data analysis techniques

4.6.1. Cross-sectional multiple regression model

The impact of corporate governance on voluntary GHG emission disclosure

Firstly, this research seeks to identify the relationship between characteristics of corporate governance and voluntary GHG emission disclosure. This study uses two dependent variables, namely, DISC and QUAL. DISC is an indicator variable that equals one if a firm responds to CDP and that information is disclosed publicly. QUAL is voluntary GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. Firstly, this study uses probit regression model using DISC as a dependent variable. Secondly, this research runs least square regression using QUAL as a dependent variable. Dhaliwal et al. (2012) have argued that since non-financial disclosure has distinct economic and consequences, control variables are not adequate. Therefore, the Heckman two-stage estimation provides additional check of the robustness. Following the above argument, this research adopts the Heckman two-step estimation to control potential selection bias due to omitted correlated variables.

$$DISC_{i,t}/QUAL_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} CRL_{i,t-1} + \beta_{15} \Sigma year + \beta_{16} \Sigma industry + \varepsilon_{i,t} \quad (6)$$

Robustness check model

Heckman Sample Selection Model

Disclosure choice model:

$$DISC_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} CRL_{i,t-1} + \beta_{15} CDP_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t} \quad (7)$$

Second stage model:

$$QUAL_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} CRL_{i,t-1} + \beta_{14} \Sigma year + \beta_{15} \Sigma industry + \varepsilon_{i,t} \quad (8)$$

The relationship between corporate governance, voluntary GHG emission disclosure and earnings management

$$DISC_{i,t}/QUAL_{i,t} = \beta_0 + \beta_1 AUG_{i,t}/MJM_{i,t}/MAT_{i,t}/MTC_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t} \quad (9)$$

Robustness check model

Heckman Sample Selection Model

Disclosure choice model:

$$DISC_{i,t} = \beta_0 + \beta_1 AUG_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} CDP_{i,t-1} + \beta_{17} \Sigma year + \beta_{18} \Sigma industry + \varepsilon_{i,t} \quad (10)$$

Second stage model:

$$QUAL_{i,t} = \beta_0 + \beta_1 AUG_{i.t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t} \quad (11)$$

Two-stage least squares regression

The equation for the first stage model is:

$$AUG_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} CRL_{i,t-1} + \beta_{15} \Sigma year + \beta_{16} \Sigma industry + \varepsilon_{i,t} \quad (12)$$

The equation for the second stage model is:

$$QUAL_{i,t} = \beta_0 + \beta_1 AFitted\_AUG_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t} \quad (13)$$

The benefits of disclosing GHG emission information

The relationship between voluntary GHG emission disclosure and stock price liquidity

$$AMILOG_{i,t} = \beta_0 + \beta_1 DISC_{i,t-1}/QUAL_{i,t-1} + \beta_2 INS_{i,t-1} + \beta_3 LTA_{i,t-1} + \beta_4 VOL_{i,t-1} + \beta_5 \Sigma year + \beta_6 \Sigma industry + \varepsilon_{i,t} \quad (14)$$

Robustness check model

$$BIDLOG_{i,t} = \beta_0 + \beta_1 DISC_{i,t-1}/QUAL_{i,t-1} + \beta_2 INS_{i,t-1} + \beta_3 LTA_{i,t-1} + \beta_4 VOL_{i,t-1} + \beta_5 \Sigma year + \beta_6 \Sigma industry + \varepsilon_{i,t} \quad (15)$$

4.7. Conclusion

This Chapter has dealt with the methodologies used in this research. Firstly, this Chapter began with the sample selection and data collection processes used in this study. Secondly, this Chapter described the dependent, independent, and control variables and their measurements. Thirdly, the Chapter dealt with controls for the potential endogeneity and sample selection bias problems. Finally, this Chapter concluded with an explanation of the data analysis techniques used in this research.

CHAPTER FIVE

DESCRIPTIVE STATISTICS

5.1. Introduction

This Chapter provides details of descriptive statistics of variables used in this study. Section 5.2 reports final sample distribution across the CDP reporting years 2006 to 2009. Section 5.3 provides descriptive statistics of the quality of GHG emission information disclosure and its sub-categories, corporate governance and firm characteristics for the full sample of firms as well as the sub-samples of publicly disclosing and non-disclosing firms. Additionally, the full sample is further split into high and low quality of GHG emission disclosure firms based on the sample median of GHG emission disclosure scores. Section 5.4 reports the descriptive statistics of five sub-categories quality of GHG emission information across the CDP reporting years. Section 5.5 shows the descriptive statistics of four different measures of earnings management across GHG emission disclosures. Section 5.6 reports the descriptive statistics of stock liquidity across the CDP responses and quality firms. Finally, the chapter ends with our conclusions.

5.2. Sample disdribution by responses

Table 5.1 shows the breakup of the final sample by the CDP reporting year and response categories. The CDP sent its questionnaire regarding GHG emission information to Australian firms belonging to ASX100 in 2006. The survey was expanded from ASX100 to ASX200 from reporting year 2008 onwards. A firm can respond to the CDP questionnaire in one of four different ways. The firm may choose to answer the CDP questionnaire (AQ), provide partial information (IN), decline to participate (DP) and not to respond (NR). When a firm chooses to answer the CDP questionnaire or provides information partially, it has two more additional options. It could either permit CDP to make the answers publicly available or restrict public access. Out of a sample of 565 firm year observations, 227 firm year observations (40%) responded to the CDP questionnaire fully or partially and granted permission to disclose their GHG emission information publicly. An additional 93 firm year observations (17%) responded the CDP questionnaire fully or partially but did not give permission to make it publicly. Eighty firm year observations (14%) declined to respond the CDP questionnaire and one hundred and sixty-five firm year observations (29%) did not respond to the CDP questionnaire.

Table 5.1Sample distribution by responses and CDP reporting years

CDP Reporting Year	2006	2007	2008	2009	Total
Answered Questionnaire (AQ)	52	57	92	100	301
Provided information (IN)	6	6	5	2	19
Permission to disclosing publicly	32	44	71	80	227
% Permission to disclosing publicly	35%	47%	38%	42%	40%
Declined to participate (DP)	23	13	26	18	80
Did not respond (NR)	11	18	66	70	165
Total	92	94	189	190	565

This table reports the entire sample as well as the breakdown by the CDP reporting years and the associated publicly disclosure rate.

5.3. Descriptive statistics for corporate governance and GHG disclosure

Table 5.2 provides descriptive statistics of voluntary disclosure quality of GHG emission information, corporate governance characteristics and control variables. This table reports mean and median value of the dependent, independent and control variables for the entire sample as well as two sub-samples categorised on the basis of whether the firm is discloses information to the CDP publicly or not. This table also presents the non-parametric test of Mann Whitney (MW) for the two sub-groups.

Panel A presents the descriptive statistics of emission disclosure quality for the entire sample. The average quality of GHG emission information for the entire sample is 37.28%. The disclosing and non-disclosing firms have averages of 48.96% and 29.43% respectively and are significantly different at the 1% level. The sub-categories of quality of GHG emission disclosure namely governance (GOVE), risk and opportunities (RISK), strategy (STRA), GHG accounting, energy and fuel use, and trading (GHGE), and communication (COMM) show highly substantial differences between the disclosing and non-disclosing firms. The Mann Whitney non-parametric test statistics indicates that the differences are statistically significant at the 1% level.

Panel B contains the descriptive statistics regarding corporate governance characteristics for the entire sample. The first corporate governance variable of this study is board independence (IND) measured as the proportion of independent directors on the board. The mean value of the proportion of independent directors for the entire sample is 65.92%. This result is comparable to that in Monem (2013) (64.00%) and Kang, Cheng and Gray (2007) (64.09%) and Bhagat and Bolton (2008) (63.69%). The subsample of disclosing firms have higher proportion of independent directors as compared to the non-disclosing sample firms. The Mann Whitney non-parametric test statistics indicates that the difference is statistically significant at the 1% level. CEO duality (DUA) is higher for non-disclosing firms than disclosing firms. The board gender diversity (DIV) is significantly higher for the disclosing firms than non-disclosing firms.

The frequency of audit committee meetings (LAT) of the full sample firms is 4.69. The disclosing firms have higher number of audit committee meetings as compared to non-disclosing firms and the difference is broadly significant at the 1% level. The average (median) size of the audit committee (MAC) for the entire sample firms are 3.90 (4.00). The disclosing and non-disclosing sample of firms has average of 4.00 and 3.83 which are significantly different at the 1% level. The average proportion of shares held by directors (MSO) on the board for the entire sample is 5.48%. This is consistent with previous research of (Henry 2011) (6.36%) and (Monem 2013) (7.09%). The disclosing and non-disclosing firms have average shareholding by directors of 1.86% and 7.90% respectively, which are significantly different at the 1% level. This indicates that the directors with more shareholding are less likely to disclose GHG emission information. The mean percentage of institutional investors' shareholding (INS) for the full sample is 64.53%. This is similar to statistics reported in other research studies, for example, (Monem 2013) (63.68%). The average percentage of institutional shareholding is 65.77% and 63.70% for disclosing sample firms and non-disclosing sample firms respectively. Overall, univariate results indicate that GHG emission disclosing firms have stronger corporate governance mechanisms than non-disclosing firms. The disclosing firms have boards that are more independent, more gender diverse, hold more board meetings and their directors' have lower shareholdings.

Table 5.2 Corporate governance and GHG emission disclosure decisions

Variables	Mean and Median	ALL	Disclosing firms (i)	Not disclosing firms (ii)	MW Test (i) vs. (ii)
Panel A: Quality of GHG emission disclosure measures					
QUAL	Mean%	37.28	48.96	29.43	11.07***
	Median%	31.91	47.14	26.09	
GOVE	Mean%	1.46	2.12	1.01	7.73***
	Median%	0.00	2.17	0.00	
RISK	Mean%	23.96	28.88	20.65	10.54***
	Median%	23.57	31.43	20.29	
STRA	Mean%	5.74	6.85	5.00	9.58***
	Median%	5.67	7.09	5.04	
GHGE	Mean%	5.30	10.05	2.10	10.22***
	Median%	0.00	7.09	0.00	
COMM	Mean%	0.81	1.04	0.65	4.80***
	Median%	1.33	1.40	0.70	
Panel B: Corporate governance measures					
IND	Mean%	65.92	70.92	62.56	5.28***
	Median%	66.67	75.00	62.50	
DUA	Mean	0.14	0.11	0.16	1.82*
	Median	0.00	0.00	0.00	
DIV	Mean	0.53	0.67	0.43	5.61***
	Median	1.00	1.00	0.00	
LAT	Mean	4.69	5.12	4.40	4.49***
	Median	4.00	5.00	4.00	
MAC	Mean	3.90	4.00	3.83	1.74*
	Median	4.00	4.00	4.00	
MSO	Mean%	5.48	1.86	7.90	7.42***
	Median%	0.37	0.15	0.86	
INS	Mean%	64.53	65.77	63.70	1.26
	Median%	66.83	69.16	66.56	

variables	Mean and Median	ALL	Disclosing firms (i)	Not disclosing firms (ii)	MW Test (i) vs. (ii)
Panel C: Control variables					
LMV	Mean	8.07	8.62	7.71	8.80***
	Median	7.97	8.62	7.55	
TOB	Mean	2.15	1.64	2.49	3.74***
	Median	1.51	1.31	1.63	
ROA	Mean%	6.91	6.39	7.26	0.76
	Median%	5.38	4.95	5.80	
LEV	Mean%	25.65	25.48	25.76	0.73
	Median%	25.52	26.10	24.73	
AGE	Mean%	17.82	22.86	14.44	3.67***
	Median%	12.30	13.64	11.58	
VOL	Mean%	3.17	2.89	3.36	2.08**
	Median%	2.70	2.60	2.84	
CRL	Mean	0.24	0.31	0.19	3.17***
	Median	0.00	0.00	0.00	
N		565	227	338	

This table provides firms characteristics of the entire sample as well as for the two groups: disclosing and non-disclosing firms. The table also provides non-parametric test statistics of Mann Whitney (MW test) differences in median value between two groups. All corporate governance and control variables are collected at the balance sheet date prior to the year of disclosure. QUAL: quality of GHG emission disclosure measured based on the CDP 2010 scoring methodology using firms' annual reports, standalone sustainability reports and corporate websites. GOVE: governance; RISK: risks and opportunities; STRA: strategy; GHGE: GHG accounting, energy and fuel use, and trading; COMM: communications; IND: Board independence measured as proportion of independent directors on the board; DUA: a dummy variable that takes one if the CEO has a role as a chairman of the board; DIV: a dummy variable equal to one if the board has female director(s); LAT: number of audit committee meetings; MAC; the size of audit committee measured as number of members of an audit committee in a financial year; MSO: the proportion of ordinary shares held by directors; INS: the proportion of shareholding by the institutional investors measured from Top20 shareholding list of a firm excluding individual shareholding; LMV: the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date; TOB: Tobin's *q* measured as the market value of common equity plus book value of preferred stock plus book value of long-term debt and current liabilities, all scaled by book value of total assets; ROA: firm profitability measured as net profit after tax before abnormal items divided by total assets; LEV: leverage measured as total debt divided by total assets; AGE: firm age calculate from its listing date (years); VOL: share return volatility, calculated as the standard deviation of adjusted share price return one year before from its annual report announcement date; CRL is an indicator variable that equals 1 if a firm is listed in another exchange besides ASX and 0 otherwise. * Significantly different from zero at the 10% level, ** significantly different from zero at the 5% level, and ***significantly different from zero at the 1% level.

Panel C reports the descriptive statistics our control variables for the entire sample. The average logarithm of market value (LMV) for the entire sample of firms is 8.07 and for the disclosing and non-disclosing sample of firms they are 8.62 and 7.71 respectively. It is significantly different between these groups suggesting that larger firms are more likely to disclose GHG emission information than smaller firms due to their visibility. The mean (median) value of the Tobin's *q* (TOB) for the entire sample is 2.15 (1.51). The disclosing and non- disclosing sample of firms have mean (median) of 1.64 (1.31) and 2.49 (1.63) respectively and the difference is significant at the 1% level. This result indicates that firms with higher growth prospects are less likely to disclose GHG emission related information. The average return on assets (ROA) is 6.91% and it is not materially different between the two groups. Leverage (LEV) has an average 25.65% for the full sample. The disclosing and non-disclosing firms have averages of 25.48% and 25.76% and the non-parametric test statistics indicate that the difference is insignificant.

On average, the listing age of the sample firms (AGE) is 17.82 years. The disclosing and non-disclosing firms have average listing age of 22.86 and 14.44 years respectively, and the difference is significant at the 1% level. It is evident that the firms that are listed on the ASX longer tend to make more GHG emission information public due to social pressure. The mean stock return volatility (VOL) for the entire sample is 2.33% and for the disclosing and non-disclosing firms are 2.16% and 2.44% respectively, significantly different at the 5% level . This indicates that the non-disclosing firms have more volatile stock returns than disclosing firms. The proportion of cross-listing (CRL) is significantly higher for the disclosing firms compared to non-disclosing firms.

Table 5.3 Quality of GHG information scores attained across years

Variables	Mean and Median	2006	2007	2008	2009
	Mean%	33.75	39.72	34.52	40.53
QUAL	Median%	28.37	33.33	28.78	35.84
	Mean%	1.47	1.63	1.24	1.58
GOVE	Median%	0.00	2.10	0.00	1.41
	Mean%	22.20	24.79	22.86	25.48
RISK	Median%	21.58	24.11	21.58	25.71
	Mean%	5.25	5.84	5.49	6.19
STRA	Median%	5.04	5.69	5.07	6.38
	Mean%	4.17	6.47	4.15	6.40
GHGE	Median%	0.00	0.00	0.00	0.00
	Mean%	0.66	0.87	0.78	0.87
COMM	Median%	0.71	1.39	1.27	1.37
N		92	94	189	190

This table reports quality of GHG emission information measured based on the CDP 2010 scoring methodology using annual reports, sustainability reports and company website for five sub categories such as governance, risk and opportunities, strategy, greenhouse gas, and communication and across the CDP reporting years. QUAL: overall quality of GHG emission disclosure GOVE: governance component of the disclosure index; RISK: risks and opportunities component of the disclosure index; STRA: strategy component of the disclosure index; GHGE: GHG accounting, energy and fuel use, and trading component of the disclosure index; COMM: communications component of the disclosure index.

Table 5.3 shows the quality of voluntary disclosure of GHG emission information for the five sub-categories as well as across the four CDP reporting years. The average total scores of voluntary disclosure of GHG emissions are 33.75 per cent in 2006 and 40.53 per cent in 2009. In general, there has been an increase in scores over time except 2008 ostensibly due to the Global Financial Crisis.

Table 5.4: Quality of GHG emission disclosure by industries

Industrial sector	Mean and Median	**Disclosure quality**	**N**	**High quality**	**N**	**Low quality**	**N**
Consumer	Mean%	24.21		40.01		20.26	
Discretionary	Median%	23.74	65	36.69	13	22.28	52
Consumer Staple	Mean%	42.26		51.45		24.57	
	Median%	34.03	38	46.76	25	25.90	13
Energy	Mean%	37.68		50.75		24.60	
	Median%	33.22	48	45.26	24	25.18	24
Financial	Mean%	35.32		54.60		19.44	
	Median%	27.54	155	53.52	70	18.84	80
Health Care	Mean%	21.84		46.44		19.87	
	Median%	20.57	27	46.44	02	18.84	25
Industrial	Mean%	39.75		52.28		23.73	
	Median%	35.97	82	47.72	46	24.65	36
Information	Mean%	24.17				24.17	
Technology	Median%	30.22	05	-	-	30.22	05
Material	Mean%	47.17		55.79		24.95	
	Median%	45.39	111	57.39	80	24.64	31
Tele communication	Mean%	46.02		53.89		27.64	
	Median%	35.71	10	60.96	07	28.06	03
Utilities	Mean%	38.84		49.16		21.64	
	Median%	34.77	24	38.13	15	21.58	09

This table provides overall quality scores of GHG emission information disclosed in annual reports, sustainability reports and company's websites. Mean and median score in percentages are reported in the third column. The sample is divided into two groups based on median GHG disclosure scores.

Table 5.4 presents the quality of voluntary disclosure of GHG emission information across ten industries. The above industry classifications are defined by the GICS downloaded from DatAnalysis database. The greenhouse gas intensive sectors such as energy, material, industrial and utilities disclose higher quality GHG information in their corporate reporting channels voluntarily. The highest mean score of those greenhouse intensive sectors is 47.17% reported in material industry sector. On the other hand, the firms belonging to less GHG intensive sectors such as health care, information technology, and consumer discretionary have lower level of quality GHG information. The lowest average score is 21.84%, which is reported in the health care industry sector. It is clear that firms in greenhouse intensive sectors report higher quality information regarding GHG emissions.

Table 5.5 Corporate governance and quality GHG emission information

Variables	Mean and Median	High quality (i)	Low quality (ii)	MW test (i) vs. (ii)
Panel A: Quality of GHG emission disclosure measures				
QUAL	Mean%	52.92	21.69	20.51***
	Median%	50.00	22.46	
GOVE	Mean%	2.47	0.45	14.67***
	Median%	3.38	0.00	
RISK	Mean%	31.38	16.56	19.86***
	Median%	32.17	16.78	
STRA	Mean%	7.37	4.12	17.25***
	Median%	7.69	4.32	
GHGE	Mean%	10.47	0.14	16.11***
	Median%	8.45	0.00	
COMM	Mean%	1.22	0.39	11.36***
	Median%	1.40	0.00	
Panel B: Corporate governance characteristics				
IND	Mean%	70.14	61.71	5.38***
	Median%	71.43	60.00	
DUA	Mean	0.07	0.21	4.68***
	Median	0.00	0.00	
DIV	Mean	0.58	0.47	2.70***
	Median	1.00	0.00	
LAT	Mean	5.06	4.33	4.15***
	Median	5.00	4.00	
MAC	Mean	3.96	3.83	1.78*
	Median	4.00	3.00	
MSO	Mean%	2.84	8.10	5.93***
	Median%	0.17	0.75	
INS	Mean%	65.84	63.23	1.97**
	Median%	69.04	65.45	

Variables	Mean and Median	High quality (i)	Low quality (ii)	MW test (i) vs. (ii)
Panel C: Control variables				
LMV	Mean	8.34	7.80	4.94***
	Median	8.32	7.65	
TOB	Mean	1.74	2.56	2.33**
	Median	1.43	1.58	
ROA	Mean%	6.28	7.54	0.57
	Median%	5.11	5.88	
LEV	Mean%	26.61	24.69	1.76*
	Median%	27.00	23.30	
AGE	Mean	23.31	12.35	6.88***
	Median	14.68	10.24	
VOL	Mean%	3.12	3.22	0.40
	Median%	2.70	2.73	
CRL	Mean	0.26	0.26	1.06
	Median	0.00	0.00	
N		282	283	

This table provides firms characteristics of the entire sample as well as for the two groups: disclosing and non-disclosing firms. The table also provides non-parametric test statistics of Mann Whitney (MW test) differences in median value between two groups. All corporate governance and control variables are collected at the balance sheet date prior to the year of disclosure. QUAL: quality of GHG emission disclosure measured based on the CDP 2010 scoring methodology using firms' annual reports, standalone sustainability reports and corporate websites. GOVE: governance; RISK: risks and opportunities; STRA: strategy; GHGE: GHG accounting, energy and fuel use, and trading; COMM: communications; IND: Board independence measured as proportion of independent directors on the board; DUA: a dummy variable that takes one if the CEO has a role as a chairman of the board; DIV: a dummy variable equal to one if the board has female director(s); LAT: number of audit committee meetings; MAC; the size of audit committee measured as number of members of an audit committee in a financial year; MSO: the proportion of ordinary shares held by directors; INS: the proportion of shareholding by the institutional investors measured from Top20 shareholding list of a firm excluding individual shareholding; LMV: the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date; TOB: Tobin's *q* measured as the market value of common equity plus book value of preferred stock plus book value of long-term debt and current liabilities, all scaled by book value of total assets; ROA: firm profitability measured as net profit after tax before abnormal items divided by total assets; LEV: leverage measured as total debt divided by total assets; AGE: firm age calculate from its listing date (years); VOL: share return volatility, calculated as the standard deviation of adjusted share price return one year before from its annual report announcement date; CRL is an indicator variable that equals 1 if a firm is listed in another exchange besides ASX and 0 otherwise. * Significantly different from zero at the 10% level, ** significantly different from zero at the 5% level, and *** significantly different from zero at the 1% level.

Table 5.5 reports univariate comparisons for all variables across samples of high quality and low quality disclosure firms. Firms that disclose more than median index scores of GHG emission information are categorised as high quality GHG emission information firms, whereas firms that disclose less than or equal to median index scores of GHG emission information are categorised as low quality GHG emission information firms. Panel A shows that the individual component scores are also significantly different across the two groups.

Panel B of Table 5.5 indicates that there is a significant difference between firms that have high quality GHG emission information released through their corporate reporting channels as compared to their low quality counterparts. High quality firms have more independent directors (IND) on the board than low quality firms. This indicates that firms that have higher proportion of independent directors on the board are more likely disclose better GHG emission information. The mean independent directors on the board is 70.14% for firms with high quality GHG information, which is significantly higher than the 61.71% for firms with low quality GHG information. CEO duality (DUA) is significantly lower for firms that disclose high quality GHG information than firms that disclose low quality GHG information. Board diversity (DIV) is not much different between high quality and low quality firms. High quality firms have more number of audit committee meetings than low quality firms. The mean frequency of audit committee meetings (LAT) for high quality firms and low quality sample firm are 5.06 and 4.33 respectively. The Mann Whitney non-parametric test statistics shows that the difference is statistically significant at the 1% level.

It is confirmed that firms that have higher audit committee meetings at the board level are more likely to disclose GHG emission information. Firms that disclose lower quality GHG emission information are more likely to have more directors' shareholding (MSO). Directors of the low quality sample firms have higher percentage of share ownership (8.10%) as compared to the high quality sample firms (2.84%) and the difference is significant at the 1% level. Average institutional shareholdings (INS) for high quality and low quality sample firms are 65.84% and 63.23% respectively and the difference is significant at the 5% level. This evidence supports the view that institutional investors exert pressure to influence firms to disclose more credible GHG information to the public through their corporate channels voluntarily. These descriptive analyses indicate that firms with high quality GHG emission disclosure are more independent, more gender diverse, having more board meetings and more shares are owned by institutional investors, less likely to have the CEO serving as board chairman and have lower directors' shareholdings than firms with low quality GHG emission disclosure.

In considering control variables, firm size measured as the logarithm of market value is significantly different between high quality and low quality firms. The average Tobin's q for firms with high quality GHG emission information (1.74) is significantly lower than the average for firms with low quality GHG information (2.56). This finding implies that firms with lower growth opportunities disclose better quality GHG emission information. Firm listing age (AGE) is significantly different between high quality and low quality firms. There is no material difference in return on assets (ROA), share volatility (VOL) and cross-listing (CRL) between the two groups.

