

**Climate Change Risks:
An Examination of Corporate Risk Responses,
Disclosures and Disclosure Implications**

by

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STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

14/08/2020

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STATEMENT OF AUTHORSHIP

This thesis consists of three studies. Although I am the principal author of these three studies, I acknowledge the contributions of Dr Rajni Mala (Principal Supervisor) and Dr Jessica Chen (Associate Supervisor). These contributions are outlined in the table below:

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STUDY 1: Climate Change Risk Responses by Companies	80%	10%	10%
STUDY 2: Climate Change Risks and Risk Response Disclosures by Companies	80%	10%	10%
STUDY 3: Investor Reactions to Climate Change Risks and Risk Response Disclosures by Companies	80%	10%	10%

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ABSTRACT

Climate change is one of the greatest challenges faced by Australian companies as it poses regulatory, physical and market risks that represent significant problems for companies and their stakeholders. Specifically, these risks can transform into large-scale financial problems exposing companies to billions of losses. Acknowledging the looming financial consequences of climate change risks, this thesis examines issues related to climate change through three studies set in the Australian context. The first study uses a survey to explore the extent of climate change risk responses by companies and whether the extent of climate change responses is influenced by the top risk managers' climate change belief, strategic management factors (i.e. company strategy and company structure) and stakeholder factors (i.e. stakeholder pressure and external stakeholder interaction). Its findings can be used by regulators to identify companies that are failing to provide adequate climate change risk responses and take necessary actions to ensure these shortcomings are addressed by companies. Using content analysis, the second study explores current climate change risk and risk response disclosures by companies, and whether the extent of these disclosures is impacted by corporate financial factors (i.e. profitability, gearing and ownership concentration) and corporate governance factors (i.e. proportion of non-executive directors, proportion of female directors and the presence of an environmental committee). Its findings provide important recommendations for companies to improve disclosure practices, which will create value for both the companies and their stakeholders, since inadequate disclosures can cause legal consequences for the former and uninformed decisions can cause unfavourable financial consequences for the latter. The third study uses a survey experiment to explore how investors react to different levels of climate change risk and risk response disclosures by companies. Its findings inform companies about investors' expectations regarding the extent of climate change risk disclosures when making investment decisions.

TABLE OF CONTENTS

CHAPTER 1: THESIS OVERVIEW	1
1. INTRODUCTION	2
1.1 MOTIVATION	3
1.2 AIMS AND OBJECTIVES	4
2. OVERVIEW OF THE STUDIES.....	6
2.1 STUDY 1: CLIMATE CHANGE RISK RESPONSES BY COMPANIES	6
2.2 STUDY 2: CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES.....	7
2.3 STUDY 3: INVESTOR REACTIONS TO CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES	8
3. RESEARCH METHOD	9
4. THESIS STRUCTURE	11
REFERENCES	12
CHAPTER 2: STUDY 1 CLIMATE CHANGE RISK RESPONSES BY COMPANIES	18
ABSTRACT.....	19
1. INTRODUCTION	20
2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT	23
2.1 DIFFERENCES IN CLIMATE CHANGE RISK RESPONSES	26
2.2 CLIMATE CHANGE BELIEF OF THE TOP RISK MANAGERS.....	28
2.3 COMPANY STRATEGY.....	29
2.4 COMPANY STRUCTURE	30
2.5 PRIMARY STAKEHOLDER PRESSURE.....	31
2.6 SECONDARY STAKEHOLDER PRESSURE.....	34
2.7 EXTERNAL STAKEHOLDER INTERACTION	35
3. METHOD.....	36
4. RESULTS AND DISCUSSION	39
5. CONCLUSION	50
REFERENCES	53
APPENDIX 1: ETHICS COMMITTEE APPROVAL	68
APPENDIX 2: RESEARCH INSTRUMENT	70
CHAPTER 3: STUDY 2 CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES.....	83
ABSTRACT.....	84
1. INTRODUCTION	85
2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT	89
2.1 GUIDELINES AND MOTIVES OF CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES	90
2.2 THE IMPACT OF CORPORATE FINANCIAL AND GOVERNANCE FACTORS ON CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES	96
3. METHOD.....	101
4. RESULTS AND DISCUSSION	105

4.1 ANALYSIS OF DISCLOSURES BY SECTOR	108
4.2 TESTS FOR COMPANIES WITH DISCLOSURES - COMPARISONS WITHIN SECTORS (ACROSS THEMES).....	110
4.3 TESTS FOR COMPANIES WITH DISCLOSURES - COMPARISONS WITHIN THEMES (ACROSS SECTORS)	111
4.4 EFFECTS OF CORPORATE FINANCIAL AND CORPORATE GOVERNANCE FACTORS ON CLIMATE CHANGE RISK DISCLOSURES.....	113
5. CONCLUSION	118
REFERENCES	122
CHAPTER 4: <i>STUDY 3</i> INVESTOR REACTIONS TO CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES.....	135
ABSTRACT.....	136
1. INTRODUCTION	137
2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT	139
3. METHOD.....	146
4. RESULTS	149
5. DISCUSSION	157
6. CONCLUSION	159
REFERENCES	162
APPENDIX 1: ETHICS COMMITTEE APPROVAL	169
APPENDIX 2.1: RESEARCH INSTRUMENT - VERSION ALPHA (CONTROL GROUP).....	171
APPENDIX 2.2: RESEARCH INSTRUMENT - VERSION BETA (EXPERIMENTAL GROUP).....	186
APPENDIX 2.3: RESEARCH INSTRUMENT - VERSION DELTA (EXPERIMENTAL GROUP)	201
CHAPTER 5: CONCLUSION.....	216
1. SUMMARY	217
2. CONTRIBUTIONS AND IMPLICATIONS.....	219
3. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH.....	220
REFERENCES	222

CHAPTER 1:

Thesis Overview

1. INTRODUCTION

This thesis acknowledges climate change as one of the greatest challenges faced by humanity (Sturmer, 2014), and explores climate change risk responses and disclosures by Australian companies along with the implications of such disclosures. Climate change, which is defined as “a change in the statistical properties of the climate system that persists for several decades or longer” (Australian Academy of Science, 2020, para. 2), is a long-established problem since scientists have judged that the Earth has “almost always been in a state of climate change” within “stable bounds” (Petit et al., 1999, p. 435). However, in Marcott et al.'s (2013) reconstruction of global temperature during the past 1500 years, the warming observed during the past three decades has been specified as unusual in comparison to changes that had occurred prior to the emergence of human activity. Marcott et al.'s (2013) observation strongly suggests that human influence has been a dominant factor driving modern global climate change which continues to increase in severity.

It is conceivable that human driven climate change would continue to result in large, abrupt events, causing serious consequences (Alley et al., 2003). The National Aeronautics and Space Administration (NASA, 2020) predicts that with the continuation of climate change, the global temperatures will increase inconsistently, heatwaves will intensify, sea levels will rise, lands will subside, the frost-free season will lengthen, precipitation patterns will change, droughts will intensify, and hurricanes will worsen. Furthermore, the United Nations has acknowledged that climate change is continuing at a rate much faster than anticipated and has recognised the urgent need for taking actions to combat climate change risks as one of its sustainable development goals for 2030 (United Nations, 2019). This recognition by the United Nations can be deemed timely as climate change is already disrupting economies, impacting lives, “costing people, communities and countries dearly today and even more tomorrow” (United Nations, 2020, para. 2). The destructive nature of climate change has also cast a long shadow over companies with a multitude of large corporations facing approximately a total of US\$ one trillion worth of losses from this looming environmental hazard (Carbon Disclosure Project, 2019).

1.1 MOTIVATION

This thesis is motivated by the climate change risks that are looming over companies and their stakeholders (e.g. investors). Specifically, climate change is expected to put billions of dollars at risk within a period of five years (Carbon Disclosure Project, 2019) and these risks may take the form of regulatory risks, physical risks and market risks. Regulatory risks can result from regulatory changes such as the introduction of mandatory climate change risk reporting, emissions taxes or emissions trading schemes that may give rise to compliance costs such as reporting and monitoring costs, additional corporate tax expenses, or non-compliance costs such as penalties and litigations (Gasbarro et al., 2017; Nikolaou et al., 2015). In comparison, physical risks result from climate induced variations in natural ecosystems such as sea level rises, and severe weather events such as bushfires, flooding and hailstorms, which may damage company property, cause resource shortages and operational disruptions (Sakhel, 2017), while market risks result from climate change induced variations in customer and financial markets and these may consequently harm companies through low customer demands and divestments by investors (Sakhel, 2017).

Whilst the risks posed by climate change will affect companies operating in multiple jurisdictions across the globe, the negative consequences of climate change for companies in Australia signal a bleak future (Plumer, 2019; Purtill, 2019). This bleak future is attributed to Australia's high level of exposure and sensitivity to the risks of climate change, as inaction on climate change could place Australia in the fifth position of the economies worst-affected by this global challenge, with a "business as usual" model expected to cause a \$29 billion annual loss from the country's gross domestic product by 2050 (Kelly, 2020; The Commonwealth Scientific and Industrial Research Organisation, 2019; The Garnaut Climate Change Review, 2011). Furthermore, Australian companies have faced regulatory risks of climate change with past governments seeking to implement a carbon pollution reduction scheme in 2008 and a carbon tax in 2012, and it is difficult to rule out this regulatory threat from the near future (Australian Broadcasting Corporation News, 2014). Another regulatory risk arises as directors of Australian companies have a legal duty to "act on climate change risk, include it in corporate strategies and report on it to shareholders", and failure to do so would attract legal consequences for the board (Ferryhough, 2019, para. 1). Additionally, Australian companies have been subject to the physical risks of climate change with bushfires, droughts, flooding and hailstorms causing multi-million dollars of damages, and this was evident with the most

recent Australian bushfires resulting in insurance losses estimated to be over AU\$300 million (British Broadcasting Corporation, 2020; Pandey, 2020; Roach, 2020; Henriques-Gomes, 2019). Moreover, climate change induced market risks have also become apparent with customers changing their attitudes with some demanding lower carbon energy and investors dropping stocks of companies that are exposed to the risks of climate change (Chalmers, 2020; Gíblom, 2019; Sakhel, 2017; Okereke and Russel, 2010).

Climate change risks faced by Australian companies also create a bleak future for investors because of its uncertain path and effect on investment portfolios (Flood, 2019). Especially with climate change induced disasters, economic losses and regulatory attention continuing to increase, risks associated with climate change have become a critical investment consideration (Morgan Stanley, 2020). This critical investment consideration is embedded in a US\$ 41 trillion investor climate campaign which pressures companies to detail how climate change impacts their businesses so equity providers can remove funds from companies that do not respond to those risks (Hurst, Massa and Chasan, 2020). Despite this effort, which also includes investor representations from Australia, investors are having to continue exerting pressure on companies to disclose their climate change risks and respond to those risks, with some going further such as taking legal action against Australian companies (Moore, 2020; Khadem, 2019). By considering these issues, Australia can be recognised as one of the most appropriate jurisdictions to study the climate change risks faced by companies.

1.2 AIMS AND OBJECTIVES

Acknowledging the risks faced by Australian companies due to climate change, their increasing severity, the significance of responding to and disclosing these risks for companies and the investors' interest in corporate climate change risk responses and disclosures, this thesis aims to achieve three objectives. First, this thesis aims to fill a crucial gap in the literature by exploring the extent of Australian company responses to climate change risks along with the effects of the top risk manager's climate change belief, strategic management factors (i.e. company strategy and company structure) and stakeholder factors (i.e. primary stakeholder pressure, secondary stakeholder pressure, external stakeholder interaction) on the extent of such disclosures. This objective carries benefits for Australian companies, corporate regulators and investors. Specifically, identifying the inadequacies of climate change risk responses would guide Australian companies to take actions to overcome these inadequacies.

Furthermore, identifying these inadequacies would benefit Australian regulators such as the Australian Securities and Investments Commission to better utilise their resources to identify companies that are likely to have inadequate climate change risk responses, to make necessary interventions to overcome these inadequacies. These corporate actions and regulatory interventions would consequently help safeguard investors' resources from the looming risks of climate change.

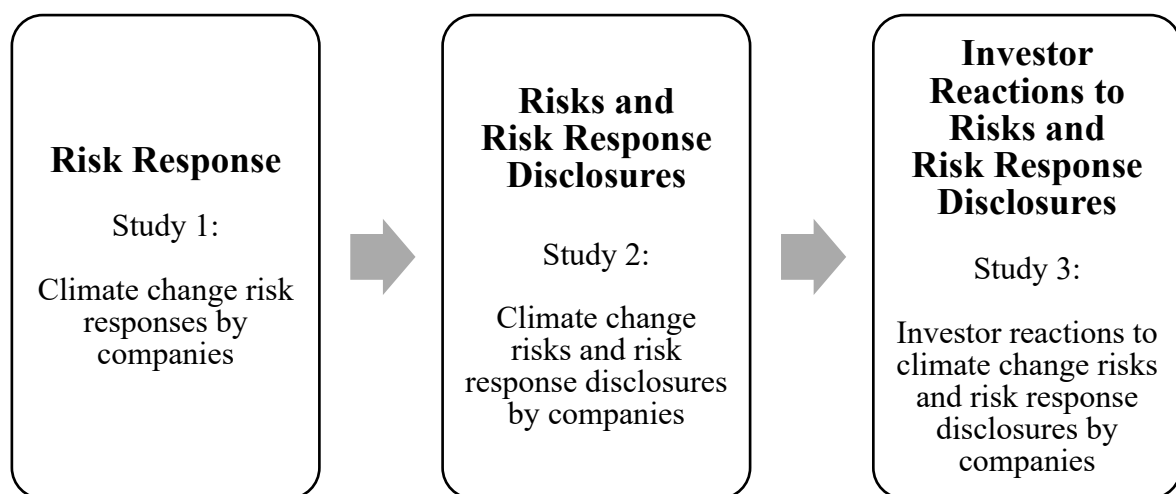
Second, this thesis aims to address another gap in the literature by exploring the extent of climate change risk and risk response disclosures by Australian companies, and whether corporate financial factors (i.e. profitability, gearing and ownership concentration) and corporate governance factors (i.e. proportion of non-executive directors, proportion of female directors and the presence of an environmental committee) influence the extent of such disclosures. Importantly, this thesis aims to produce recommendations to address company climate change risks and risk response disclosure inadequacies. These recommendations would guide companies to better address their climate change risk and risk response disclosure inadequacies, which would consequently help protect directors from breaching their statutory duty of due care and diligence. Furthermore, these recommendations would benefit regulators such as the Australian Securities and Investments Commission to improve the effectiveness of their oversight of corporate climate change risk disclosures and to protect investors from being left uninformed about the climate change risks faced by Australian companies.

Third, this thesis explores investors' reactions to varying levels of climate change risks and risk response disclosures, whilst considering investment time horizons (i.e. short-term and long-term) and investor personality traits (i.e. extraversion, neuroticism and climate change belief). This study benefits companies by demonstrating how different levels of climate change risk disclosures can impact the amount of resources allocated by short-term and long-term investors. The study also benefits investment companies by providing guidance on personality traits that would prove suitable for recruiting personnel to manage investment portfolios that are increasingly exposed to the impacts of climate change.

2. OVERVIEW OF THE STUDIES

To achieve the aims and objectives stated in the preceding section, this thesis introduces three self-contained studies. The first study explores climate change risk responses by Australian companies. The second study explores climate change risks and risk response disclosures of Australian companies. The third study explores how investors react to climate change risks and risk response disclosures. The links amongst these three studies are presented in Figure 1.

Figure 1



2.1 STUDY 1: CLIMATE CHANGE RISK RESPONSES BY COMPANIES

The first study explores the extent to which Australian companies respond to their regulatory risks (e.g. emissions management and the disclosure of climate change risks and risk responses), physical risks (e.g. bushfires, droughts hurricanes) and market risks (e.g. changes in customer and investor behaviour) resulting from climate change risks, and further investigates whether these responses are impacted by the top risk manager's climate change belief, strategic management factors (i.e. company strategy and company structure) and stakeholder factors (i.e. primary stakeholder pressure, secondary stakeholder pressure and the extent of the interaction with external stakeholders). This study uses survey data from the top risk managers of 120 Australian companies operating in the Insurance and Financial Services, Agriculture, Food and Beverages and Mining and Energy Production sectors, which are heavily impacted by climate change risks. Data are analysed using Wilcoxon Signed Ranks tests and regression analysis.

This study is motivated by the climate change risk response inadequacy of Australia's biggest companies, with Australia's top 100 companies not having identified climate change as a material business risk and 22 of Australia's biggest companies undermining climate action (Market Forces, 2020; Khadem, 2019). This response inadequacy can be detrimental for directors as they have a legal obligation to act on climate change risks, and failure to do so may create legal consequences for directors (Fernyhough, 2019). Furthermore, inadequate climate change risk responses by companies can be detrimental to stakeholders such as shareholders and creditors, as climate change poses a material risk to shareholder returns and poses a credit risk for banks when the financial health of their (corporate) borrowers is negatively impacted (The United Nations Environment Programme, 2018; Williams, 2018). Recognising these detrimental impacts on companies and their stakeholders, this study aims to demonstrate how companies and their stakeholders can improve company responses to climate change risks by for example, choosing a top risk manager who believes in climate change, changing company structure, and improving interaction with external stakeholders.

2.2 STUDY 2: CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES

The regulatory risk response of disclosing climate change risks and risk responses, which forms a crucial aspect of the first study, is extensively investigated in the second study by exploring the extent to which Australian companies produce disclosures about their climate change risks and risk responses. Specifically, it addresses two crucial areas of research. First, it explores the extent to which climate change risks and risk responses are disclosed by Australian companies with reference to the governance, strategy, risk management and metrics and targets themes under the Task Force on Climate Related Financial Disclosures (TCFD) framework, which aims to guide companies to effectively address stakeholders' demands for adequate climate change risk disclosures (TCFD, 2016). Second, it explores how the extent of these disclosures could be impacted by corporate financial factors (consisting of profitability, gearing and ownership concentration), and corporate governance factors (consisting of the proportion of non-executive directors, the proportion of female directors and the presence of an environmental committee). This study is conducted by performing content analyses on annual and sustainability reports which involves the analysis of sentence counts, word counts and disclosure type scores of disclosures, and archival data, of 114 Australian companies

representing the (i) insurance and financial services, (ii) agriculture, food and beverages, (iii) mining and energy production, (iv) transportation and tourism, and (v) healthcare providers and services sectors, which are heavily impacted by climate change risks are chosen for the content analysis.¹

This study is motivated by the inadequacy of climate change risk disclosures produced by Australian companies, as observed in prior studies. For example, “a third of Australia's biggest listed companies are keeping investors in the dark about how they are managing the potentially large financial risks of climate change” (Yeates, 2017, para. 1), leaving investors unaware of the potentially dire financial consequences that may await them. Further, this inadequacy of disclosures can also prove detrimental for companies since failure to disclose foreseeable climate-related risks forms a breach of the “statutory duty of due care and diligence” under the Australian Corporations Act 2001, which could consequently result in legal liabilities (Boyd, 2017, para. 13). Acknowledging these detrimental consequences, this study aims to identify the shortcomings of climate change risks and risk response disclosures by Australian companies and present recommendations for improved disclosures which will create value for the companies and stakeholders whilst helping directors to safeguard themselves from breaching their statutory duty of due care and diligence.