5.4. Earnings management and GHG emission disclosure

Table 5.6 provides basic descriptive statistics of earnings management and voluntary disclosure of GHG emission information. This study measures earnings management as the absolute value of discretionary accrual using four different earnings management proxies. The average absolute current discretionary accrual estimated using the modified Jones model with ROA (AUG) is 6.97% for the entire sample. However, the disclosing and non-disclosing firms have averages of AUG 5.75% and 7.71% respectively and the difference is statistically significant at the 5% level. Mean value of the absolute value of total accruals calculated using performance matched modified Jones Model (MAT) is 13.20% for the entire sample. The disclosing and non-disclosing firms have a mean value of MAT 11.11% and 14.47% respectively and significant at the 10% level. There are no significant differences across the two groups when we use the MJM and MTC proxies for earnings management.

Table 5.6 Absolute value of discretionary accruals

Panel A: Absolute value of abnormal accruals across disclosures groups					
		ALL	Disclosure	Non-Disclosure	MW test
AUG	Mean%	6.97	5.75	7.71	2.25**
	Median%	4.46	3.76	4.71	
MJM	Mean%	7.99	6.22	9.05	1.31
	Median%	4.94	4.91	5.05	
MAT	Mean%	13.20	11.11	14.47	1.78*
	Median%	8.58	7.18	8.76	
MTC	Mean%	10.86	9.85	11.47	1.03
	Median%	7.72	7.04	7.99	
N		420	158	262	
Panel B: Absolute value of abnormal accruals across GHG quality					
		High Quality	Low Quality		MW test
AUG	Mean%	5.75	8.20		
	Median%	3.64	4.86		2.59***
MJM	Mean%	7.53	8.44		
	Median%	4.90	5.05		0.35
MAT	Mean%	12.76	13.65		
	Median%	8.73	7.94		0.07
MTC	Mean%	9.59	12.14		
	Median%	6.81	8.31		2.13**
N		210	210		

This table provides descriptive statistics of the absolute value of abnormal accruals. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. MJM is the absolute value of total accruals calculated using the modified Jones model. MAT is the absolute value of discretionary accruals calculated using performance matched modified Jones model. MTC is the absolute value of current accruals calculated using performance matched modified Jones model adjusted with ROA. Panel A provides the absolute value of discretionary accruals for the entire sample as well as the two groups of disclosing and non-disclosing firms. The table also provides the non-parametric Mann Whitney test statistics of differences in median value between disclosing and non-disclosing firms. Panel B of Table 8 provides the absolute value of four different measures of earnings management across two groups classified on the basis of high and low quality GHG emission disclosure.

The mean absolute value of discretionary accruals in this study is comparable to previous research findings. For example, Choi, Lee and Park (2013) in their Korean study, report that the average absolute value of discretionary accruals calculated using the modified Jones model is equal to 6.06%. Hazarika, Karpoff and Nahata (2012) in their US study, find that the average absolute value of discretionary accruals calculated using the modified Jones model is 7.93%. High quality and low quality GHG emission disclosing firms have average absolute value of discretionary accruals calculated using the modified Jones model with ROA (AUG) of 5.75% and 8.20% respectively and are significant at the 1% level. Another earnings management measure, the absolute value of current discretionary accruals calculated using performance matched modified Jones Model with ROA (MTC), have mean values of 9.59% and 12.14% respectively and are significant at the 5% level. Collectively, these primary results indicate that high quality GHG emission disclosure firms are less likely to engage in earnings management and suggest firms that disclose high quality GHG emission information provide high quality financial reporting quality to the stakeholders supporting the stakeholder value maximisation view.

5.5. Voluntary disclosure of GHG emission and liquidity

Amihud's (2002) illiquidity measure and bid-ask spreads are the two main proxies for stock liquidity. These two proxies are widely used in the literature (Balakrishnan et al. 2013; Bardos 2011). The quality of GHG emission information is measured based on the annual reports and their announcement dates are available in the DatAnalysis database. This study uses firm's annual report release date as the announcement date.

Table 5.7 Amihud's illiquidity for disclosing and non-disclosing samples

Post-announcement period		Full sample N = 562	Disclosing N = 226	Non-disclosing N = 336	MW test
Quarter year	Mean	0.067	0.048	0.081	7.67***
	Median	0.041	0.030	0.052	
Half year	Mean	0.073	0.051	0.087	7.73***
	Median	0.043	0.031	0.057	
Three quarters of a year	Mean	0.073	0.052	0.087	7.72***
	Median	0.044	0.031	0.057	
One year	Mean	0.073	0.052	0.087	7.88***
	Median	0.044	0.030	0.059	

This table presents mean and median of Amihud's (2002) illiquidity measure for different periods (quarter year, half a year, three quarters of a year, and one year) after announcement date. This table reports illiquidity results for the entire sample, and for disclosing and non-disclosing groups. This table also reports nonparametric Mann-Whitney (MW) test statistics for the difference in median Amihud's (2002) illiquidity across disclosure and not disclosure sub groups. *Significantly different from zero at the 10% level, **significantly different from zero at the 5% level, and ***significantly different from zero at the 1% level.

The results from Table 5.7 show that Amihud's (2002) illiquidity measure has a mean (median) of 0.067 (0.047) and 0.073 (0.044) for the post announcement periods of a quarter year and one year respectively. With regards to the above findings, the mean Amihud's (2002) illiquidity measure of this study is comparable to that of prior studies in stock price liquidity. For example, Balakrishnan et al. (2013), in their study, report that the mean Amihud's (2002) illiquidity measure is equal to 0.073. The disclosing firms have lower Amihud's (2002) illiquidity measure as compared to the non-disclosing sample firms for various post announcement periods suggesting that the disclosing firms may have higher stock price liquidity than the non-disclosing firms. The Mann-Whitney non-parametric test statistics point out that the difference is statistically significant at the 1% level for all time horizons.

Table 5.8 Amihud's illiquidity measure and disclosure quality

post-announcement period		High quality N = 281	Low quality N = 281	MW test
Quarter year	Mean	0.059	0.076	3.96***
	Median	0.034	0.046	
Half a year	Mean	0.062	0.083	4.24***
	Median	0.036	0.050	
Three quarters of a year	Mean	0.062	0.085	4.33***
	Median	0.036	0.052	
One year	Mean	0.061	0.085	4.65***
	Median	0.035	0.055	

This table presents mean and median of Amihud's (2002) illiquidity measure for different periods (quarter year, half a year, three quarters of a year, and one year) after announcement date. This table reports illiquidity results for the entire sample, and for firms with high quality and low quality GHG emission disclosures. This table also reports nonparametric Mann-Whitney (MW) test statistics for the difference in median Amihud's (2002) illiquidity across high quality and low quality sub groups. *Significantly different from zero at the 10% level, **significantly different from zero at the 5% level, and ***significantly different from zero at the 1% level.

The results from table 5.8 show that for all time horizons, firms that have greater GHG emission disclosure quality have lower mean and median value of Amihud's (2002) illiquidity measure as compared to low quality disclosure firms. The mean values of Amihud's (2002) illiquidity measure for the high and low quality firms are 0.061 and 0.085 one year after the annual report announcement date. As suggested earlier, firms with higher quality GHG emission disclosure have more stock price liquidity than firms with lower quality of GHG emission information after post announcement date. The Mann-Whitney non-parametric test statistics point out that difference is statistically significant at the 1% level for all time horizons.

The bid-ask spread is an additional liquidity measure to the Amihud's (2002) illiquidity measure. The bid-ask spreads for the entire, disclosing and non-disclosing sample firms for the four different time horizons namely, quarter year, half-a year, three quarters of a year, and one year are presented in Table 5.9. The average bid-ask spread for the entire sample is 1.43 and 1.42 for the periods of quarter year and one year respectively. The disclosing and non-disclosing firms have average bid-ask spreads of 1.22 and 1.56 for the period of one year respectively and the difference is significant at the 1% level. It is evident that the firms' decision to disclose is more likely to positively impact share price liquidity even one year after the release date.

Table 5.9 Bid-ask spreads and disclosing and non-disclosing sample

Post-announcement period		Full sample N = 562	Disclosing N = 226	Non-disclosing N = 336	MW test
Quarter year	Mean	1.43	1.23	1.56	4.10***
	Median	0.97	0.75	1.12	
Half year	Mean	1.46	1.23	1.61	4.52***
	Median	1.06	0.86	1.28	
Three quarters of a year	Mean	1.44	1.24	1.58	4.58***
	Median	1.12	0.87	1.32	
One year	Mean	1.42	1.22	1.56	4.91***
	Median	1.16	0.86	1.38	

This table presents mean and median bid-ask spread for different periods (quarter year, half a year, three quarters of a year, and one year) after announcement date. This table reports the results on bid-ask spread for the entire sample, and for disclosing and non-disclosing groups. This table also reports nonparametric Mann-Whitney (MW) test statistics for the difference in median bid-ask spread across disclosure and non-disclosure sub groups. *Significantly different from zero at the 10% level, **significantly different from zero at the 5% level, and ***significantly different from zero at the 1% level.

Our findings are robust to the use of alternate time horizons. The disclosing and non-disclosing sample of firms have median bid-ask spreads that are significantly different for the post announcement periods. The Mann-Whitney non-parametric test statistics confirm that the difference is statistically significant at the 1% level for all time horizons.

Table 5.10 Bid-ask spreads and disclosure quality

Post-announcement period		High quality N = 281	Low quality N = 281	
Quarter year	*Mean*	1.39	1.48	1.12
	Median	0.94	0.99	
Half a year	*Mean*	1.37	1.54	1.66*
	Median	0.96	1.18	
Three quarters	*Mean*	1.35	1.53	2.02**
	Median	1.00	1.25	
One year	*Mean*	1.33	1.52	2.54**
	Median	1.02	1.26	

This table presents mean and median of bid-ask spread for different periods (quarter year, half a year, three quarters of a year, and one year) after announcement date. This table reports bid-ask spread results for the entire sample, and for firms with high quality and low quality GHG emission disclosures. This table also reports nonparametric Mann-Whitney (MW) test statistics for the difference in median bid-ask spread across high quality and low quality sub groups. *Significantly different from zero at the 10% level, **significantly different from zero at the 5% level, and ***significantly different from zero at the 1% level.

High quality and low quality sample firms show significant differences in the bid-ask spreads for the time horizons of half-a year, three quarter of a year, and one year. High quality disclosure firms have smaller bid-ask spreads than low quality disclosure firms. This result validates our proposition that that high quality firms have more liquid shares and try to further improve their liquidity by disseminating high quality GHG emission information. This may lead to a decrease in the information asymmetry among a broader group of stakeholders.

5.6. Conclusion

This Chapter discussed in detail the descriptive statistics of variables used in this research. There are two different disclosures used in this study. Based on the two disclosure variables, all independent variables and control variables are divided into two major categories. Statistical significances are identified using the Mann-Whitney (MW) non-parametric test statistics. The next Chapter presents the main results of testing the hypotheses developed in Chapter 3.

CHAPTER SIX

DATA ANALYSIS AND RESULTS

6.1. Introduction

The objective of this Chapter is to present correlations and regression analysis to test the stated hypotheses in Chapter 3. This Chapter on data analysis and results consists of three key sections. The first part of this Chapter discusses the empirical results regarding the impact of corporate governance attributes on voluntary disclosure of GHG emission information. The second section provides the empirical results for the relationship between voluntary disclosure of GHG emission information and earnings management. The third section of this Chapter reports empirical results on the link between stock market liquidity and voluntary disclosure of GHG emission information.

6.2. The impact of corporate governance on voluntary GHG emission disclosure

This section analyses the impact of corporate governance mechanisms on voluntary disclosure of GHG emission information using correlations and regressions. There are two competing views suggested in Chapter 3 with regards to the relationship between corporate governance and voluntary disclosure of GHG emission information. Based on stakeholder value maximisation view, it is posited that :

Hypothesis 1(a): There is a positive association between effective corporate governance mechanisms and voluntary disclosure of GHG emission information.

Based on shareholder expense view, the following hypothesis is posited:

Hypothesis 1(b): Voluntary disclosure of GHG emission information is inversely associated with effective corporate governance mechanisms.

6.2.1. Correlation results for H1 (a) and (b)

Table 6.1 presents Pearson and Spearman correlations between voluntary disclosure of GHG emission information, corporate governance variables, and control variables. As discussed in Chapter 4, there are two proxies that are used to capture voluntary disclosure of GHG emission information. DISC is the first dependent variable which is an indicator variable and takes the value one if a firm responds to the CDP and that information is publicly disclosed. QUAL is the second dependent variable and is calculated using information based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology.

Pearson correlation coefficients between the choice of GHG emission disclosure (DISC) and quality of GHG emission disclosure (QUAL) is positive, with a coefficient of 0.489 and is statistically significant at the 1% level. Spearman correlation coefficient also provides similar results between these two variables, with a coefficient of 0.466 and is statistically significant at the 1% confidence level. These results suggest that there is an association between managers' decision to disclose GHG emission information publicly via the CDP and the quality of GHG emission disclosure. A positive association is found between the proportion of independent directors (IND) and the two proxies for GHG emission disclosure DISC and QUAL and both are statistically significant at the 1% level. These results indicate preliminary support for the stakeholder value maximisation hypothesis, as stated in Hypothesis (1a) suggesting that effective corporate governance mechanisms, such as greater independence of directors on the board, are positively associated with the probability and the quality of GHG emission disclosure.

CEO duality (DUA) has a negative correlation with the quality of GHG emission disclosure and is statistically significant at the 1% level. The correlation between DISC and CEO duality is also negative but only significant at the 10% level. These results also show preliminary support for the stakeholder value maximisation hypothesis, as stated in Hypothesis (1a). A positive correlation is found between board gender diversity (DIV) and the two proxies of voluntary GHG emission disclosure (DISC and QUAL). These results also indicate initial support for the stakeholder value maximisation hypothesis (H1a), which suggests that gender diversity on the board of directors is positively associated with the probability and the quality of GHG emission disclosures. The frequency of audit committee meetings (LAT) has a positive and statistically significant correlation with DISC and QUAL.

Spearman correlation coefficients between the size of audit committee and the two proxies (DISC and QUAL) of voluntary disclosure of GHG emission information are positive, and are statistically significant at the 5% and 10% confidence levels respectively. The Pearson and Spearman coefficients between shareholding by all directors on the board (MSO) and the two proxies of voluntary GHG emission disclosure (DISC and QUAL) are negative. These results suggest that firms with higher shareholding by all directors on the board tend to disclose less GHG emission information voluntarily. Institutional shareholders (INS) have no significant correlations with DISC and QUAL. Blockholder ownership (BHD) has positive association between two proxies of DISC and QUAL. The highest correlation coefficient result reported in Table 6.1 is 0.92 between INS and BHD. This study uses one of these variables at a time due to the multicollinearity problem.

Table 6.1 Correlation matrix (Pearson above diagonal and Spearman below diagonal)

	DISC	QUAL	IND	DUA	DIV	LAT	MAC	MSO	INS	BHD	LMV	TOB	ROA	LEV	AGE	VOL	CRL
DISC	1	0.489***	0.230***	-0.077*	0.236***	0.204***	0.067	-0.261***	0.064	0.116***	0.365***	-0.164***	0.230***	-0.008	0.178***	-0.118***	0.133***
QUAL	0.466***	1	0.308***	-0.211***	0.196***	0.242***	0.088**	-0.239***	0.032	0.106**	0.378***	-0.172***	0.226***	-0.008	0.401***	-0.055	0.330***
IND	0.222***	0.300***	1	-0.299***	0.259***	0.220***	0.287***	-0.402***	-0.219***	-0.175***	0.329***	-0.097**	0.204***	-0.142***	0.260***	-0.193***	0.175***
DUA	-0.077*	-0.212***	-0.285***	1	-0.113***	-0.160***	-0.241***	0.258***	0.050	-0.004	-0.064	-0.012	-0.035	0.052	-0.180***	0.137***	-0.140***
DIV	0.236***	0.156***	0.271***	-0.113***	1	0.284***	0.295***	-0.138***	-0.058	0.009	0.421***	-0.105**	0.291***	-0.080*	0.143***	-0.275***	0.167***
LAT	0.189***	0.216***	0.198***	-0.160***	0.268***	1	0.267***	-0.123***	-0.105**	-0.052	0.361***	-0.237***	0.300***	-0.029	0.220***	-0.220***	0.145***
MAC	0.073*	0.087**	0.321***	-0.243***	0.315***	0.261***	1	-0.184***	-0.092*	-0.042	0.287***	-0.164***	0.262***	0.054	0.193***	-0.204***	0.107**
MSO	-0.312***	-0.301***	-0.328***	0.223***	-0.168***	-0.171***	-0.219***	1	0.142***	0.138***	-0.161***	0.347***	-0.111***	-0.055	-0.185***	0.196***	-0.047
INS	0.053	0.044	-0.241***	0.036	-0.042	-0.113***	-0.086*	-0.057	1	0.919***	0.024	0.083*	-0.116***	0.054	-0.030	0.091**	0.114***
BHD	0.100**	0.113***	-0.196***	-0.010	0.001	-0.059	-0.061	-0.096**	0.923***	1	0.101**	0.091**	-0.066	0.007	0.036	0.068	0.174***
LMV	0.371***	0.318***	0.328***	-0.064	0.427***	0.333***	0.279***	-0.367***	0.058	0.115***	1	-0.162***	0.507***	-0.127***	0.340***	-0.439***	0.355***
TOB	-0.157***	-0.089**	-0.114***	-0.059	-0.132***	-0.119***	-0.126***	0.313***	0.106**	0.126***	-0.127***	1	-0.076	-0.166***	-0.146***	0.151***	-0.056
ROA	0.243***	0.169***	0.273***	-0.117***	0.354***	0.303***	0.294***	-0.125***	-0.068	-0.023	0.522***	0.004	1	-0.240***	0.294***	-0.120***	0.176***
LEV	0.031	0.048	-0.139***	0.040	-0.063	-0.037	0.030	-0.027	0.078*	0.038	-0.089**	-0.079	-0.218***	1	-0.157***	0.046	-0.104*
AGE	0.155***	0.369***	0.245***	-0.176***	0.141***	0.175***	0.210***	-0.198***	-0.008	0.053	0.319***	0.089**	0.346***	-0.138***	1	-0.179***	0.242***
VOL	-0.087*	0.021	-0.202***	0.096**	-0.281***	-0.183***	-0.249***	0.323***	0.097**	0.104*	-0.489***	0.199***	-0.254***	-0.014	-0.148***	1	-0.134***
CRL	0.133***	0.335***	0.207***	-0.140***	0.167***	0.159***	0.132***	-0.196***	0.101**	0.158***	0.309***	0.004	0.128***	-0.103*	0.255***	-0.102**	1

Table 6.1 reports the Pearson correlations between variables related to voluntary disclosures, corporate governance and control variables. DISC is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP, and 0 otherwise. QUAL is quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board; DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is proportion of ordinary shares held by all directors. INS is proportion of shareholding held by the institutional investors measured from Top20 shareholding list of a firm excluding individual shareholdings. BHD is the proportion of shareholding held by blockholders, who hold 5% or more shares. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. ***, **, * indicate that correlation is significant at the 1%, 5% and 10% (2-tailed) levels respectively.

With regards to control variables, firm size (LMV) and listing age of the firm (AGE) reveal high positive association with both GHG emission disclosure measures (DISC and QUAL). These results suggest that larger and older firms are more likely to disclose more GHG emission information via the CDP and their corporate reporting channels to meet the demand of a broader group of stakeholders. Tobin's *q* (TOB) shows negative association with both measures of GHG emission disclosures suggesting that firms with higher growth prospects are less likely to provide voluntary GHG emission information because at the high growth stage, managers of the firms are not motivated to measure and report GHG emission information. In addition, Pearson and Spearman correlation coefficients show positive association between profitability (ROA) and the proxies of DISC and QUAL. Leverage (LEV) indicates no association with both GHG emission disclosures. Share price volatility (VOL) has negative association with only DISC. This result suggests that firms that decide to disclose more GHG emission are more likely to have lower information asymmetry between insiders and outside investors. The cross-listed firms reveal high positive correlation with both GHG emission disclosure measures suggesting that Australian firms that are cross-listed in a foreign stock exchange need to respect their regulations therefore need to provide more information with regards to GHG emissions.

6.2.2. Voluntary GHG emission disclosure and corporate governance variables

This section relates corporate governance variables to the firm's decision to voluntarily respond to the CDP as well as the quality of GHG emission disclosure calculated based on firms' annual reports, standalone sustainability reports, and corporate websites using sing the CDP 2010 scoring methodology. Corporate governance variables and control variables used in this research are lagged variables. Table 6.2 reports the results of cross sectional logistic regression analysis with the firms' decision to disclose their GHG emission information (DISC) as the dependent variable. The list of effective corporate governance variables are greater board independence (IND), absence of CEO duality (DUA), presence of board gender diversity (DIV), more audit committee meetings (LAT), smaller size of the audit committee (MAC), lower directors' ownership (MSO), higher institutional ownership (INS), and greater level of blockholders ownership (BHD).

Table 6.2 presents two different models of logistic regression. Models 1 and 2 show the results including year and industry fixed effects, which control for potential time and industry effects. The board independence (IND) is slightly associated with managers' choice of GHG emission disclosure. CEO duality is insignificant in model 1 and 2. The board gender diversity (DIV) is positively related to managers' decision to disclose GHG emission information via the CDP. Firms with more audit committee members are less likely to disclose GHG emission disclosure to public. These findings are not consistent with previous research findings of a positive association between the size of the audit committee and quality of financial disclosure (Felo, Krishnamurthy & Solieri 2003; Pucheta-Martínez & De Fuentes 2007). On the other hand, others (Lin, Xiao & Tang 2008; Scarbrough, Rama & Raghunandan 1998; Yermack 1996) argue that the more members in an audit committee may lead to unnecessary debates and delay in decision making process, this in turn, it is not necessarily considered as an effective functioning mechanisms.

Table 6.2 Decision to disclose GHG emission information and corporate governance

Model	**1**	**2**
Intercept	-5.9030 (-4.71)***	-5.3203 (-4.49)***
IND	1.2302 (1.62)	1.2861 (1.68)*
DUA	0.1772 (0.50)	0.2225 (0.62)
DIV	0.5538 (2.35)**	0.5291 (2.25)**
LAT	0.2344 (0.90)	0.2276 (0.88)
MAC	-0.2608 (-2.63)***	-0.2694 (-2.70)***
MSO	-6.1918 (-3.55)***	-6.1061 (-3.57)***
INS	1.8628 (2.65)***	
BHD		1.8314 (2.83)***
LMV	0.5704 (4.33)***	0.5467 (4.13)***
TOB	-0.1647 (-2.11)**	-0.1620 (-2.07)**
ROA	0.1506 (0.78)	0.1645 (0.84)
LEV	0.5929 (0.93)	0.6345 (0.99)
AGE	0.0786 (0.62)	0.0716 (0.57)
VOL	-3.5636 (-0.55)	-3.8687 (-0.59)
CRL	0.0442 (0.15)	0.0315 (0.11)
Year	Yes	Yes
Industry	Yes	Yes
Pseudo R^2 (%)	22.50	22.72
Wald chi^2	102.44	104.27
Probability	0.0000	0.0000
N	565	565

This table provides the results of multivariate logistic regression analysis. The dependent variable is DISC which is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. BHD is the proportion of shareholding held by blockholders, who hold 5% or more shares. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *.z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Particularly, Kent and Stewart (2008) find a negative relationship between the size of the audit committee and financial disclosure for Australian firms. Consistent with this study and the above argument, Australian firms with more members in the audit committee are less likely to provide greater GHG emission disclosure to stakeholders.

Directors' shareholding (MSO) is negatively associated with managers' decision to disclose GHG emission information via the CDP. The negative associations between managerial share ownership and voluntary GHG emission disclosure support the stakeholder value maximisation hypothesis, as stated in Hypothesis (1a) and indicate that firms in which directors hold greater proportion of ordinary shares are less likely to disclose GHG emission information to the public. The coefficient on institutional shareholding and blockholder ownership are positive and significant suggesting firms with more institutional and blockholder ownership are more likely to disclose voluntary GHG emission information publicly. These results also support our prediction and supports for the stakeholder value maximisation view hypotheses (H1a). The frequency of audit committee meetings is not significant in all models.