2.3 STUDY 3: INVESTOR REACTIONS TO CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES BY COMPANIES

The third study extends the second study by exploring how investors react to varying levels of climate change risk disclosures by companies. Specifically, it explores how investors react to non-disclosure (of any climate change risk information), disclosures limited to climate change risks, and disclosures of both climate change risks and risk responses, when short-term and long-term investment horizons are considered. Second, it explores the influence of investors' personality and climate change belief on their investment decisions. Specifically, the study examines the effect of an investor's extraversion, a personality trait which is characterised by “an orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience” (American Psychological Association, 2019a, para. 1); neuroticism, which is characterised by “a chronic level of emotional instability

¹ In addition to industry considerations, this sample was obtained from the S&P ASX (Australian Securities Exchange) 300 list (on 30th May 2018), which resulted in a final sample size of 114 companies.

and proneness to psychological distress” (American Psychological Association, 2019b, para. 1), and investor’s climate change belief, on their investment decisions. This study is based on a survey experiment of 96 experienced stock market investors. The instrument used by Milne and Patten (2002) and extracts from annual and sustainability reports of Australian listed companies are used to design the survey experiment.

This study is motivated by the ambivalence in the existing literature which suggests that negative environmental disclosures, such as climate change risks, are “likely to turn investors off” whilst also indicating that they could “signal proactivity and awareness of risk” which is in turn “honoured by investors” (Reimsbach and Hahn, 2015, p. 220; Chan and Milne, 1999, p. 274). This ambivalence combined with the absence of a unanimously accepted standard for disclosing information on climate change risks makes it difficult to anticipate how investors would react to varying levels of climate change risk information disclosures produced by companies. This contradiction in terms of environmental disclosures is problematic for companies as they would find it difficult to assess the extent to which climate change risk information should be disclosed to achieve desired investor reactions. Also, uncertainties surrounding how investors would allocate resources to companies that face climate change risks could prove problematic for investment firms, especially when determining the personnel who should manage investment funds that are highly exposed to climate change risks. Recognising these problems, this study aims to identify how investors react to different levels of climate change risk disclosures.

3. RESEARCH METHOD

This thesis adopts a mixed method approach consisting of a survey questionnaire, content analysis, archival data and a survey experiment. Specifically, the first study uses an online survey questionnaire to explore corporate climate change risk responses and the influence of the top risk manager’s climate change belief, strategic management factors and stakeholder factors on these responses. A survey is suitable for this study since a survey allows the researcher to directly investigate the subject’s attitudes, therefore avoiding the internal validity problems associated with archival studies, whilst removing some of the external validity problems associated with laboratory experiments by questioning the subject’s attitudes about real-life behaviour (Gassen and Schwedler, 2010). Furthermore, this anonymous online survey carries the benefit of minimising the potential for social desirability bias (Larson, 2019). This

survey was pre-tested by accounting academics prior to being administered to top risk managers of Australian companies through Qualtrics, a company that specialises in online data collection services. Top risk managers were chosen for this study since they could knowledgeably answer questions concerning the climate change risks faced by their companies and their companies' responses to the risks. 120 useable responses were obtained with a 39.34% response rate. Data were analysed through Wilcoxon Signed Ranks tests and regression analysis. Reliability tests, factor analysis and Harman's (1967) single-factor test for assessing common method bias were preformed to ascertain the rigour of the research method (Craighead et al., 2011).

The second study uses content analysis and archival data to explore the extent of corporate climate change risks and risk response disclosures, and the impact of corporate financial and governance factors on these disclosures. Content analysis is suitable for the analysis of disclosures since this method has been extensively used by scholars for analysing published information in corporate environmental responsibility research (Beck et al., 2010; Turker, 2009; Jose and Lee, 2007; Guthrie and Abeysekera, 2006). Archival data are used to study the impact of corporate financial factors and corporate governance factors on disclosures since the literature has demonstrated how archival studies have helped scholars better understand possible motivations for company disclosure choices (Moser and Martin, 2012). The content analysis was performed on annual and sustainability reports of 114 companies to assess the extent of climate change risks and risk response disclosures with reference to the Task Force on Climate-related Financial Disclosures (TCFD) framework. 5% of this sample was used to assess the inter-coder reliability. Sentence counts, word counts and disclosures type scores that were obtained from the content analysis were assessed using descriptive statistics, Friedman tests and Kruskal-Wallis test. Archival data for corporate financial and corporate governance factors were obtained for all but three companies that are considered for this study from multiple databases including Morningstar, IBIS World, D&B Hoovers, and company annual reports. Archival data of all companies (except for three) were assessed against their extent of climate change risk and risk response disclosures using regression analysis.

The third study follows the method of Holm and Rikhardsson (2008), Milne and Patten (2002) and Chan and Milne (1999) by using an online survey experiment to explore investor reactions to climate change risks and risk response disclosures. A survey experiment is suitable for this study since this enables the manipulation of the variable of interest - climate change risks and

risk response disclosures. The research instrument used in this study was developed by using content from annual and sustainability reports of Australian companies and Milne and Patten's (2002) research instrument. Three versions of the research instrument were prepared to represent the control group with no disclosures, first treatment group with risk disclosures and second treatment group with risks and risk response disclosures. The research instruments were pre-tested with five academic colleagues who have extensive experience in survey-based experimental studies and pilot tested by 18 stock market investors to evaluate feasibility, survey duration and the effectiveness of validation controls. The survey was administered to 195 stock market investors through Qualtrics. A final sample of 96 complete responses representing a 49% response rate was obtained. Data were then assessed using factor analysis and reliability tests to ensure the rigour of the method. Finally, data were analysed using descriptive statistics and Maan-Whitney Z-score tests and regression analysis.

4. THESIS STRUCTURE

The above-mentioned self-contained studies are presented in the second, third and fourth chapters of this thesis. References that accompany each study are presented at the end of each chapter. Furthermore, appendices containing survey instruments along with the corresponding Macquarie University Human Research Ethics Committee approval letters are presented at the end of each study where relevant. The fifth and final chapter concludes this thesis by consolidating the findings, contributions, limitations of the three studies and suggesting avenues for future research.

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CHAPTER 2:

STUDY 1

Climate Change Risk Responses by Companies

ABSTRACT

Climate change is a critical issue that poses regulatory, physical and market risks for companies. Yet, Australian companies are reportedly failing to adequately respond to climate change risks. This climate change risk response inadequacy can cause business losses and legal consequences, whilst also placing interests of stakeholders (e.g. investors and creditors) at risk. Acknowledging these problems, this study aims to explore the extent to which Australian companies respond to regulatory, physical and market risks of climate change. This study also explores the impact of the top risk manager's climate change belief, strategic management factors (i.e. company structure which is represented by the extent of organicity and company strategy which is represented by the extent of cost leadership) and stakeholder factors (i.e. stakeholder pressure and interaction with external stakeholders) on the extent of corporate climate change risk responses. Data for this study are collected from an online survey administered to 120 top risk managers of Australian companies from three sectors that are heavily exposed to climate change risks. Findings show that companies respond to regulatory risks to a greater extent than physical risks and market risks. It also shows that top risk managers' climate change belief, pressure from secondary stakeholders, the extent of cost leadership and stakeholder interaction are positively and significantly associated with the company's responses to regulatory, physical and market risks. This study fills a crucial gap in the literature by being one of the first to identify the extent to which Australian companies respond to regulatory, physical and market risks imposed by climate change. The findings of this study will guide Australian companies to take action to improve their climate change risk responses. These findings also benefit Australian regulators to better utilise their resources to identify companies that are likely to have insufficient climate change risk responses, to make necessary interventions to overcome these insufficient responses, which can consequently help safeguard investors' resources.

1. INTRODUCTION

Climate change is a critical issue faced by companies in the modern era with over 200 of the world's largest companies facing approximately a total of US\$ one trillion worth of risks from climate change (Carbon Disclosure Project, 2019). Given that these risks have become quite pronounced, investors and regulators are calling companies to manage their climate change risks by responding to them (Harvard University, 2019; Khadem, 2019). The risks are diverse, but the literature generally categorises them as regulatory risks, physical risks and market risks, all of which have also been encountered by certain companies in Australia (Chartered Accountants Australia and New Zealand, 2019; Bui and de Villiers, 2017; Sakhel, 2017). In Australia, the main climate change related regulatory risk arises from the legal duty of company directors to "act on climate change risk, include it in corporate strategies and report on it to shareholders, raising the real prospect that boards failing to act could end up in court" (Fernyhough, 2019, para. 1). In addition, regulatory risks can arise from greenhouse gas emissions. For example, Australian companies were subject to carbon tax from 2012 to 2013 (Australian Broadcasting Corporation News, 2014).

Furthermore, physical risks of climate change such as bushfires, flooding, hailstorms, amongst others, have severely impacted Australian companies in recent years by causing immense destruction to the businesses assets and continue to be a significant threat (British Broadcasting Corporation, 2020; Pandey, 2020; Henriques-Gomes, 2019). Unfortunately, no area/region in Australia appears to be safe from some of these impacts (e.g. hailstorms and bushfire smoke) as they cannot be contained within a specific geographical area. Additionally, market risks that arise from climate change induced shifts in customer and financial markets have also become prominent with investors dropping stocks of companies that are exposed to the risks of climate change and customers changing their attitudes with some demanding lower carbon energy (Chalmers, 2020; Giblom, 2019; Sakhel, 2017; Okereke and Russel, 2010).

The seriousness of climate change risks looming over companies is further emphasised in a 2019 report published by the environmental campaign group Market Forces, which has found that Australia's biggest companies are failing to plan for climate change risks with Australia's top 100 companies not having identified climate change as a material business risk (Khadem, 2019). If the companies are simply acknowledging the seriousness of climate change risks without actively responding to the risks, four crucial problems would emerge. First, it would

deprive investors, who have already emphasised the importance of climate change risks on their investment decisions from making well-informed resource allocation judgements (Potter, 2019). Second, it would put companies and their directors at risk of facing legal consequences under the Australian Corporations Act 2001 (Boyd, 2017). Third, it would lead to business losses and possible bankruptcies when businesses succumb to expensive natural disasters, and these can consequently damage the nation's financial stability (Burroughs, 2019; Murphy, 2019). Fourth, inadequate response to climate change risks, such as failing to meet public expectations for emission reductions, could also lead to reputational damage for a company, since subpar environmental performance is difficult to be concealed and consequently it can threaten a company's reputation (Esty, 2007).

The above-mentioned problems relate to the regulatory, physical and market risks and highlight the importance for Australian companies to respond to climate change risks as an urgent need rather than just acknowledging the risks. Therefore, in view of this need, this study aims to understand the extent of climate change risk response of Australian companies in the Insurance and Financial Services, Agriculture, Food and Beverages and Mining and Energy Production sectors, all of which are considerably exposed to risks posed by climate change and have greatly suffered during the past decade due to natural disasters (Bell, 2020; Caisley and O'Dwod, 2020; Actuaries Institute, 2016; International Council on Mining and Metals, 2013; Schaeffer et al., 2012; Business for Social Responsibility, 2011; Maddison, 2011). Specifically, this study explores the climate change risk response of the companies by focusing on two crucial facets. First, the study explores the climate change risk response of these companies by separately considering their responses to regulatory, physical and market risks posed by climate change. Second, this study investigates whether the response by these companies to regulatory, physical and market risks could be impacted by six crucial factors.

The first factor is the top risk manager's (i.e. chief risk officer's) climate change belief, which represents the belief attached to a powerful corporate position that has been considered by multiple studies as a proxy for enterprise risk management (Lundqvist, 2015). The second and third are strategic management factors consisting of company strategy (represented through the extent of cost leadership) which is closely associated with the environment (Nandakumar, Ghobadian, and O'Regan, 2010), and company structure (represented through the extent of organicity), which according to the literature, must be favourably aligned with the external environment which can produce significant constraints and contingencies (Nandakumar,

Ghobadian, and O'Regan, 2010). The fourth, fifth and sixth are stakeholder factors consisting of primary and secondary stakeholder pressure that represents a fundamental explanation of a company's environmental behaviours and strategies (González-Benito, Lannelongue and Queiruga, 2011), and external stakeholder interaction which is needed for companies for addressing complex environmental problems that expand into disciplines external to the business (Delgado-Ceballos et al., 2012). Until now, these six factors have not been examined by scholars with reference to the extended threat of climate change that arises from regulatory, physical and market risks. Addressing this gap in the literature is imperative since climate change, in addition to the seriousness of its threats, is a highly controversial topic, and practices that deal with climate change are debateable (Porter, Kuhn and Nerlich, 2018).

Data for this study were obtained through an online survey administered to the top risk managers of Australian companies operating in the Insurance and Financial Services, Agriculture, Food and Beverages and Mining and Energy Production sectors. The data obtained from a final sample of 120 responses were then analysed using Wilcoxon Signed Ranks test and regression analyses. The results show that companies respond significantly better to regulatory risks that carry a higher degree of certainty through clearly defined legislations, in comparison to their responses to physical and market risks that are less certain due to being complex, long-term and hidden in familiar and natural processes. This observation conforms to construal level theory which suggests that the psychological distance of climate change risks, created by the uncertainties about when, where, to whom and whether a climate risk event occurs, impacts people's assessment of the event and behavioural intentions. Furthermore, the results show that the top risk managers' climate change belief, the degree to which cost leadership is used as a company strategy, pressure from secondary stakeholders and external stakeholder interaction are positively and significantly related to the extent of company responses to regulatory, physical and market risks. Moreover, the results show a positive, significant association between an organic company structure and the company's response to regulatory risks imposed by climate change.

This study delivers three important contributions. First, it contributes to the literature by being one of the first to provide research insights into the responses of Australian companies to the regulatory, physical and market risks posed by climate change. Second, the results of the study deliver a practical contribution by demonstrating how Australian companies and their stakeholders can improve their responses to climate change risks by considering the selection

of the top risk manager, strategic management factors and stakeholder factors. Third, the findings deliver a practical contribution for regulators such as the Australian Securities and Investments Commission and the Australian Securities Exchange by helping them recognise companies that are inadequately responding to climate change risks. This will consequently help the regulators take necessary actions to ensure shortcomings of climate change risk responses are addressed in a timely manner.

The remainder of the study proceeds as follows. The second section provides a review of the literature and hypotheses development. The third section outlines the research method. The fourth section discusses the results. The fifth section provides the conclusion and the implications of the study.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Amongst the key risks faced by businesses due to climate change, regulatory risks typically arise from carbon taxes and emissions reducing cap and trade schemes which can cause substantial expenses through compliance requirements of environmental legislation and regulations or through penalties associated with non-compliance (Gasbarro, Iraldo, and Daddi, 2017; Nikolaou, Evangelinos and Leal Filho, 2015). This risk can be expected to affect emission-intensive industries such as the Mining and Energy production sector and the Agriculture, Food and Beverages sector (Climate Council, 2018). It is also worth noting that this risk can indirectly impact the Insurance and Financial Services sector especially when corporate lending contracts are considered, since corporate borrowers' exposure to carbon risk increases the uncertainty of future cash flows, which can consequently impact the credit default risk (Jung, Herbohn and Clarkson, 2018). Furthermore, these industries would also be subject to regulatory risks arising from the legal duty of directors to respond to climate change risks and report them to shareholders, as non-compliance could cause legal consequences (FERNYHOUGH, 2019). In comparison, physical risks that may arise from cyclones, droughts, bushfires, heatwaves and floods, amongst others, can cause millions' worth of losses through damages to corporate assets, disruptions to operations and resource supplies and therefore the whole business model becomes unviable (Sakhel, 2017; Winn et al., 2011). As mentioned earlier, some of these physical risks such as hailstorms and bushfire smoke cannot be limited to a specific geographical area. Hence, the physical risks of climate change have the potential to threaten any location, any company and any industry. The same can be anticipated for market

risks that can arise from shifts in demands for products or services and investor withdrawals of funds from companies, and these can cause financial implications for companies through reputational damages, boycotts and poor purchasing power of economies susceptible to the impacts of climate change (Sakhel, 2017; Linnenluecke et al., 2015; Wittneben et al., 2012; Baiocchi et al., 2010). Therefore, climate change can lead to detrimental impacts on companies across all industries, leading to a heightened need for companies to respond to these regulatory, physical and market risks (Sakhel, 2017).

Literature on corporate responses to risks posed by climate change mostly focuses on the reduction of greenhouse gas emissions, which is typically introduced in response to regulatory risks (Gasbarro, Iraldo and Daddi, 2017; Galbreath, 2010). Many studies have explored the corporate strategies used to cope with current and future climate change policies and regulations surrounding emissions (e.g. Bui and de Villiers, 2017; Weinhofer and Hoffmann, 2010; Kolk and Pinkse, 2005). These strategies include (i) product improvements (e.g. to achieve energy efficiency products), (ii) process and supply improvements (e.g. to achieve emission reductions), (iii) internal transfer of emission reductions, (iv) new market combinations (e.g. strategic alliance between oil and automobile companies to develop fuel cells) and (v) acquisition of emissions credits (Lee, 2012; Kolk and Pinkse, 2005). Studies have also explored the disclosure of greenhouse gases from a regulatory perspective (e.g. Andrew and Cortese, 2011). However, climate change risk disclosures are remaining largely voluntary for companies across many jurisdictions (Cotter and Najah, 2012). Despite the voluntary nature of such disclosures, there is a growth in mandatory regulatory regimes, such as the Australian Securities Exchange listing requirement 4.10.3, which mandates the disclosure of material environmental risks; and the European Union directive 2014/95, which mandates the disclosure of greenhouse gas emissions (Task Force on Climate-related Financial Disclosures, 2017; Andrew and Cortese, 2011). Hence, it is imperative for companies operating in jurisdictions such as Australia that have partially regulated climate change risk disclosures to acknowledge such regulatory risks and respond to them accordingly.