A number of control variables are associated with the decision to disclose GHG emission information. The size of firm is significantly positively associated with the firms' decision to disclose their GHG emissions information in all models. This result is consistent with previous research (Ben-Amar & McIlkenny 2014; Matsumura, Prakash & Vera-Muñoz 2014; Peters & Romi 2014; Prado-Lorenzo & Garcia-Sanchez 2010; Rankin, Windsor & Wahyuni 2011). Tobin's *q* is negatively and significantly associated with managers' choice of GHG emission disclosure, indicating that managers' decision with regards to disclosure is negatively associated with firms' growth opportunities. Profitability, leverage, firm age, stock return volatility, and cross-listing are not significant in all models.

In Table 6.3, the dependent variable is quality of GHG emission disclosure (QUAL). This table presents two different models of multiple regression results. Models 1 and 2 of Table 6.3 show the results including year and industry fixed effects. This study corrected heteroskedasticity using robust standard errors in all of our models. Model 1 of Table 6.3 is highly significant with an adjusted R square of 44.62%, F-statistics of 25.79, p-value of 0.0000, and maximum variance inflation factor of 2.50 (Please see the appendix 2 for further details).

There is a statistically significant positive association between the proportion of independent directors on the board (IND) and quality of GHG emission disclosure, which supports the stakeholder value maximisation view hypothesis (H1a). This suggests that firms provide greater amount of quality of voluntary GHG emission information in their annual, sustainability reports, and corporate websites when they have higher proportion of independent directors on the board. These results are consistent with prior research. Rupley, Brown and Marshall (2012) and Iatridis (2013) found a similar result for environmental disclosure quality. With regards to GHG emission disclosure quality, Liao, Luo and Tang (2014) found a similar result for the UK firms. This result supports the findings of Irani and Oesch (2013) who report that better corporate governance mechanisms that act to mitigate agency costs often require management to disclose more information.

There is a significant negative association between CEO duality (DUA) quality of GHG emission information (QUAL) which supports the stakeholder value maximisation view hypothesis (H1a). This result shows that firms with CEO duality are associated with lower quality of GHG emission information. There is association between board gender diversity (DIV) and the quality of GHG emission information. The number of audit committee members has a negative association with the quality of GHG emission information. It is concluded here that firms make better quality voluntary GHG emission information disclosure when they have a smaller sized audit committee. The results regarding board gender diversity and the size of the audit committee are consistent with the stakeholder value maximisation view hypothesis (H1a). MSO is not associated with the quality of GHG information disclosure.

Table 6.3 Quality of GHG emission information and corporate governance

Model	1	2
Intercept	-0.1555 (-1.96)**	-0.1509 (-2.00)**
IND	0.1254 (3.15)***	0.1286 (3.21)***
DUA	-0.0539 (-2.91)***	-0.0531 (-2.85)***
DIV	0.0314 (2.29)**	0.0310 (2.27)**
LAT	0.0239 (1.44)	0.0240 (1.45)
MAC	-0.0185 (-2.96)***	-0.0186 (-2.99)***
MSO	-0.0955 (-1.45)	-0.0970 (-1.48)
INS	0.0227 (0.52)	
BHD		0.0328 (0.89)
LMV	0.0471 (6.00)***	0.0463 (5.86)***
TOB	-0.0056 (-1.63)	-0.0057 (-1.66)*
ROA	-0.0071 (-0.74)	-0.0065 (-0.68)
LEV	0.1222 (3.07)***	0.1225 (3.09)***
AGE	0.0401 (5.23)***	0.0400 (5.22)***
VOL	-0.1364 (-0.30)	-0.1432 (-0.31)
CRL	0.0623 (3.65)***	0.0614 (3.57)***
Year	Yes	Yes
Industry	Yes	Yes
Adjusted R2 (%)	44.62	44.67
F-statistic	25.79	25.86
P value	0.0000	0.0000
N	565	565
Max VIF	2.50	2.54

This table provides the results of multivariate regression analysis. The dependent variable (QUAL) is the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. BHD is the proportion of shareholding held by blockholders, who hold 5% or more shares. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

With regards to control variables, firm size, leverage, listing age and cross-listing have significant results. Firm size is positively associated with quality of GHG emission disclosure, which supports our earlier results. The positive relationship between firm size and quality of GHG emission disclosure can be explained by the fact that larger firms have additional resources to disclose the quality GHG emission information. This result is consistent with previous studies (Ben-Amar & McIlkenny 2014; Choi, Lee & Psaros 2013; Freedman & Jaggi 2011; Prado-Lorenzo et al. 2009). Tobin's *q* is slightly negatively related to the quality of GHG emission information suggesting that firms with higher growth opportunities are less likely to disclose high quality GHG emission information.

Listing age appears to be positive and significant in all of the models. Leverage is significantly positively associated with the quality of voluntary GHG emission disclosures in all models. This result indicates that debt holders exert pressure on firms to disclose more GHG emission information. Profitability (ROA) does not have any significant association with the quality of voluntary GHG emission disclosure. Choi, Lee and Psaros (2013) find a similar result between ROA and carbon emission disclosure in Australian firms but they use a different methodology to measure carbon emission disclosure. Stock return volatility (VOL) is not associated with the quality of voluntary GHG emission disclosure. Cross-listing appears to be positive and significant suggesting that cross-listed firms are more likely to provide GHG emission information to fulfill the needs of regulators and investors from other countries.

Overall, effective corporate governance mechanisms such as greater board independence, absence of CEO duality, presence of board gender diversity, lower directors' ownership, higher institutional ownership, greater blockholders ownership and smaller size of the audit committee impact on voluntary GHG emission disclosure information. These results suggest that firms with better corporate governance mechanisms are more likely to pursue climate change agenda and direct the management to provide better quality GHG emission information to a broader group of stakeholders to legitimise their activities. These results fail to reject the stakeholder value maximisation hypothesis and supports Hypothesis (1a). The author was unable to find support for the shareholder expense view posited in Hypothesis (1b).

The findings of this research are comparable to previous research. Ntim and Soobaroyen (2013) find that better-governed firms are more likely to pursue more active CSR initiatives in South Africa. Specifically, they find that board size, board diversity, government ownership, and a greater percentage of independent directors on board have positive impact on disclosure about CSR initiatives. On the other hand, blockholder ownership and institutional shareholding have negative effect on CSR. Rupley, Brown and Marshall (2012) show that board independence, board diversity, and multiple directorships are positively associated with voluntary environmental disclosure suggesting that good corporate governance features based on a broad range of monitoring mechanisms pressure management to act in the best interests of stakeholders, thereby increasing the quality of voluntary environmental disclosure.

Liao, Luo and Tang (2014) have shown that firms with better corporate governance are more likely to disclose more voluntary GHG emission information in the UK. Particularly, they found evidence that board diversity, board independence, and the presence of board level environmental committee have positive effects on voluntary GHG emission disclosure. Their findings indicated that an independent and diversified board and the existence of an environmental committee at board level may balance a firm's financial and non-financial goals with limited resources and moderating the possible conflicting expectations of stakeholders' demands.

6.2.3. Long-term performance

This study investigates the long-term stock performance with regards to the CDP reporting announcement based on whether firms disclose GHG emission information, focusing on portfolio returns using calendar-time methodology. The model given below is used in our empirical estimations:

$$R_{Pt} - R_{ft} = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{pt} \quad (16)$$

The proxy for the risk-free rate (R_{ft}) is the 90-day Australian bank accepted bill rate; R_{mt} is the return on ASX all ordinaries share price index; SMB_t is the difference in the returns of portfolios of small and large capitalisation stocks; HML_t is the is the difference in returns of portfolios of high and low book-to-market ratio. This study uses Morgan and Stanley Capital International (MSCI) indices from DataStream for large, small, value, and growth stocks in the Australian market to calculate returns on the SMB and HML portfolio. The expected value of the intercept (α), which measures the monthly abnormal return, is zero under null hypothesis of no abnormal performance (Chan, Kot & Tang 2013).

Table 6.4 Long-term performance

Panel A: The long-term performance for disclosing versus not disclosing firms for a THREE-year period					
	α	β_1	β_2	β_3	Adj. R^2
Disclosing firms	0.0040 (2.85)***	0.8983 (28.9)***	0.2717 (5.49)***	0.2197 (5.88)***	95.11
Not disclosing firms	0.0048 (2.44)**	0.9997 (23.02)***	0.5268 (7.62)***	0.2865 (5.49)***	93.53
Panel B: The long-term performance for disclosing versus not disclosing firms for a FIVE-year period					
	α	β1	β2	β3	Adj. R2
Disclosing firms	0.0044 (3.56)***	0.8903 (30.92)***	0.3012 (6.63)***	0.1769 (4.93)***	94.11
Not disclosing firms	0.0042 (2.23)**	0.9197 (20.91)***	0.5330 (7.68)***	0.2648 (4.83)***	89.65

The candar time regression results are reported in Table 6.4. This provides average abnormal monthly return (α) for the rolling portfolios employing equally weighted monthly returns for three- and five-year periods from the month after announcing the CDP report. Panel A of Table 6.4 reports the long-term abnormal returns for GHG emission disclosing firms versus not disclosing firms for a three-year period. The long-term intercepts (α) are 0.40% (with a t-value of 2.85) and 0.48% (with a t-value of 2.44) for disclosing and not disclosing firms respectively. When comparing long-term abnormal returns for the three- and five year periods, the long term return for disclosing firms are higher whereas the long term returns for non disclosing firms are reduced. These results provide very strong support for the stakeholder value maximazation view.

6.2.4. Year-by-year regression results

Table 6.5 Decision to Disclose GHG emission information and corporate governance by years

Reporting year	**2006**	**2007.**	**2008**	**2009**
Model	1	2	3	4
Intercept	-5.9316 (-1.30)	-4.4936 (-0.77)	-7.6196 (-3.27)***	-6.9258 (-2.48)**
IND	-1.3682 (-0.62)	-3.5017 (-1.04)	3.4006 (2.30)**	-0.3479 (-0.24)
DUA	-2.9763 (-1.55)	-1.2140 (-1.13)	1.0277 (1.65)*	0.5526 (0.71)
DIV	0.3638 (0.51)	3.3721 (1.96)*	0.3122 (0.71)	0.6886 (1.49)
LAT	0.2592 (0.37)	-0.0882 (-0.09)	-0.0252 (-0.05)	0.9280 (1.55)
MAC	-0.1721 (-0.73)	-1.0365 (-2.54)**	-0.2888 (-1.42)	-0.4821 (-2.22)**
MSO	1.6300 (0.31)	-21.1738 (-1.84)*	-3.5175 (-1.20)	-14.5896 (-4.19)***
INS	-1.8006 (-0.98)	-4.6846 (-1.72)*	2.6218 (1.96)*	4.1360 (2.45)**
LMV	1.0024 (1.78)*	1.1054 (2.20)**	0.5247 (2.15)**	0.8815 (3.09)***
TOB	-0.9296 (-2.49)**	0.5449 (0.74)	-0.2155 (-1.73)*	-0.3115 (-2.43)**
ROA	-0.9636 (-1.06)	-0.9885 (-1.83)*	0.4247 (1.15)	1.0380 (2.71)***
LEV	-0.5462 (-0.23)	3.0861 (1.07)	2.2292 (1.70)*	-2.6317 (-1.90)
AGE	0.1704 (0.54)	0.8797 (1.80)*	0.1662 (0.73)*	-0.4018 (-1.24)
VOL	6.0263 (0.10)	33.8784 (0.28)	-23.7670 (-1.95)*	3.5334 (0.30)
CRL	-1.5413 (-1.89)*	-0.3227 (-0.30)	0.6152 (1.15)	0.3967 (0.67)
Industry	Yes	Yes	Yes	Yes
Pseudo R2 (%)	21.39	37.61	29.23	42.60
Wald chi2	17.46	18.56	53.74	59.75
Probability	0.6828	0.6135	0.0003	0.0000
N	90	83	189	186

This table provides the results of multivariate logistic regression analysis. The dependent variable is DISC which is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Table 6.5 reports the multivariate logistic regression results of managers' decision to report voluntary GHG emission disclosure publicly by year. Four CDP reporting years are considered in this study. These results include industry fixed effects. With regards to corporate governance variables, the proportion of independent directors on the board is significant only for 2008. Board gender diversity appears to be positive and significant only for the year 2007. The size of the audit committee has a significantly negative coefficient for the years 2007 and 2009. Managerial share ownership's coefficient is statistically significant ($p > 0.01$) in 2009. The coefficient on institutional investors is positive and significant in CDP reporting years 2007, 2008 and 2009. With regards to control variables, larger firms are more likely to disclose their GHG emission information for all years. TOB is negative and significant in all models except in 2007. ROA shows a conflicting result in 2007 and 2008. Stock return volatility is insignificant in all the models except in 2008. Cross-listing appears to be insignificant in all models except in 2006.

Table 6.6 reports the regression results by year using disclosure quality as the dependent variable. All models include industry fixed effects. The proportion of independent directors on the board is significantly positively associated with the quality of GHG emission information in 2008 and 2009. CEO duality is significantly negatively associated with GHG emission information in 2006 and 2007. Board gender diversity is not significant in all models except in 2009. Frequency of audit committee meetings is insignificant in all models. The size of the audit committee has significant negative coefficients in 2007 and 2009. Managerial share ownership is significantly negatively related to quality of GHG emission information only for year 2009. INS provides a conflicting result in year 2006 and 2009.

With regards to the control variables, firm size exhibits positive relation with quality of GHG emission disclosure in all the CDP reporting years except 2006 and 2007. TOB appears to be negative and significant only for year 2008. ROA shows an insignificant relation with quality of GHG emission disclosure. Leverage is positive in 2007 and 2008. There is a positive association between listing age and voluntary disclosure of GHG emissions in all reporting years. Stock return volatility tends to be insignificant in all models. Cross-listing shows a positive relation with quality of GHG emission disclosure in 2006 and 2008.

Table 6.6 Quality of GHG disclosure and corporate governance by years

Reporting year	**2006**	**2007**	**2008**	**2009**
Model	1	2	3	4
Intercept	0.2930 (1.22)	0.3064 (1.03)	-0.2636 (-2.30)**	-0.4708 (-3.44)***
IND	-0.1024 (-0.92)	-0.0959 (-0.83)	0.1328 (1.94)*	0.2552 (3.44)***
DUA	-0.0997 (-1.92)*	-0.1956 (-3.90)***	-0.0439 (-1.42)	-0.0393 (-1.18)
DIV	0.0299 (0.86)	0.0488 (1.38)	0.0151 (0.62)	0.0425 (1.70)*
LAT	0.0139 (0.32)	0.0524 (1.16)	0.0299 (1.05)	0.0152 (0.49)
MAC	-0.0171 (-1.21)	-0.0504 (-2.59)**	-0.0109 (-0.84)	-0.0213 (-2.06)**
MSO	0.0347 (0.13)	-0.1898 (-0.89)	-0.0465 (-0.45)	-0.2113 (-2.05)**
INS	-0.2519 (-2.08)**	-0.1696 (-1.21)	0.0565 (0.85)	0.1590 (2.04)**
LMV	0.0272 (1.32)	0.0296 (1.36)	0.0487 (3.91)***	0.0639 (4.44)***
TOB	-0.0124 (-1.24)	-0.0154 (-1.39)	-0.0130 (-2.60)***	-0.0012 (-0.35)
ROA	-0.0282 (-0.78)	-0.0180 (-0.58)	-0.0122 (-0.65)	0.0007 (0.04)
LEV	0.1268 (0.80)	0.2738 (2.18)**	0.1056 (1.78)*	0.0121 (0.19)
AGE	0.0359 (2.21)**	0.0782 (3.73)***	0.0330 (2.51)**	0.0404 (2.70)***
VOL	-4.4284 (-1.41)	-7.4566 (-1.63)	-0.5845 (-1.04)	1.0310 (1.40)
CRL	0.0783 (1.95)*	0.0462 (1.09)	0.0670 (2.17)**	0.0361 (1.21)
Industry	Yes	Yes	Yes	Yes
Adjusted R2 (%)	42.45	47.30	40.96	44.09
F-statistic	3.92	4.63	6.67	7.48
P value	0.0000	0.0000	0.0000	0.0000
N	92	94	189	190
Max VIF	2.72	2.57	2.45	2.46

This table provides the results of multivariate regression analysis. The dependent variable (QUAL) is the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

Overall, the link between corporate governance mechanisms and voluntary disclosure of GHG emission information is supported albeit the results are weaker when we conduct a year by year analysis. A possible explanation is that the power of statistical tests is weaker when we use fewer observations.

6.2.5. Disclosure sub-scores and corporate governance

Table 6.7 reports the regression results of five sub-scores of GHG emission disclosures. The CDP 2010 rating methodology uses five sub-scores. These are (i) governance, (ii) risks and opportunities, (iii) strategy, (iv) GHG accounting, energy and fuel use, and trading, and (v) communications. Table 6.6 presents the results with year and industry fixed effects for all models. Considering corporate governance variables among sub-disclosure categories, the proportion of independent directors on the board and CEO duality appears to be significant in all categories of GHG emission disclosures in the predicted directions. Board gender diversity exhibits a positive and significant relation with quality of GHG emission disclosure for all categories except strategy and GHG.

The size of the audit committee has significant impact on all sub-categories of quality of GHG emission disclosure except strategy. Managerial share ownership and frequency of audit committee meetings do not seem to be associated with any sub-categories of GHG emission disclosures except strategy and risk and opportunities respectively. Institutional shareholding is insignificant in all sub-categories. Turning to the control variables, firm size is positively significantly associated with all sub-categories of GHG emissions. Tobin's q shows a negative and significant coefficient in governance and communication sub-categories of quality of GHG emission disclosure suggesting that growth firms tend to disclose less GHG emission information. Profitability is insignificant at all sub-categories except risk sub-category. Leverage is positive and significant in all models except governance and communication sub-categories. Listing age seems to be positively associated with all sub-categories of GHG emission disclosures except communications.

Table 6.7 Sub-scores of disclosures and corporate governance

Sub-scores	GOVE	RISK	STRA	GHGE	COMM
Intercept	-1.2745 (-1.83)*	0.9381 (0.24)	1.3016 (1.27)	-15.8835 (-4.64)***	-0.3602 (-1.18)
IND	1.8114 (4.73)***	4.1330 (2.26)**	1.0976 (2.03)**	4.7433 (2.48)**	0.6870 (4.12)***
DUA	-0.6475 (-3.83)***	-1.9151 (-2.02)**	-0.4052 (-1.56)	-2.2679 (-2.85)***	-0.1229 (-1.41)
DIV	0.3487 (2.86)***	1.8885 (2.79)***	0.1256 (0.70)	0.8927 (1.39)	-0.1315 (-2.36)**
LAT	-0.1974 (-1.45)	1.3403 (1.73)*	0.2543 (1.26)	0.9442 (1.27)	0.0834 (1.31)
MAC	-0.1322 (-2.37)**	-0.7758 (-2.72)***	-0.0768 (-0.99)	-0.8090 (-2.82)***	-0.0547 (-2.20)**
MSO	-0.6629 (-1.14)	-4.3420 (-1.25)	-1.6853 (-2.01)**	-2.7553 (-1.03)	0.1172 (0.40)
INS	-0.0178 (-0.05)	2.9434 (1.37)	-0.7192 (-1.20)	-0.0033 (0.01)	0.0142 (0.08)
LMV	0.1756 (2.52)**	1.7961 (4.99)***	0.4652 (4.60)***	2.1018 (5.52)***	0.1448 (4.73)***
TOB	-0.0609 (-2.27)**	-0.3193 (-1.54)	-0.0582 (-1.26)	-0.0979 (-1.04)	-0.0404 (-3.03)***
ROA	-0.0582 (-0.82)	-0.9586 (-2.52)**	-0.1753 (-1.33)	0.5437 (1.05)	-0.0546 (-1.58)
LEV	0.4218 (0.99)	5.9627 (3.08)***	1.9915 (3.78)***	3.7990 (2.14)**	0.1502 (0.93)
AGE	0.2017 (3.08)***	1.9512 (5.22)***	0.2958 (3.22)***	1.5259 (4.17)***	0.0311 (1.08)
VOL	4.7808 (1.10)	-1.1248 (-0.05)	-6.8334 (-0.99)	-7.2694 (-0.37)	-4.3772 (-2.26)**
CRL	0.6235 (4.14)***	2.8916 (3.66)***	0.5677 (2.77)***	2.1540 (2.49)**	0.0475 (0.77)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Adjusted R2 (%)	33.63	41.73	31.33	34.26	26.72
F-statistic	24.01	27.56	13.66	13.05	13.77
P value	0.0000	0.0000	0.0000	0.0000	0.0000
N	565	565	565	565	565
Max VIF	2.50	2.50	2.50	2.50	2.50

This table provides the results of multivariate regression analysis. The dependent variables are GOVE: governance; RISK: risks and opportunities; STRA: strategy; GHGE: GHG accounting, energy and fuel use, and trading; COMM: communications. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

The coefficient on stock return volatility is highly negatively significant only for the communication sub-category. Cross-listing is positive and significant in all sub-categories except communication. Overall, our findings support the stakeholder value maximisation view hypothesis and suggest that firms with effective corporate governance mechanisms are more likely to disclose higher quality GHG emission information to satisfy a variety of stakeholders' interests and reduce the legitimacy gap between the firm and the society in which it operates.

6.2.6. Robustness analysis

Three additional tests are conducted to check the robustness of reported results. Firstly, this study performs the Heckman two-stage sample selection regression to account for the self-selection problem. Secondly, this study uses the Horwath Corporate Governance ranking (HCG) as an alternative measure of corporate governance quality. Finally, regressions were run excluding financial sector firms. The purpose of this exercise is to check for the robustness of results after controlling for self-selection, alternative measure of corporate governance quality and to control for industry effects.

6.2.5.1 Self-selection and two-stage regression

The decision to disclose GHG emission information to the CDP could also have a bearing on the quality of GHG emission disclosure. Thus, we need to control for this self-selection bias. Prior studies on voluntary GHG emission disclosure use the Heckman two-stage sample selection regression to control the potential selection bias. For example, Peters and Romi (2014) and Matsumura, Prakash and Vera-Muñoz (2014) incorporated the Heckman two-stage sample selection regression to control the possibility of selection bias. This study also performs the Heckman two-stage sample selection regression to control for self-selection. The inverse Mills ratio (LAMBDA) was included in the second stage of regression to control for potential selection bias due to omitted variables (Dhaliwal et al. 2012).

Table 6.8 Heckman two-stage sample selection model

	Full sample	Excluding Financial sector
Intercept	-0.0828 (-0.55)	-0.2634 (-1.63)
IND	0.1508 (1.87)*	0.2843 (3.58)***
DUA	-0.1865 (-4.82)***	-0.1170 (-2.75)***
DIV	0.0347 (1.32)	0.0583 (2.18)**
LAT	0.0380 (1.24)	0.0656 (1.96)*
MAC	-0.0045 (-0.45)	-0.0012 (-0.12)
MSO	0.2125 (1.00)	0.3428 (1.74)*
INS	0.0248 (0.29)	0.0053 (0.06)
LMV	0.0264 (2.05)**	0.0296 (2.10)**
TOB	-0.0211 (-2.14)**	-0.0342 (-3.09)***
ROA	-0.0048 (-0.37)	0.0098 (0.72)
LEV	0.1851 (2.49)**	0.0225 (0.26)
AGE	0.0398 (3.11)***	0.0447 (3.34)***
VOL	2.5219 (3.16)***	4.4252 (4.02)***
CRL	0.0708 (2.80)***	0.0796 (3.00)***
LAMBDA	-0.0690 (-3.65)***	-0.0693 (-3.54)***
Year	Yes	Yes
Industry	Yes	Yes
Wald chi2	103.21	195.25
Probability	0.0000	0.0000
N	565	410

This table provides the results of the second stage of the Heckman two-stage sample selection model. The dependent variable (QUAL) is quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. LAMBDA is the invere Mills ratio obtained from the first stage probit model. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively

This study examines the impact of corporate governance mechanisms on voluntary disclosure of GHG emission information using the Heckman two-stage sample selection estimates. Managers choose to disclose their GHG emission information to the CDP and their reporting channels, which may be affected by a self-selection problem (Matsumura, Prakash & Vera-Muñoz 2014). This study corrects for this problem by jointly estimating the decision to disclose GHG emission information and the effect of corporate governance mechanisms on the quality of GHG emission information.

In the first stage of the Heckman model, we use managers' decision to disclose voluntary GHG emission information as the dependent variable (DISC) and employ a set of independent and control variables. The probit model is used in the estimations. The procedure also generates the inverse Mills ratio (LAMBDA) which is used in the second stage regression. The inverse Mill's ratio is added in the second stage as an explanatory variable. In this choice equation, we add prior CDP disclosure responses as an additional variable for specification purposes and do not include this in the second stage of the Heckman model (Peters & Romi 2014). One or more variables from the choice model can be excluded from the second stage outcome model of Heckman two stage estimates (Lennox, Francis & Wang 2012). In the second stage model, the dependent variable is the quality of GHG emission information.