In addition to regulatory risk responses, a few studies have explored climate change related physical risk responses implemented by companies. In the business literature, studies on corporate responses to physical risks posed by climate change appear to be outnumbered by studies investigating corporate responses to regulatory risks posed by climate change. In order to overcome this limitation, the crisis and disaster management literature, which provides

insights into a company's safeguarding capabilities for preventing the development of a crisis or lessening the effects of a crisis once it occurs, could serve as a useful addition to the limited research on corporate responses to physical risks posed by climate change (Preble, 1997). These studies that have emerged during the past decade have sought to explore how companies could better adapt and become resilient to the physical risks posed by climate change (Pinkse and Gasbarro, 2019; Linnenluecke, Griffiths and Winn, 2012). Some of these physical risk responses include planning for crisis management and business continuity (e.g. developing alternatives to overcome property damages caused by severe weather events), taking out insurance for property damages and operation interruptions, and transfer of business activities to unexposed geographical locations to reduce the risk exposure (Pinkse and Gasbarro, 2019; Sakhel, 2017; Weinhofer and Busch, 2013; Linnenluecke, Stathakis and Griffiths, 2011).

Scholars have also explored how companies respond to market risks posed by climate change. As an example, Pellegrino and Lodhia (2012, p. 70), who argue that mining companies are under "continuous public scrutiny to conduct their operations in a more environmentally sustainable manner and consider the effect of their activities on various stakeholders", have identified that these environmentally sensitive companies are communicating to stakeholders internal company changes directed at reducing emissions (i.e., a legitimising strategy). Furthermore, Kolk and Pinkse's (2004) study on market strategies for climate change has identified three competitive effects arising from changes in costs (e.g. high energy costs), demand fluctuations (e.g. products with low emissions potential) and new technologies (e.g. energy efficient improvements), all of which carry the potential to become business opportunities. Moreover, Kollias and Papadamou (2016) have observed how mutual funds are offering environmentally responsible investment opportunities, such as energy derived from renewable energy sources, in response to investors' demand for portfolios specialising in green investments. In comparison, Ferguson, de Aguiar and Fearfull's (2016) study on corporate emissions trading scheme participation has found that companies are using linguistic strategies such as discourse to displace their responsibility of tackling climate change to constituents such as suppliers. Additionally, Sakhel (2017) has found that companies in high polluting sectors do not recognise a higher market risk when compared to companies in low polluting sectors, and that companies are taking substantial time to develop new markets, products, or processes, despite the availability of options to respond to market pressure.

The above mentioned climate change risk responses hold heightened importance currently, since companies are having to respond to climate change to protect economic interests, such as shareholder wealth, meet regulatory requirements, and to manage legitimacy threats such as pressures of meeting community expectations (Kumarasiri and Gunasekarage, 2017; Pellegrino and Lodhia, 2012). These expectations are embedded in the social contract between the company and the society, and therefore, breaking this contract can threaten the long-term survival of the company (Kumarasiri and Gunasekarage, 2017). This looming threat combined with the devastating direct effects that could result from the regulatory, physical, and market risks of climate change, has placed a great deal of urgency for companies to identify and assess the risks, and take actions to minimise the risks (Weinhofer and Busch, 2013). Yet, the literature suggests that companies' responses to climate change risks are inadequate. In this literature, only a handful of researchers have sought to explore company responses to regulatory, physical and market risks in a single study (Sakhel, 2017). Despite these limited efforts, there is an absence of academic studies on how Australian companies respond regulatory, physical and market risks of climate change as a whole, since studies generally focus on a single type of risk (e.g. regulatory risks). This is a crucial gap in the literature since Australia is a nation with a high level of exposure and sensitivity to the risks of climate change (The Commonwealth Scientific and Industrial Research Organisation, 2019; The Garnaut Climate Change Review, 2011). Acknowledging this literature gap, this study explores the extent to which Australian companies respond to regulatory, physical and market risks of climate change.

2.1 DIFFERENCES IN CLIMATE CHANGE RISK RESPONSES

Amongst the handful of studies that have sought to explore company responses to regulatory, physical and market risks of climate change, Sakhel's (2017, p. 112) study on climate change risk management by European companies has found that "most of the risk responses companies deploy are aimed at regulatory risks, rather than physical or market risks". This finding partially supports Pinkse and Gasbarro's (2016) study on managing the physical impacts of climate change in the oil and gas industry, which suggests that firms notice and respond to certain stimuli whilst ignoring others. It is unclear whether the uncertainties surrounding extreme weather events, specifically about their magnitude, timing, and location (Linnenluecke and Griffiths, 2010), could result in insufficient physical risk response. Literature does suggest that uncertainties may affect company responses to market risks, as it can be argued that

considerable uncertainty associated with markets (e.g. deaccelerating growth of the renewable energy market) may lead to ambiguity in company responses (Jones and Levy, 2007). This notion of uncertainty is also embedded in construal level theory, which helps explain why company responses to climate change risks might differ.

Construal level theory argues that “varying levels of psychological distance” including hypothetical (certain vs. uncertain), spatial (here vs. far away), temporal (now vs. future/past) or social (me vs. others) can “influence how people represent objects mentally and what information they consider when making judgments and decisions” (Brügger, Morton and Dessai, 2016, pp. 125 - 126). In other words, this theory suggests that the psychological distance, created by the perception of when, where, to whom and whether an event occurs, impacts people’s assessment of the event and behavioural intentions. When the notion of ‘psychological distance’ is applied to climate change, which is perceived by a majority of the public as a ‘distant threat’ (Brügger, Morton and Dessai, 2016, p. 126), people’s assessment of climate change risks and their intentions to respond to those risks can be expected to differ depending on the psychological distance attributed to each risk. As an example, regulatory risks that arise from clearly defined legislations could be viewed by companies as a proximal threat when legal consequences for non-compliance is certain. In comparison, physical risks that raise uncertainties about their magnitude, timing, and location (Linnenluecke and Griffiths, 2010), could be more likely to be viewed as a distant threat (i.e. likely to take place in the long-run), especially with the defining characteristics of this environmental problem being “complex, long-term, distant, and ‘hidden’ in familiar and natural processes” (Lorenzoni, Nicholson-Cole and Whitmarsh, 2007, p. 454). Similarly, market risks could be viewed as a distant threat if the realisation of market risks is uncertain with the rise in public uncertainties about climate change (Poortinga et al., 2011). With this reasoning, company responses to regulatory risks posed by climate change are likely to be far greater than their responses to physical and market risks posed by climate change, resulting in the following hypothesis:

H1 Company’s responses to regulatory risks of climate change would be greater than their responses to physical risks and market risks of climate change.

Furthermore, evidence from the literature suggests that organisation-level factors could influence how companies respond to environmental problems such as climate change. As an example, Reid and Toffel’s (2009, p. 1168) study on corporate climate change responses

suggests that “regulatory threats influence the practices even of firms not directly targeted by the threat”. Furthermore, Galbreath’s (2010) study on corporate governance practices that address climate change suggests that larger boards, separation of the chief executive officer and the chair, younger directors and a greater representation of inside directors lead to better performance across climate change related governance practices. Moreover, Aggarwal and Dow’s (2012) study on corporate climate change and environmental mitigation has observed that higher institutional ownership is related to a lower extent of environmental policy implementation. Despite these research efforts, the extant literature lacks studies that explore the influence of top risk manager’s personal climate change belief and organisation-level factors, including strategic management factors and stakeholder factors, on companies’ responses to climate change risks. Addressing this literature gap is warranted since these factors are linked with the literature on corporate environmental management and corporate risk management (Lundqvist, 2015; Su and Tsang, 2015; Gordon, Loeb and Tseng, 2009; Bleda and Shackley, 2008; Murillo-Luna, Garcés-Ayerbe and Rivera-Torres, 2008; Covin and Slevin, 1989). Addressing this gap is further warranted since the resulting knowledge can guide companies and their stakeholders in improving companies’ climate change risk responses.

2.2 CLIMATE CHANGE BELIEF OF THE TOP RISK MANAGERS

The top risk managers’ climate change belief can be anticipated to affect corporate climate change risk responses since many studies consider the role of top risk manager as a proxy for company risk management (Lundqvist, 2015; Gordon, Loeb and Tseng, 2009). When assessing corporate climate change risk responses, the top risk manager’s climate change belief needs to be considered for three reasons. First, the top risk manager, whether it may be the chief risk officer (CRO) or a chief executive officer (CEO, who may also assume the risk manager role in some companies), holds an influential position within the company by being responsible for overseeing and managing the risks of the whole company (Liebenberg and Hoyt, 2003). Second, these individuals’ climate change belief can be expected to influence company risk responses, since studies suggest that cognitive factors such as beliefs have greater relevance as causes of organisational inertia in the context of adaptation to climate change (Bleda and Shackley, 2008). Third, this investigation is further warranted since studies show a decline in public concern about climate change in major industrialised countries, including Australia, which has a fierce opposition of climate change (Jang and Hart, 2015; Engels et al., 2013). This raises the possibility that in Australia, the top risk managers’ climate change belief may differ

from that of other organisational members. Consequently, the climate change beliefs of top risk managers coupled with the fierce debate on climate change taking place in the Australian society can be expected to cause differences in companies' risk responses to climate change. Since the literature presents climate change risk perceptions as crucial predictors of attitudes towards adaptational behaviours and suggests that believing the existence of this problem and perceiving its threats are essential to motivate adaptational measures (Mase, Cho and Prokopy, 2015), it can be argued that the stronger the top risk managers' climate change belief is, the better the company's responses to climate change risks would be. This leads to the following hypothesis:

H2 The degree of the top risk manager's climate change belief is positively associated with the extent of the company's response to the:

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

2.3 COMPANY STRATEGY

Porter (1980) introduced two generic business strategies named 'cost leadership' and 'differentiation' for creating a defensible position in the long run (Banker, Mashruwala and Tripathy, 2014; White, 1986). According to Porter, these two strategies represent opposite ends on a continuum (Parnell, 2014; Jones and Butler, 1988). Companies with a cost leadership strategy aim to increase market share by forming a low-cost position when compared to their competitors, and this strategy requires aggressive pursuit of cost reductions and tight cost control (Banker, Mashruwala and Tripathy, 2014; Auzair and Langfield-Smith, 2005). In comparison, companies with a differentiation strategy elevate costs and aim to achieve competitive advantage by offering products or services that carry unique qualities desirable to customers by commanding a price premium (Banker, Mashruwala and Tripathy, 2014; Jones and Butler, 1988).

When these two generic business strategies are considered in a hostile environment resulting from climate change, one can argue that since cost leaders are concerned with scanning for environmental opportunities rather than environmental threats (Nandakumar, Ghobadian and

O'Regan, 2010), the extent to which a company follows a cost leadership strategy may have a negative impact on the company's climate change risk responses. Similarly, since responding to climate change risks carries the pressure of additional expenses for measures such as insurance and technological improvements (Sakhel, 2017), companies with a cost leadership strategy that prioritise a low-cost position would be less likely to spend money on climate change risk responses. Conversely, it can also be argued that cost leaders can be anticipated to accept upfront costs of climate change risk responses to minimise long-term negative financial implications of climate change resulting from regulatory pressures, physical damages and losses in demand for products/shares (Sakhel, 2017). Therefore, cost leaders who seek a defensible long-term low-cost position can be expected to prefer long-term cost reductions over short-term reductions (Besanko, Dranove and Shanley, 2001), and consequently such companies can be anticipated to implement climate change risk responses to reduce long-term costs despite the likelihood of incurring upfront costs. This argument is supported in Soltanizadeh et al.'s (2016) study which shows that companies with a cost leadership strategy have a higher likelihood of enterprise/company risk management/response implementation. Hence, the following hypothesis is proposed:

H3 The degree to which a company adopts a cost leadership strategy is positively associated with the extent of the company's response to the:

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

2.4 COMPANY STRUCTURE

The way companies are structured can be expected to have an impact on how they respond to the risks posed by climate change. In general, the literature has categorised company structures as either an 'organic' structure, which is characterised by decentralised decision making, informality, flexibility and open communications, or, the opposing 'mechanistic' structure, which is characterised by centralised decision making, strict adherence to formal rules/procedures, clearly structured reporting relationships and tight control (Osipova and Eiksson, 2013; Slevin and Coven, 1997; Covin, Slevin and Schultz, 1994). Since a high degree of organicity paves way for open communication, one may argue that organic structures could

fuel debates on uncertainties of climate change and the costs associated with climate change policies, especially in countries such as Australia where climate change is fiercely debated (Jang and Hart, 2015; Schmidt, Ivanova and Schäfer, 2013). Consequently, organicity can be anticipated to cause conflicts that may hinder corporate responses to climate change risks.

However, literature suggests that organic structures are better suited for less stable, less predictable environments as their open communication leads to a greater information processing capability demanded by uncertain environments (Burnes, Cooper and West, 2003; Gordon and Narayan, 1984). Since climate change poses the risk of sudden, disruptive changes, it can be argued that companies with a high degree of organicity, which is also characterised by a high degree of decentralisation and flexibility would be better prepared for responding to the risks posed by climate change, in comparison to companies with highly mechanistic structures with tight control, low decentralisation and high bureaucracy that creates difficulties in responding to changes in a timely manner (Winn et al., 2011; Kalagnanam and Lindsay, 1999; Jennings and Seaman, 1994). This argument coupled with Beach et al.'s (2000) extensive literature review which suggests the broad recognition of the use of flexibility to accommodate environmental uncertainty strongly indicates that organicity would have a positive effect on how a company responds to its climate change risks. This leads to the following hypothesis:

H4 The degree of company organicity is positively associated with the extent of the company's response to the

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

2.5 PRIMARY STAKEHOLDER PRESSURE

Insights from institutional theory suggests that the environment in which a company operates is characterised by rules and regulations the company must obey to secure legitimacy (Al-Twaijry, Brierley and Gwilliam, 2003). This legitimacy is gained when company stakeholders determine that the activities and goals of the company conform to their expectations (Surroca, Tribó and Zahra, 2013). Companies have a range of stakeholders, who can affect or can be affected by the company's operations (Freeman and Gilbert, 1987). Clarkson (1995) classifies

these stakeholders into primary and secondary stakeholders. Amongst these two groups, the participation and survival of primary stakeholders is essential for a company to survive (González-Benito and González-Benito, 2010). Some of the notable primary stakeholders include the government, shareholders/investors, customers, suppliers and employees (Clarkson, 1995). These stakeholders and companies have influence on each other, since stakeholders depend on the companies and companies depend on the stakeholders (Sharma and Henriques, 2005). When the latter is considered, empirical research shows that stakeholder needs serve as a dominant driver in the planning of company's environmental strategies and stakeholder theory itself explains that a company's efforts to meet their stakeholders' environmental needs results in proactive or advanced environmental strategies (Garcés-Ayerbe, Rivera-Torres and Murillo-Luna, 2012). This has been proven by Murillo-Luna, Garcés-Ayerbe and Rivera-Torres (2008) through empirical evidence of a positive and significant relationship between stakeholder pressure and environmental proactivity.

However, one can argue that primary stakeholders may not always drive environmentally proactive corporate responses (e.g. emissions reduction) especially when suppliers and customers are considered. Specifically, suppliers who are being pressured by customers to adopt particular environmental standards (e.g. ISO 14001 Environmental Management System Standard) and present information about their "vulnerability to climate change and their strategies to reduce greenhouse gas emissions" (Jira and Toffel, 2013, p. 1), may not be keen to exert pressure on buyer companies to respond to climate change risks as this pressure may present additional demands for suppliers themselves. In a similar vein, investors with short-term interests in companies would not have a strong enough motive to pressure companies to respond to long-term threats posed by climate change, especially with the literature on investment behaviour showing that investors following a short-term strategy avoid companies that incur pollution abatement expenditures (Milne and Patten, 2002; Chan and Milne, 1999).

Conversely, it can be argued that suppliers who themselves are responding to the risks posed by climate change may exert some influence on the buyer companies to respond to climate change risks to help the buyer companies survive in the long-run, which could consequently help maintain a long-term supplier-buyer relationship. This influence may also depend on the suppliers' bargaining power which forms a crucial aspect of the Porter's Five Forces model (Porter, 2008). Specifically, powerful suppliers such as those who hold a monopolistic position, those who do not heavily rely on the industry for its revenue, those who operate in industries

that cause supplier switching costs for buyers and those who offer distinctive products with no substitutes can be anticipated to exert a considerable level of influence on the buyer companies (Porter, 2008). Similarly, it can also be argued that if short-term investors acknowledge that climate change risks have become more apparent recently, increasing the possibility of causing damages for companies in the short term which could consequently impact their short-term returns, they can be anticipated to exert pressure on companies to respond to climate change risks in the short term (Chartered Accountants Australia and New Zealand, 2019; Bui and de Villiers, 2017).

Moreover, it can be argued that other primary stakeholders, including the government, customers, long-term investors and creditors would exert pressure on companies to spend money on climate change responses to ensure the company is able to survive in the long run. Evidence from the literature supports this view by demonstrating that governments, customers and shareholders/investors have put pressure on companies to reduce greenhouse gas emissions (Sprengel and Busch, 2011; Reid and Toffel, 2009; Jeswani, Wehrmeyer and Mulugetta, 2008). Especially, long-term investors may have stronger motivation to exert pressure on companies to produce responses as their financial stake in the company may be jeopardized by long-lasting environmental problems such as climate change that could lead to substantial costs in the long run (Milne and Patten, 2002). Additionally, creditors such as banks are considering environmental risks during lending decisions as environmental exposure of lending can be “direct (e.g. remediation costs of a contaminated land used as a security for a loan), indirect (compliance with stricter environmental regulations and/or altered customer preferences may affect a company's revenues and thus its ability to repay its loan) and reputational” (Georgopoulou et al., 2015, p. 874). This strengthens the argument that the overall effect of primary stakeholder pressure would have a positive influence on climate change risk responses of companies, leading to the following hypothesis:

H5 The degree of primary stakeholder pressure is positively associated with the extent of the company's response to the:

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

2.6 SECONDARY STAKEHOLDER PRESSURE

In comparison to primary stakeholders, the secondary stakeholders do not directly engage in transactions with the company (González-Benito and González-Benito, 2010). Some of the secondary stakeholders include communities/social groups, competitors, media and non-governmental organisations (Clarkson, 1995). Like primary stakeholders, secondary stakeholders can also exert pressure on companies to respond to impending climate change risks. These stakeholders do not hold formal contractual bonds with companies. Despite this, secondary stakeholders can engage in communication of environmental practices that could discourage companies from responding to climate change risks. As an example, media outlets can create controversies about climate change and exaggerate its uncertainties (Whitmarsh, 2008). One can argue that such actions by secondary stakeholders may pressure companies to refrain from implementing climate change risk responses.