This study uses the following disclosure choice model (first stage) to endogenise the decision to disclose GHG emission using the following equation.

$$DISC_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} CDP_{i,t-1} + \beta_{15} \Sigma year + \beta_{16} \Sigma industry + \varepsilon_{i,t} \quad (16)$$

The following equation is used to estimate the impact of corporate governance mechanisms on the quality of GHG emission information disclosure (second stage model).

$$QUAL_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{14} \Sigma year + \beta_{15} \Sigma industry + \varepsilon_{i,t} \quad (17)$$

The results reported in table 6.7 show that board independence and CEO duality impact disclosure quality in the predicted direction consistent with earlier results. Overall, our results are robust to controls for self-selection bias.

6.2.5.2 Alternative corporate governance and GHG emission disclosure

This study uses the Horwath Corporate Governance ranking (HCG) as an alternative measure of corporate governance quality to check for the robustness of our results. The HCG ranks the largest 250 Australian firms on their corporate governance structures and policies based on national and international best practice in corporate governance. Since this measure uses ranks, lower numbers indicate higher corporate governance quality. The coefficient on the HCG is negative and significant at the 1% level indicating that firms with high quality corporate governance are more likely to disclose better quality GHG emission information. This result suggests that Australian firms with good corporate governance practices monitor and guide the top management to focus on stakeholders' demand and reduce legitimacy gap through disclosing climate change related information, particularly GHG emission reduction policy and strategies. Our results support stakeholder value maximisation hypothesis (1a).

Table 6.9 GHG emission disclosure and alternative corporate governance

Logistic Regression		OLS Regression	
Dependent variable	DISC	Dependent variable	QUAL
Intercept	-4.5074 (-3.47)***	Intercept	-0.0639 (-0.81)
HCG	-0.0080 (-3.87)***	HCG	-0.0005 (-4.66)***
LMV	0.6119 (4.25)***	LMV	0.0460 (5.44)***
TOB	-0.2084 (-2.66)***	TOB	-0.0062 (-1.75)
ROA	0.1580 (0.80)	ROA	-0.0027 (-0.28)
LEV	0.0841 (0.11)	LEV	0.0777 (1.85)*
AGE	-0.0574 (-0.42)	AGE	0.0395 (5.03)***
VOL	2.2315 (0.24)	VOL	-0.5251 (-1.05)
CRL	0.2151 (0.75)	CRL	0.0844 (4.55)***
Year	Yes	Year	Yes
Industry	Yes	Industry	Yes
Pseudo R2 (%)	20.08	Adjusted R2 (%)	51.75
Wald chi2	85.95	F-statistic	48.35
Probability	0.0000	P value	0.0000
N	450	N	454
		Max VIF	2.43

This table provides the results of multivariate logistic and OLS regression analysis. The dependent variables for the logistic and OLS regressions are DISC and QUAL. DISC is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. QUAL is the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. HCG is the ranking of corporate governance of the top 250 Australian firms collected from the Horwath Corporate Governance reports. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

6.2.5.3 Excluding financial sector

Table 6.10 Regression results excluding financial sector

Logistic regression		Ordinary least square regression	
Intercept	-4.8266 (-2.98)***	Intercept	-0.0607 (-0.65)
IND	1.4040 (1.68)*	IND	0.1883 (4.45)***
DUA	0.2366 (0.52)	DUA	-0.0407 (-1.95)
DIV	0.6132 (2.22)**	DIV	0.0451 (3.09)***
LAT	-0.3688 (-1.21)	LAT	0.0165 (0.93)
MAC	-0.2317 (-2.06)**	MAC	-0.0173 (-2.56)**
MSO	-4.6007 (-2.57)***	MSO	-0.0416 (-0.61)
INS	1.0707 (1.28)	INS	-0.0099 (-0.22)
LMV	0.6102 (3.84)***	LMV	0.0419 (4.65)***
TOB	-0.2253 (-2.10)**	TOB	-0.0100 (-3.72)***
ROA	0.4273 (1.37)	ROA	0.0263 (3.13)***
LEV	1.2332 (1.58)	LEV	0.0978 (2.00)**
AGE	-0.0352 (-0.24)	AGE	0.0363 (4.32)***
VOL	-6.8204 (-0.66)	VOL	0.4671 (0.75)
CRL	-0.4688 (-1.40)	CRL	0.0501 (2.88)***
Year	Yes	Year	Yes
Industry	Yes	Industry	Yes
Pseudo R2	22.00	Adj R2 (%)	53.39
Wald chi2	68.28	F-statistic	32.40
Probability	0.0000	P value	0.0000
N	410	N	410
		Max VIF	2.64

This table provides the results of multivariate logistic and OLS regression analysis. The dependent variables for the logistic and OLS regressions are DISC and QUAL. DISC is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. QUAL is the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *Z and t* -statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

The author conducted another sensitivity analysis by excluding financial firms from the sample. The reason for conducting this additional analysis is that our sample period includes the Global Financial Crisis. Both regressions (logistic and OLS) were run with the reduced sample. The results reported in Table 6.10 are consistent with previously reported ones. We find that board independence, board diversity, the size of the audit committee, and managerial share ownership significantly influence disclosure quality. This sensitive test also supports the stakeholder value maximisation view stated in hypothesis (1a).

6.3. Voluntary GHG emission disclosure and earnings management

This section analyses the relationship between voluntary disclosure of GHG emission information and earnings management using correlations and regressions. There are two competing hypotheses suggested in Chapter 3 with regards to the relationship between voluntary disclosure of GHG emission information and earnings management.

Based on the stakeholder value maximisation view, we posit the following hypotheses:

Hypothesis 2(a): There is a negative association between the extent and quality of GHG emission disclosure and earnings management.

Based on the shareholder expense view, we posit the following hypothesis:

Hypothesis 2(b): There will be a positive association between the extent and quality of GHG emission disclosure and earnings management.

Based on the stakeholder value maximisation view, we posit the following hypothesis:

Hypothesis 2(c): The negative association between voluntary disclosure of GHG emission information and earnings management will be strengthened by effective corporate governance mechanisms.
Based on the shareholder expense view, we posit the following hypothesis:

Hypothesis 2(d): The positive association between voluntary disclosure of GHG emission information and earnings management will be moderated by effective corporate governance mechanisms.

6.3.1. Correlation matrix

Table 6.11 presents the Pearson and Spearman correlations of voluntary GHG emissions disclosure, earnings management, and other control variables. The author used four different proxies for earnings management, namely, the absolute value of discretionary accruals calculated using the modified Jones model with ROA (AUG), the absolute value of total accruals calculated using the modified Jones model (MJM), the absolute value of discretionary accruals calculated using performance matched modified Jones model (MAT), and the absolute value of current accruals calculated using performance matched modified Jones model adjusted with ROA (MTC). These measures have a high positive association between themselves and are statistically significant.

The Pearson and Spearman correlation between DISC and the absolute value of discretionary accruals calculated using the modified Jones model with ROA (AUG) is significantly negative. The quality of GHG emission disclosure is negatively correlated with AUG and statistically significant at the 1% level. This evidence suggests that higher quality disclosure firms are less likely to engage in earnings management as compared to lower quality of GHG emission disclosure firms as reported in the literature and provides initial support for the stakeholder value maximisation view.

Furthermore, earnings management proxies are significantly and negatively correlated with the size of firms indicating that larger firms are more likely to provide transparent financial reports. Tobin's q reveals high positive association with the four earnings management proxies. The correlation between leverage and earnings management proxies is statistically significant and negative. Finally, stock return volatility has high positive correlation with all earnings management proxies.

Table 6.11 Correlation between GHG disclosure and earnings management (Pearson above diagonal and Spearman below diagonal)

	DISC	QUAL	AUG	MJM	MAT	MTC	LMV	TOB	ROA	LEV	AGE	VOL	CRL
DISC	1	0.467***	-0.120**	-0.143***	-0.118**	-0.076	0.353***	-0.154***	-0.008	0.068	0.142***	-0.172***	0.056
QUAL	0.430***	1	-0.163***	-0.084*	-0.058	-0.109**	0.406***	-0.209***	-0.042	0.073	0.389***	-0.030	0.315***
AUG	-0.110**	-0.165***	1	0.429***	0.308***	0.564***	-0.114**	0.272***	-0.058	-0.231***	-0.134***	0.211***	-0.092*
MJM	-0.064	-0.043	0.282***	1	0.584***	0.254***	-0.162***	0.191***	-0.072	-0.195***	-0.060	0.214***	-0.079
MAT	-0.087*	-0.025	0.197***	0.303***	1	0.340***	-0.139***	0.161***	0.051	-0.162***	-0.040	0.188***	0.025
MTC	-0.050	-0.111**	0.381***	0.211***	0.296***	1	-0.083*	0.163***	-0.008	-0.208***	-0.067	0.163***	-0.080
LMV	0.363***	0.343***	-0.112*	-0.101**	-0.138***	-0.062	1	-0.088*	0.085	0.004	0.338***	-0.447***	0.333***
TOB	-0.128***	-0.162***	0.245***	0.231***	0.215***	0.204***	0.030	1	0.482***	-0.259***	-0.191***	0.177***	-0.064
ROA	0.029	-0.024	0.064	0.036	0.085*	0.006	0.199***	0.467***	1	-0.198***	-0.031	-0.094*	-0.004
LEV	0.117**	0.119**	-0.240***	-0.254***	-0.185***	-0.198***	0.044	-0.312***	-0.292***	1	-0.081*	-0.055	-0.011
AGE	0.118**	0.346***	-0.169***	0.031	-0.033	-0.102**	0.307***	0.049	0.099**	-0.047	1	-0.179***	0.154***
VOL	-0.137***	0.040	0.191***	0.176***	0.209***	0.165***	-0.502***	0.196***	-0.157***	-0.127***	-0.154***	1	-0.110**
CRL	0.056	0.323***	-0.108**	-0.062	0.021	-0.105*	0.297***	-0.005	0.056	0.005	0.172***	-0.082*	1

This table reports the Pearson correlations between variables related to voluntary disclosures, earnings management, and control variables. DISC is an indicator variable that equals 1 if the firm discloses GHG emission information to CDP and 0 otherwise. QUAL is quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. MJM is the absolute value of total accruals calculated using the modified Jones model. MAT is the absolute value of discretionary accruals calculated using performance matched modified Jones model. MTC is the absolute value of current accruals calculated using performance matched modified Jones model adjusted with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculate from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *** Correlation is significant at 1% level, ** correlation is significant at 5% level, and * correlation is significant at 10% level.

6.3.2. Voluntary GHG emission disclosure and earnings management

Table 6.12 reports the results of cross-sectional logistic regression analysis of the managers' decision to disclose GHG emission information. Model 1 shows the results without including control variables, year and industry fixed effects. Models 2 to 5 report the results including year and industry dummies. In supporting stakeholder value maximisation point of view, Model 1 shows a significant negative association between the managers' decision to disclose GHG emission information and earnings management. This result is no longer significant when the regression run with control variables and year and industry effects. Interestingly, the coefficients of earnings management variables are still negative. Similar results are found when the regressions are run with different earnings management proxies. Turing to the control variables, larger and visible firms (as proxied by size) disclose more GHG emission information as reported earlier. In addition, firms with higher growth opportunities are less likely to disclose GHG emission information to stakeholders. The author found no significant association with other control variables.

The regression results for the relationship between quality of GHG emission disclosure and earnings management proxies are presented in Model 1 of Table 6.13 shows that there is a significant negative association between the quality of GHG emission disclosure and the absolute value of discretionary accruals without including control variables, year and industry fixed effects. Models 2 to 5 present the regression results for the relationship between quality of GHG emission disclosure and the four proxies of earnings management. The author found negative associations between the modified Jones model with ROA (AUG) and the quality of GHG emission disclosure in model 2. These findings indicate that firms with higher quality of GHG emission information disclosure are less likely to engage in earnings management through discretionary accruals. These results are consistent with the stakeholder value maximisation hypothesis. This is consistent with previous CSR studies (Choi, Lee & Park 2013; Kim, Park & Wier 2012).

Table 6.12 Choice of GHG disclosure and earnings management

Model	1	2	3	4	5
Intercept	-0.2738 (-2.02)**	-4.1549 (-3.21)***	-4.0690 (-3.15)***	-4.1057 (-3.13)***	-4.1486 (-3.18)***
AUG	-3.4944 (-2.43)**	-1.8753 (-1.00)			
MJM			-2.0885 (-1.47)		
MAT				-0.8308 (-1.01)	
MTC					-0.9754 (-0.82)
LMV		0.6837 (4.55)***	0.6650 (4.40)***	0.6701 (4.41)***	0.6809 (4.54)***
TOB		-0.2354 (-2.21)**	-0.2308 (-2.21)**	-0.2405 (-2.36)**	-0.2454 (-2.35)**
ROA		0.3683 (1.43)	0.3498 (1.34)	0.3608 (1.38)	0.3706 (1.42)
LEV		0.6633 (0.85)	0.6374 (0.79)	0.7317 (0.93)	0.7142 (0.91)
AGE		-0.0352 (-0.25)	-0.0283 (-0.20)	-0.0291 (-0.20)	-0.0304 (-0.21)
VOL		-12.3268 (-1.48)	-13.3697 (-1.62)	-13.1701 (-1.59)	-13.2468 (-1.60)
CRL		-0.3524 (-1.17)	-0.3736 (-1.23)	-0.3137 (-1.04)	-0.3482 (-1.16)
Year	No	Yes	Yes	Yes	Yes
Industry	No	Yes	Yes	Yes	Yes
Pseudo R2 (%)	1.16	17.58	17.73	17.53	17.50
Wald chi2	5.93	56.73	60.26	59.61	57.41
Probability	0.0149	0.0000	0.0000	0.0000	0.0000
N	420	420	420	420	420

This table provides the results of multivariate logistic regression analysis. The dependent variable is DISC which is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. MJM is the absolute value of total accruals calculated using the modified Jones model. MAT is the absolute value of discretionary accruals calculated using performance matched modified Jones model. MTC is the absolute value of current accruals calculated using performance matched modified Jones model adjusted with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Table 6.13 Quality of GHG information disclosure and earnings management

Model	1	2	3	4	5
Intercept	0.4014 (33.52)***	-0.2465 (-2.79)***	-0.2594 (-2.96)***	-0.2562 (-2.88)***	-0.2481 (-2.79)***
AUG	-0.3875 (-3.84)***	-0.1826 (-1.83)*			
MJM			-0.0011 (-0.01)		
MAT				-0.0165 (-0.30)	
MTC					-0.0981 (-1.38)
LMV		0.0507 (5.21)***	0.0506 (5.17)***	0.0504 (5.11)***	0.0506 (5.17)***
TOB		-0.0082 (-1.74)*	-0.0091 (-1.78)*	-0.0091 (-1.79)*	-0.0088 (-1.82)*
ROA		0.0223 (2.44)**	0.0218 (2.33)**	0.0218 (2.35)**	0.0222 (2.44)**
LEV		0.0753 (1.84)*	0.0902 (2.22)**	0.0886 (2.19)**	0.0798 (1.95)*
AGE		0.0496 (5.11)***	0.0510 (5.35)***	0.0510 (5.35)***	0.0505 (5.28)***
VOL		2.3863 (3.94)***	2.2603 (3.54)***	2.2758 (3.58)***	2.3340 (3.75)***
CRL		0.0761 (3.90)***	0.0781 (3.97)***	0.0785 (3.96)***	0.0767 (3.90)***
Year	No	Yes	Yes	Yes	Yes
Industry	No	Yes	Yes	Yes	Yes
Adjusted R^2 (%)	2.41	32.33	31.81	31.82	32.08
F-statistic	14.77	35.02	31.59	31.34	33.54
P value	0.0001	0.0000	0.0000	0.0000	0.0000
N	420	420	420	420	420
Max VIF	-	1.74	1.75	1.75	1.74

This table provides the results of multivariate regression analysis. The dependent variable is QUAL, the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. MJM is the absolute value of total accruals calculated using the modified Jones model. MAT is the absolute value of discretionary accruals calculated using performance matched modified Jones model. MTC is the absolute value of current accruals calculated using performance matched modified Jones model adjusted with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

Models 3 to 5 report insignificant relationship between earnings management and the quality of GHG emission disclosure. Overall, the results suggest that Australian corporate managers do not use the quality of GHG emission disclosure information as a tool to mask their opportunistic behaviour. This finding is consistent with the results of Sun et al. (2010). Control variables such as firm size, Tobin's *q*, profitability, leverage, firm age and cross-listing have an impact on quality of GHG emission disclosure. This is consistent with previous results, which indicate that larger, visible, older and cross-listed firms with higher leverage disseminate more GHG emission information whereas firms with higher growth opportunities do the opposite.

Overall, the author found weak support for the stakeholder value maximisation hypothesis (2a). This finding shows some evidence indicating that firms' disclosing higher quality GHG emission information are less likely to engage in earnings management through discretionary accruals.

Table 6.14 reports the logistic regression results of managers' decision to disclose voluntary GHG emission information publicly and earnings management proxies on a yearly basis. This table shows the results including industry dummies. There is a positive association between managers' decision to disclose GHG emission information and the absolute value of discretionary accruals (AUG) in the reporting year 2006 indicating that managers are playing an opportunistic role. The managers of these firms are using voluntary GHG emission disclosure for their rent-seeking activities. The author found insignificant negative association in the CDP reporting years 2007, 2008 and 2009. The size of the firm is positively associated with managers' disclosure decision in 2008 and 2009. TOB, ROA and CRL show significant results in some years. Further, the author found mostly insignificant negative association between earnings management and the disclosure decision.

6.3.3. Year-by-year regression results

Table 6.14 Choice of GHG disclosure and earnings management by years

Reporting Year	2006	2007	2008	2009
Intercept	-3.4472 (-0.53)	-3.9912 (-0.84)	-5.7469 (-2.57)***	-4.3499 (-1.78)*
AUG	17.7333 (2.37)**	-6.5782 (-0.72)	-4.5743 (-1.35)	-2.8571 (-0.57)
LMV	0.7714 (1.07)	0.2444 (0.49)	0.7000 (2.75)***	0.8420 (2.81)***
TOB	-0.6236 (-2.33)**	0.4087 (1.23)	-0.2970 (-1.46)	-0.2800 (-2.22)**
ROA	-0.5449 (-0.42)	-0.1041 (-0.18)	0.3412 (0.98)	1.0022 (2.30)**
LEV	1.0578 (0.40)	6.3451 (2.02)**	1.9621 (1.37)	-1.3805 (-1.03)
AGE	0.1489 (0.33)	0.6920 (1.43)	0.1383 (0.58)	-0.5439 (-1.61)
VOL	-26.4692 (-0.33)	5.1321 (0.04)	-20.9041 (-1.46)	-6.8595 (-0.53)
CRL	-3.4423 (-1.99)**	-1.8081 (-1.57)	-0.0723 (-0.14)	0.2562 (0.48)
Industry	Yes	Yes	Yes	Yes
Pseudo R^2 (%)	31.21	20.02	22.26	29.33
Wald chi^2	16.65	12.05	29.26	36.27
Probability	0.2754	0.6755	0.0322	0.0016
N	59	53	143	146

This table provides the results of multivariate logistic regression analysis. The dependent variable is DISC which is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Table 6.15 presents the regression results between the quality of GHG emission disclosure and the absolute value of discretionary accruals calculated using the modified Jones model with ROA (AUG) for each of CDP reporting years. All models show the results including industry fixed effects. A significantly negative association exists between the quality of GHG emission disclosure and the absolute value of discretionary accruals only for 2008. This result supports stakeholder value maximisation view suggesting that socially responsible firms accede to stakeholders' demands and provide higher quality GHG emission information.

Table 6.15 Quality of GHG emissions disclosure and earnings management by years

CDP Reporting Year	2006	2007	2008	2009
Intercept	0.0971 (0.37)	-0.0060 (-0.03)	-0.0453 (-0.38)	-0.1002 (-0.62)
AUG	-0.0022 (0.01)	-0.5128 (-1.76)*	-0.2633 (-2.05)**	0.0131 (0.08)
LMV	0.0299 (1.13)	0.0424 (1.66)	0.0500 (3.62)***	0.0563 (3.13)***
TOB	-0.0072 (-0.56)	-0.0173 (-1.54)	-0.0119 (-2.65)***	-0.0046 (-1.15)
ROA	0.0303 (0.58)	0.0126 (0.60)	0.0116 (0.78)	0.0272 (1.83)*
LEV	0.1944 (1.47)	0.2489 (1.88)*	0.0781 (1.13)	0.0424 (0.52)
AGE	0.0402 (1.65)	0.0739 (3.27)***	0.0364 (2.49)**	0.0302 (1.70)*
VOL	-1.5827 (-0.52)	-0.7928 (-0.18)	-0.3689 (-0.50)	0.5252 (0.67)
CRL	0.0665 (1.57)	0.0080 (0.21)	0.0767 (2.51)**	0.0569 (1.69)*
Industry	yes	yes	Yes	Yes
Adjusted R2 (%)	51.92	55.72	46.45	36.62
F-statistic	4.94	5.66	8.25	6.06
P value	0.0000	0.0000	0.0000	0.0000
N	63	64	143	150
Max VIF	2.64	2.34	1.87	2.12

This table provides the results of multivariate regression analysis. The dependent variable is QUAL, the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

There is insignificant negative association between quality of GHG emission disclosure and the absolute value of discretionary accruals in the CDP reporting years 2006, 2007 and 2009. Overall, these findings show weak support for the stakeholder value maximisation view.

6.3.4. Disclosure sub-scores and corporate governance

Table 6.16 Sub-scores of quality of GHG emissions information and earnings management

Model	1	2	3	4	5
Sub-scores	GOVE	RISK	STRA	GHGE	COMM
Intercept	-0.2436 (-0.32)	8.9893 (2.30)**	2.8377 (2.57)***	-12.8256 (-3.41)***	0.2801 (0.96)
AUG	-0.8556 (-0.94)	-6.5637 (-1.49)	-2.8980 (-2.51)**	-4.3054 (-1.13)	-1.1500 (-3.17)***
LMV	0.2301 (2.74)***	1.9866 (4.75)***	0.3935 (3.51)***	2.2707 (5.34)***	0.1365 (4.26)***
TOB	-0.0524 (-1.66)*	-0.3464 (-1.55)	-0.0647 (-1.46)	-0.1002 (-1.05)	-0.0343 (-2.95)***
ROA	0.1144 (1.39)	-0.1217 (-0.30)	0.3112 (2.78)***	1.5029 (3.39)***	0.0311 (0.95)
LEV	0.3277 (0.55)	5.4195 (2.27)**	2.3722 (3.87)***	2.9787 (1.45)	-0.0706 (-0.36)
AGE	0.1928 (2.30)**	1.8123 (4.22)***	0.2939 (2.89)***	1.4265 (3.41)***	0.0155 (0.52)
VOL	2.8895 (0.52)	6.0235 (0.22)	-5.4034 (-0.61)	-11.3822 (-0.48)	-3.1453 (-1.64)
CRL	0.4736 (2.83)***	3.1513 (3.49)***	0.4900 (2.23)**	2.1414 (2.44)**	0.0244 (0.35)
Year	Yes	Yes	Yes	Yes	yes
Industry	yes	yes	yes	yes	yes
Adjusted R^2 (%)	27.53	44.89	35.99	36.43	28.78
F-statistic	15.60	28.73	16.72	20.37	17.79
P value	0.0000	0.0000	0.0000	0.0000	0.0000
N	420	420	420	420	420
Max VIF	2.16	2.16	2.16	2.16	2.16

This table provides the results of multivariate regression analysis. The dependent variables are GOVE: governance; RISK: risks and opportunities; STRA: strategy; GHGE: GHG accounting, energy and fuel use, and trading; COMM: communications. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. t-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

Table 6.16 reports the regression results using five sub-scores of GHG emission disclosures as dependent variables and absolute value of discretionary accruals (AUG) as an independent variable. This table reports the results with year and industry fixed effects for all models. Models 3 and 5 indicate a negative and significant association between the absolute value of discretionary accruals and two sub-categories of strategy and communication components of GHG emission disclosure at the 5% and 1% level respectively. The other sub-categories of GHG emission disclosures such as governance, risks and opportunities and GHG show insignificant negative associations with the absolute value of discretionary accruals.

In summary, the findings here give limited support for the stakeholder value maximisation view hypothesis 2(a). The author found no support for the alternate view labelled as shareholder expense hypothesis 2(b).