Yet, evidence from the literature strongly suggests that high pressure from secondary stakeholders such as non-governmental organisations, social groups and competitors can drive environmental proactivity (Castka and Prajogo, 2013; Eesley and Lenox, 2006; Madsen and Ulhøi, 2001; Berry and Rondinelli, 1998). Furthermore, the literature suggests that secondary stakeholders communicate the company's environmental practices to wider audiences, which can consequently force companies to substantially address their environmental management (Castka and Prajogo, 2013). These stakeholders can induce companies to respond to their requests by engaging in actions such as protests, civil suits and the use of media communications that can consequently strain a company's reputation (Su and Tsang, 2015; Castka and Prajogo, 2013; Eesley and Lenox, 2006). Additionally, since secondary stakeholders do not have a financial stake in the company, they may not demonstrate a significant level of resistance to company expenses attached to climate change risk management/response. Consequently, the overall effect of secondary stakeholder pressure can be anticipated to improve climate change risk responses by companies, leading to the following hypothesis:

H6 The degree of secondary stakeholder pressure is positively associated with the extent of the company's response to the:

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

2.7 EXTERNAL STAKEHOLDER INTERACTION

In comparison to stakeholder pressure, which is initiated by the stakeholders, interactions with stakeholders are initiated by companies. Such interactions can be expected to provide companies with alternative and novel insights, especially if the interactions are with external stakeholders who are not involved with daily operations and decision-making processes. According to the literature, external stakeholders such as governments, customers, communities contribute to companies through participating in corporate decisions (Tian, Liu and Fan, 2015). Such external stakeholder interactions can be anticipated to cause conflicting stakeholder opinions on the risks posed by climate change on businesses, since climate change is a “highly charged and partisan political issue intertwined with deeper ideological and cultural divisions” (Wright and Nyberg, 2017, p. 1636). Consequently, a high degree of external stakeholder interaction could potentially restrict the climate change risk responses by companies if faced with conflicting stakeholder opinions.

Conversely, the literature strongly suggests that the extent of external stakeholder interaction may improve company responses to climate change risks. Especially, the environmental management literature has demonstrated how external stakeholders such as governments have exerted pressure on companies to implement the regulatory risk response of reducing greenhouse gas emissions, making it difficult to exclude the likelihood of such interactions with powerful external stakeholder influencing a company to improve its climate change risk response (Sprengel and Busch, 2011). Furthermore, external stakeholder interactions can also give rise to symbiotic and collective learning effects between the company and its stakeholders (Plaza-U'beda et al., 2010). The knowledge gathered through these learning efforts could prove useful for companies to better understand the risks posed by climate change, which is a problem of an interdisciplinary nature. This view is supported by many studies that have emphasised the importance of interaction with external stakeholders for environmental management

(Onkila, 2011). When the issue of climate change is considered, external stakeholder collaboration can be expected to assist companies to expand its knowledge and to induce innovations for proactive environmental strategies (Delgado-Ceballos et al., 2012). Based on this reasoning, the following hypothesis is proposed:

H7 The degree of the company's interaction with external stakeholders is positively associated with the extent of the company's response to the:

- i. regulatory risks posed by climate change
- ii. physical risks posed by climate change
- iii. market risks posed by climate change

3. METHOD

Data for this study were collected through an online survey administered through Qualtrics to the top risk managers of Australian companies. The survey method was chosen for this study since it allows researchers to directly investigate the subject's attitudes, therefore avoiding the internal validity problems associated with archival studies, whilst removing some of the external validity problems associated with laboratory experiments by questioning the subject's attitudes about real-life behaviour (Gassen and Schwedler, 2010). Furthermore, this self-administered online survey, which ensures respondent anonymity, carries the benefit of minimising the potential for social desirability bias (Larson, 2019).

The survey participants were randomly chosen from Australian companies operating in the Insurance and Financial Services, Agriculture, Food and Beverages, and Mining and Energy Production sectors. Australia was chosen due to its high level of exposure and sensitivity to the risks of climate change (The Commonwealth Scientific and Industrial Research Organisation, 2019; The Garnaut Climate Change Review, 2011). The Insurance and Financial Services sector was chosen as it faces pressure due to transfer of climate change risks from organisations, large claims and bad debts in lending that results due to climate change (Vincent, 2018; Yeates, 2017; Actuaries Institute, 2016). The Agriculture, Food and Beverages sector was chosen as it faces climate change induced temperature increases, extreme weather events, rainfall variations, and water scarcity (National Climate Change Adaptation Research Facility, 2018; Organisation for Economic Co-Operation and Development; 2015; Business for Social

Responsibility, 2011). The emissions intensive Mining and Energy Production sector was chosen as it can attract regulatory pressures such as government-imposed emission limits to control its greenhouse gas emissions (Fernyhough, 2018; Morton, 2018).

A final sample of 120 responses representing a 39.34% (120/305) response rate was obtained after expending a significant amount of time setting and conducting rigorous quality checks, jointly conducted by Qualtrics and the researcher. This response rate is high, considering the role/position specificity of the survey participants and difficulties associated with accessing top risk management personnel. To ascertain that non-response bias is not likely to be a concern, a comparison of early versus late respondents was performed (Roberts, 1999). Specifically, this involved comparing the means of the early versus late responses of the independent and dependent variables using Mann-Whitney tests. The results confirmed that there are no significant differences between the early and the late responses, ascertaining that non-response bias is not likely to be a concern. Moreover, a screen out question at the very beginning of the survey ensured that these survey respondents were top risk managers who oversee all the risks in their companies. This measure provided confidence that respondents knowledgably answered the questions concerning the risks faced by their companies and their companies' responses to the risks.

All the variables were measured on seven-point Likert scales. The regulatory risk response (RegRR)² was measured on a scale developed by using the content from the Task Force on Climate-Related Financial Disclosures (TCFD) framework (TCFD, 2017) and Lee and Klassen (2016). Both physical (PhyRR)³ and market (MktRR)⁴ risk responses were measured using scales developed by Sakhel (2017) – e.g. “energy-efficient or less carbon-intensive products/services”, “taking out insurances for covering potential damage to assets or supply chain disruptions” and “research and development activities aiming to improve reputation/address changing customer preferences on changing climate conditions”. The top risk manager's climate change belief (CCBlf) was measured on a scale adapted from Engels et al. (2013) – e.g. “climate change is currently occurring”. Cost leadership (Cost_L) was measured on scale adapted from Hoejmose et al. (2013) – e.g. “Our prices are among the lowest in the industry”. Organicity (Orgncty) were measured on a scale adapted from Covin and Slevin

² For items that measure regulatory risk responses, please see Appendix items 15.1 to 16.4 (inclusive).

³ For items that measure physical risk responses, please see Appendix items 17.1 to 17.7 (inclusive).

⁴ For items that measure market risk responses, please see Appendix items 17.8 to 17.16 (inclusive).

(1989) - e.g. “a strong insistence on a uniform managerial style throughout the company” vs. “managers’ operating styles allowed to range freely from the very formal to the very informal”.

Primary and secondary stakeholder pressure (STKPres_P and STKPres_S) were measured using items adapted from González-Benito and González-Benito (2010). Primary stakeholders consisted of governments and regulatory agents, customers/consumers, suppliers, employees, investors and creditors, whilst secondary stakeholders consisted of communities and social groups, nongovernmental organisations, competitors and the media (González-Benito and González-Benito, 2010). External stakeholder interaction (STKInt) which represents the interaction with governments and regulatory agents, customers/consumers, suppliers, creditors, communities and social groups, non-governmental organisations, competitors and media, was measured on a scale adapted from Plaza-Úbeda et al. (2010) – e.g. “The company consults the external stakeholders and asks them for information before making decisions”. All these scales have good reliability, with the individual Cronbach’s alpha scores exceeding the cut-off score of 0.65 (Taber, 2018). Factor analyses were also performed to establish the construct validity of each scale by ensuring that items that measure each variable have minimum loadings of 0.30, which is commonly considered as a cut-off high enough to provide interpretive value (Comrey and Lee, 1992).

Data analysis commenced by performing descriptive statistics, and this included Friedman and Wilcoxon Signed Ranks Tests to explore the differences amongst the three risk responses. Regression analysis was then performed to explore whether the top risk manager’s climate change belief, strategic management factors and stakeholder factors influence the extent to which Australian companies respond to the regulatory, physical and market risks of climate change. The regression model below was separately considered for the regulatory risk response, physical risk response and market risk response. Three control variables were added, that is, sector/industry (Mining_EP and Agri_FB), company size (Comp_Size) and the climate change risk exposure of the company (CCRE). The first two control variables are considered since differences in sector and company size can be anticipated to cause differences in climate change risk exposure. Specifically, when compared to the Insurance and Financial Services sector, the Agriculture, Food and Beverages sector and the Mining and Energy Production sector can be expected to face greater exposure to regulatory and physical risks arising from climate change due to the nature of the businesses, whilst companies that are larger in size could be easily targeted by regulatory risks (e.g. higher carbon taxes attached to higher emissions),

physical risks (e.g. multiple natural disasters if the company has operations across multiple locations) and market risks (e.g. high public scrutiny associated with high media exposure) of climate change. The third control variable is considered since differences in climate change risk exposure can cause deviations in the company's response to the climate change risks it faces. Company size was measured by the total number of full-time employees in the company (Hoque and James, 2000), whilst climate change risk exposure was measured using a scale adapted from Kouloukoui et al. (2019).

$$\text{Risk Response} = \beta_0 + \beta_1 \text{CCBlf} + \beta_2 \text{STKPres_P} + \beta_3 \text{STKPres_S} + \beta_4 \text{Cost_L} + \beta_5 \text{Orgncty} + \beta_6 \text{STKInt} + \beta_7 \text{Sector} + \beta_8 \text{Comp_Size} + \beta_9 \text{CCRE} + \varepsilon^5$$

As the data for the predictor and criterion variables of this study were obtained from the same source, this study is subject to the risk of common method variance which leads to common method bias. Mindful of the potential for common method bias, this survey was carefully designed in accordance with the procedural remedies to mitigate this bias suggested by Podsakoff, MacKenzie and Podsakoff (2012). Furthermore, Harman's (1967) single-factor test, which is the most commonly used remedy to control for common method variance, was performed to assess whether common method bias is a problem in this study (Craighead et al., 2011). Results of Harman's (1967) single-factor test shows that the single factor accounts for 37.479%, 34.692% and 35.481% of the total variance of the regulatory, physical and market risk response models. These results are less than the 50% cut-off used by scholars for establishing that common method bias is not a problem in a study (Fuller et al., 2016).

4. RESULTS AND DISCUSSION

Table 1 provides the demographic information regarding the participants from small, medium and large companies, ranging from having 3 to 26,000 full-time equivalent employees. Of the 120 participants, 75 (62.5%) were males and 45 (37.5%) were females. On average, participants across the three industries had been holding the top risk manager role for more than six years. 43 participants represented the Insurance and Financial Services sector, 45

⁵ CCBlf = Climate change belief, STKPres_P = Primary stakeholder pressure, STKPres_S = Secondary stakeholder pressure, Cost_L = Cost leadership, Orgncty = Organicity, STKInt = Stekeholder interaction, MiningEP = Mining and energy production sector, AgriFB = Agriculture, food and beverages sector, Comp_Size = Company size, CCRE = Climate change risk exposure

represented the Agriculture, Food and Beverages sector, and 32 represented the Mining and Energy Production sector.

Table 1: Demographic Information of the Participants

Demographic	Insurance and Financial Services	Agriculture, Food and Beverages	Mining and Energy Production
Sample size	43	45	32
<u>Gender</u>			
Male	22 (51.2%)	28 (62.2%)	25 (78.1%)
Female	21 (48.8%)	17 (37.8%)	7 (21.9%)
<u>Age</u>			
20-29 years	7 (16.3%)	12 (26.7%)	2 (6.3%)
30-39 years	15 (34.9%)	16 (35.6%)	12 (37.5%)
40-49 years	14 (32.6%)	8 (17.8%)	6 (18.8%)
50-59 years	7 (16.3%)	7 (15.6%)	10 (31.3%)
Over 59 years	0 (0%)	2 (4.4%)	2 (6.3)
<u>Education level</u>			
No college/university education	1 (2.3%)	2 (4.4%)	3 (9.4%)
Diploma/certificate or equivalent	5 (11.6%)	11 (24.4%)	3 (9.4%)
Bachelors' degree or equivalent	19 (44.2%)	19 (42.2%)	12 (37.5%)
Masters' degree or equivalent	17 (39.5%)	13 (28.9%)	12 (37.5%)
Doctorate	1 (2.3)	0 (0%)	2 (6.3%)
Years in the role as a top risk manager	Average: 8.16 Minimum: 1 Maximum: 34	Average: 6.16 Minimum: 1 Maximum: 18	Average: 8.19 Minimum: 2 Maximum: 34

H1 predicts that company responses to regulatory risks posed by climate change would be better than their responses to physical and market risks posed by climate change. Table 2 addresses H1 by showing the differences in company responses to the regulatory, physical and market risks. Panel A shows the descriptive statistics, Panels B and C contain the Friedman Test result and the Wilcoxon Signed Ranks Test result which shows the differences amongst the three risk responses. The means recorded under Panel A show that companies better respond to regulatory risks (4.70), followed by responses to physical risks (4.57) and market risks (4.49). Panel B demonstrates a significant ($p < 0.05$) difference amongst the three responses. The results in Panel C further expands the Panel B observation by showing that the

regulatory risks response of companies is significantly greater compared to the physical risk response ($p < 0.05$) and market risk response ($p < 0.01$). Therefore, results in Table 2 support H1. The difference between physical and market risk responses is not significant.

This result is consistent with Sakhel's (2017) finding of greater deployment of regulatory risk responses in comparison to physical and market risk responses by European and American companies. When this result is framed using construal level theory, it can be argued that the differences in psychological distances associated with these risks may have contributed to the observed differences in the risk responses. Specifically, it can be argued that companies are better responding to 'proximal' regulatory risks that carry a great deal of certainty through clearly defined legislations, in comparison to the 'distant' physical risks that are complex, long-term and "hidden in familiar and natural processes" (Lorenzoni, Nicholson-Cole and Whitmarsh, 2007, p. 454) and 'distant' market risks that are uncertain with the rise in public uncertainties about climate change (Poortinga et al., 2011). This finding is a major concern since physical risks of climate change such as bushfires, flooding, hailstorms amongst others have severely impacted Australian companies in the recent past and continues to be a significant threat (British Broadcasting Corporation, 2020; Pandey, 2020; Henriques-Gomes, 2019) and since market risks have also become prominent with investors dropping stocks of companies that are exposed to the risks of climate change (Chalmers, 2020; Gibblom, 2019). Hence, it is imperative that companies consider the physical and market risks of climate change as equally significant as the regulatory risks posed by climate change and better respond to the risks.

Table 2: Comparison of Climate Change Risk Responses

Panel A: Descriptive Statistics

	N	Mean	Std. Dev.	Min.	Max.
REG_RR	120	4.70	1.29	1	7
PHY_RR	120	4.57	1.29	1	7
MKT_RR	120	4.49	1.28	1	7

Panel B: Friedman Test

	N	Mean Rank	Chi-square	Asymp. Sig.
REG_RR	120	2.18	8.004	0.018*
PHY_RR	120	2.00		
MKT_RR	120	1.82		

*p < 0.05

Panel C: Wilcoxon Signed Ranks Test

		N	Mean Rank	Sum of Ranks	Z	Sig.
PHY_RR – REG_RR	Neg. Ranks	63	64.29	4050.50	-1.997	0.046*
	Pos. Ranks	52	50.38	2619.50		
	Ties	5	N/A	N/A		
	Total	120	N/A	N/A		
MKT_RR – REG_RR	Neg. Ranks	74	64.29	4757.50	-3.759	0.000***
	Pos. Ranks	42	48.30	2028.50		
	Ties	4	N/A	N/A		
	Total	120	N/A	N/A		
MKT_RR – PHY_RR	Neg. Ranks	63	61.79	3893.00	-1.558	0.119
	Pos. Ranks	52	53.40	2777.00		
	Ties	5	N/A	N/A		
	Total	120	N/A	N/A		

*p < 0.05, ***p < 0.001

Note: REG_RR = Regulatory risk response, PHY_RR = Physical risk response, MKT_RR = Market risk response

To answer the remaining hypotheses, regression analyses were performed. The descriptive statistics are presented in Table 3 – Panel A. The Pearson correlation matrix is presented in Table 3 – Panel B. Multicollinearity is unlikely as the correlation values are below the 0.8 cut-off specified by Judge et al. (1980). The regression analysis results are presented in Table 3 Panels C and D.

Table 3: Impacts of Top Risk Managers' Climate Change Belief, Strategic Management Factors and Stakeholder Factors

Panel A: Descriptive Statistics

	Mean	Median	Standard Deviation
CCBlf (1 = Low, 7 = High)	5.14	5.25	1.41
Cost_L (1 = Low, 7 = High)	3.74	3.83	1.01
Orgncty (1 = Low, 7 = High)	4.41	4.50	1.11
STKPres_P (1 = Low, 7 = High)	4.42	4.50	1.03
STKPres_P – Gov (1 = Low, 7 = High)	4.48	5.00	1.30
STKPres_P – Cus (1 = Low, 7 = High)	4.63	5.00	1.25
STKPres_P – Sup (1 = Low, 7 = High)	4.46	5.00	1.32
STKPres_P – Emp (1 = Low, 7 = High)	4.42	5.00	1.35
STKPres_P – Shd (1 = Low, 7 = High)	4.53	5.00	1.36
STKPres_P – Cre (1 = Low, 7 = High)	4.03	4.00	1.44
STKPres_S (1 = Low, 7 = High)	; 4.47	4.75	1.18
STKInte (1 = Low, 7 = High)	4.44	4.50	1.77
Mining_EP (1 = Mining_EP, 0 = Other)	0.26	0.00	0.44
Agri_FB (1 = Agri_FB, 0 = Other)	0.37	0.00	0.48
Comp_Size (Natural logarithm of the full-time employee total)	4.95	4.88	1.90
CCRE (1 = Low, 7 = High)	4.30	4.50	1.12

Note: REG_RR = Regulatory risk response, PHY_RR = Physical risk response, MKT_RR = Market risk response, CCBlf = Climate change belief, Cost_L = Cost leadership, Orgncty = Organicity, STKPres_P-Gov = Government pressure, STKPres_P-Cus = Customer/consumer pressure, STKPres_P-Sup = Supplier pressure, STKPres_P-Emp = Employee pressure, STKPres_P-Shd = Shareholder pressure, STKPres_P-Cre = Creditor pressure, STKPres_S = Secondary stakeholder pressure, STKInt = Stakeholder interaction, Mining_EP = Mining and energy production sector, Agri_FB = Agriculture, food and beverages sector, Comp_Size = Company size, CCRE = Climate change risk exposure.

Panel B: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1. REG_RR	-											
2. PHY_RR	0.911***	-										
3. MKT_RR	0.917***	0.942***	-									
4. CCBIf	0.522***	0.543***	0.483***	-								
5. Cost_L	0.096	0.172 ⁺	0.184*	-0.225*	-							
6. Orgncty	0.389***	0.313**	0.298**	0.223*	0.047	-						
7. STKPres_P	0.605***	0.618***	0.634***	0.489**	0.017	0.216*	-					
8. STKPres_S	0.690***	0.717***	0.753***	0.470***	0.022	0.106	0.765***	-				
9. STKInt	0.727***	0.681***	0.696***	0.472***	-0.061	0.398***	0.717***	0.693***	-			
10. Mining_EP	0.094	0.077	0.090	0.085	-0.017	-0.030	0.163 ⁺	0.151	0.129	-		
11. Agri_FB	0.089	0.055	0.064	0.094	-0.051	0.068	-0.062	0.059	0.109	-0.467***	-	
12. Comp_Size	-0.080	-0.087	-0.042	-0.131	-0.017	-0.026	-0.009	-0.006	0.044	-0.017	-0.157 ⁺	-
13. CCRE	0.366***	0.414***	0.415***	0.345***	0.013	0.076	0.643***	0.607***	0.415***	0.150	-0.023	0.005

⁺p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Note: REG_RR = Regulatory risk response, PHY_RR = Physical risk response, MKT_RR = Market risk response, CCBIf = Climate change belief, STKPres_P = Primary stakeholder pressure, STKPres_S = Secondary stakeholder pressure, Cost_L = Cost leadership, Orgncty = Organicity, STKInt = Stakeholder interaction, MiningEP = Mining and energy production sector, AgriFB = Agriculture, food and beverages sector, Comp_Size = Company size, CCRE = Climate change risk exposure.

Panel C: Main Analysis

	REG_RR		PHY_RR		MKT_RR	
Adjusted R square	0.647		0.657		0.671	
	<i>Coef.</i>	<i>Sig.</i>	<i>Coef.</i>	<i>Sig.</i>	<i>Coef.</i>	<i>Sig.</i>
CCBlf	0.201	0.004**	0.269	0.000***	0.170	0.011*
Cost_L	0.147	0.012*	0.232	0.000***	0.223	0.000***
Orgncty	0.163	0.010*	0.094	0.131	0.094	0.122
STKPres_P	-0.070	0.506	-0.077	0.455	-0.051	0.616
STKPres_S	0.421	0.000***	0.462	0.000***	0.547	0.000***
STKInte	0.376	0.000***	0.301	0.002**	0.288	0.002**
Mining_EP	-0.016	0.808	-0.064	0.315	-0.037	0.553
Agri_FB	-0.023	0.729	-0.071	0.277	-0.037	0.559
Comp_Size	-0.065	0.252	-0.069	0.219	-0.030	0.591
CCRE	-0.083	0.270	-0.037	0.618	-0.068	0.347

⁺p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Note: REG_RR = Regulatory risk response, PHY_RR = Physical risk response, MKT_RR = Market risk response, CCBlf = Climate change belief, Cost_L = Cost leadership, Orgncty = Organicity, STKPres_P = Primary stakeholder pressure, STKPres_S = Secondary stakeholder pressure, STKInt = External stakeholder interaction, Mining_EP = Mining and energy production sector, Agri_FB = Agriculture, food and beverages sector, Comp_Size = Company size, CCRE = Climate change risk exposure.

Panel D: Additional Analysis

	REG_RR		PHY_RR		MKT_RR	
Adjusted R square	0.649		0.668		0.671	
	<i>Coef.</i>	<i>Sig.</i>	<i>Coef.</i>	<i>Sig.</i>	<i>Coef.</i>	<i>Sig.</i>
CCBlf	0.206	0.003**	0.289	0.000***	0.173	0.011*
Cost_L	0.149	0.014*	0.229	0.000***	0.213	0.000***
Orgncty	0.152	0.017*	0.094	0.129	0.088	0.153
STKPres_P - Gov	0.102	0.134	0.033	0.621	0.080	0.223
STKPres_P - Cus	-0.109	0.168	-0.055	0.471	-0.089	0.240
STKPres_P - Sup	-0.034	0.687	-0.138	0.095 ⁺	-0.021	0.796
STKPres_P - Emp	0.033	0.695	0.087	0.291	0.008	0.922
STKPres_P - Shd	-0.109	0.210	-0.139	0.101	-0.114	0.175
STKPres_P - Cre	0.004	0.961	0.158	0.076 ⁺	0.068	0.439
STKPres_S	0.421	0.000***	0.407	0.000***	0.537	0.000***
STKInte	0.418	0.000***	0.295	0.003**	0.315	0.001**
Mining_EP	-0.031	0.637	-0.082	0.207	-0.059	0.359
Agri_FB	-0.029	0.662	-0.092	0.161	-0.043	0.505
Comp_Size	-0.049	0.404	-0.046	0.427	-0.018	0.751
CCRE	-0.080	0.288	-0.024	0.741	-0.065	0.372

⁺p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Note: REG_RR = Regulatory risk response, PHY_RR = Physical risk response, MKT_RR = Market risk response, CCBlf = Climate change belief, Cost_L = Cost leadership, Orgncty = Organicity, STKPres_P-Gov = Government pressure, STKPres_P-Cus = Customer/consumer pressure, STKPres_P-Sup = Supplier pressure, STKPres_P-Emp = Employee pressure, STKPres_P-Shd = Shareholder pressure, STKPres_P-Cre = Creditor pressure, STKPres_S = Secondary stakeholder pressure, STKInt = Stakeholder interaction, Mining_EP = Mining and energy production sector, Agri_FB = Agriculture, food and beverages sector, Comp_Size = Company size, CCRE = Climate change risk exposure.

H2 suggests that the top risk manager's degree of climate change belief is positively related to the company's climate change risk responses. Findings in Table 3 support H2 as the top risk manager's climate change belief is positively and significantly related to regulatory ($p < 0.05$), physical ($p < 0.01$) and market ($p < 0.05$) risk responses. These results support the argument that cognitive factors such as beliefs have greater relevance as causes of organisational inertia in the context of adaptation to climate change (Bleda and Shackley, 2008). It further supports the literature by demonstrating that climate change risk perceptions are crucial predictors of attitudes towards adaptational behaviours (Mase, Cho and Prokopy, 2015). Specifically, these results suggest that the top risk manager's perceived characteristics of climate change influence their assessment of climate change risks, and these assessments coupled with their influential position in the company affects how the company responds to the risks of climate change. This result strongly signals to companies that are susceptible to climate change risks to assess the climate change belief of personnel considered for the positions that oversee the management of risks faced by the company, as it could have a considerable effect on the company's response to the risks posed by climate change.

H3 suggests that the degree to which the company follows a cost leadership strategy is positively related to the company's climate change risk responses. Results in Table 3 support H3 as the degree to which the company follows a cost leadership strategy is positively and significantly related to regulatory ($p < 0.05$), physical ($p < 0.01$) and market ($p < 0.01$) risk responses. This result does not support the argument that climate change risk responses that carry added expenses such as insurance and technological improvements could demotivate companies with a cost leadership strategy that prioritise a low-cost position from spending money on climate change risk responses. In comparison, this result supports the argument that seeking a defensible, long-term position, a cost leader that exploits the advantage of lower prices can be expected to prefer long-term cost reductions over short-term reductions (Besanko, Dranove and Shanley, 2001).

H4 suggests that the company's degree of organicity is positively related to the company's climate change risk responses. Findings in Table 3 support H4(i) by showing that the degree of organicity is positively and significantly ($p < 0.05$) related to regulatory risk response. However, H4(ii) and H4(iii) are not supported as the positive relationships observed for the physical and market risk responses are not significant. The results for H4(i) support the argument that companies with an organic structure that features a high degree of

decentralisation and flexibility would be better prepared to respond to climate change risks that can produce disruptive changes (Jennings and Seaman, 1994). It can be speculated that the low visibility of these risks (when compared to the clear-cut regulatory risks) combined with open communication of an organic structure, which may fuel debates on uncertainties of climate change and the costs associated with climate change policies, may have contributed to the lower physical and market risk responses (Schmidt, Ivanova and Schäfer, 2013). Yet, the positive relationship observed between organicity and the climate change risk responses implies that if a company adopts a combination of a mechanistic and an organic structure to better respond to climate change risks, emphasis needs to be placed on maintaining a high degree of decentralisation, informality, flexibility and open communications.

H5 suggests that primary stakeholder pressure is positively related to the company's climate change risk responses. However, results in Table 3 do not provide support to H5 as primary stakeholder pressure is negatively (and insignificantly) related to all the risk responses (regulatory, physical and market). To obtain further insights into the influence of primary stakeholder pressure, an additional regression analysis was conducted to separately explore the pressure of each primary stakeholder group. Consistent with the main analysis results, results of this additional analysis presented in Table 5 largely fails to demonstrate significant primary stakeholder pressure. Two exceptions for this are found under the PHY_RR (physical risk response) column as it shows that the pressure exerted by suppliers is negative and marginally significant ($p < 0.10$), whilst the pressure exerted by creditors is positive and marginally significant ($p < 0.10$). The negative pressure observed for suppliers support the argument that suppliers may not be keen to exert pressure on buyer companies to respond to climate change risks as this pressure may present additional demands for suppliers, who are increasingly being asked by customers to present information about their "vulnerability to climate change and their strategies to reduce greenhouse gas emissions" (Jira and Toffel, 2013, p. 1). Furthermore, the positive pressure observed for creditors implies that this pressure may have been motivated by exposure of lending to environmental risks such as remediation costs and altered customer preferences that could impact a company's revenues and the resulting ability to repay debts (Georgopoulou et al., 2015).

However, it is unclear if the observed insufficient primary stakeholder pressure may have been caused by conflicting pressures exerted by short-term and long-term investors. As an example, long-term investors who have a long-term stake in the company are likely to pressure companies to implement climate change responses to ensure the company can survive in the long run. Especially from long-term investors' perspective, environmental problems could lead to substantial costs in the long run (Milne and Patten, 2002), and hence they would have a considerable interest in ensuring that companies are effectively responding to these problems. In comparison, other primary stakeholders, such as short-term investors, who have a short-term stake in the company, can be expected to discourage companies from implementing climate change risk responses that can create short-term expenses. This argument can be backed up by studies on investment behaviour, since they report investors following a short-term strategy avoid investing in companies that incur pollution abatement expenditures (Milne and Patten, 2002; Chan and Milne, 1999). Similarly, short-term expenditures associated with climate change risk responses may lead to reductions in short-term profit, which may reduce the value of short-term dividends, consequently leading short-term investors to discourage companies from incurring such expenses.

H6 suggests that secondary stakeholder pressure is positively related to the company's climate change risk responses. Findings in Table 3 show support for H6 as secondary stakeholder pressure is positively and significantly ($p < 0.01$) related to all the risk responses (regulatory, physical and market). This result supports the existing literature by proving that secondary stakeholder pressure can force companies to substantially address their environmental management (Castka and Prajogo, 2013). Furthermore, the observed positive significant relationship supports the argument that secondary stakeholders, who do not have a financial stake in the company, are unlikely to exert pressure on companies to limit expenses relating to climate change responses. Moreover, this result is supported by the literature which suggests that environmental proactivity can be anticipated when companies experience high pressures from secondary stakeholders such as communities/social groups, competitors, non-governmental organisations and the media (Castka and Prajogo, 2013; Eesley and Lenox, 2006; Madsen and Ulhøi, 2001; Berry and Rondinelli, 1998).

H7 suggests that the degree of external stakeholder interaction is positively related to the company's climate change risk responses. Results in Table 3 support H7 as the degree of external stakeholder interaction is positively and significantly related to regulatory ($p < 0.01$),

physical ($p < 0.05$) and market ($p < 0.05$) risk responses. These results support the literature by demonstrating that external stakeholders such as governments and communities contribute to companies through participation decisions (Tian, Liu and Fan, 2015), and that symbiotic and collective learning effects associated with the interaction of a company with its external stakeholders assists companies to better understand their climate change risks and consequently produce better risk responses (Plaza-U'beda et al., 2010). Importantly, these results suggest that even though climate change is established as a “highly charged and partisan political issue intertwined with deeper ideological and cultural divisions” which could give rise to conflicting stakeholder opinions about the importance of responding to climate change risks, integration of external stakeholders plays a crucial role in improving companies’ responses to climate change risks (Wright and Nyberg, 2017, p. 1636).

5. CONCLUSION

Climate change is one of the most significant and controversial problems faced by companies, and the regulatory, physical and market risks of climate change have currently become more pronounced. Acknowledging this crucial problem, this study surveyed 120 top risk managers of Australian companies operating within the Insurance and Financial Services, Agriculture, Food and Beverages, and Mining and Energy Production sectors to explore how those companies respond to the regulatory, physical and market risks posed by climate change. Furthermore, this study explored how the top risk manager’s climate change belief, two strategic management factors (consisting of company strategy and company structure), and three stakeholder factors (consisting of primary stakeholder pressure, secondary stakeholder pressure and external stakeholder integration) could influence the extent of a company’s response to regulatory, physical and market risks posed by climate change.

The results demonstrated that Australian companies in the three sectors respond to regulatory risks significantly better when compared to their responses to physical and market risks posed by climate change. The reasons for these significant differences are uncertain, although the literature raises the question whether this may be a consequence of companies estimating market and physical risks to be less important when compared to regulatory risks (Sakhel, 2017). Also, insights from construal theory suggests that this difference in the response levels may have been caused by the differences of psychological distances associated with these risks (Brügger, Morton and Dessai, 2016), especially with regulatory risks that appear in clearly

defined legislations carrying a greater certainty in comparison to physical and market risks that carry uncertainties about where, how and when they would be realised. Yet, irrespective of the underlying reasons, the inadequacy of physical and market risk responses can prove detrimental for companies as physical and market risks of climate change are becoming more prominent, and any subsequent losses suffered by companies due to this lack of responsiveness may also prove detrimental to stakeholders, especially to those who hold a financial stake in the company (British Broadcasting Corporation, 2020; Chalmers, 2020; Pandey, 2020; Giblom, 2019; Henriques-Gomes, 2019; Sakhel, 2017; Okereke and Russel, 2010). This result delivers a practical contribution for Australian companies, their stakeholders and regulators, as it specifies two key shortcomings arising from physical and market risk responses that Australian companies need to address to avoid legal consequences and Australian regulators need to consider when surveilling climate change risk management by companies to protect their stakeholders.

Furthermore, the results from the regression analyses demonstrate that the degree of the top risk manager's climate change belief, cost leadership, secondary stakeholder pressure, external stakeholder interaction can significantly affect the extent of company responses to regulatory, physical and market risks. Additionally, results observed for company structure shows that an organic structure, which contains characteristics such as decentralisation and open communication significantly improves company responses to regulatory risks. Moreover, the results observed for primary stakeholder pressure show that companies are facing conflicting stakeholder pressure for their climate change risk responses. Specifically, results show that customers, suppliers and shareholders are exerting pressure against companies to respond to climate change risks. Overall, these results deliver implications for companies and their stakeholders, as it shows how these factors, controllable either by the companies or by their stakeholders to improve the corporate climate change risk responses.

This study has several limitations. First, this study is limited to the Australian context. Hence, future studies are encouraged to replicate this study in other countries that are subject to the risks posed by climate change. Second, due to time and space restrictions associated with the survey instrument, this study was limited to exploring the influence of only six factors on company responses to climate change risks. Future studies are encouraged to explore whether other factors such as organisational culture, ethical climate, leadership styles could have an influence on how companies respond to the regulatory, physical and market risks of climate

change. Third, due to the limitations associated with the survey method, this study did not obtain insights into why the companies' responses to physical and market risks are significantly lower when compared to the regulatory risk response. Future studies can address this by using interviews to obtain rich insights into of the variations in responses to different climate change risks.

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Appendix 1 (pages 68-69) removed from Open Access version as it may contain sensitive/confidential content.

Pages 70-71 removed from Open Access version as they may contain sensitive/
confidential content.

Are you responsible for overseeing and managing the risks (including climate change related risks) of your whole company?

- ☐ Yes
☐ No

Please read the attached consent form and choose one of the following options:

- ☐ I have read the consent form and I agree to participate in this study.
☐ I have read the consent form and I do not agree to participate in this study.

Demographic Questions

DQ1 Please indicate your gender

- ☐ Male
☐ Female

DQ2 Please indicate your age bracket:

- ☐ 20 - 29 years
☐ 30 - 39 years
☐ 40 - 49 years
☐ 50 - 59 years
☐ Over 59 years

DQ3 Please select the level of your highest education

- ☐ No college/university education
☐ Diploma/certificate
☐ Bachelor's degree or equivalent
☐ Master's degree or equivalent
☐ Doctorate

DQ4 For how many years have you worked in this role in your current company? _____

DQ5 What is the approximate number of full-time employees within your company? (Please treat part-time employees as fractions of full-time employees)

DQ6 Please select the industry in which your company operates in:

- ☐ Insurance and Financial Services
☐ Agriculture, Food and Beverages
☐ Mining and Energy Production

DQ7 Please rate the overall performance of your company over the past three years relative to others in your industry on each of the following items:

	Much worse	1	2	3	4	5	6	7	Much better
Revenue									
Profits									
Return on sales									
Return on investment									

DQ8 How many directors make up your company's board of directors? _____

DQ9 Does the board of directors have a committee to oversee climate change related risks faced by your company?

- ☐ Yes
☐ No








DQ10 How many female directors are part of your company's board of directors? _____

DQ11 How many non-executive directors are part of your company's board of directors? _____

DQ12 Please specify the number of board meetings that were held in the last 12 months. _____

DQ13 Please specify the number of board meetings that discussed climate change related risks faced by your company during the last 12 months. _____

Q1 Please indicate the extent to which you agree with the following statements in relation to your company's business strategy.

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7
1.1 We command a higher price than other companies by making distinctive, high quality products							
1.2 Our prices are among the lowest in the industry							
1.3 We primarily seek to provide our goods and services at the lowest possible price							
1.4 We are often the first to introduce innovative products							
1.5 We spend more heavily on research and development than our competitors							
1.6 We focus on a narrow, specific customer group							
1.7 We provide products and services primarily to a well-defined customer group							

Q2 How would you characterise the external environment within which your company operates?