6.3.5. GHG emission disclosure, corporate governance, and earnings management

Table 6.17 reports the logistic regression results between the managers' decision to report GHG emission disclosure, characteristics of corporate governance and earnings management measured by the absolute value of discretionary accruals. All models present the results including year and industry dummies. Board independence, board gender diversity, the size of audit committee, and directors' ownership are corporate governance characteristics which are associated with disclosure as reported earlier. When the author attempted to test each of the corporate governance variables of this study along with earnings management proxies, there was no significant association identified between the managers' decision to disclose GHG emission disclosure and different measures of earnings management. For example, we use CEO duality (DUA), directors' ownership (MSO), and institutional ownership (INS) with earning management measure. With regards to control variables, the size of the firm is positively associated and Tobin's *q* is negatively associated with managers' decision to disclose GHG emission information respectively. These results are consistent with previous finding suggesting. Overall, the author found support for neither the stakeholder value maximisation view nor the shareholder expense view.

Table 6.17 GHG disclosure, corporate governance and earnings management

Model	1	2	3	4	5
Intercept	-4.8311 (-3.19)***	-4.9619 (-3.25)***	-4.8447 (-3.19)***	-4.9058 (-3.22)***	-5.1975 (-3.40)***
AUG	-0.9884 (-0.47)	-0.5268 (-0.24)	-0.6931 (-0.29)		-1.0040 (-0.43)
AUG*DUA		-5.4667 (-0.95)			-4.1255 (-0.66)
AUG*MSO			-5.4810 (-0.27)		-1.0857 (-0.05)
AUG*INS				-1.6724 (-0.50)	
IND	1.3988 (1.69)*	1.3687 (1.63)	1.4062 (1.70)*	1.4132 (1.70)*	1.5170 (1.82)*
DUA	0.1919 (0.42)	0.5436 (1.00)	0.1975 (0.43)	0.1889 (0.41)	0.3673 (0.64)
DIV	0.5060 (1.78)*	0.5314 (1.84)*	0.5082 (1.78)*	0.5032 (1.77)*	
LAT	-0.2257 (-0.73)	-0.2368 (-0.77)	-0.2278 (-0.74)	-0.2251 (-0.73)	-0.2375 (-0.77)
MAC	-0.2327 (-2.07)**	-0.2401 (-2.10)**	-0.2329 (-2.07)**	-0.2349 (-2.09)**	-0.2095 (-1.83)*
MSO	-4.7302 (-2.66)***	-4.7723 (-2.63)***	-4.3642 (-2.16)**	-4.7211 (-2.65)***	-4.7162 (-2.23)**
INS	1.1438 (1.37)	1.1178 (1.33)	1.1435 (1.37)	1.2469 (1.46)	1.0827 (1.29)
LMV	0.6266 (4.05)***	0.6351 (4.09)***	0.6251 (4.06)***	0.6274 (4.06)***	0.6847 (4.42)***
TOB	-0.2231 (-2.17)**	-0.2196 (-2.08)**	-0.2223 (-2.15)**	-0.2216 (-2.14)**	-0.2421 (-2.21)**
ROA	0.4602 (1.56)	0.4550 (1.54)	0.4569 (1.55)	0.4617 (1.57)	0.4782 (1.61)
LEV	0.7161 (0.92)	0.7383 (0.94)	0.7241 (0.93)	0.7200 (0.93)	0.6455 (0.82)
AGE	-0.0800 (-0.53)	-0.0821 (-0.54)	-0.0795 (-0.53)	-0.0800 (-0.53)	-0.0709 (-0.46)
VOL	-8.1994 (-0.95)	-6.1703 (-0.70)	-8.2344 (-0.95)	-8.1871 (-0.95)	-7.3078 (-0.82)
CRL	-0.3804 (-1.14)	-0.3611 (-1.07)	-0.3756 (-1.12)	-0.3833 (-1.14)	-0.3601 (-1.07)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Pseudo R2 (%)	22.04	22.16	22.06	22.05	21.51
Wald chi2	67.84	68.05	67.37	67.67	63.17
Probability	0.0000	0.0000	0.0000	0.0000	0.0002
N	420	420	420	420	420

This table provides the results of multivariate logistic regression analysis. The dependent variable is DISC which is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*DUA is an interaction variable between CEO duality and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*MSO is an interaction variable between the proportion of shareholding by all directors and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*INS is an interaction variable between the proportion of institutional shareholding and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculate from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Table 6.18 Quality of GHG, corporate governance and earnings management

Model	1	2	3	4	5
Intercept	-0.0729 (-0.86)	-0.0681 (-0.80)	-0.0612 (-0.70)	-0.0822 -0.97	-0.0816 (-0.92)
AUG	-0.1039 (-1.22)	-0.1450 (-1.63)	-0.1634 (-1.61)		-0.2160 (-2.07)**
AUG*DUA		0.3007 (1.48)			0.3578 (1.89)*
AUG*MSO			0.4207 (0.98)		0.2359 (0.55)
AUG*INS				-0.1121 (-0.84)	
IND	0.1701 (4.09)***	0.1713 (4.15)***	0.1638 (3.87)***	0.1707 (4.10)***	0.1758 (4.08)***
DUA	-0.0551 (-2.86)***	-0.0798 (-3.17)***	-0.0537 (-2.76)***	-0.0554 (-2.87)***	-0.0854 (-3.29)***
DIV	0.0474 (3.16)***	0.0452 (2.98)***	0.0480 (3.21)***	0.0477 (3.18)***	
LAT	0.0221 (1.22)	0.0237 (1.32)	0.0224 (1.24)	0.0225 (1.25)	0.0234 (1.30)
MAC	-0.0191 (-2.87)***	-0.0185 (-2.77)***	-0.0192 (-2.87)***	-0.0192 (-2.89)***	-0.0157 (-2.30)**
MSO	-0.0435 (-0.61)	-0.0408 (-0.57)	-0.0940 (-0.95)	-0.0457 (-0.64)	-0.0731 (-0.72)
INS	0.0052 (0.11)	0.0078 (0.17)	0.0048 (0.11)	0.0149 (0.32)	0.0040 (0.09)
LMV	0.0444 (5.00)***	0.0441 (4.95)***	0.0443 (5.02)***	0.0443 (4.99)***	0.0485 (5.48)***
TOB	-0.0049 (-1.29)	-0.0052 (-1.31)	-0.0050 (-1.26)	-0.0050 (-1.27)	-0.0054 (-1.27)
ROA	0.0167 (2.07)**	0.0168 (2.10)**	0.0170 (2.11)**	0.0168 (2.07)**	0.0182 (2.25)**
LEV	0.1151 (2.48)**	0.1128 (2.43)**	0.1111 (2.35)**	0.1179 (2.55)**	0.1014 (2.16)**
AGE	0.0320 (3.73)***	0.0320 (3.73)***	0.0319 (3.71)***	0.0322 (3.78)***	0.0329 (3.78)***
VOL	0.4270 (0.89)	0.3425 (0.69)	0.4141 (0.86)	0.4147 (0.86)	0.1982 (0.40)
CRL	0.0590 (3.36)***	0.0584 (3.36)***	0.0584 (3.33)***	0.0594 (3.37)***	0.0598 (3.39)***
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Adjusted R2 (%)	53.55	53.62	53.53	53.47	52.56
F-statistic	30.24	28.90	29.05	30.30	28.85
P value	0.0000	0.0000	0.0000	0.0000	0.0000
N	420	420	420	420	420
Max VIF	2.27	2.32	2.90	2.27	2.99

This table provides the results of multivariate regression analysis. The dependent variable is the quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*DUA is an interaction variable between the CEO duality and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*MSO is an interaction variable between the proportion of shareholding by all directors and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*INS is an interaction variable between the proportion of institutional shareholding and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. IND is board independence measured as proportion of independent directors on the board; DUA is an indicator variable that equals to 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is a board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is proportion of ordinary shares held by all directors. INS is proportion of shareholding by the institutional investors measured from Top20 shareholding list of a firm excluding individual shareholding. LMV is the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items all divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculate from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. t-statistics are reported in parenthesis. . CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

Table 6.18 presents the regression results between the quality of GHG emission disclosure, corporate governance attributes and the absolute value of discretionary accruals. All models show the results including year and industry fixed effects. Most interestingly, the author found a positive association between the interaction variable AUG*DUA and the quality of GHG emission disclosure. This finding indicates that firms with CEO duality disclose reduced levels GHG emission information while practicing earnings management supporting the stakeholder value maximisation view. An insignificant negative association exists between the interaction variable AUG*INS and quality of GHG emission disclosure suggesting that institutional investors do not play a monitoring role to curb the unethical behavior of earnings management. This study tried other corporate governance variables with earnings management proxy but failed to find any significant association. Overall, there is weak support for the stakeholder value maximisation view hypothesis.

6.3.6. Robustness tests

This study adopts three different tests to check the robustness of previous results. First, the author used the Heckman two-stage sample selection regression. Second, the author ran the two-stage least squares regression. Finally, an alternative corporate governance quality measure was used to check the sensitivity of results to control for self-selection bias, alternative specifications and procedures.

Panel A of Table 6.19 reports the results of the Heckman two-stage estimations. In the first stage of the Heckman model, we use managers' decision to disclose voluntary GHG emission information (DISC) as the dependent variable and incorporate earnings management proxy, corporate governance characteristics, and control variables as dependent variables. Our first stage model is as follows:

$$DISC_{i,t} = \beta_0 + \beta_1 AUG_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} CDP_{i,t-1} + \beta_{17} \Sigma year + \beta_{18} \Sigma industry + \varepsilon_{i,t} \quad (18)$$

Table 6.19 Heckman two-stage and OLS two-stage

Panel A			**Panel B**		
Heckman two-stage sample selection model			**Two-stage least squares regression**		
Model	1	2	Model	1	2
Intercept	-0.1231 (-0.61)	-0.1047 (-0.51)	Intercept	-0.0812 (-0.96)	-0.0802 (-0.94)
AUG	-0.2043 (-1.13)	-0.2542 (-1.37)	Fitted-AUG	-0.1039 (-1.22)	-0.1450 (-1.63)
AUG*DUA		0.3816 (0.33)	AUG_DUA		0.1821 (0.92)
IND	0.1793 (2.11)**	0.2028 (2.40)**	IND	0.1685 (4.06)***	0.1688 (4.10)***
DUA	-0.1411 (-2.69)***	-0.1706 (-2.23)**	DUA	-0.0554 (-2.87)***	-0.0705 (-2.88)***
DIV	0.0481 (1.69)*		DIV	0.0492 (3.29)***	0.0484 (3.20)***
LAT	0.0841 (2.54)**	0.0847 (2.53)**	LAT	0.0229 (1.27)	0.0240 (1.34)
MAC	-0.0078 (-0.75)	-0.0036 (-0.35)	MAC	-0.0191 (-2.86)***	-0.0187 (-2.81)***
MSO	0.3738 (1.75)*	0.3926 (1.81)*	MSO	-0.0534 (-0.76)	-0.0542 (-0.78)
INS	0.0075 (0.09)	0.0147 (0.17)	INS	0.0101 (0.22)	0.0129 (0.28)
LMV	0.0373 (2.52)**	0.0391 (2.62)***	LMV	0.0441 (4.97)***	0.0438 (4.91)***
TOB	-0.0125 (-1.08)	-0.0172 (-1.52)	TOB	-0.0053 (-1.42)	-0.0056 (-1.42)
ROA	0.0074 (0.55)	0.0099 (0.73)	ROA	0.0164 (2.04)**	0.0164 (2.05)**
LEV	0.0579 (0.61)	0.0216 (0.23)	LEV	0.1213 (2.58)***	0.1215 (2.59)***
AGE	0.0275 (2.14)**	0.0276 (2.11)**	AGE	0.0324 (3.82)***	0.0326 (3.83)***
VOL	1.3835 (0.89)	0.8331 (0.54)	VOL	0.3759 (0.78)	0.3125 (0.62)
CRL	0.0924 (3.21)***	0.0850 (2.95)***	CRL	0.0604 (3.42)***	0.0604 (3.44)***
LAMBDA	-0.0395 (-1.98)**	-0.0429 (-2.12)**	Year	Yes	Yes
Year	Yes	Yes	Industry	Yes	Yes
Industry	Yes	Yes	Adj. R2 (%)	53.55	53.62
Wald chi2	217.86	210.83	F-statistic	30.24	28.90
Probability	0.0000	0.0000	P value	0.0000	0.0000
N	420	420	N	420	420
			Max VIF	2.25	2.30

This table provides the results of Heckman two-stage sample selection model and two-stage least squares method. The dependent variable is quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. AUG*DUA is an interaction variable between the CEO duality and the absolute value of discretionary accruals calculated using the modified Jones model with ROA. IND is board independence measured as proportion of independent directors on the board; DUA is an indicator variable that equals to 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is a board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is proportion of ordinary shares held by all directors. INS is proportion of shareholding by the institutional investors measured from Top20 shareholding list of a firm excluding individual shareholding. LMV is the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items all divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculate from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. *z*/*t* statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

The second stage is modelled based on the following equation:

$$QUAL_{i,t} = \beta_0 + \beta_1 AUG_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t\ t} \quad (19)$$

Higher corporate governance quality shows a positive relationship with voluntary GHG emission disclosure information implying that firms with higher corporate governance quality were more likely to disclose more information about GHG emission reduction strategies. The author found a similar finding with regards to the link between earnings management and GHG disclosure indicating that Australian managers are not motivated to use voluntary GHG emission information as a means to distract the stakeholders.

Panel B of Table 6.19 provides the results of two-stage least squares regression. The two-state least squares method is one of the most powerful and versatile tools, which allows for consistent estimation of simultaneous equations with endogenous predictors (Antonakis et al. 2012). In this method, firstly, the dependent (endogenous) variable is regressed on relevant independent and control variables, and the predicted value is extracted. For this purpose, this study uses $AUG_{i,t}$ as a dependent variable in the first stage using the following equation and calculates the fitted value.

The equation for the first stage model is:

$$AUG_{i,t} = \beta_0 + \beta_1 IND_{i,t-1} + \beta_2 DUA_{i,t-1} + \beta_3 DIV_{i,t-1} + \beta_4 LAT_{i,t-1} + \beta_5 MAC_{i,t-1} + \beta_6 MSO_{i,t-1} + \beta_7 INS_{i,t-1} + \beta_8 LMV_{i,t-1} + \beta_9 TOB_{i,t-1} + \beta_{10} ROA_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} AGE_{i,t-1} + \beta_{13} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t\ t} \quad (20)$$

In the second stage, the dependent variable is QUAL and the calculated predicted value of AUG is used as an independent variable. The following equation shows the details of variables used in this second stage.

$$QUAL_{i,t} = \beta_0 + \beta_1 AFitted\_AUG_{i,t} + \beta_2 IND_{i,t-1} + \beta_3 DUA_{i,t-1} + \beta_4 DIV_{i,t-1} + \beta_5 LAT_{i,t-1} + \beta_6 MAC_{i,t-1} + \beta_7 MSO_{i,t-1} + \beta_8 INS_{i,t-1} + \beta_9 LMV_{i,t-1} + \beta_{10} TOB_{i,t-1} + \beta_{11} ROA_{i,t-1} + \beta_{12} LEV_{i,t-1} + \beta_{13} AGE_{i,t-1} + \beta_{14} VOL_{i,t-1} + \beta_{15} CRL_{i,t-1} + \beta_{16} \Sigma year + \beta_{17} \Sigma industry + \varepsilon_{i,t\ t} \quad (21)$$

The author found no relationship between earnings management and voluntary GHG emission disclosure. The interaction effect between CEO duality and earnins management were insignificant. The author tested other corporate governance variables and found similar results. These findings suggest that Australian corporate managers were unlikely to use voluntary disclosure of GHG emission information as a tool to mask their opportunitistic behaviour.

The author also used the HCG measure which is the ranking of corporate governance of the top 250 Australian firms collected from the Horwath Corporate Governance reports to test the robustness of the results reported earlier. Table 6.20 presents the results of logistic and OLS regressions using this corporate governance measure. The results show insignificant negative association between GHG emission disclosures and earnings management consistent with the results reported earlier. The interaction effect between CEO duality and GHG emission disclosure was also

insignificant Overall, the author found only a weak support for the stakeholder value maximization hypothesis.

Table 6.20 Analysis of an alternative measure of corporate governance

Logistic Regression		OLS Regression	
Dependent variables	DISC		QUAL
Intercept	-3.5385 (-2.38)**	Intercept	0.1378 (1.56)
AUG	-1.6593 (-0.79)	AUG	-0.1461 (-1.62)
HCG	-0.0060 (-2.67)***	HCG	-0.0005 (-4.35)***
LMV	0.6737 (3.98)***	LMV	0.0390 (4.11)***
TOB	-0.2301 (-2.11)**	TOB	-0.0044 (-1.19)
ROA	0.3147 (1.05)	ROA	0.0157 (1.89)*
LEV	0.5864 (0.65)	LEV	0.1251 (2.60)***
AGE	-0.1707 (-1.06)	AGE	0.0321 (3.51)***
VOL	-11.0967 (-1.09)	VOL	-0.1864 (-0.34)
CRL	-0.2726 (-0.83)	CRL	0.0700 (3.77)***
Year	Yes	Year	Yes
Industry	Yes	Industry	Yes
Pseudo R2 (%)	20.58	Adj R2 (%)	54.05
Wald chi2	61.56	F-statistic	55.60
Probability	0.0000	P value	0.0000
N	367	N	371
		Max VIF	2.30

This table provides the results of multivariate logistic and OLS regression analysis. This table provides the results of multivariate logistic and OLS regression analysis. The dependent variables for logistic and OLS regressions are quality of GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology (QUAL) and DISC is an indicator variable that equals 1 if the firm discloses GHG emission information to the CDP and 0 otherwise respectively. AUG is the absolute value of discretionary accruals calculated using the modified Jones model with ROA. HCG is the ranking of corporate governance of the top 250 Australian firms collected from the Horwath Corporate Governance reports. LMV is the size of a firm measured as natural logarithm of market value in millions one month before disclosure annual report announcement date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is natural logarithm of firm age calculate from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. z/t and *z*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

6.4. Stock market liquidity and voluntary disclosure of GHG information

This section reports the results of the relationship between stock market liquidity and voluntary disclosure of GHG emission information as proposed in Chapter 3. We posited the following hypothesis which is repeated below for convenience.

Hypothesis 3: Voluntary disclosure of GHG emission information will be associated with an improvement in the liquidity of its shares, *ceteris paribus*.

6.4.1. Correlation results

Table 6.21 presents the Pearson and Spearman correlation between stock market liquidity measures, voluntary disclosure of GHG emission information and other control variables. There are two proxies that are used to capture stock market liquidity. First, Amihud's measure of illiquidity (AMILOG) which is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and expressed in natural log terms. Second, the relative bid-ask spread which is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and expressed in natural log terms (BIDLOG). The correlation between dependent variables AMILOG and BIDLOG is 0.80 and is statistically significant at the 1% level.

Table 6.21 Correlation between liquidity and disclosure of GHG (Pearson above diagonal and Spearman below diagonal)

	AMILOG	BIDLOG	DISC	QUAL	INS	LTA	VOL	LSP
AMILOG	1	0.805***	-0.385***	-0.387***	-0.016	-0.786***	0.444***	-0.517***
BIDLOG	0.803***	1	-0.198***	-0.193***	0.161***	-0.577***	0.533***	-0.448***
DISC	-0.388***	-0.206***	1	0.489***	0.064	0.392***	-0.118***	0.193***
QUAL	-0.338***	-0.128***	0.466***	1	0.032	0.390***	-0.055	0.169***
INS	-0.030	0.166***	0.053	0.044	1	-0.038	0.091**	-0.161***
LTA	-0.778***	-0.557***	0.411***	0.382***	0.005	1	-0.324***	0.393***
VOL	0.507***	0.658***	-0.087*	0.021	0.097**	-0.385***	1	-0.168***
LSP	-0.508***	-0.437***	0.189***	0.127***	-0.138***	0.325***	-0.215***	1

This table reports the Pearson correlations between variables related to stock market liquidity and voluntary disclosure of GHG emissions, and control variables. AMILOG is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and expressed in natural log terms. BIDLOG is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and expressed in natural log terms. DISC is a dummy variable which takes the value of one if a firm responds to CDP and that information is disclosed publicly. QUAL is the voluntary GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. INS is the institutional shareholding calculated from Top20 shareholding excluding individuals. LTA is the logarithm of total assets. VOL is the volatility calculated as standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. LSP is natural logarithm of stock price over the annual report announcement period from day -260 to day -2. *** Correlation is significant at 1% level, ** correlation is significant at 5% level, and * correlation is significant at 10% level.

Table 6.21 reports Pearson and Spearman correlations between Amihud's illiquidity ratio and both measures of GHG emission disclosures namely DISC and QUAL are -0.385 and -0.387 (Pearson) -0.388 and -0.338 (Spearman) and are statistically significant at the 1% level. Similarly, the relative bid-ask spread and both measures of GHG emission disclosure are negatively correlated and statistically significant at the 1% level. These results indicate that firms with more GHG emission disclosure have higher liquidity of shares, which implies lower information asymmetry. The correlation between Amihud's illiquidity measure and institutional shareholding is insignificant. The correlation between relative bid-ask spread and institutional ownership is positively significant at the 1% level.

The correlations between Amihud's illiquidity ratio and the size of the firms and relative bid-ask spread and the size of the firms are statistically significant at the 1% level. We use logarithm of book value of total assets (LTA) as a size of the firms instead of LMV due to multicollineraity problem. The results show that larger firms are more liquid compared to smaller firms. Stock return volatility appears to have statistically significantly positive correlations with both measures of illiquidity suggesting that illiquid shares are more volatile. The correlation between both illiquidity measures and average share prices are strongly negatively statistically significant indicating that firms with higher share prices have higher liquidity.

6.4.2. Stock liquidity and voluntary disclosure of GHG emissions

Table 6.22 Liquidity and disclosure of GHG information

	Panel A: Effect of voluntary disclosure of GHG emissions on Amihud's Liquidity		***Panel B: Effect of voluntary disclosure of GHG emissions on BIDASK Spread***	
Model	1	2	3	4
Intercept	1.5902 (12.71)***	1.5947 (12.61)***	-0.1677 (-1.42)	-0.1539 (-1.29)
DISC	-0.0552 (-3.63)***		-0.0108 (-0.75)	
QUAL		-0.1329 (-3.05)***		-0.0090 (-0.22)
INS	-0.1581 (-3.62)***	-0.1687 (-3.87)***	0.1462 (3.54)***	0.1436 (3.49)***
LTA	-0.2913 (-24.27)***	-0.2882 (-22.79)***	-0.1797 (-15.83)***	-0.1812 (-15.19)***
VOL	6.0445 (6.51)***	5.9533 (6.36)***	1.6767 (1.91)*	1.7060 (1.93)*
LSP	-0.0655 (-9.27)***	-0.0665 (-9.39)***	-0.0488 (-7.30)***	-0.0490 (-7.34)***
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Adj R^2	0.7799	0.7784	0.7532	0.7529
F-statistic	117.55	116.51	101.33	101.21
P value	0.0000	0.0000	0.0000	0.0000
N	560	560	560	560
Max VIF	2.70	2.72	2.70	2.72

This table provides the results of regression analysis that examines the cross-sectional effects on stock market liquidity, as proxied by Amihud's (2002) illiquidity measure and relative Bid-ask spread. The dependent variables are AMILOG and BIDLOG. AMILOG is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and expressed in natural log terms. BIDLOG is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and expressed in natural log terms. DISC is a dummy variable which takes the value of one if a firm responds to CDP and that information is disclosed publicly. QUAL is the voluntary GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. INS is the institutional shareholding calculated from Top20 shareholding excluding individuals. LTA is the logarithm of total assets. VOL is the volatility calculated as standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. LSP is natural logarithm of stock price over the annual report announcement period from day -260 to day -2. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

Panel A and B in Table 6.22, we use Amihud's illiquidity and relative bid-ask spread as dependent variables respectively. The association between stock market illiquidity and voluntary disclosure of GHG emission information is expected to be positive. Lower values of Amihud's illiquidity and relative bid-ask spread measures indicate greater liquidity. Panel A of Table 6.22 indicate that Amihud's illiquidity ratio and DISC are inversely related suggesting that firms that disclose more GHG emission information voluntarily tend to have higher liquidity supporting hypothesis (3). The coefficient on the quality of GHG emission disclosure is negative and significant suggesting that high quality disclosure firm benefit from improved stock market liquidity as compared to low quality disclosure firms supporting hypothesis (3). Prior empirical evidence supports the view that the quality of information disclosure improves stock market liquidity (Balakrishnan et al. 2013; Bardos 2011; Lang & Maffett 2011; Ng 2011).

There is an inverse relationship between institutional shareholding and Amihud's illiquidity and relative bid-ask spread measure. These results suggest that firms that have more institutional shareholding have increased market liquidity. With regards to other variables, firm size and stock prices are negatively associated with Amihud's illiquidity indicating that firms with higher value and share price seem to have better liquidity. Stock return volatility has a very strong positive association with Amihud's illiquidity ratio. This result shows that firms with more volatile share prices tend to have lower liquidity.