	1	2	3	4	5	6	7	
2.1 Very safe, little threat to the survival and well-being of my company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.1 Very risky, a false step can mean my company's undoing
2.2 Rich in investment and marketing opportunities, making it easier to keep the company afloat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.2 Very stressful, exacting, hostile; very hard to keep afloat
2.3 An environment that my company can control and manipulate to its own advantage (such as a dominant company in an industry with little competition and few hindrances)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.3 A dominating environment in which my company's initiatives count for very little against the tremendous competitive, political, or technological forces





Q3 Please rate the following.

In general, the leadership philosophy in my company favours ...











1 2 3 4 5 6 7

3.1 Highly structured channels of communication and a highly restricted access to important financial and operating information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.1 Open channels of communication with important financial and operating information flowing quite freely throughout the organisation
3.2 A strong insistence on a uniform managerial style throughout the company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.2 Managers' operating styles allowed to range freely from the very formal to the very informal
3.3 A strong emphasis on giving the most say in decision-making to the formal line authority instead of the expert in a given situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.3 A strong tendency to let the expert in a given situation have the most say in decision-making, even if this means temporary bypassing of formal line authority
3.4 A strong emphasis on holding fast to tried and true management principles despite any changes in business conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.4 A strong emphasis on adapting management practices to changes in business conditions without too much concern for past practice
3.5 A strong emphasis on always getting personnel to follow the formally laid down procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.5 A strong emphasis on getting things done even if this means disregarding formal procedures
3.6 Tight formal control of most operations by means of sophisticated control and information systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.6 Loose, informal control; heavy dependence on informal relationships and norm of cooperation for getting work done
3.7 A strong emphasis on getting line and staff personnel to adhere closely to formal job descriptions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.7 A strong tendency to let the requirements of the situation and the individual's personality define proper on-job behaviour







Q4 Please rate the degree of the following risks faced by your company as a result of climate change.

	Very low 1	2	3	4	5	6	Very high 7
4.1 Regulatory risks arising from emissions							
4.2 Regulatory risks arising from disclosure requirements							
4.3 Physical risks (e.g. damages by floods, bushfires, etc.)							
4.3 Market and other risks (e.g. reduced demand for products/services)							


Q5 Please rate the extent to which your company faces pressure to manage your company's climate change related risks from the stakeholder groups listed below.

	Not at all 1	2	3	4	5	6	To a great extent 7
5.1 Governments and regulatory agents							
5.2 Customers/consumers							
5.3 Suppliers							
5.4 Employees							
5.5 Shareholders							
5.6 Creditors							
5.7 Communities and social groups							
5.8 Nongovernmental organisations							
5.9 Competitors							
5.10 Media							





Q6 Please rate the following statements in relation to your company's interactions with its external stakeholders (i.e. governments and regulatory agents, customers/consumers, suppliers, creditors, communities and social groups, non-governmental organisations, competitors, media).

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7
6.1 The company frequently has meetings with its external stakeholders							
6.2 The company consults the external stakeholders and asks them for information before making decisions							
6.3 The company's formal or informal cooperation with the external stakeholders is intense (e.g. commitments, collaboration agreements...)							
6.4 External stakeholders participate in the company's decision-making process							
6.5 The company strives to develop new contacts with all the external stakeholders							
6.6 The company dedicates time and resources to assessing and prioritizing the demands of the different external stakeholders							





Q7 Please rate the engagement level of employees at the lower level of the company hierarchy when assessing climate change related risks faced by your company.

	Very low 1	2	3	4	5	6	Very high 7
Level of engagement of lower-level employees when assessing climate change related risks							





Q8 Please rate the extent to which your company's environmental information system is characterised by each of the following statements.

	Not at all 1	2	3	4	5	6	To a great extent 7
8.1 Climate change related risk information that relates to possible future events (e.g. new environmental regulations)							
8.2 Climate change related risk information on broad factors external to your organisation (e.g. technological developments)							
8.3 Non-economic information, such as employee and governmental attitudes regarding climate change							
8.4 Quantification of the likelihood of future climate change related risks occurring (e.g. scenario relative to climatic changes)							


Q9 Please indicate the extent to which you agree with the following statements in relation to your company's learning.

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7
9.1 There are well-established ways to share information and knowledge between people within the company (e.g. formal and informal forums for debate, well-developed systems and practices for sharing information)							
9.2 The company's beliefs, attitudes and ways of doing business provide a strong basis for interpreting information (e.g. the business unit's mission, or culture, is reflected in distributed information)							
9.3 There are extensive formal and informal procedures and processes for the acquisition of information and knowledge from internal and external sources that are potentially useful to the company (e.g. regular informal discussions)							
9.4 The company stores information and knowledge from prior experiences in formal systems (e.g. databases, documentation of programs, plans, procedures and reports)							













Q10 Please indicate the extent to which you agree with the following statements.

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7
10.1 Climate change is currently occurring							
10.2 Climate change is caused by humans							
10.3 Climate change is a serious problem							
10.4 There is a consensus in climate science that climate change is happening							







Q11 Please rate the explication/quantification of climate change risk tolerance by your company.

	No explication of risk tolerance 1	2	3	Risk tolerance is explicated in qualitative terms 4	5	6	Risk tolerance is quantified 7
Explication/quantification of climate change risk tolerance							








Q12 Please rate to what extent your company's leadership team perceives the importance of having the following adaptation measures for your company to address climate change related risks (please note that these measures may or may not have been implemented at your company):

	Not at all important 1	2	3	4	5	6	Very important 7
12.1 Adjustments to the current business model to account for the risks posed by climate change							
12.2 Adjustments to the product/service mix to account for climate change impacts							
12.3 Conducting firm-internal research into climate change impacts							
12.4 Climate proofing of assets and infrastructure (e.g. relocating of lines underground, new building standards, retrofiting)							
12.5 Implementation of carbon reduction processes							
12.6 Development of disaster preparedness programmes (e.g. early warning systems)							
12.7 Development of infrastructure resilient to climate change impacts such as extreme weather							
12.8 Application for government funding or subsidies related to climate change							
12.9 Development of firm-internal climate change education campaigns							
12.10 Diversification of income across business processes, assets, or locations less vulnerable to potential impacts of climate change (e.g. policy change, extreme weather)							
12.11 Divestments of business processes, assets or locations highly vulnerable to potential impacts of climate change (e.g. policy change, extreme weather)							
12.12 Changes to insurance policies and/or premiums in preparation for potential climate change impacts							

Q13 Please rate the extent of your company's climate change risk assessment.










	Not at all 1	2	3	4	5	6	To a great extent 7
13.1 The identified climate change related risks are checked for plausibility by the respective manager or risk manager							
13.2 Relevant climate change related risks are registered, observed, and reported correctly and on time							
13.3 All climate change related risks are evaluated quantitatively as far as possible							
13.4 All climate change related risks are checked for their interdependencies							
13.5 All climate change related risks are aggregated as regards the total business risk							
13.6 Climate change related risks resulting in damage are thoroughly analysed as regards the amount of damage							

Q14 Please rate the extent to which the following are practiced in your company to address climate change related risks.





	Not at all 1	2	3	4	5	6	To a great extent 7
14.1 Periodic evaluation and testing of climate change risk management controls by internal audit							
14.2 Continuous climate change risk monitoring programs built into information systems							
14.3 Analysis of, and follow-up on, reports/metrics that identify anomalies of a climate change risk management control failure							
14.4 Supervisory reviews of climate change risk management controls, such as reconciliation reviews as a normal part of processing							
14.5 Self-assessments by boards and management regarding the tone they set and the effectiveness of their climate change risk management oversight functions							
14.6 Audit committee inquiries of internal auditors about climate change risk management							
14.7 Climate change risk management quality assurance reviews of the internal audit department							

Q15 Please indicate the extent to which you agree with the following statements in relation to your company's carbon/emissions management?

















Our company has

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7
15.1 Continued to develop energy-efficient or less carbon-intensive products/services							
15.2 Invested in research and development for less carbon-intensive products/technologies/services							
15.3 Continued to undertake projects to increase energy-efficiency in the production/service processes							
15.4 Continued to conduct projects to reduce greenhouse gas (GHG) emissions in production/service processes							
15.5 Introduced innovative process technologies to reduce GHG emissions in production/service							
15.6 Substituted existing energy sources with cleaner fuels							
15.7 Integrated carbon measures into the company's performance evaluation and compensation system							
15.8 Engaged the entire employees and departments in reducing GHG emissions							
15.9 Provided employees education and training on carbon/emissions reduction							

















Q16 To what extent did your company report information to external stakeholders in the following aspects in your company's most recent annual/sustainability report?

	Not at all 1	2	3	4	5	6	To a great extent 7
16.1 Governance of climate change related risks							
16.2 Impacts of climate change related risks on the company's business strategy (e.g. climate change impacts on products/services)							
16.3 Management of climate change related risks (e.g. processes for mitigating, transferring, accepting, or controlling those risks)							
16.4 Metrics or targets to measure climate change related risks (e.g. metrics/targets on emissions, energy use, water use, etc.)							

Q17 Please rate the extent to which your company manages the physical and market risks posed by climate change.

	Not at all 1	2	3	4	5	6	To a great extent 7
17.1 Development of plans for crisis management, business continuity, etc. at an operational level for physical risks							
17.2 Research and development activities/implementation of measures aiming at the reduction of the impacts of physical risks to assets							
17.3 Surveillance of physical risks (e.g. processes of data mining and analysis, internal reporting, risk assessment, etc.)							
17.4 Adaptation of the business model/dispersion of business activities (e.g. enlargement of business portfolio to non-exposed fields)							
17.5 Implementation of physical risk action plans and initiatives at a strategic level							
17.6 Taking out insurances for covering potential damage to assets or supply chain disruptions							
17.7 Transferring the impact of physical risks to other corporate actors (e.g. adaptation/negotiation of contract conditions, etc.)							
17.8 Research and development activities aiming to improve reputation/address changing customer preferences on changing climate conditions							
17.9 Funding of foundations, initiatives, projects or research associations, etc., which engage in market risk identification and/or action							
17.10 Surveillance of market risks (e.g. identification and assessment of market developments, etc.)							
17.11 One-way communication (e.g. broader sustainability report, etc.) addressing shareholders and other stakeholders							
17.12 Two-way communication/interaction with different actors (e.g. roundtables with customers etc.)							
17.13 Adaptation of the business model/dispersion of business activities to fields that are not exposed to climate change related risks							
17.14 Transfer of market risks arising from climate change to other corporate actors (e.g. outsourcing carbon-intensive processes to suppliers etc.)							
17.15 Withdrawal from or downsizing/sale of business activities in one or more fields exposed to market risks arising from climate change							
17.16 Marketing campaigns on the company's efforts in the field of climate change mitigation and adaptation							

Q18 Please rate the extent of your company's use of environmental management control systems when managing climate change related risks.

	Not at all 1	2	3	4	5	6	To a great extent 7
18.1 Integration of climate change risk management objectives in planning systems							
18.2 Integration of climate change risk related performance indicators in reward systems							
18.3 Comparison of climate change risk management results to climate change related risk management objectives							
18.4 Climate change risk information communication employees							
18.5 Integration of climate change risk criteria in investment decisions							
18.6 Reference to well-documented climate change risk management rules and procedures							
18.7 Detailed description of climate change risk management functions							
18.8 Procedure of climate change risk communication with external stakeholders							
18.9 All workers are encouraged to make suggestions for improvements in the production/service process in relation to climate change risks							
18.10 All workers are encouraged to make suggestions for improvements in products/services in relation to climate change risks							
18.11 All employees are encouraged to make suggestions in the field of climate change risk management							
18.12 Top management is actively involved in the climate change risk management process							
18.13 Climate change risks are discussed during formal and informal periodic meetings							
18.14 Managers have enough freedom to manage climate change risks							
18.15 Work teams at the lower level of the organisation are built to manage climate change risks							
18.16 Persons from different departments and/or functions work in teams to manage climate change risks							

CHAPTER 3:

STUDY 2

Climate Change Risks and Risk Response

Disclosures by Companies

Conference presentation:

Hewa, S., Mala, R., and Chen, J. (2018). *Climate Change Impact Disclosures by Australian Entities*. ACSEAR Emerging Scholar Colloquium, Monash University, Melbourne, December 4, 2018.

ABSTRACT

Australian companies are criticised by stakeholders for inadequate climate change risks and risk response disclosures. Such inadequacies deprive stakeholders from accessing decision-useful information and creates the risk of legal liabilities for companies. Acknowledging this problem, this study explores the extent of climate change risks and risk responses disclosed by Australian companies with reference to the Task Force on Climate Related Financial Disclosures (TCFD) guidelines. This study also explores the impact of corporate financial and governance factors on the extent of corporate climate change risks and risk response disclosures. The disclosures are assessed using content analysis of annual and sustainability reports of 114 Australian companies from five sectors that are heavily impacted by climate change. The impacts of corporate financial and corporate governance factors on disclosures are analysed using archival data. The findings show that one third of the companies did not disclose any climate change risks or risk responses, and only 16.67% of the companies addressed all four TCFD themes consisting of Governance, Strategy, Risk Management and Metrics and Targets. Also, additional analysis showed that the presence of an environmental committee and ownership concentration were related to the level of climate change risk and risk response disclosure. This study fills a crucial gap in the literature by being one of the first to investigate the extent of Australian companies' reporting of climate change risk and risk responses with reference to the TCFD guidelines. It provides important recommendations to companies for improving disclosure practices, which will create value for both the companies and their stakeholders.

1. INTRODUCTION

Climate change is one of the biggest human-induced environmental predicaments faced by many Australian companies, and the realisation of climate change risks has already taken a heavy toll on several sectors (Australian National University, 2020; Harrison, 2020). Amongst some of these hardest hit financial and non-financial sectors, the insurance and financial services sector in Australia endured losses amounting to AU\$700 million following the recent 2019-2020 bushfire crisis, following the billions of dollars' impacts on the agriculture, food and beverages sector in 2019 due to the ongoing drought (Rollins, 2020; Sullivan, 2019). Furthermore, coalmines in the state of Queensland (a state in Australia) suffered a \$7 billion loss in exports due to the 2011 flooding, whilst the state's transportation sector suffered a \$1 billion loss due to rail damage resulting from floods (The Climate Institute, 2012). Moreover, the Australian tourism sector was considerably impacted by the 2013 Blue Mountains bushfires which caused approximately \$30 million loss (Hawke, 2013). Additionally, the healthcare providers and services sector are increasingly facing the strain of managing health impacts of frequent and longer heatwaves and multiple cases of thunderstorm asthma (Carey, 2016). Although these examples are from the previous decade, the corporate world had acknowledged the significance of climate change risks years earlier, as a 2007 study by KPMG shows that 71% of the surveyed corporate leaders perceived climate change as a crucial business issue which "would increase significantly over time" (Andrew and Cortese, 2013, p. 400).

Despite the acknowledgement of climate change as a significant business issue by corporate leaders, a critical problem persists as the corporate world has been slow to react and adequately communicate the impending climate change risks to their stakeholders (Williams, 2018; Hutchens, 2017; Linnenluecke, Birt and Griffiths, 2015). As this critical problem persists, Linnenluecke, Birt and Griffiths (2015) have called companies to incorporate climate change adaptation as a key component of the business strategy and risk management, and importantly, to reflect them through corporate disclosures. This call for a reflection on climate change risks and risk responses in corporate disclosures is a timely request for Australian companies as multiple recent news stories have demonstrated the inadequacy of climate change risks and risk response disclosures by Australian companies (Williams, 2018; Fitzimmons, 2017; Hutchens, 2017). Furthermore, news sources have reported that "a third of Australia's biggest listed companies are keeping investors in the dark about how they are managing the potentially large financial risks of climate change", leaving investors unaware of the potentially dire financial

consequences that may await them (Yeates, 2017, para. 1). This is concerning given that Australia is a nation with a high level of exposure and sensitivity to the risks of climate change (The Commonwealth Scientific and Industrial Research Organisation, 2019; The Garnaut Climate Change Review, 2011).

The lack of disclosures of climate change risks faced by Australian companies is detrimental for users who rely on formal communication of information (e.g. annual reports, sustainability reports) by companies for resource allocation decisions, as inadequate disclosures create information asymmetry and prevent stakeholders, such as investors, insurance underwriters, creditors and lenders from gaining access to complete information needed for their decision making (Sharma et al., 2017; Task Force on Climate Related Financial Disclosures (TCFD), 2017). Therefore, it is quite evident that investors and other stakeholders would have an interest in climate change risks faced by companies, the governance practices in terms of business strategy and risk management and adaptation practices implemented by companies to respond to such issues (Haque and Deegan, 2010). In addition to the stakeholder needs, it is important for companies to produce decision-useful climate information for regulatory reasons. As an example, the Australian corporate watchdog, Australian Securities and Investments Commission (ASIC, 2018), emphasises that it would be misleading for companies to discuss future financial prospects without referring to material business risks, including climate change risks, that can adversely impact those future prospects as such risks are having great potential to hinder the existing business models by affecting its supply chains and physical destruction of assets (TCFD, 2017). Importantly, failure to disclose foreseeable climate change risks forms a breach of the “statutory duty of due care and diligence” under the Australian Corporations Act 2001, which could consequently cause legal liabilities for companies (Boyd, 2017, para. 13). Furthermore, company directors in Australia have a “legal duty to act on climate change risk, include it in corporate strategies and report on it to shareholders”, which, if breached, will result in legal consequences (Fernyhough, 2019, para. 1). These reporting requirements are stringent, especially for listed companies since section 299A (1) (c) of the Corporations Act 2001 requires the disclosure of material business risks, including climate change risks, in the operating and financial review section (OFR) of company annual reports (ASIC 2018, 2013, 2012).

Although there are stringent requirements for the disclosure of climate change risks, there is no unanimously accepted reporting framework that prescribes exactly what companies need to

disclose so that investors, lenders and other stakeholders are able to judge the materiality of climate-related financial risks associated with their investment and lending portfolios (Centre for Climate and Energy Solutions, 2020; TCFD, 2017). According to O'Dwyer and Unerman (2020, p. 2) the previously existing “sustainability impact reporting does not focus upon providing a broader range of (mainstream) investors or lenders with information about the potentially substantial risks to financial returns resulting from a corporation’s dependencies upon climate”. This makes it challenging for companies to meet both regulatory and stakeholder demands.