When the alternative illiquidity measure of relative bid-ask spread is used, the results are weaker. The association between DISC and relative bid-ask spread is insignificant in the regression model Panel B of model 3. The quality of voluntary disclosure of GHG emission information and relative bid-ask spread is insignificantly associated in models 4 of Panel B. Surprisingly, the author found a positive association between institutional investors' shareholding and relative bid-ask spreads. The other variables namely size, stock return volatility and stock prices show the similar results as indicated in Panel A of Table 6.22.

6.4.3. Year-by-year regression results

Table 6.23 Liquidity and disclosure of GHG information by years

Panel A: Effect of decision to disclose (CDP) on illiquidity by year								
	2006		2007		2008		2009	
Variable	AMILOG	BIDLOG	AMILOG	BIDLOG	AMILOG	BIDLOG	AMILOG	BIDLOG
Intercept	1.5616 (5.37)***	-0.1323 (-0.53)	1.5168 (4.92)***	-0.4232 (-1.49)	1.8614 (7.08)***	-0.3381 (-1.37)	1.4716 (7.17)***	-0.1460 (-0.75)
DISC	0.0007 (0.02)	-0.0055 (-0.20)	-0.0461 (-1.44)	-0.0155 (-0.53)	-0.0863 (-2.86)***	-0.0177 (-0.63)	-0.0595 (-2.02)**	-0.0100 (-0.36)
INS	-0.3053 (-2.96)***	-0.0017 (-0.02)	-0.0380 (-0.33)	0.2059 (1.97)*	-0.2023 (-2.64)***	0.0558 (0.77)	-0.1164 (-1.45)	0.2477 (3.25)***
LTA	-0.2956 (-10.74)***	-0.2089 (-8.90)***	-0.2987 (-10.15)***	-0.1875 (-6.94)***	-0.3113 (-12.46)***	-0.1746 (-7.43)***	-0.2811 (-13.63)***	-0.1912 (-9.75)***
VOL	9.1995 (2.16)**	1.1715 (0.32)	0.2050 (0.06)	-2.9410 (-0.88)	2.5123 (0.97)	-0.1659 (-0.07)	6.8450 (5.75)***	2.3134 (2.04)**
LSP	-0.0659 (-3.55)***	-0.0876 (-5.54)***	-0.0469 (-2.62)***	-0.0573 (-3.49)***	-0.0663 (-4.79***	-0.0437 (-3.35)***	-0.0685 (-5.97)***	-0.0403 (-3.70)***
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.7507	0.6723	0.6774	0.8582	0.7380	0.4712	0.7586	0.5577
F-statistic	20.36	14.19	14.95	8.44	38.21	12.77	43.20	17.94
P value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	91	91	94	94	186	186	189	189
Max VIF	1.83	1.83	2.18	2.18	2.41	2.41	1.84	1.84
Panel B: Effect of quality of GHG emissions information on illiquidity by year								
Year	2006		2007		2008		2009	
Variable	**AMILOG**	**BIDLOG**	**AMILOG**	**BIDLOG**	**AMILOG**	**BIDLOG**	**AMILOG**	**BIDLOG**
Intercept	1.5371 (5.29)***	-0.1233 (-0.50)	1.5097 (4.90)***	-0.4476 (-1.60)	1.9259 (7.22)***	-0.2577 (-1.04)	1.4554 (7.00)***	-0.1937 (-0.98)
QUAL	-0.0632 (-0.61)	0.0087 (0.10)	-0.1416 (-1.50)	-0.1194 (-1.39)	-0.1700 (-1.93)*	0.0441 (0.54)	-0.1554 (-2.01)**	-0.0742 (-1.01)
INS	-0.3136 (-3.02)***	-0.0008 (-0.01)	-0.0347 (-0.31)	0.2011 (1.95)*	-0.2234 (-2.90)***	0.0473 (0.66)	-0.1214 (-1.52)	0.2535 (3.35)***
LTA	-0.2903 (-10.21)***	-0.2104 (-8.66)***	-0.2929 (-9.67)***	-0.1789 (-6.50)***	-0.3128 (-11.87)***	-0.1847 (-7.54)***	-0.2771 (-12.91)***	-0.1843 (-9.05)***
VOL	8.9896 (2.11)**	1.2355 (0.34)	-0.9517 (-0.26)	-3.9735 (-1.17)	2.0515 (0.78)	0.0400 (0.02)	6.8889 (5.80)***	2.2200 (1.97)*
LSP	-0.0667 (-3.60)***	-0.0875 (-5.52)***	-0.0507 (-2.78)***	-0.0617 (-3.72)***	-0.0723 (-5.20)***	-0.0447 (-3.46)***	-0.0659 (-5.69)***	-0.0389 (-3.54)***
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R2	0.7519	0.6722	0.6780	0.0.5378	0.7313	0.4708	0.7586	0.5600
F-statistic	20.49	14.18	14.99	8.73	36.97	12.76	43.19	18.09
P value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	91	91	94	94	186	186	189	189
Max VIF	2.27	2.27	2.56	2.56	2.70	2.70	2.07	2.07

This table provides the results of regression analysis on voluntary disclosure of GHG emission information by CDP reporting years. The dependent variables are Amihud's illiquidity measure (AMILOG) and Bid-ask spreads (BIDLOG). AMILOG is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and expressed in natural log terms. BIDLOG is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and expressed in natural log terms. DISC is a dummy variable which takes the value of one if a firm responds to CDP and that information is disclosed publicly. QUAL is the voluntary GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. INS is the institutional shareholding calculated from Top20 shareholding excluding individuals. LTA is the logarithm of total assets. VOL is the volatility calculated as standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. LSP is natural logarithm of stock price over the annual report announcement period from day -260 to day -2. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

Next, this study examines the impact of voluntary disclosure of GHG emission information on liquidity for each year to test whether there is any difference between years. Panel A of Table 6.23 shows the relationship between Amihud's illiquidity measure and voluntary disclosure of GHG emission information and Panel B shows the relationship between voluntary disclosure of GHG emission information and bid-ask spread. The author found a negative and significant association between Amihud illiquidity measure and two proxies of voluntary GHG emission disclosures of DISC and QUAL only for the years 2008 and 2009.

Table 6.24 presents the results of multivariate regression of the association between sub-scores of quality of GHG emission information and liquidity measures. Regressions are run with year and industry fixed effects. The governance component appears to be significantly negatively associated with both illiquidity measures. As far as the strategy component is concerned, it seems to be positively associated with both illiquidity measures. With regards to GHG accounting, energy and fuel use, and trading sub-score, it is negatively and statistically significantly related to the Amihud's illiquidity ratio. The governance, risks and opportunities, and communication components are not associated with either of the liquidity measures.

Overall, the author has found support for hypothesis 3 which states that firms with more voluntary disclosure of GHG emission information are more likely to experience increases in stock liquidity.

6.4.4. Market liquidity and sub-disclosures of GHG emission information

Table 6.24 Liquidity and sub-scores of GHG emission information disclosure

Dependent Variable	AMILOG	BIDLOG
Model	**1**	**2**
Intercept	1.5622 (12.22)***	-0.1626 (-1.35)
GOVE	-0.8516 (-1.38)	-0.4407 (-0.76)
RISK	-0.0955 (-0.70)	-0.0671 (-0.52)
STRA	1.1027 (2.09)**	1.2542 (2.53)**
GHGE	-0.3550 (-2.88)***	-0.2574 (-2.22)**
COMM	-0.0193 (-0.01)	1.7069 (1.31)
INS	-0.1630 (-3.70)***	0.1545 (3.74)***
LTA	-0.2910 (-22.86)***	-0.1861 (-15.56)***
VOL	5.8012 (6.20)***	1.4913 (1.70)*
LSP	-0.0653 (-9.21)***	-0.0477 (-7.16)***
Year	Yes	Yes
Industry	Yes	Yes
Adjusted R^2	0.7804	0.7570
F-statistic	95.78	83.94
P value	0.0000	0.0000
N	560	560
Max VIF	3.42	3.42

This table provides the results of regression analysis of components of voluntary disclosure of GHG emission information on measures of stock illiquidity. The dependent variables are Amihud's illiquidity (AMILOG) and Bid-ask spreads (BIDLOG). AMILOG is measured as the square root of the absolute value of the daily return divided by daily trading volume over the periods of one year and expressed in log terms. BIDLOG is calculated as the difference the closing ask and bid prices, divided by the midpoint of ask and bid prices and expressed in log terms. Independent variables are: GOVE: governance; RISK: risks and opportunities; STRA: strategy; GHGE: GHG accounting, energy and fuel use, and trading; COMM: communications. INS: institutional shareholding calculated from Top20 shareholding excluding individuals. LTA is the logarithm of total assets. VOL is the volatility calculated as standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. LSP is natural logarithm of stock price over the annual report announcement period from day -260 to day -2. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

6.4.5. Market liquidity,GHG emission information and corporate governance

Table 6.25 Liquidity, disclosure and corporate governance

	AMILOG		BIDLOG	
Model	1	2	3	4
Intercept	2.3213 (11.73)***	2.3075 (11.72)***	0.2146 (1.38)	0.2127 (1.37)
DISC	-0.0389 (-2.38)**		-0.0067 (-0.47)	
QUAL		-0.1243 (-2.91)***		-0.0206 (-0.49)
IND	-0.1569 (-3.25)***	-0.1512 (-3.14)***	-0.0388 (-0.96)	-0.0380 (-0.94)
DUA	-0.0559 (-2.82)***	-0.0624 (-3.18)***	-0.0474 (-2.84)***	-0.0485 (-2.89)***
DIV	-0.0305 (-1.81)*	-0.0308 (-1.83)*	-0.0178 (-1.27)	-0.0179 (-1.29)
LAT	-0.0117 (-0.76)	-0.0101 (-0.66)	-0.0030 (-0.22)	-0.0028 (-0.20)
MAC	0.0044 (0.68)	0.0038 (0.59)	-0.0054 (-0.98)	-0.0055 (-1.01)
MSO	0.0984 (1.40)	0.1092 (1.53)	-0.0278 (-0.44)	-0.0259 (-0.41)
INS	-0.1761 (-3.69)***	-0.1835 (-3.86)***	0.1512 (3.18)***	0.1499 (3.20)***
LTA	-0.1455 (-16.60)***	-0.1441 (-16.38)***	-0.0887 (-12.37)***	-0.0885 (-12.40)***
TOB	-0.0238 (-3.06)***	-0.0238 (-3.00)***	-0.0199 (-3.87)***	-0.0199 (-3.86)***
ROA	0.0038 (0.33)	0.0027 (0.24)	-0.0339 (-3.49)***	-0.0341 (-3.50)***
LEV	0.0430 (0.99)	0.0530 (1.21)	0.0753 (2.06)**	0.0770 (2.08)**
AGE	-0.0132 (-1.73)*	-0.0086 (-1.10)	-0.0071 (-1.02)	-0.0063 (-0.87)
VOL	1.0949 (1.84)*	1.1377 (1.91)*	-0.1426 (-0.39)	-0.1349 (-0.37)
LSP	-0.0549 (-7.14)***	-0.0553 (-6.92)***	-0.0251 (-4.28)***	-0.0252 (-4.27)***
CRL	0.0221 (1.22)	0.0290 (1.60)	0.0026 (0.15)	0.0037 (0.21)
SWT	-0.0001 (0.01)	-0.0130 (-0.65)	-0.0007 -0.03	-0.0029 (-0.15)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Adj R2	79.65	79.70	78.57	78.57
F-statistic	120.47	116.69	95.77	96.19
P value	0.0000	0.0000	0.0000	0.0000
N	561	561	561	561
Max VIF	3.53	3.62	3.53	3.62

The dependent variables are Amihud's illiquidity (AMILOG) and Bid-ask spreads (BIDLOG). Independent variables are: DISC is a dummy variable which takes the value of one if a firm responds to CDP and that information is disclosed publicly. QUAL is the voluntary GHG emission disclosure index calculated based on annual reports, sustainability reports, and corporate website using the CDP 2010 scoring methodology. IND is board independence measured as proportion of independent directors on the board. DUA is an indicator variable that equals 1 if the CEO has a role as a chairman of the board, and 0 otherwise. DIV is board diversity measured as an indicator variable that equals to 1 if the board has female director and 0 otherwise. LAT is natural logarithm of number of audit committee meetings. MAC is the size of the audit committee measured as number of members of an audit committee. MSO is the proportion of ordinary shares held by all directors. INS is the proportion of shareholding by the institutional investors measured from the Top20 shareholding list of a firm excluding individual shareholdings. LMV is the size of a firm measured as natural logarithm of market value in millions one month before the annual report release date. TOB is Tobin's *q* measured as the market value of common equity plus book value of preferred stock and book value of long-term debt and current liabilities, all scaled by book value of total assets. ROA is firm profitability measured as net profit after tax before abnormal items divided by total assets. LEV is leverage measured as total debt divided by total assets. AGE is the natural logarithm of firm age calculated from its listing date (years). VOL is the volatility calculated as the standard deviation of daily stock returns over the annual report announcement period from day -260 to day -2. LSP is natural logarithm of stock price over the annual report announcement period from day -260 to day -2CRL is an indicator variable that equals to 1 if a firm is listed other than ASX and 0 otherwise. SWT is a dummy variable that takes 1 if a firm switches its decision on GHG information disclosure from one year to next year. *t*-statistics are reported in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. Max VIF is the maximum variance inflation factor.

Table 6.25 reports the results of regression on the association between stock market liquidity, voluntary disclosures of GHG emission information, and the characteristics of corporate governance. Corporate governance variables such as board independence, CEO duality, and institutional share ownership have an impact on stock market liquidity. Most importantly, higher the board independence and institutional investors' holdings higher the firms' share liquidity.

6.4.6. Conclusion

This Chapter discusses in detail the results of the associations between voluntary disclosure of GHG emission information and corporate governance aspects. The results suggest that better governed firms tend to voluntarily disclose more information regarding GHG emissions. This result suggests that a range of effective corporate governance mechanisms mitigate agency costs and support the stakeholder value maximisation view hypothesis (1a). In addition to that, firms that disclose more voluntary GHG information to the public are less likely to engage in earnings management suggesting that managers are more likely to be ethically oriented and disclose more GHG emission information to the investors. This finding also supports partially the stakeholder value maximisation view hypothesis (2a). Overall, these findings are the stakeholder value maximisation view which is based on stakeholder and legitimacy theories. There is no support for the shareholder expense view.

Moreover, firms that disclose more voluntary GHG information to the public are more likely to have liquid stocks suggesting that information asymmetry will be reduced when firms disclose more transparent and high quality information to the investors supporting hypothesis (3).

CHAPTER SEVEN

CONCLUSIONS AND IMPLICATIONS

7.1. Introduction

In this concluding Chapter, the main findings are summarised and implications are discussed. Section 7.2 presents a summary of the research questions, reports the findings and discusses the validity of the hypotheses developed in this thesis. Section 7.3 provides the implications of the research. Section 7.4 discusses the limitations of the study. The suggestions for the future research are provided in Section 7.5. This Chapter concludes with the chapter summary in Section 7.6.

7.2. Research questions

This thesis seeks to examine the impact of corporate governance mechanisms on voluntary disclosure of GHG emission information and to what extent are disclosure of GHG emission information associated with the earnings management and the liquidity of firms' shares. The following research questions are addressed empirically:

1. What are the impacts of corporate governance attributes on disclosure of voluntary GHG emission information?
2. What is the relationship between voluntary disclosures of GHG emission information and earnings management and to what extent do corporate governance mechanisms affect this relationship?
3. Do Australian firms with higher voluntary disclosure of GHG emission information have higher liquidity of the firms' shares, *ceteris paribus?*

This thesis draws conclusions using empirical tests regarding the above questions.

7.2.1. What are the impacts of corporate governance characteristics on voluntary GHG emission information disclosure?

This study examines the impact of corporate governance characteristics on voluntary GHG emission disclosure information using two competing views stakeholder value maximisation and shareholder expense. Stakeholder value maximisation view supports the notion that firms engage in socially responsible initiatives such as GHG emission reduction strategies and targets associated with climate change to fulfil the demands and interest of stakeholders in order to have long-term relationship with stakeholders and to achieve long term wealth maximisation. The stakeholder value maximisation view expects that a firm's voluntary GHG emission disclosure decision can be seen as a result of effective internal and external monitoring through various corporate governance mechanisms to resolve conflicts among various stakeholders.

Therefore, the author expected to find a positive association between effective corporate governance characteristics and voluntary disclosure of GHG emission information.

On the other hand, the shareholder expense view argues that managers may use voluntary GHG emission information disclosure for their personal interests. Thus effective internal and external monitoring through various corporate governance mechanisms may reduce managerial incentives and opportunistic use of GHG emission information disclosure. As a result, it is expected that there will be a negative association between effective corporate governance mechanisms and voluntary disclosure of GHG emission information.

The corporate governance characteristics of Australian publicly listed firms that voluntarily disclosed their greenhouse gas emission information through voluntary disclosure channels such as the CDP, annual reports, standalone sustainability reports, and corporate websites are board independence, CEO duality, board gender diversity, directors' share ownership, institutional shareholding, blockholder ownership, frequency of audit committee meetings and the size of the audit committee. This study finds empirical evidence suggesting that a firm's voluntary GHG emission information disclosure may be driven by corporate governance mechanisms. The author has found that corporate governance mechanisms such as board independence, CEO duality, board gender diversity, directors' share ownership, institutional ownership, blockholder ownership, the size of the audit committee all have a significant influence on voluntary disclosure of GHG emission information. There is no evidence to support the impact of frequency of audit committee meetings on GHG emissions disclosure.

Independent boards representing outsider members have a significant impact on voluntary disclosure of GHG emission information made by Australian firms suggesting that as independent directors tend to have long-term perspective, they are expected to encourage top management to disclose a wide range of information on GHG. This result is consistent with prior studies (Khan, Muttakin & Siddiqui 2013; Ntim & Soobaroyen 2013; Rupley, Brown & Marshall 2012) that have found that a greater percentage of independent non-executive directors have significant and positive effect on disclosure about GHG emission reduction initiatives.

CEO duality provides more power to the CEO which may enable him/her to neglect climate change related issues and demands of stakeholders. This study has found a negative relationship between CEO duality and managers' decisions to disclose GHG emission information voluntarily and supports the separation of the role of chairman and CEO to improve monitoring quality in socially responsible decision making. Board gender diversity has positive effect on voluntary GHG emission disclosure. This study has found a positive impact on voluntary disclosure of GHG emission information suggesting that since women directors are more socially responsible, the presence of women on the board would increase voluntary disclosure of GHG emission information. This result is consistent with existing studies (Boulouta 2013; Liao, Luo & Tang 2014) which suggest that since women directors have more social empathy and caring qualities they are more likely to be in favour of disseminating more socially responsible disclosures.

This study has found that directors' share ownership is negatively associated with voluntary GHG emission disclosures. This indicates that a greater share ownership concentration by the directors influence top management to involve less in GHG emission reduction activities because of their shareholding power and report less on such GHG emission disclosure. This finding is consistent with previous research finding (Khan, Muttakin & Siddiqui 2013) that firms with higher managerial shareholding are less likely to report less amount of CSR disclosure. We document a positive association between institutional ownership and voluntary GHG emission disclosure suggesting that institutional investors are playing a vital role in ensuring the interests of a variety of stakeholders through voluntary GHG emission disclosure.

This study has found that the size of the audit committee is negatively related to the voluntary disclosure of GHG emission information. This finding is consistent of previous research finding of a negative association between the size of the audit committee and disclosure (Lin, Xiao & Tang 2008; Scarbrough, Rama & Raghunandan 1998; Yermack 1996) that more members in an audit committee may lead to unnecessary debates and delays in decision making processes, and this in turn, is not necessarily considered as an effective functioning mechanisms. In supporting the above argument, we find that firms with more members in an audit committee are less likely to provide GHG emission related information to stakeholders.

An independent, diverse group of members with some degree of separation from the CEO and chairman on the board may balance a stakeholders' conflicting demand from a variety of stakeholder groups. In addition, ownership aspects of corporate governance impact on voluntary GHG emission disclosure. For instance, the increase in the proportion of shares owned by institutional investors induces GHG emission disclosure whereas the shares held by executive and non-executive directors do the opposite. Interestingly, the smaller audit committees are more likely to have an impact on firms' GHG emission reduction strategies and initiatives. Overall, these results suggest that Australian firms adopt corporate governance mechanisms that are indeed stakeholder-focused, which balance the interests of a broader group of stakeholders' with regards to climate change, particularly in reporting GHG emission reduction initiatives and strategies. Overall, our results are consistent with the stakeholder value maximisation view of the firm which is based on stakeholder theory and legitimacy theory.

With regards to control variables, the size of the firms is positively and significantly associated with firms' decisions to disclose GHG emission information. The larger and more visible firms are responding to the information requests made by the CDP due to social pressure and support legitimacy theory. Tobin's *q*, which is used as an indicator for firms' growth opportunities, has a negative and significant relationship with managers' decisions to disclose GHG emission information. This result indicates that the firms with higher growth opportunities are less likely to disclose GHG information. Firms may respond to pressure from debtholders; therefore, there is a positive association between quality of GHG emission disclosure and leverage. Firm age is positively associated with the quality of GHG emission disclosure, which indicates that older firms may disclose more information on GHG emission to maintain their reputation among the stakeholders (Dhaliwal et al. 2012).

7.2.2. What is the relationship between voluntary disclosures of GHG emission information and earnings management?

This study investigates the relationship between voluntary disclosure of GHG emission information and earnings management and the extent to which corporate governance mechanisms affect the relationship. This study has found a negative relationship between voluntary disclosure of GHG emission information and earnings management indicating that socially responsible firms provide better quality of environmental information to stakeholders (Cho, Lee & Pfeiffer 2013; Kim, Park & Wier 2012) and are less likely to engage in earnings management supporting stakeholder value maximisation view. When control variables are included, this research has found an insignificant negative relationship between voluntary disclosure of GHG emission disclosure and earnings management. The sub-categories of quality of GHG emission disclosure namely, strategy and communication reveals significant and negative associations with earnings management, which support the previous argument that socially responsible firms are less likely to engage in earnings management. Overall, the author has found weak support for the stakeholder value maximisation hypothesis.

When the relationship between voluntary disclosure of GHG emission disclosure and earnings management is examined while controlling for corporate governance attributes, this thesis finds similar weak results. Effective corporate governance mechanisms play a marginal role in limiting Australian firms engaging in earnings management practice. This study has found some support for the premise that Australian firms with effective corporate governance engage in less earnings management supporting stakeholder value maximisation view. These results suggest that Australian firms with effective corporate governance mechanisms encourage management to focus on a broader group of stakeholders' interests with regards to climate change. These results are robust to controls for endogeneity using the two-stage least squared method.

7.2.3. Do Australian firms with higher voluntary disclosure of GHG emission information have higher liquidity of the firms' shares?

This thesis seeks to identify whether voluntary disclosure of GHG emission information may have an effect on liquidity of the firms' shares. Amihud's (2002) illiquidity and relative bid-ask spread are the measures which are used to see whether the firms with higher voluntary disclosure of GHG emission information have higher liquidity in the firms' shares. The Amihud's (2002) illiquidity measures are inversely related voluntary disclosure of GHG emission information. These results indicate that firms disclosing more GHG emission information voluntarily experience an increase in the liquidity of the firms' shares. These results support the view of Balakrishnan et al. (2013) that managers' decisions to disclose more voluntary information could affect the liquidity of their firms' liquidity directly. Managers may shape the liquidity of their firms' shares by providing more GHG emission information voluntarily through the CDP and their corporate reporting channels. Overall, these results support the view that Australian firm with higher voluntary disclosure of GHG emission information have higher liquidity of the firms' shares.

7.3. The contributions of the study

7.3.1. Contributions to the literature

Firstly, this thesis contributes to the link between carbon disclosure and corporate governance literature by examining two competing views, namely, stakeholder value maximisation view and shareholder expense view. This study supports the stakeholder value maximisation view which predicts that better governed firms tend to be more socially responsible and take care of the interests of stakeholders. This study finds evidence that a range of effective corporate governance mechanisms enhance voluntary GHG emission disclosure information to fulfil the needs of stakeholders.

Secondly, this study adds to the existing literature by investigating the relationship between earnings management and voluntary GHG emission disclosure information. This study finds a weak negative relationship between earnings management and voluntary GHG emission disclosure information. Similar findings are reported when we use corporate governance mechanisms as moderating variables.

Finally, this thesis adds to the large body of literature on the link between voluntary disclosure and stock market liquidity. The author has found that firms with higher voluntary disclosure of GHG emission information experience higher liquidity of their shares.

7.3.2. Contributions to the practice

Firstly, this study could benefit regulatory bodies that are considering effective corporate governance reforms. The author has found that effective corporate governance mechanism such as greater board independence, the absence of CEO duality, the presence of board gender diversity, lower directors' share ownership, greater institutional shareholding and smaller size of the audit committee drive voluntary GHG emission disclosure. The Australian Corporate Governance Council may consider suggesting these as best practices of effective corporate governance mechanisms to address climate change related issues at the firm level.

Secondly, the findings of this study are useful for potential and current investors in firms who are concerned about climate change information from firms' operations. For example, currently investors have started incorporating GHG emission information related to climate change in their investment decisions. This study provides evidence that firms with better corporate governance mechanisms are more likely to be stakeholder focused. Thus investors who seek to mitigate climate change related risk are better off in investing in firms with effective corporate governance mechanisms in place. In addition to that, this study provides evidence that firms that disclose higher quality of GHG emission information through the CDP, annual reports, standalone sustainability reports, and corporate websites experience improved liquidity of shares. Therefore, potential and current investors may incorporate these findings in their investment decisions.

7.4. The limitations of the study

The quality of GHG emission disclosure is measured using the CDP 2010 scoring methodology, which was the latest methodology available when measuring the scores. Firm's annual reports, sustainability reports, and corporate website are sources for scoring the quality of GHG emission information. Some firms may have other different channels to disclose their GHG emission information to the stakeholders. This study did not consider channels consider other than annual reports, sustainability reports, and each firm's corporate website. These could include social networking sites, disclosure through radio and television channels and press releases.

This study uses the absolute value of discretionary accrual methods as a proxy for earnings management. Prior research on earnings management criticises these models and argue that these models provide noisy and biased results (Kothari, Leone & Wasley 2005; Teoh, Wong & Rao 1998). In recent years, researchers have shown their interest in measuring earnings management through real activities in addition to accrual based activities (Roychowdhury 2006). Managers may prefer to use real activities manipulation over accruals manipulation as a way to manage reported earnings. This study did not use real earnings management proxies due to unavailability of data and time.

7.5. Recommendations for future research

This research considers GHG emission disclosure in a voluntary disclosure setting in Australia. Since corporate governance practice and climate change related legislations vary from country to country, future research must consider other countries as well to see the relationships among corporate governance, GHG emission disclosure, and earnings management.

This thesis calculates earnings management using absolute values of discretionary accruals methods. Future research should consider other methods such as real earnings management and signed accrual methods.

This study focuses on GHG emission disclosure before implementation of NEGR Act. Future research could compare disclosures consider pre and post NEGR Act.

This study depends entirely on secondary data. Future studies could consider a case study approach augmented with primary data collected from interviews with directors and management regarding GHG emission reduction management and their disclosure practices.

This study considers four sources to measure the GHG emission disclosure such as firms' responses to the CDP, annual reports, standalone sustainability reports, and corporate websites. Firms may have other reporting channels such as social media to disclose their GHG emission information. Future research may consider these sources in addition to the sources used in this research to score the quality of GHG emission disclosure.

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APPENDICES

Appendix 1: CDP 2010 scoring methodology

This appendix provides an explanation about the quality of GHG emission disclosure scoring methodology (CDP 2010 scoring methodology). This methodology has been developed jointly by CDP and their global advisor PricewaterhouseCoopers (PwC). All questions are not applicable for all companies. It provides a detail scoring approach, which includes different types of questions such as lead question and conditional questions as well as scales questions.

The number of points allocated to each question depends on the amount of data availability at a particular financial year of a firm's voluntary communication channels such as annual report, sustainability report or corporate website. Some questions have more than one point attached to a single piece of information where the information is of particularly high importance, e.g. scope 1 emissions figure. Questions which allow data available at corporate channels are usually judge according to how many points of the required data points they achieve. At the end of scoring, the number of points a company has been awarded is divided by the maximum number that could have been awarded. The fraction is then converted to a percentage by multiplying by 100 and rounded to the nearest whole number.

(Points awarded / points attainable) = Disclosure Score
With respect to the scales, this methodology has been using two types of scaling namely scale A and scale B. Scale A consists of a two point scales. First point provides the reader direct answer to the question. Second point provides the reader increased level of detail of a specific company. Scale B contains a three point scales. Third point provides the reader further details of quantitative information with respective to a particular question in addition to first and second points

Unavailable disclosure information with respect to a particular question/a set of questions will be scored zero out of the maximum available points for that question or set of questions. If a question is not relevant to a firm, it will be scored a zero.

	Denominator range	
Categorise	Minimum	Maximum
Governance		
Governance	4	5
Total range for this section	***4***	***5***
Risks and Opportunities		
Risks and Opportunities identification process	2	2
Regulatory risks	10	11
Physical risks	10	11
Other risks	10	11
Regulatory opportunities	10	11
Physical opportunities	10	11
Other opportunities	10	11
Total range for this section	***62***	***68***
Strategy		
Strategy	6	14
Total range for this section	***6***	***14***
GHG accounting, energy and fuel use, and trading		
Emissions – boundary and methodology	8	9
Scope 1	13	13
Scope 2	11	11
Contractual Scope 2	2	7
Scope 3	3	9
Emissions – other 1	2	4
Emissions – other 2	18.5	21.5
Emissions trading	2	8
Total range for this section	***59.5***	***82.5***
Communications		
Communications	1	2
Total range for this section	***1***	***2***
Overall total	**133**	**171.5**

CDP 2010 scoring methodology

Governance				
No.	**Question**	**Disclosure Score**		**Answer -** This column shows the answer options from which a company is asked to select. If the question is answered in a free text field, this is indicated.
		Points	Denominator	
	Group and Individual Responsibility			
	1.1 "Board Committee" route			
1.1	Where is the highest level of responsibility for climate change within your company?		0.5	**Drop down menu option:** Board committee or other executive body
1.1a	Please specify who is responsible.		0.5	Selection made from the drop down menu or, if selecting "Other", answer given in text box.
1.2	What is the mechanism by which the board committee or other executive body reviews the company's progress and status regarding climate change?		2	Scale A
			3	**Denominator for this route**
	1.1 "Lower level" route			
1.1	Where is the highest level of responsibility for climate change within your company?		0.5	**Drop down menu option**: Other, lower level departments.
1.1b	Select the lower level department responsible.		0.5	Selection made from the drop down menu or, if selecting "Other", answer given in text box.
1.3	Please explain how overall responsibility for climate change is managed within your company.		2	Scale A.
			3	**Denominator for this route**
	1.1 "No individual / committee" route			
1.1	Where is the highest level of responsibility for climate change within your company?		1	**Drop down menu option:** There is no individual or committee with overall responsibility for climate change
1.3	Please explain how overall responsibility for climate change is managed within your company.		2	Scale A
			3	**Denominator for this route**
	1.1 No answer given			
1.1	Where is the highest level of responsibility for climate change within your company?		1	No selection made from drop down menu
			3	**Maximum denominator as no selection made**
	Individual Performance Incentives			
	1.4 "Yes" route			
1.4	Do you provide incentives for the management of climate change issues, including the attainment of greenhouse gas (GHG) targets?		1	**Drop down menu option:** Yes
1.5	Please complete the table.		1	1 point

			2	**Denominator for this route**
	1.4 "No" route			
1.4	Do you provide incentives for the management of climate change issues, including the attainment of greenhouse gas (GHG) targets?		1	**Drop down menu option:** No.
			1	**Denominator for this route**
	1.4 "No answer" route			
1.4	Do you provide incentives for the management of climate change issues, including the attainment of greenhouse gas (GHG) targets?		1	No selection made from drop down menu
			2	**Maximum denominator as no selection made**
			5	**Total Points**
Risk & Opportunity Identification Process				
2.1	Describe your company's process for identifying significant risks and/or opportunities from climate change and assessing the degree to which they could affect your business, including the financial implications.		2	Scale A
			2	**Denominator**
	Regulatory Risks			
	3.1 Lead question - "Yes" route			
3.1	Do current and/or anticipated regulatory requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Yes
3.2 A/ B	What are the current and/or anticipated significant regulatory risks related to climate change and the associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographical area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
3.3	Describe the ways in which the identified risks affect or could affect your business and your value chain.		3	Scale B
			6	**Denominator for this route - sub-total**
	3.4 Sub-lead question financial implications - "Yes" route			
3.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** Yes

3.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).
			2	**Denominator for this route - sub-total**
	3.4 Sub-lead question financial implications - "No" route			
3.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	3.4 Sub-lead question financial implications - "No selection made" route			
3.4	Are there financial implications associated with the identified risks?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 3.1 will be asked 3.6			
3.6	Describe any actions the company has taken or plans to take to manage or adapt to the risks that have been identified, including the cost of those actions.		3	Scale A
				Possible denominators: the denominator is 11 if "Yes" selected at 3.4; 10 if "No" selected at 3.4; 11 if no selection made at 3.4.
	3.1 Lead question - "No" route			
3.1	Do current and/or anticipated regulatory requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** No
3.7	Please explain why you do not consider your company to be exposed to significant regulatory risks - current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	3.1 Lead question - "Don't know" route			
3.1	Do current and/or anticipated regulatory requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Don't know
3.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	3.1 Lead question - No answer			
3.1	Do current and/or anticipated regulatory requirements related to climate change present significant risks for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
	Physical Risks			
	4.1 Lead question - "Yes" route			
4.1	Do current and/or anticipated Physical requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Yes

4.2 A/ B	What are the current and/or anticipated significant Physical Risks related to climate change and the associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographical area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
4.3	Describe the ways in which the identified risks affect or could affect your business and your value chain.		3	Text answer scored under Scale B
			6	**Denominator for this route - sub-total**
	4.4 Sub-lead question financial implications - "Yes" route			
4.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** Yes
4.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).
			2	**Denominator for this route - sub-total**
	4.4 Sub-lead question financial implications - "No" route			
4.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	4.4 Sub-lead question financial implications - "No selection made" route			
4.4	Are there financial implications associated with the identified risks?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 3.1 will be asked 3.6			
4.6	Describe any actions the company has taken or plans to take to manage or adapt to the risks that have been identified, including the cost of those actions.		3	Description of actions scored on Scale A. Additionally 1 point is scored if the costs of the actions are given - or, if there are none, this is made clear.
				Possible denominators: the denominator is 11 if "Yes" selected at 3.4; 10 if "No" selected at 3.4; 11 if no selection made at 3.4.
	4.1 Lead question - "No" route			
3.1	Do current and/or anticipated Physical requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** No

4.7	Please explain why you do not consider your company to be exposed to significant Physical Riskis - current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	3.1 Lead question - "Don't know" route			
4.1	Do current and/or anticipated Physical requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Don't know
4.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	3.1 Lead question - No answer			
4.1	Do current and/or anticipated Physical requirements related to climate change present significant risks for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
	This pattern will be repeated for both the other risk questions.			
	Oil and gas sector companies should include their estimated value of assets exposed to extreme weather events in table O&G2.1. A cross-reference from question 4 on physical risks to O&G2.1 will be scored.			
	Other Risks			
	5.1 Lead question - "Yes" route			
5.1	Do current and/or anticipated Other requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Yes
5.2 A/ B	What are the current and/or anticipated significant Other risks related to climate change and the associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographical area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
5.3	Describe the ways in which the identified risks affect or could affect your business and your value chain.		3	Text answer scored under Scale B
			6	**Denominator for this route - sub-total**
	5.4 Sub-lead question financial implications - "Yes" route			
5.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** Yes
5.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).

			2	**Denominator for this route - sub-total**
	5.4 Sub-lead question financial implications - "No" route			
5.4	Are there financial implications associated with the identified risks?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	3.4 Sub-lead question financial implications - "No selection made" route			
5.4	Are there financial implications associated with the identified risks?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 3.1 will be asked 3.6			
5.6	Describe any actions the company has taken or plans to take to manage or adapt to the risks that have been identified, including the cost of those actions.		3	Description of actions scored on Scale A. Additionally 1 point is scored if the costs of the actions are given - or, if there are none, this is made clear.
				Possible denominators: the denominator is 11 if "Yes" selected at 3.4; 10 if "No" selected at 3.4; 11 if no selection made at 3.4.
	5.1 Lead question - "No" route			
5.1	Do current and/or anticipated Other requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** No
5.7	Please explain why you do not consider your company to be exposed to significant Other risks - current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	5.1 Lead question - "Don't know" route			
5.1	Do current and/or anticipated Other requirements related to climate change present significant risks for your company?		1	**Drop-down menu option:** Don't know
5.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	5.1 Lead question - No answer			
5.1	Do current and/or anticipated Other requirements related to climate change present significant risks for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
	This pattern will be repeated for both the other risk questions.			
	Oil and gas sector companies should include their estimated value of assets exposed to extreme weather events in table O&G2.1. A cross-reference from question 4 on physical risks to O&G2.1 will be scored.			
Opportunities				
	Regulatory Opportunities			
	6.1 Lead question - "Yes" route			

6.1	Do current and/or anticipated regulatory requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Yes
6.2A /B	What are the current and/or anticipated significant opportunities and their associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographic area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
6.3	Describe the ways in which the identified opportunities affect or could affect your business and your value chain.		3	Text answer scored on Scale B
			6	**Denominator for this route - sub-total**
	6.4 Sub-lead question financial implications - "Yes" route			
6.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** Yes
6.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).
			2	**Denominator for this route - sub-total**
	6.4 Sub-lead question financial implications - "No" route			
6.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	6.4 Sub-lead question financial implications - "No selection made" route			
6.4	Are there financial implications associated with the identified opportunities?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 6.1 will be asked 6.6			
6.6	Describe any actions the company has taken or plans to take to exploit the opportunities that have been identified, including the investment needed to take those actions.		3	Description of actions scored on Scale A. Additionally 1 point is scored if the amount of investment needed is given - or, if it is nil, this is made clear.
				Possible denominators: the denominator is 11 if "Yes" selected at 6.4; 10 if "No" selected at 6.4; 11 if no selection made at 6.4.
	6.1 Lead question - "No" route			

6.1	Do current and/or anticipated regulatory requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** No
6.7	Please explain why you do not consider your company to be presented with significant opportunities – current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	6.1 Lead question - "Don't know" route			
6.1	Do current and/or anticipated regulatory requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Don't know
6.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	6.1 Lead question - No answer			
6.1	Do current and/or anticipated regulatory requirements related to climate change present significant opportunities for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
Opportunities				
	Physical Opportunities			
	7.1 Lead question - "Yes" route			
7.1	Do current and/or anticipated Physical requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Yes
7.2A /B	What are the current and/or anticipated significant opportunities and their associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographic area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
6.3	Describe the ways in which the identified opportunities affect or could affect your business and your value chain.		3	Text answer scored on Scale B
			6	**Denominator for this route - sub-total**
	7.4 Sub-lead question financial implications - "Yes" route			
7.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** Yes

7.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).
			2	**Denominator for this route - sub-total**
	7.4 Sub-lead question financial implications - "No" route			
7.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	7.4 Sub-lead question financial implications - "No selection made" route			
7.4	Are there financial implications associated with the identified opportunities?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 6.1 will be asked 6.6			
7.6	Describe any actions the company has taken or plans to take to exploit the opportunities that have been identified, including the investment needed to take those actions.		3	Description of actions scored on Scale A. Additionally 1 point is scored if the amount of investment needed is given - or, if it is nil, this is made clear.
				Possible denominators: the denominator is 11 if "Yes" selected at 6.4; 10 if "No" selected at 6.4; 11 if no selection made at 6.4.
	6.1 Lead question - "No" route			
6.1	Do current and/or anticipated Physical requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** No
6.7	Please explain why you do not consider your company to be presented with significant opportunities – current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	7.1 Lead question - "Don't know" route			
7.1	Do current and/or anticipated Physical requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Don't know
7.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	7.1 Lead question - No answer			
7.1	Do current and/or anticipated Physical requirements related to climate change present significant opportunities for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
	This pattern will be repeated for both the other risk questions.			

	Oil and gas sector companies should include their estimated value of assets exposed to extreme weather events in table O&G2.1. A cross-reference from question 4 on physical risks to O&G2.1 will be scored.			
	Other Opportunities			
	8.1 Lead question - "Yes" route			
8.1	Do current and/or anticipated Other requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Yes
8.2A /B	What are the current and/or anticipated significant opportunities and their associated countries/regions and timescales?		2	Table format data entry: Selection of risk category (0.5 points), geographical area affected (0.5), timescale of impact (0.5). Elaboration of risk in comment field (0.5). If geography, timescale & comment given, but no risk is selected - 0 points. Text box data entry: Answer must describe risk (1 point), the geographic area affected (0.5), and timescale of impact (0.5). If geography and timescale given, but no risk is described - 0 points.
6.3	Describe the ways in which the identified opportunities affect or could affect your business and your value chain.		3	Text answer scored on Scale B
			6	**Denominator for this route - sub-total**
	8.4 Sub-lead question financial implications - "Yes" route			
8.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** Yes
8.5	Please describe them.		1	If the financial implications are described (0.5). If they are quantified in some way (0.5).
			2	**Denominator for this route - sub-total**
	8.4 Sub-lead question financial implications - "No" route			
8.4	Are there financial implications associated with the identified opportunities?		1	**Drop-down menu option:** No
			1	**Denominator for this route - sub-total**
	8.4 Sub-lead question financial implications - "No selection made" route			
8.4	Are there financial implications associated with the identified opportunities?		1	No selection made from the drop-down menu
			2	**Maximum denominator as no selection made**
	All companies that answer "Yes" at 6.1 will be asked 6.6			
8.6	Describe any actions the company has taken or plans to take to exploit the opportunities that have been identified, including the investment needed to take those actions.		3	Description of actions scored on Scale A. Additionally 1 point is scored if the amount of investment needed is given - or, if it is nil, this is made clear.

				Possible denominators: the denominator is 11 if "Yes" selected at 6.4; 10 if "No" selected at 6.4; 11 if no selection made at 6.4.
	8.1 Lead question - "No" route			
8.1	Do current and/or anticipated Other requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** No
8.7	Please explain why you do not consider your company to be presented with significant opportunities – current or anticipated.		10	Text answer which is awarded either 5/10 or 10/10. 5/10 for a direct answer. 10/10 for an increased level of detail that is specific to the company.
			11	**Denominator for this route**
	8.1 Lead question - "Don't know" route			
8.1	Do current and/or anticipated Other requirements related to climate change present significant opportunities for your company?		1	**Drop-down menu option:** Don't know
8.8	Please explain why not.		1	Explanation given (1) No explanation given (0)
			11	**Maximum denominator has been selected for this route**
	8.1 Lead question - No answer			
8.1	Do current and/or anticipated Other requirements related to climate change present significant opportunities for your company?		1	No selection made from the drop-down menu
			11	**Maximum denominator as no selection made**
Strategy				
	Strategy			
9.1	Please describe how your overall group business strategy links with actions taken on risks and opportunities (identified in questions 3 to 8), including any emissions reduction targets or achievements, public policy engagement and external communications.		3	Scale B
			3	**Denominator**
	Targets			
	9.2 "No current target" route			
9.2	Do you have a current emissions reduction target?		1	**Drop down menu option:** No
9.3	Please explain why not and forecast how your Scope 1 and Scope 2 emissions will change over the next 5 years.		2	Explanation (1) Forecast - 0.5 point if qualitative; 1 if quantitative.
			3	**Denominator for this route**
	9.2 "Target in development" route			
9.2	Do you have a current emissions reduction target?		1	**Drop down menu option:** No, but we are developing one.
9.4	Please give details of the target(s) you are developing and when you expect to announce it/them.		2	Details of target (1). Announcement date (1).
			3	**Denominator for this route**
	9.2 "Target completed" route			

9.2	Do you have a current emissions reduction target?		1	**Drop down menu option:** No, we had a target and the date for completing it fell within our reporting year.
9.5	Please explain if you intend to set a new target.		1	If disclosed (1). If not (0).
9.6	Please complete the table.		1	To score 1 point, companies with an absolute or an intensity target need to complete columns 1-8. Companies with other types of target do not need to supply base year emissions.
			3	**Denominator for this route**
	9.2 "Yes, we have a target" route			
9.2	Do you have a current emissions reduction target?		1	**Drop down menu option:** Yes
9.6	Please complete the table.		1	To score 1 point, companies with an absolute or an intensity target need to complete columns 1-8. Companies with other types of target do not need to supply base year emissions. Target met? column does not have to be completed or can be completed with selection of "Target ongoing".
			2	**Denominator for this route**
	9.2 "No selection made" route			
9.2	Do you have a current emissions reduction target?		1	No selection made from the drop-down menu
			3	**Maximum denominator selected as no selection made.**
	Emission Reduction Activities			
	Organisations answer 9.7 & 9.9 or 9.8			
	9.7 "Question relevant" route			
9.7	Please use the table below to describe your company's actions to reduce its GHG emissions.		5	Actions (2). Emissions reduction (1) Achieved/anticipated (1) If relevant, investment amount, currency & timescale (all data points required - 0.5) - or if stated not relevant (0.5). If relevant, monetary savings amount, currency and achieved/anticipated (all data points required - 0.5) - or if stated not relevant/not quantified (0.5).
9.9	Please provide any other information you consider necessary to describe your emissions reduction activities.		0	Optional
			5	**Denominator for this route**
	9.8 "Question not relevant" route			
¿9.8	Please explain why not.		3	Text answer scored on Scale B
			3	**Denominator for this route**
	9.7 & 9.8 "No answer given to either" route			
9.7/ 9.8	No answer given to either 9.7 or 9.8		5	
			5	**Maximum denominator selected as no selection made**
	Engagement with Policy Makers			

	9.10 "Yes, we engage with policy-makers" route			
9.1	Do you engage with policy makers on possible responses to climate change including taxation, regulation and carbon trading?		1	**Drop down menu option:** Yes
9.11	Please describe.		2	Text answer scored on Scale A
			3	**Denominator for this route**
	9.11 "No, we don't engage with policy-makers" route			
9.1	Do you engage with policy makers on possible responses to climate change including taxation, regulation and carbon trading?		1	**Drop down menu option:** No
			1	**Denominator for this route**
	9.11 "No answer" route			
9.1	Do you engage with policy makers on possible responses to climate change including taxation, regulation and carbon trading?		1	No selection made from the drop-down menu
			3	**Maximum denominator selected as no selection made**
Emissions - Boundary and Methodology				
	Reporting Boundary			
10.1	Please indicate the category that describes the company, entities, or group for which Scope 1 and Scope 2 GHG emissions are reported.		1	Selection made (1) no selection made (0). If "Other" selected, a description of the reporting boundary must be provided in the text box to score 1.
			1	**Denominator**
	10.2 "Yes, there are excluded sources" route			
10.2	Are there are any sources (e.g. facilities, specific GHGs, activities, geographies, etc.) of Scope 1 and Scope 2 emissions within this boundary which are not included in your disclosure?		1	**Drop down menu option:** Yes
10.3	Please complete the following table.		1	1 point scored if all 3 data points supplied i.e. source, scope, explanation. 0 if one element is missing.
			2	**Denominator for this route**
	10.2 "No excluded sources" route			
10.2	Are there are any sources (e.g. facilities, specific GHGs, activities, geographies, etc.) of Scope 1 and Scope 2 emissions within this boundary which are not included in your disclosure?		1	**Drop down menu option:** No
			1	**Denominator for this route**
	10.2 "No answer" route			
10.2	Are there are any sources (e.g. facilities, specific GHGs, activities, geographies, etc.) of Scope 1 and Scope 2 emissions within this boundary which are not included in your disclosure?		1	No selection made from the drop-down menu
			2	**Maximum denominator selected as no selection made.**
	Methodology			
11.1 A	Please give the name of the standard, protocol or methodology you have used to		3	Companies are asked to provide the name of the published standard(s)

& 11.1 B	collect activity data and calculate Scope 1 and Scope 2 emissions and/or describe the procedure you have used.			they use (if applicable) in 11.1A (1) AND how they apply it in their company in 11.1B (Scale A). Companies not using a published standard should describe the procedure used in 11.1B (Scale B)
11.2	Please also provide the names of and links to any calculation tools used.		1	Selection made and/or text answer given (1), no answer (0)
11.3	Please give the global warming potentials you have applied and their origin.		1	Gas, origin, & figure must all be supplied to score 1
11.4	Please give the emission factors you have applied and their origin.		1	Fuel/material, number, unit & reference must all be supplied to score 1.
			6	**Denominator**
Scope 1				
	Total Scope 1			
12.1	Please give your total gross global Scope 1 GHG emissions in metric tonnes of CO2-e.		6	Number given (6) No number given (0)
			6	**Denominator**
	Scope 1 by country			
	Organisations answer 12.2 or 12.3.			
	12.2 "Question relevant" route			
12.2	Please break down your total gross global Scope 1 emissions in metric tonnes CO2-e by country/region.		2	Number & country/region given (2) No number or no country/region (0)
			2	**Denominator for this route**
	12.3 "Question not relevant" route			
¿12.3	¿Please explain why not.		2	Explanation scored on Scale A
			2	**Denominator for this route**
	12.2 & 12.3 "No answer given to either" route			
12.2/ 12.3	No answer given for either 12.2 or 12.3		2	
			2	**Denominator for this route**
	Scope 1 by business division/facility			
	Where it will facilitate a better understanding of your business, please also break down your total gross global Scope 1 emissions by business division and/or facility.			
12.4	Business division		0	Optional
12.5	Facility		0	Optional
			0	**Denominator**
	Scope 1 by GHG type			
	Organisations answer 12.6 or12.7			
	12.6 "Question relevant" route			
12.6	Please break down your total gross global Scope 1 emissions by GHG type. (Only data for the current reporting year requested.)		1	Numbers for more than one gas entered in the table (1), Number for only one gas entered (0)
			1	**Denominator for this route**
	12.7 "Question not relevant" route			
¿12.7	Please explain why not.		1	Explanation given (1), No explanation given (0)
			1	**Denominator for this route**