To provide a better direction regarding what climate change risk and risk response information should be disclosed, the Task Force on Climate Related Financial Disclosures (TCFD) in consultation with users of company information has produced a framework in 2016 to guide companies to effectively address stakeholders’ demands for adequate climate change related risks and risk response disclosures (TCFD, 2016). This TCFD framework is based on four core themes consisting of (i) governance, (ii) strategy, (iii) risk management, and (iv) metrics and targets. The TCFD framework can be viewed as best practice climate change risk reporting guidelines available, given its comprehensiveness and alignment with existing environmental disclosure guidelines including the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI). Also, the TCFD framework has received support from the ASIC, 500 public and private-sector companies and investors representing more than USD \$30 trillion in assets (TCFD, 2018).

Despite the existence of the TCFD framework since 2016 which has been considered to better assist the investors and lenders to evaluate the financial outcomes of the business from the business’s dependencies on the changing state of the climate, it is questionable to what extent Australian companies have adopted its guidelines to produce disclosures on climate change risks and risk responses. Addressing this question is crucial since Australian companies have struggled to satisfy stakeholders’ climate change risk information needs, especially in an era where the climate change risks are becoming more prominent and stakeholders are increasingly demanding more information from companies to be better informed about effective market-based outcomes (Williams, 2018; Hutchens, 2017; Yeates, 2017; Linnenluecke, Birt and Griffiths, 2015). Although Ernst and Young (2019) and ASIC (2018) have attempted to explore the alignment of corporate climate change risk disclosures with reference to the TCFD framework, no such attempts have been made in the academic literature. Furthermore, neither

Ernst and Young (2019) nor ASIC (2018) have sought to understand the extent of disclosures by assessing disclosure quantity/volume which signify the importance of disclosures (Unerman, 2000), and the depth of disclosures which is known to vary widely across companies (Moody's Investor Service, 2019). This is a crucial literature gap since the identification of disclosures lacking in quantity/volume and depth can be presented as an important step in guiding companies towards overcoming the limitations of their climate change disclosures. Acknowledging this gap, this study aims to identify to what extent Australian companies are communicating information on climate change risks and risk responses in line with the TCFD recommendations by considering both the quantity/volume and depth of disclosures. Moreover, since the literature suggests that company specific factors can impact the extent of disclosures, this study explores whether the extent of climate change risk and risk response disclosures can be influenced by corporate financial factors (represented by profitability, gearing and ownership concentration), and corporate governance factors (represented by the proportion of non-executive directors, the proportion of female directors and the presence of an environmental committee).

To obtain insights into corporate climate change risk and risk response disclosures, this study uses content analysis of annual reports and sustainability reports of 114 Australian companies of the 2016-2017 financial year, as these were the latest reports available at the time of the study, which was well timed following the publication of the TCFD framework in 2016. The results showed that one third (38/114) of the sampled companies did not disclose any climate change risks or risk responses and only 16.67% (19/114) of the sampled companies addressed all four TCFD themes. It was also observed that companies predominantly disclosed climate change risks and risk responses without any numerical elements. Most of the disclosures were observed under the risk management theme with the least observed under the governance theme. Furthermore, the possible influence of corporate financial factors and corporate governance factors on the climate change risk disclosures is assessed using regression analysis. The results show that (i) sentence counts, (ii) word counts and (iii) disclosure type scores of companies are positively and significantly related to the presence of an environmental committee. By contrast, a significant negative relationship is observed between ownership concentration and (i) sentence counts, (ii) word counts and (iii) the disclosure type scores of companies.

This study delivers three practical contributions. First, this study helps regulators identify the themes that are not yet sufficiently addressed by Australian companies in their disclosures of climate change risks and risk responses. This knowledge can consequently be used by regulators to inform and direct Australian companies towards producing a (more) comprehensive set of disclosures on the climate change risks and risk responses which will serve the information needs of the stakeholders. Second, by exploring whether key company specific factors may influence the extent of climate change risks and risk response disclosures, this study assists regulatory bodies to identify companies that may need to be closely monitored to ensure that stakeholders are not kept in the dark due to inadequate information. Third, this study provides recommendations for companies to improve their climate change risks and risk response disclosures, which will create value for the companies and stakeholders whilst helping directors to safeguard themselves from breaching their statutory duty of due care and diligence.

The remainder of this study is structured as follows. Section two provides the literature review. Section three discusses the research method. Section four presents and discusses the results. Lastly, section five presents the conclusion.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Empirical studies demonstrate that climate change is generating serious financial risks and strategic challenges for companies (PricewaterhouseCoopers, 2020; Winn et al., 2011). Specifically, climate change gives rise to regulatory risks that attract penalties and liabilities for non-compliance, physical risks that cause the destruction of critical infrastructure (e.g. damages to property due to severe storms), and market risks that cause stock price decreases and reputational damage (Bui and de Villiers, 2017; Linnenluecke, Birt and Griffiths, 2015; Flammer, 2013; Lodhia and Martin, 2011; Fomburn, Gardberg and Barnett, 2000). These risks posed by climate change can be considerably detrimental for some sectors over others. One of these is the Insurance and Financial Services sector as organisations are transferring their climate change risks to this sector, thus burdening insurers with large claims whilst lenders become affected by a considerable amount of bad debts (Vincent, 2018; Actuaries Institute, 2016; Yeates, 2016). The Agriculture, Food and Beverages sector is another casualty since increased temperature, extreme weather events, rainfall variations, and water scarcity have a major detrimental impact on this sector (National Climate Change Adaptation Research

Facility, 2018; Organisation for Economic Co-Operation and Development; 2015; Business for Social Responsibility, 2011).

The Mining and Energy Production sector is also affected since the emissions intensity of this sector places it under regulatory pressures such as government-imposed emission limits to control its greenhouse gas emissions (FERNYHOUGH, 2018; MORTON, 2018). Considerable impacts have also been seen in the Transportation and Tourism sector since extreme weather damages transportation infrastructure and vehicles, while increasing temperatures and rising sea-levels negatively impact the viability of ski resorts, eco-tourism and coastal tourism (National Climate Change Adaptation Research Facility, 2018; United States Environmental Protection Agency, 2018; European Climate Foundation, 2013). Healthcare Providers and Services is another affected sector due to pressures of injuries, psychological impacts and vector borne diseases arising from the changing environment and extreme weather events such as the “world’s most devastating thunderstorm asthma epidemic” which impacted residents in Victoria (a state in Australia) in November 2016 (Climate and Health Alliance, 2018; Monash University, 2017, para. 1).

2.1 GUIDELINES AND MOTIVES OF CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES

As climate change is posing significant risks for a number of sectors, there is a growing demand by stakeholders for information on climate change risks and risk responses from companies. (Williams, 2018; Hutchens, 2017). In response to these demands, efforts have been made through both voluntary and mandatory disclosure initiatives to hold companies accountable for collecting, managing, and communicating matters concerning climate change (KUMARASIRI and GUNASEKARAGE, 2017; Cowan and Deegan, 2011). Some of the popular, voluntary reporting initiatives that have evolved during the past three decades include the Carbon Disclosure Project (CDP) which requests information on climate risks; the Global Reporting Initiative (GRI) which assists businesses and governments to communicate their impact on sustainability issues; and the Climate Disclosure Standards Board’s (CDSB) Climate Change Reporting Framework which elicits climate change-related information of value to investors (CDP, 2020; GRI, 2020; CDSB, 2012).

At present, the CDP provides companies the opportunity to disclose their climate-related data and the strategies they have adopted in response to climate change (Andrew and Cortese, 2011). Companies are provided with the flexibility to skip information when answering the CDP questionnaire. Moreover, information disclosed to the CDP does not need to be audited, and companies have the option to request their information to be kept private (Andrew and Cortese, 2011). In comparison, the GHG Protocol prescribes companies to report emissions by categorising them amongst scope 1 – direct emissions, scope 2 – indirect emissions and scope 3 – other emissions (Andrew and Cortese 2011, p. 135). Companies have the flexibility to refrain from reporting scope 3 emissions, and according to Andrew and Cortese (2011), this flexibility may result in significant underreporting of carbon emissions. Moreover, the Climate Disclosure Standards Board's (CDSB) disclosure framework provides companies the opportunity to disclose how climate change affects their “strategy, performance and prospects” and how they are placed to manage the “risks, opportunities, and financial impacts association with climate change” (Andrew and Cortese, 2011, p. 405).

With multiple voluntary environmental reporting frameworks in existence, a demand developed for a standardised framework for climate-related disclosures that promotes “alignment across existing regimes and G20 jurisdictions” (TCFD, 2017, p. 5). Acknowledging this growing demand, the Financial Stability Board established the Task Force on Climate-Related Financial Disclosures (TCFD) in December 2015 to produce a “consistent climate-related financial disclosures that would be useful to investors, lenders, and insurance underwriters” (TCFD, 2018, p. 1). The TCFD released its initial report in December 2016 after consultations with users and preparers of climate change-related financial disclosures and published its finalised recommendations in June 2017 (TCFD, 2019).

The TCFD recommendations are established upon four fundamental themes, which are (i) Governance, (ii) Strategy, (iii) Risk Management and (iv) Metrics and Targets (O'Dwyer and Unerman, 2020). The Governance theme is concerned with the disclosures of “the organization's governance around climate related risks and opportunities” (TCFD, 2017, p. 14). The Strategy theme is concerned with the disclosure of “the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material” (TCFD, 2017, p. 14). The Risk Management theme is concerned with disclosures on “how the organization identifies, assesses, and manages climate-related risks” (TCFD, 2017, p. 14). Lastly, the Metrics and

Targets theme is concerned with disclosures on “the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material” (TCFD, 2017, p. 14).

Although the finalised TCFD recommendations were published in 2017, calls for organisations to report environmental information such as climate-related disclosures along the four TCFD themes can be found in the existing literature and in non-academic sources. As an example, Haque and Deegan’s (2010) study advocates for disclosures on governance by arguing that investors and other interest groups would have an interest in the governance practices implemented by companies to address climate change related issues. In addition, Certified Professional Accountants Canada (2008) emphasises the need to report on the likely impacts of climate change on the business’ strategy and competitiveness. Furthermore, the need to disclose information on climate change risk management emerges from the ASX Corporate Governance Recommendation 7.4, which states that companies should report material risks posed by the environment and how they manage (or plan to manage) those risks (Linnenluecke, Birt and Griffiths, 2015).⁶ Moreover, the demand for companies to consider metrics and targets is stressed in a 2014 report published by the European Commission, which emphasises that there is an increasing demand for companies to grasp the relationship between the determinants of climate change risks and metrics for dealing with them (Miola and Simonet, 2014).

The TCFD themes are aligned with existing environmental disclosure initiatives including the Carbon Disclosure Project (CDP), the Global Reporting Initiative (GRI), and the Climate Change Disclosure Standards Board’s (CDSB) reporting frameworks (TCFD, 2019). These alignments observed within the TCFD framework are beneficial for information preparers and users, since an overwhelming number of reporting approaches can be confusing as well as paralysing for companies and market participants alike (Tähtinen, 2018). Considering this advantage and the growing support received from multinational companies and governments, the TCFD framework can be viewed as one of the best practice voluntary reporting guidelines currently available for companies focusing on disclosing financial implications of climate-related risks and dependencies.

⁶ This recommendation is specified in the ASX Corporate Governance Principles and Recommendations, which was updated in July 2014 (Deloitte, 2014).

In addition to voluntary disclosure initiatives, mandatory reporting initiatives have also directed the climate change information reporting of Australian companies. Some of these mandatory initiatives include the National Pollutant Inventory (NPI) and the National Greenhouse Gas Energy Reporting (NGER) Act 2007 (Cowan and Deegan, 2011). The NPI seeks to inform Australians “what large factories are discharging into the environment, as well as showing what actions a factory may be taking to reduce its emissions of pollution” (Cowan and Deegan, 2011, p. 410), whilst the NGER Act 2007 requires specific controlling corporations to report “greenhouse gas emissions, energy production and consumption and other information specified under the Act to the Greenhouse and Energy Reporting Office” (Kumarasiri and Gunasekarage, 2017, p. 28). These include controlling corporations whose “operation of facilities under the operational control of entities that are members of the group” are (i) producing at least 50 kilo tonnes of carbon dioxide per financial year, (ii) producing or consuming at least 200 terajoules of energy per financial year, (iii) having operational control of a facility which causes at least 25 kilotones of greenhouse gas emissions per financial year, and (iv) having operational control of a facility which produces or consumes at least 100 terajoules of energy per financial year (NGER Act, 2007, p. 30-31). These regulatory interventions can be viewed as a favourable move to hold companies accountable for their climate change reporting, but the effectiveness and the strength of these interventions are questionable. For example, following a descriptive examination of NPI disclosures by companies, Cowan and Deegan (2011) has identified a general avoidance of information concerning the source of pollution emission information. In comparison, the NGER Act 2007 does not mandate GHG disclosure for all companies, nor does it mandate the assurance of GHG disclosures (Green, Taylor and Wu, 2017).

The above discussion demonstrates that despite regulatory efforts, reporting of information related to climate change risks is largely voluntary, that is, some companies choose to report such information. A possible explanation for this is apparent in legitimacy theory which relies on the concept of companies requiring a community licence to operate. This theory suggests that corporate disclosures react to environmental factors by legitimising actions, with managers expected to follow strategies such as the production of disclosures to demonstrate that the company is complying with societal expectations (Deegan, Rankin and Tobin, 2002; Hogner, 1982; Preston and Post, 1975). According to Deegan, Rankin and Tobin (2002), legitimising disclosures is associated with company survival, and company disclosures will be limited when they are faced with limited public concerns. Extending this explanation to climate change risk

disclosures, it can be argued that companies that are exposed to climate change risks and have not responded to those risks would be faced with an elevated level of stakeholder concern, and therefore such companies can be expected to produce extensive disclosures. This view is supported in the literature as it implies that poor environmental performers may use voluntary disclosures as a “safety net against threats to legitimacy”, which can arise from a company’s failure to meet expectations of the community (Luo and Tang, 2014; Dawkins and Frass, 2011, p. 315-316). It can be further argued that disclosing poor environmental performance, such as inadequate responses to climate change risks, may help companies to protect themselves from losing control of sensitive information revelations and minimize adverse market reactions (Dawkins and Frass, 2011). This defensive strategy could involve “subtle avoidance tactics” to enhance stakeholder relations with “superficial policy adjustments” and generate a perception of compliance with society expectations instead of truly altering company strategies (Luo and Tang, 2014; Dawkins and Frass, 2011, p. 305).

Furthermore, signalling theory also helps to explain voluntary disclosures by companies. Signalling theory is concerned with communication amongst actors (e.g. companies and their stakeholders) in the presence of information asymmetries, and decision makers are expected to rely on signals that would serve to reduce information asymmetries between the signal receiver and the sender (Spence, 1973). An information asymmetry arises when companies hold information that is unavailable to investors, and this information asymmetry will be reduced when high-quality companies distinguish themselves from low-quality companies through voluntary disclosures (Watson, Shrivies and Marston, 2002). This theory is supported by Borghei, Leung and Guthrie (2016, p. 121) who have identified that companies report greenhouse gas information to promote their “superior environmental performance”. This observation is consistent with Dawkins and Fraas’ (2011, p. 315) argument that companies with good environmental performance may use voluntary disclosures as an ‘opportunity platform’ to aid their competitive position. Signalling theory also suggests that “companies use information to signal their values to address social and environmental issues, while ensuring that the stakeholders are aware that the issues are being handled by the companies” (Mata et al., 2018, p. 1206). Applying this reasoning to climate change disclosures, good performers that respond to their climate change risks can be expected to produce extensive disclosures in comparison to those who do not respond to their climate change risks.

The insights drawn from legitimacy and signalling theories suggest that companies release environmental disclosures, such as climate change risk information, irrespective of their environmental performance. Yet, in reality, companies have attracted criticisms for failing to sufficiently meet stakeholder demands for climate change risk and risk response disclosures. One study which has investigated climate change risk disclosure patterns in Standards and Poor's 500 (S&P's 500) from 2000 to 2008 has observed that approximately 76.3% of the sample had not disclosed climate change risks in their annual filings (Cotter and Najah, 2012). Similarly, a 2008 study by the Ceres Inc. has found that a majority of the sampled 100 global corporations had not disclosed any climate change risk information (Cotter and Najah, 2012). With reference to Linnenluecke, Birt and Griffiths (2015), it can be argued that climate change related disclosure inadequacy may have been driven by difficulties surrounding the calculation of climate losses, climate allowances, discount rates when assessing climate impacted assets, recognition of provisions for future vulnerability and methodological difficulties associated with appraising climate change impacts (Linnenluecke, Birt and Griffiths, 2015). Qualitative assessments including expert assessments and stakeholder consultations and quantitative approaches such as cost-benefit and multicriteria analysis may serve as pathways for companies to overcome climate change risk measurement difficulties (Linnenluecke, Birt and Griffiths, 2015).

The climate change risks and risk response disclosures inadequacies have also been reported in Australia as Ernst and Young (2019) and the ASIC (2018) have explored these disclosures by referring to the TCFD framework. Insights obtained by the ASIC (2018) into company Operating and Financial Reviews (OFRs) show that only 17% of the listed companies in their sample had identified climate change as a material risk, whilst Ernst and Young (2019) had found that approximately two thirds of the sampled companies have started to disclose climate change risks. Despite these valuable insights, neither of these studies have sought to understand the extent of disclosures by assessing the quantity/volume of disclosures under each of the TCFD themes. This creates a notable gap in the literature since scholars have argued that quantity/volume signifies the importance of disclosures, with some even arguing that the quantity/volume of disclosures could be a proxy for quality (Hooks and van Staden, 2011; Unerman, 2000). Acknowledging this literature gap, this study explores the extent of climate change risks and risk responses disclosures of Australian companies with reference to the TCFD framework by considering first the volume of disclosures. This study also explores the extent of climate change risk disclosures by considering the depth of disclosures since

disclosure depth is an important dimension which contributes to information quality - crucial for decision makers to accurately and effectively interpret issues and situations (Linnenluecke, Griffiths and Mumby, 2015; Beretta and Bozzolan, 2008).

2.2 THE IMPACT OF CORPORATE FINANCIAL AND GOVERNANCE FACTORS ON CLIMATE CHANGE RISKS AND RISK RESPONSE DISCLOSURES

According to the literature, the extent of corporate disclosures can also be impacted by factors specific to a company. For example, environmental accounting studies from the United Kingdom (Brammer and Pavelin, 2006), United States (Stanny and Ely, 2008), Spain (Reverte, 2009) and Portugal (Branco and Rodrigues, 2008) demonstrates that company specific factors can play a crucial role in affecting the volume and quality of environmental disclosures. Specifically, the literature strongly suggests that corporate financial factors such as profitability, gearing and ownership concentration, and corporate governance factors such as the proportion of non-executive directors, proportion of female directors and the presence of an environmental committee have an impact on the corporate environmental disclosures. However, the literature does not unanimously present a directional relationship between these company-specific factors and environmental disclosures. In addition to this heterogeneous research evidence, there has been an absence of studies exploring whether these company specific factors would impact the climate change risk and risk response disclosures of Australian companies. Acknowledging this literature gap, the current study examines the influence of six corporate financial and governance factors on climate change risk disclosures.