	12.6 & 12.7 "No answer given to either" route			
12.6/ 12.7	No answer given for either 12.6 or 12.7		**1**	
			1	**Maximum denominator selected as no selection made.**
	Fuel consumption			
	Organisations answer 12.8 or 12.9			
	12.8 "Question relevant" route			
12.8	Please use the table to give the total amount of fuel in MWh that your organisation has consumed during the reportingyear.		1	Number entered (1). No number entered (0)
			1	**Denominator for this route**
	12.9 "Question not relevant" route			
¿12.9	Please explain why not.		1	Explanation given (1), No explanation given (0)
			1	**Denominator for this route**
	12.8 & 12.9 "No answer given to either" route			
12.8/ 12.9	No answer given for either 12.8 or 12.9		1	
			1	**Maximum denominator selected as no selection made.**
	Fuel consumption breakdown			
	Organisations answer 12.10 or 12.11			
	12.10 "Question relevant" route			
12.1	Please complete the table by breaking down the total figure by fuel type.		1	Fuel type & number entered in table (1). No number or no fuel type (0).
			1	**Denominator for this route**
	12.11 "Question not relevant" route			
¿12.1 1	Please explain why not.		1	Explanation given (1) No explanation given (0)
			1	**Denominator for this route**
	12.10 &12.11 "No answer given to either" route			
12.1 0/12. 11	No answer given for either 12.10 or 12.11		1	
			1	**Maximum denominator selected as no selection made.**
	Data Accuracy			
12.1 2	Please estimate the level of uncertainty of the total gross global Scope 1 figure that you have supplied in answer to question 12.1 and specify the sources of uncertainty in your data gathering, handling, and calculations.		2	Number entered in "Uncertainty range" (1), "Main sources of uncertainty in your data" (0.5), and explanation (0.5).
			2	**Denominator**
Scope 2 Indirect GHG Emissions				
	Total Scope 2			
13.1	Please give your total gross global Scope 2 GHG emissions in metric tonnes of CO2-e.		6	Number given (6), No number given (0)
			6	**Denominator**
	Scope 2 by country			
	Organisations answer 13.2 or 13.3.			
	13.2 "Question relevant" route			

13.2	Please break down your total gross global Scope 2 emissions in metric tonnes CO2-e by country/region.		2	Number & country/region given (2) No number or no country/region (0)
			2	**Denominator for this route**
	13.3 "Question not relevant" route			
¿13.3	Please explain why not.		2	Explanation scored on Scale A
			2	**Denominator for this route**
	13.2 & 13.3 "No answer given to either" route			
13.2/ 13.3	No answer given for 13.2 or 13.3		2	
			2	**Denominator for this route**
	Scope 2 by business division/facility			
	Where it will facilitate a better understanding of your business, please also break down your total gross global Scope 2 emissions by business division and/or facility.			
13.4	Business division		0	Optional
13.5	Facility		0	Optional
			0	**Denominator**
	Purchased Energy			
	Organisations answer 13.6 or 13.7			
	13.6 "Question relevant" route			
13.6	How much electricity, heat, steam, and cooling in MWh has your organisation purchased for its own consumption during the reporting year?		1	Selection & 1 number entered in table (1), No selection or no number (0)
			1	**Denominator for this route**
	13.7 "Question not relevant" route			
¿13.7	Please explain why not.		1	Explanation given (1), No explanation given (0)
			1	**Denominator for this route**
	13.6&13.7 "No answer given to either" route			
13.6/ 13.7	No answer given for 13.6 or 13.7		1	
			1	**Maximum denominator selected as no selection made.**
	Data Accuracy			
13.8	Please estimate the level of uncertainty of the total gross global Scope 2 figure that you have supplied in answer to question 13.1 and specify the sources of uncertainty in your data gathering, handling, and calculations.		2	Number entered in "Uncertainty range" (1), "Main sources of uncertainty in your data" (0.5), explanation (0.5).
			2	**Denominator**
Scope 2 - Contractual				
	Contractual Arrangements Supporting Particular Types of Electricity Generation:			
	14.1 "Yes" route			
14.1	Do you consider that the grid average factors used to report Scope 2 emissions in question 13 reflect the contractual arrangements you have with electricity suppliers?		1	**Drop down menu option:** Yes
			1	**Denominator for this route**
	14.1 "No" route			

14.1	Do you consider that the grid average factors used to report Scope 2 emissions in question 13 reflect the contractual arrangements you have with electricity suppliers?		1	**Drop down menu option:** No
14.2	You may report a total contractual Scope 2 figure in response to this question. Please provide your total global contractual Scope 2 GHG emissions figure in metric tonnes CO2-e.		2	2 points awarded provided that an answer for 13.1 has been given. If no answer has been provided for 13.1, no point will be awarded for 14.2.
14.3	Explain the origin of the alternative figure including information about the emission factors used and the tariffs.		2	Description of the tariffs via which electricity is purchased or explanation of circumstances if electricity not bought via tariffs (1); emission factors numerical values (0.5); process for calculating alternative figures (0.5). If no answer has been provided for 13.1, no points will be awarded for 14.3.
			5	**Denominator for this route**
	14.1 "Don't know" route			
14.1	Do you consider that the grid average factors used to report Scope 2 emissions in question 13 reflect the contractual arrangements you have with electricity suppliers?		1	**Drop down menu option:** Don't know
			1	**Denominator for this route**
	14.1 "No answer" route			
14.1	Do you consider that the grid average factors used to report Scope 2 emissions in question 13 reflect the contractual arrangements you have with electricity suppliers?		5	No selection made from drop-down menu.
			5	**Maximum denominator selected as no selection made**
	Retiring certificates			
	14.4 "Yes, certificates retired" route			
14.4	Has your organisation retired any certificates, e.g. Renewable Energy Certificates, associated with zero or low carbon electricity within the reporting year or has this been done on your behalf?		1	**Drop down menu option:** Yes
14.5	Please provide details including the number and type of certificates.		1	Number and type (1), No number or no type (0)
			2	**Denominator for this route**
	14.4 "No, certificates not retired" route			
14.4	Has your organisation retired any certificates, e.g. Renewable Energy Certificates, associated with zero or low carbon electricity within the reporting year or has this been done on your behalf?		1	**Drop down menu option:** No
			1	**Denominator for this route**
	14.4 "No answer given" route			
14.4	Has your organisation retired any certificates, e.g. Renewable Energy Certificates, associated with zero or low carbon electricity within the reporting year or has this been done on your behalf?		2	No selection made from the drop-down menu.

			2	**Maximum denominator selected as no selection made.**
Scope 3 Other Indirect GHG Emissions				
	Scope 3 emissions			
	Organisations answer either 15.1 or 15.2			
	15.1 "Question relevant" route			
15.1	Please provide data on sources of Scope 3 emissions that are relevant to your organisation.		9	Source (2) Emission figure scores 4/4. If no figure given but emissions are described including an indication of scale 2/4. If another measure reflecting quantity of S3 emissions is used 1/4. Methodology is scored on Scale B i.e. out of 3 points.
			9	**Denominator for this route**
	15.2 "Question not relevant" route			
¿15.2	Please explain why not.		3	Text scored on Scale B
			3	**Denominator**
	15.1&15.2 "No answer given to either" route			
15.1/ 15.2	No answer provided to either 15.1 or 15.2		9	
			9	**Maximum denominator selected as no selection made**
Emissions - Other 1				
	Emissions Avoided Through Use of Goods and Services			
	16.1 "Yes" route			
16.1	Does the use of your goods and/or services enable GHG emissions to be avoided by a third party?		1	**Drop-down menu option:** Yes
16.2	Please provide details including the anticipated timescale over which the emissions are avoided, in which sector of the economy they might help to avoid emissions and their potential to avoid emissions.		2	Explain why products enable emissions to be avoided (0.5); where emissions will be avoided i.e. which economic sector (0.5); timescale over which emissions are avoided (0.5); give a quantitative indication of the emissions that may be avoided (0.5).
			3	**Denominator**
	16.1 "No" route			
16.1	Does the use of your goods and/or services enable GHG emissions to be avoided by a third party?		1	**Drop-down menu option:** No
			1	**Denominator**
	16.1 "No answer given" route			
16.1	Does the use of your goods and/or services enable GHG emissions to be avoided by a third party?		3	No selection made from the drop-down menu.
			3	**Maximum denominator selected as no selection made**
	Carbon Dioxide Emissions from Biologically Sequestered Carbon			
	Organisations answer either 17.1 or 17.2			
	17.1 "Question relevant" route			

17.1	Please provide your total carbon dioxide emissions in metric tonnes CO2 from the combustion of biologically sequestered carbon i.e. carbon dioxide emissions from burning biomass/biofuels.		1	Number given (1) No number given (0)
			1	**Denominator**
	17.2 "Question not relevant" route			
¿17.2	Please explain why not.		1	Explanation given (1) No explanation given (0)
			1	**Denominator**
	17.1&17.2 "No answer given" route			
	No answer provided to either 17.1 or 17.2.		1	
			1	**Maximum denominator selected as no selection made.**
Emissions - Other 2				
	Emissions Intensity			
18.1	Please describe a financial and an activity-related intensity measurement for the reporting year for your gross combined Scope 1 and Scope 2 emissions.			
	Financial metric		2	Columns 1-5 must be completed (2). Not all completed (0). Column 6 - contextual information is optional. If a company says that a financial metric is not relevant, they must supply an explanation. Explanation to be scored on Scale A. Saying "not relevant" without an explanation scores 0/2.
			2	**Denominator**
	Activity-related metric		2	Columns 1-3 must be completed (2). Not all completed (0). Column 4 - contextual information is optional. If a company says that an activity metric is not relevant, they must supply an explanation. Explanation to be scored on Scale A. Saying "not relevant" without an explanation scores 0/2.
			2	**Denominator**
	Emissions History			
	19.1 "Yes, they vary significantly" route			
19.1	Do the absolute emissions (Scope 1 and Scope 2 combined) for the reporting year vary significantly compared to the previous year?		2	**Drop-down menu option:** Yes
19.2	Please explain why they have varied and why the variation is significant.		3	Explanation of why they have varied (Scale A i.e. out of 2 points), explanation of why variation is significant (1)
			5	**Denominator**
	19.1 "No, they don't vary significantly" route			
19.1	Do the absolute emissions (Scope 1 and Scope 2 combined) for the reporting year vary significantly compared to the previous year?		2	**Drop-down menu option:** No
			2	**Denominator**
	19.1 "First year of estimation" route			

19.1	Do the absolute emissions (Scope 1 and Scope 2 combined) for the reporting year vary significantly compared to the previous year?		2	**Drop-down menu option:** This is our first year of estimation.
			2	**Denominator**
	19.1 "No data/Data not provided/Not sufficient data" route			
19.1	Do the absolute emissions (Scope 1 and Scope 2 combined) for the reporting year vary significantly compared to the previous year?		2	**Drop-down menu options:** We don't have any emissions data./Data not provided to CDP./We do not have sufficient emissions data to answer the question.
			2	**Denominator**
	19.1 "No selection made" route			
19.1	Do the absolute emissions (Scope 1 and Scope 2 combined) for the reporting year vary significantly compared to the previous year?		5	No selection made
			5	**Maximum denominator selected as no selection made.**
	External Verification/ Assurance			
20.1	Please complete the following table indicating the percentage of reported emissions that have been verified/assured and attach the relevant statement.			
	Scope 1			
	20.1 "Scope 1 emissions verified & statement provided" route			
20.1 A	Scope 1 - % of reported emissions verified/assured			Selection indicates that some or all emissions have been verified.
20.1 B	Verification/assurance statement provided			S1 must be selected in answer to 20.1B to score.
			5	**Denominator**
	20.1 "No selection made from S1 drop down but statement provided" route			
20.1 A	Scope 1 - % of reported emissions verified/assured			No selection made
20.1 B	Verification/assurance statement provided			S1 must be selected in answer to 20.1B to score.
			5	**Denominator**
	20.1 "Scope 1 emissions verified, but statement not provided" route			
20.1 A	Scope 1 - % of reported emissions verified/assured			Selection indicates that some or all emissions have been verified.
20.1 B	Verification/assurance statement			No statement provided
			5	**Denominator**
	20.1 "Scope 1 emissions not verified" route			
20.1 A	Scope 2 - % of reported emissions verified/assured			Emissions not verified
20.1 B	Verification/assurance statement			Not applicable
			5	**Denominator**
	20.1 "No selection made and no statement provided" route			
20.1 A	Scope 2 - % of reported emissions verified/assured			No selection made

20.1 B	Verification/assurance statement			No statement provided
			5	**Maximum denominator selected as no answers given.**
	Scope 2 is scored in the same way as Scope 1.			
	Scope 3			
	20.1 "Scope 3 emissions verified & statement provided" route			
20.1 A	Scope 3 - % of reported emissions verified/assured			Selection indicates that some or all emissions have been verified.
20.1 B	Verification/assurance statement provided			S3 must be selected in answer to 20.1B to score.
			2.5	**Denominator**
	20.1 "No selection made from S3 drop down but statement provided" route			
20.1 A	Scope 3 - % of reported emissions verified/assured			No selection made
20.1 B	Verification/assurance statement provided			S3 must be selected in answer to 20.1B to score.
			2.5	**Denominator**
	20.1 "Scope 3 emissions verified, but no statement provided" route			
20.1 A	Scope 3 - % of reported emissions verified/assured			Selection indicates that some or all emissions have been verified.
20.1 B	Verification/assurance statement			No statement provided
			2.5	**Denominator**
	20.1 "Scope 3 emissions not verified" route			
20.1 A	Scope 3 - % of reported emissions verified/assured			Emissions not verified
20.1 B	Verification/assurance statement			Not applicable
			2.5	**Denominator**
	20.1 "No selection made and no statement provided" route			
20.1 A	Scope 3 - % of reported emissions verified/assured			No selection made
20.1 B	Verification/assurance statement			No statement provided
			2.5	**Maximum denominator selected as no answers given.**
Emissions trading & offsetting				
	Emissions Trading and Offsetting			
	21.1 "Yes, we do trade emissions" route			
21.1	Do you participate in any emission trading schemes?		1	**Drop-down menu option:** Yes
21.2	Please complete the following table for each of the emission trading schemes in which you participate.			
	Scheme name		0.5	Given (0.5), Not given (0)
	Start date & End date		0.5	Both given (0.5), One or both not given (0)

	Allowances allocated		0.5	Given (0.5), Not given (0)
	Allowances purchased		0.5	Given (0.5), Not given (0)
	Verified emissions - number & units		0.5	Both given (0.5), One or both not given (0)
	Details of ownership		0.5	Given (0.5), Not given (0)
21.3	What is your strategy for complying with the schemes in which you participate or anticipate participating?		1	Strategy given (1) Not given (0)
			5	**Denominator**
	21.1 "Not currently, but anticipate doing so within the next two years" route			
21.1	Do you participate in any emission trading schemes?		1	**Drop-down menu option:** We don't currently, but anticipate participating in emissions trading within the next two years.
21.3	What is your strategy for complying with the schemes in which you participate or anticipate participating?		1	Strategy given (1), Not given (0)
			2	**Denominator**
	21.1 "No, we don't participate nor do we currently anticipate participating in any emissions trading scheme within the next two years." route			
21.1	Do you participate in any emission trading schemes?		1	**Drop-down menu option:** No, we don't participate nor do we currently anticipate participating in any emissions trading scheme within the next two years.
			1	**Denominator**
	21.1 "No answer given" route			
21.1	Do you participate in any emission trading schemes?		5	No selection made from the drop-down menu
			5	**Maximum denominator selected as no selection made.**
	Carbon credits			
	21.4 "Yes, we have purchased/originated credits" route			
21.4	Has your company originated any project-based carbon credits or purchased any within the reporting period?		1	**Drop-down menu option:** Yes
21.5	Please complete the following table.			
	Credit origination/credit purchase		2	1-2 data items from list covered - 0.5 point. 3-4 items - 1 point. 5-6 items - 1.5 points. 7 items - 2 points
	Project identification			
	Project documentation URL			
	Verified to which standard?			
	Number of credits			
	Credits retired?			
	Purpose			
			3	**Denominator**
	21.4 "No, we haven't purchased/originated credits" route			

21.4	Has your company originated any project-based carbon credits or purchased any within the reporting period?		1	**Drop-down menu option:** No
			1	**Denominator**
	21.4 "No answer" given			
21.4	Has your company originated any project-based carbon credits or purchased any within the reporting period?		3	No selection made from the drop-down menu
			3	**Maximum denominator selected as no answer given.**
Communications				
	Climate Change Communications			
	22.1 "Yes, we do publish" route			
22.1	Have you published information about your company's response to climate change/GHG emissions in other places than in your CDP response?		1	**Drop down menu option:** Yes
22.2	In your Annual Reports or other mainstream filing? Please attach your latest publication(s).		1	Attachment provided in Further Information (maximum 1, even if more than 1 report is attached), no attachment (0)
22.3	Through voluntary communications such as CSR reports? Please attach your latest publication(s).			
			2	**Denominator**
	22.1 "No, we don't publish" route			
22.1	Have you published information about your company's response to climate change/GHG emissions in other places than in your CDP response?		1	**Drop down menu option:** No
			1	**Denominator**
	22.1 "No, answer given" route			
22.1	Have you published information about your company's response to climate change/GHG emissions in other places than in your CDP response?		2	No selection made from the drop-down menu.
			2	**Maximum denominator selected as no selection made.**

Appendix 2: Regression normality test

It is vital to confirm that the regression results acquired are meeting the assumptions of regression analysis. There are three assumptions which need to be addressed for the individual variables are linearity, constant variance (homoscedasticity), and normality. A key issue in interpreting the regression variate is the correlation among the independent variables called multicollineraity. A measure of multicollineraity is the variance inflation factor (VIF) and a common cut-off threshold is a VIF value of 10 (Hair et al. 2010). The maximum VIF value of this model is 2.50, which indicates that no multicollineraity problem exists in this regression model.

A perfect regression model should have a residual which is normally distributed. Therefore, it is important to test the residual calculated from the regression model is normally distributed or not. For this purpose, this thesis adopts Kernel density plot and histogram Kernel density plot to check the normality of the regression residuals. Figure 1 and 2 shows the Kernel density plot and histogram Kernel density plot respectively.

Figure: Kernel Density Plot

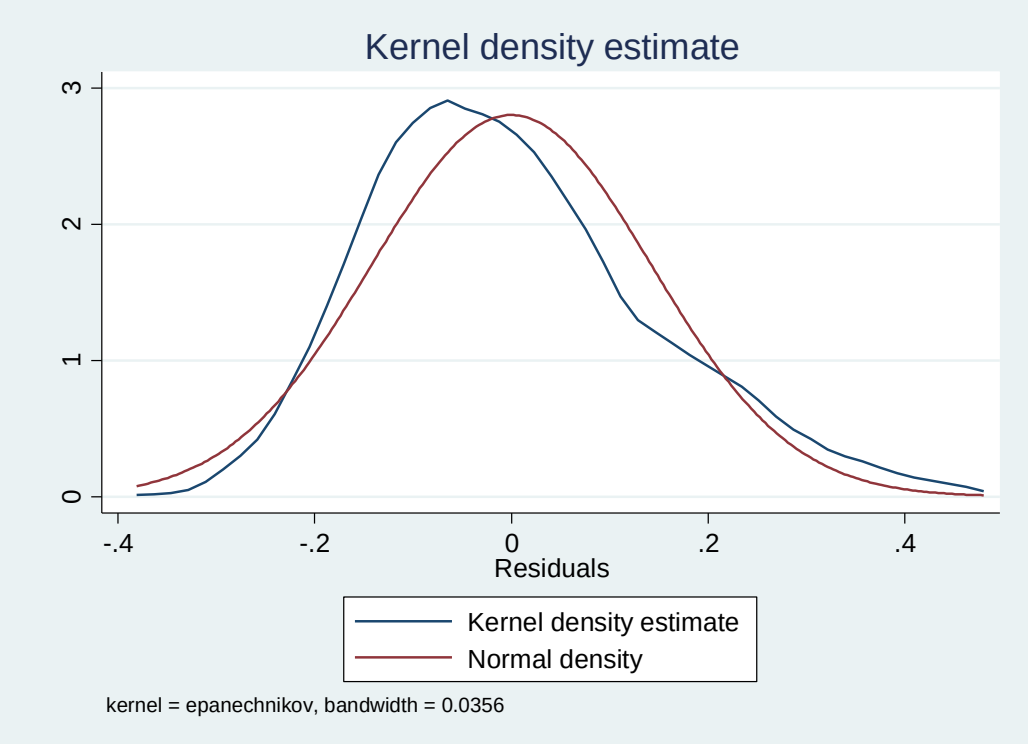
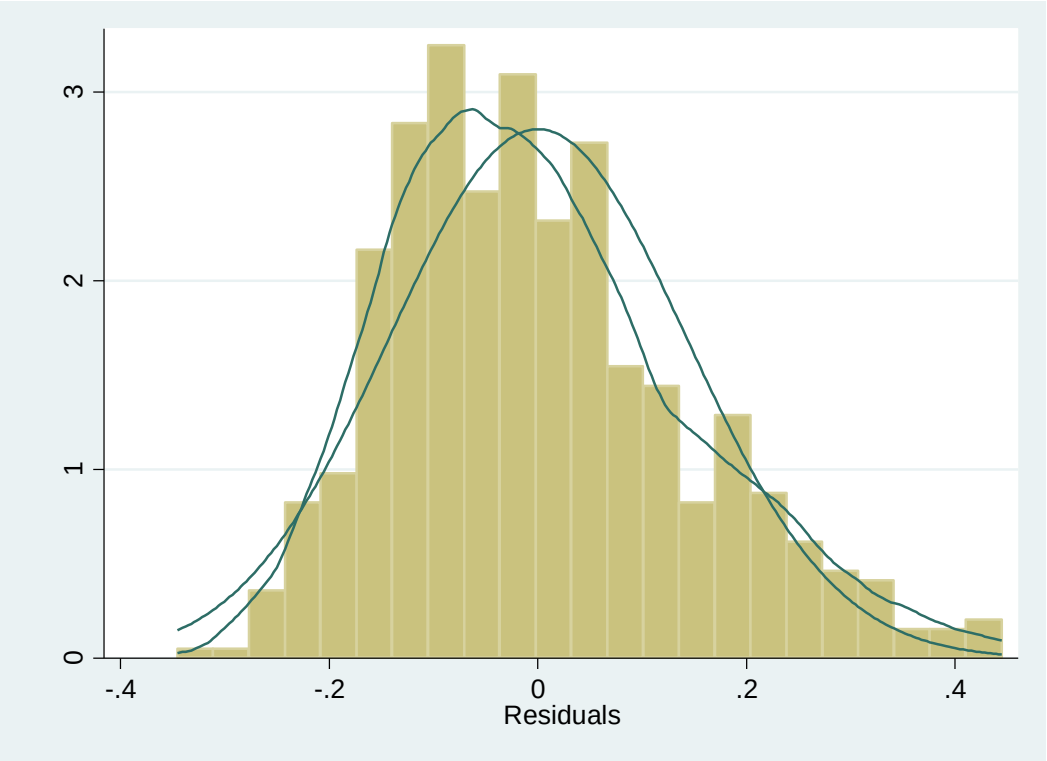


Figure: Histogram Kernel Density Plot



The figures confirm that the residual calculated from the regression in model 1 of Table 6.3 are normally distributed. Since the above two figures appear to be normal, figures confirms that there is no normality problem. To test the heteroskedasticity problem, this study relies on Breusch-Pagan / Cook-Weisberg test for heteroskedasticity. The significance of chi square of test is 0.1330 and indicates that it does not present of heteroskedasticity problem. We follow the same procedures for other regressions run in this study but not reported.