2.2.1 Profitability

Unprofitable companies can be anticipated to produce extensive disclosures, since these companies can argue that their lack of profitability is a consequence of an environmental investment which will lead to competitive advantage and profitability in the future (Reverte, 2009; Neu, Warsame and Pedwell, 1998). This view is supported by Ho and Taylor's (2007) and Smith, Yahya, and Amiruddin's (2007) observation of a significant negative association between profitability and company disclosures. Conversely, Ng and Koh (1994) argue that profitable companies are more subject to political pressure and public scrutiny which will drive them towards self-regulating mechanisms such as the voluntary disclosure of information. Furthermore, high company profits increase political visibility of the company, which can subsequently lead to adverse political actions such as pressures from government and

regulatory agencies (Branco and Rodrigues, 2008). To avoid political scrutiny, profitable companies with high political visibility are expected to produce increased voluntary disclosures. Similarly, profitability can be expected to drive voluntary disclosures as profits provide companies a pool of resources to support the cost of disclosures (Brammer and Pavelin, 2006). These arguments support Cormier and Gordon's (2001) and Cormier and Magnan's (1999) observation of a significant positive association between profitability and company disclosures. Gray et al. (2001) have also observed that more profitable companies tend to have extensive environmental disclosures. Similarly, Ullmann (1985) has cited seven studies that converge on a weak positive relationship between disclosures and economic performance, whilst Roberts (1992) and Haniffa and Cooke (2005) also found a positive relationship. Therefore overall, a positive association is anticipated between profitability and company climate change risk disclosures, leading to the following hypothesis:

H1: Company profitability is positively associated with the extent of climate change risks and risk response disclosures.

2.2.2 Gearing/Leverage

Gearing/leverage, which measures the long-term risk indicated by the company's financial structure is an important explanatory variable in multiple studies on company disclosures (Haniffa and Cooke, 2005; Watson, Shrive and Marston, 2002; Wallace, Naser and Mora, 1994). The extent of a company's gearing/leverage can be expected to have an effect on the pressure exerted by creditors on corporate disclosures. This is because creditors form an important stakeholder group, and insights from stakeholder theory suggest that companies are expected to undertake activities deemed important to their stakeholders (such as creditors) and report on those activities (An, Davey and Eggleton, 2011). However, there is no agreement amongst scholars about the anticipated impact of leverage/gearing on the extent of disclosures. The possibility of a negative relationship between gearing/leverage and public disclosures emerges in the literature with some scholars arguing that highly leveraged/geared companies may have close relationships with creditors, creating alternative means to disclose information (Branco and Rodrigues, 2008). Similarly, scholars have also suggested that an increase in gearing can lead to less disclosures as the company can fear "unfavourable forecasts" and pressure from lenders due to increasing risk (Watson, Shrive and Marston, 2002, p. 295). Yet, many scholars provide an opposing view, arguing that highly geared companies produce

extensive disclosures to address creditors' expectations and to assure that the company is likely to meet creditors needs' and unlikely to breach their debt covenant claims (Rankin, Windsor and Wahyuni, 2011; Haniffa and Cooke, 2005). Specifically, creditors such as banks can incur environmental liabilities as lenders (e.g. having to re-possesses a land that is subject to environmental liabilities/risks), and therefore creditors can request highly geared/leveraged companies to communicate the company's management of environmental responsibilities appropriately, which can lead to extensive disclosures (Chan, Watson and Woodliff, 2014). This argument is supported by the findings of multiple studies including Chan, Watson and Woodliff (2014), Zhang et al. (2008), Clarkson, Richardson and Vasvari (2007) that have observed a positive, significant relationship between leverage and disclosures. Considering this contemporary research evidence, highly geared/leveraged companies can be anticipated to produce extensive disclosures. This leads to the following hypothesis:

H2: Company gearing/leverage is positively associated with the extent of climate change risks and risk response disclosures.

2.2.3 Ownership concentration

Evidence from the literature does not provide a unanimous view of how ownership concentration is associated with disclosures, with Chau and Gray (2002) and Hannifa and Cooke (2002) showing positive relationship, whilst Brammer and Pavelin (2006) and Barako, Hancock and Izan (2006) found a negative relationship. Yet, studies generally argue that opportunistic management behaviour is likely to occur in companies with dispersed ownership and therefore ownership distribution among many investors leads to increased pressure for disclosure (Reverte, 2009). Specifically, dispersed ownership contributes to information asymmetry and conflicts between the company management and the shareholders, and consequently companies can be subject to adverse shareholder reactions such as environmental disclosure activism (Chan, Watson and Woodliff, 2014; García-Meca and Sánchez-Ballesta, 2010; Brammer and Pavelin, 2006). Therefore, companies with dispersed ownership can be expected to produce extensive disclosures, especially through formal modes such as annual reports to communicate environmental information of the company to diffused shareholders (Brammer and Pavelin, 2006). As a result, voluntarily disclosing information when company ownership is dispersed can reduce information asymmetry and agency conflicts between the company management and shareholders, leading companies to disclose more (Chan, Watson

and Woodliff, 2014). Similarly, when there is low ownership dispersion (high ownership concentration), controlling shareholders can obtain the required information through special channels, thus reducing the company's incentive to disclose (Chiu and Wang, 2015). This is further supported by proprietary cost theory which suggests that "proprietary costs arise when private information, if released, may harm the firm's competitive position" and consequently, large shareholders may prefer to limit disclosure related costs" (Khlif, Ahmed and Souissi, 2017, p. 379). Therefore, it can be argued that companies with a high degree of ownership concentration (low ownership dispersion) would be inclined to produce less climate change disclosures, resulting in the following hypothesis:

H3: Ownership concentration is negatively associated with the extent of climate change risks and risk response disclosures.

2.2.4 Non-executive directors

Non-executive directors represent the "check and balance mechanism in enhancing boards' effectiveness" and are often viewed by themselves as having an advisory role instead of a decision-making role (Haniffa and Cooke, 2002, p. 319). The proportion of non-executive directors is deemed by scholars to be "strongly aligned with external stakeholder interests" and since they are seen as monitors of management's actions, which creates the expectation of a positive relationship between their proportional representation and the extent of disclosures, "if they do actually carry out their monitoring role" (Brammer and Pavelin, 2008, p. 125; Haniffa and Cooke, 2002, p. 320). Also, they are likely to address matters on honour and social obligations and are more concerned with satisfying the social responsibilities of the company (Haniffa and Cooke, 2005). Furthermore, non-executive directors, who act as corporate outsiders, have minimal involvement in the daily management of a company, and consequently they can be anticipated to demand more disclosures from the company to minimise risks to their personal reputation (Oliveira, Rodrigues and Craig, 2011). Similarly, the proportion of non-executive directors can be anticipated to drive the extent of company climate change disclosures, leading to the following hypothesis:

H4: The proportion of non-executive directors is positively associated with the extent of climate change risks and risk response disclosures.

2.2.5 Female directors

According to the literature, female directors are less self-oriented and considered to improve corporate decision making and board effectiveness (Coffey and Wang, 1998). However, scholars have argued that female representation on the board seems to have a limited impact unless a critical mass of at least three females are represented on a board (Post, Rahman and Rubow, 2011). Yet, females are considered to have a focus on “the needs of others and understanding the social demands on stakeholders”, and they are deemed to increase the “likelihood that the board understands the ethical and social demand of providing meaningful and transparent disclosures” (Hollindale et al., 2019, p. 281). Furthermore, studies suggest that females are more concerned with environmental issues when compared to males and are more likely to take actions to minimise environmental risks (Liao, Luo and Tang, 2015; Diamantopoulos et al., 2003). Moreover, female directors advocate environmental reporting, especially when there is a minimum of three female representations on the board of directors (Liao, Luo and Tang, 2015; Bear, Rahman and Post, 2010). This leads to the following hypothesis:

H5: The proportion of female directors is positively associated with the extent of climate change risks and risk response disclosures.

2.2.6 Environmental committee

Companies are increasingly designating committees to address environmental issues (Peters and Romi, 2014). Rodrigue, Magnan and Cho (2013) indicate that such committees are concerned with avoiding reputational and regulatory damages for a company. Furthermore, environmental committees are presented in the literature as a proxy for the board’s inclination towards environmental accountability, which contains adequate communication with external stakeholders (Liao, Luo and Tang, 2015). Yet, there is inconclusive evidence on an association between the presence of committee for environmental matters and environmental disclosures. As an example, Helfaya and Moussa (2017) have found that the presence of a corporate social responsibility (CSR) committee and the publishing of a stand-alone CSR report are positively and significantly related to environmental sustainability disclosures, whilst Rankin, Windsor and Wahyuni’s (2011) study on the voluntary adoption of an environmental committee and the propensity for greenhouse gas disclosure found no association. Yet, Peters and Romi (2014)

found a positive, significant association between the presence of an environmental committee and the propensity for companies to disclose their greenhouse gas emission accounting. Based on this evidence, the presence of an environmental committee is anticipated to drive climate change disclosures of companies, leading to the following hypothesis:

H6: The presence of an environmental committee is positively associated with the extent of climate change risks and risk response disclosures.

3. METHOD

To analyse the disclosure of climate change risks and risk responses, this study uses content analysis, as this method has been used extensively for analysing published information, including in the field of corporate social and environmental disclosures (Beck, Campbell and Shrivies, 2010; Turker, 2009; Jose and Lee, 2007; Guthrie and Abeysekera, 2006). The annual and sustainability reports of Australian companies on the S&P ASX (Australian Securities Exchange) 300 list (on 30th May 2018) are considered for this study. The S&P ASX 300 list is considered to secure an adequate sample size with minimal data availability problems. Of the S&P ASX 300 list, companies representing five sectors that are heavily impacted by climate change were considered for this study. This resulted in a final sample of 114 Australian companies. Australia is chosen since company directors in Australia have a legal duty to act on climate change risk (FERNYHOUGH, 2019), and since Australian companies are required under section 299A (1) (c) of the Corporations Act 2001 to disclose material business risks, which includes climate change risks, in the company annual reports (ASIC 2018, 2013, 2012). Of the chosen 114 companies, 23 (20.18%) represents the Insurance and Financial Services sector, 15 (13.16%) represents the Agriculture, Food and Beverages sector, 55 (48.25%) represents the Mining and Energy Production sector, 11 (9.64%) represents the Transportation and Tourism sector and 10 (8.77%) represents the Healthcare Providers and Services sector. The latest annual and sustainability reports available at the time of the analysis (i.e. reports from the 2016-2017 financial year) were chosen since companies are expected to have disclosures based on the four TCFD themes which was first published by the TCFD in 2016.⁷ Reporting related to climate change risks and risk responses by the 114 chosen companies was analysed utilising the following six-step content analysis approach. In the first step, the identified content on

⁷ As mentioned in the Literature Review, calls for companies to report climate-related disclosures along the four TCFD themes can be found in the existing literature and in non-academic sources prior to 2016.

climate change risks and risk responses were disaggregated into four sub-categories consisting of (i) Governance, (ii) Strategy, (iii) Risk Management and (iv) Metrics and Targets. The sub-category 'Governance' demonstrates how a company's board oversees and manages climate related issues, whilst 'Strategy' shows the actual and possible impacts of climate-related risks on the company's "businesses, strategy, and financial planning" (TCFD, 2017, p. 21). Risk Management demonstrates how the company "identifies, assesses, and manages climate-related risks" whilst the fourth sub-category discloses the 'Metrics and Targets' used to "assess and manage relevant climate-related risks and opportunities" (TCFD, 2017, p. 22).

Following this disaggregation, step two provides a quantitative assessment of the content for each sub-category by obtaining a volumetric (frequency) measurement by calculating the number (raw count without any adjustments) of sentences per coded sub-category for each company. The sentence count method for measuring environmental disclosures has been adopted by multiple scholars including Guthrie, Cuganesan and Ward (2008) and de Villiers and Lubbe (2001). Similarly, the third step was used for another volumetric measurement to calculate the word count (raw count without any adjustments) of each sentence identified in step two to obtain the aggregated word count per coded sub-category for each company which has also been adopted by multiple scholars including Gao, Heravi and Xiao (2005) and Campbell (2004). In step four, the depth of disclosures is examined by awarding disclosure type scores for each sentence following the guideline in *Table 1*, which was developed based on Beck, Campbell and Shrives (2010). The total disclosure type score obtained for each company under each theme was divided by the number of coded sentences to obtain an average disclosure type score for each company under each theme.

Table 1: Disclosure Type Scoring

Disclosure type score	Description	Example
+1	Pure narrative disclosure presented succinctly	“We note that in the current year, consistent from prior years, we have not exceeded the reportable NGER threshold”
+2	Pure narrative disclosure presented in detail	“Reduced power system losses, increased load availability using existing equipment and a reduction in carbon emissions were achieved following power factor correction implementation at the Angaston plant”
+3	Disclosure contains a numerical element, but with no additional details/explanation on the numerical element	“REDUCTION in Scope 1 and Scope 2 emissions 6%”
+4	Disclosure contains a numerical element, and it also contains additional information or explanation regarding numerical information	“The project by CWP Renewables and Partners Group uses the latest in wind technology and its 75 turbines are expected to generate enough energy to power an estimated 100,000 households and offset over 600,000 tonnes of carbon emissions per year”
+5	Numerical disclosure, where numbers are contextualised by means of comparisons	“Due to a combination of energy efficiency initiatives and sale of assets, we achieved a 21% reduction in Scope 1 emissions, and a 7% reduction in Scope 2 emissions with an overall 8% reduction in total emissions for FY17”

In the fifth step, reliability tests were conducted on a randomly selected sample (6 out of 114 companies, 5%) by three coders. The Krippenforff’s Alpha scores for sentence counts, word counts, and disclosure type scores were 0.8222, 0.8268 and 0.8133 respectively. These scores meet Krippenforff’s (1980) proposed guideline of “reporting variables only if their reliability is above 0.80” (Neuenforf, 2002, p. 143). In the sixth step, statistical analyses consisting of descriptive statistics, Friedman test and Kruskal-Wallis test were performed. Specifically, Friedman test which is used for related sample analysis was performed to assess the differences in disclosures within sectors (across themes) whilst Kruskal-Wallis test which is used for unrelated sample analysis was performed to assess the differences across sectors (within themes).

Data for analysing the impact of company specific factors on disclosures were separately obtained from multiple databases including Morningstar, IBIS World, D&B Hoovers, and company annual reports. Three companies with missing data were excluded, leaving a final sample of 111 companies. Aggregated sentence counts, aggregated word counts and the total

average disclosure type scores were separately considered as the dependent variables. Aggregated counts (i.e. sum of four themes) are used to minimise the high number of zeros in the dependent variable (which would result if counts are obtained separately for each theme). Of the independent variables, profitability consists of two measures, that is, return on assets (Branco and Rodrigues, 2008) and return on shareholder's funds/equity (Haniffa and Cooke, 2002). Gearing/leverage is measured by the debt to equity percentage (Reverte, 2009). Ownership concentration is measured as the aggregated percentage of share ownership of those holding more than 3% of the company's shares (Brammer and Pavelin, 2008). The proportion of non-executive directors is represented by the proportion of non-executive directors on the board as at 30th June 2017 (Haniffa and Cooke, 2002). The proportion of female directors is represented by the proportion of female directors on the board as at 30th June 2017 (Liao, Luo and Tang, 2015). The presence of an environmental/sustainability committee is denoted by 1 (presence) or 0 (absence) (Hollindale et al., 2019).

Following a careful review of the environmental disclosure literature, four other variables were included as control variables. The first is company size, which is measured using the natural logarithm of total assets (Brammer and Pavelin, 2008). This control variable is considered since the literature demonstrates a positive relationship between company size and the extent of disclosures (Reverte, 2009; Archambault and Archambault, 2003). The second control variable is the presence of a separate CEO-chair structure denoted as 1 or otherwise 0 (Liao, Luo and Tang, 2015). Literature argues that CEO-chair separation may improve monitoring quality, reduce benefits associated with withholding information and consequently improve the quality of disclosed information (Haniffa and Cooke, 2002).

The third control variable is the number of board meetings held during the 2016-2017 financial year (Liao, Luo and Tang, 2015). The number of board meetings is considered in prior studies as a proxy for the diligence and effectiveness of board members, which is consequently expected to have a positive impact on the company's disclosures (Jizi et al., 2014). The fourth control variable is sector/industry category, since studies on environmental disclosures have considered industry/sector as a control variable since higher industry exposure to environmental risks is expected to increase the likelihood of disclosures (Eleftheriadis and Anagnostopoulou, 2015). Sector is denoted by four binary variables representing the (i) insurance and financial services sector, (ii) agriculture, food and beverages sector, (iii) mining and energy production sector, and (iv) transportation and tourism sector. Following Brammer

and Pavelin (2008), regression analysis and correlation analysis were performed to explore the relationship between company specific factors and the extent of climate change risks and risk responses disclosures. The following model was used for the regression analysis.

$$\text{Dependent variable} = \beta_0 + \beta_1 \text{ROA} + \beta_2 \text{ROSF} + \beta_3 \text{Gearing} + \beta_4 \text{Own_Concentration} + \beta_5 \text{Non_Executive} + \beta_6 \text{Female_Directors} + \beta_7 \text{Env_Committee} + \beta_8 \text{Total_Assets_LN} + \beta_9 \text{Sep_CEO_Chair} + \beta_{10} \text{Board_Meetings} + \beta_{11} \text{Insurance_and_Financial_Services} + \beta_{12} \text{Agriculture_Food_and_Beverages} + \beta_{13} \text{Mining_and_Energy_Production} + \beta_{14} \text{Transportation_and_Tourism}$$

4. RESULTS AND DISCUSSION

The results show that many companies have failed to comprehensively address the TCFD recommendations through their climate change risks and risk response disclosures. Table 2 – Panel A shows that disclosures addressing all four TCFD themes were uncommon. Only 7% (1/15) of the Agriculture, Food and Beverages sector, which is subject to the detrimental impacts of extreme weather events, had addressed all four TCFD themes (National Climate Change Adaptation Research Facility, 2018; Organisation for Economic Co-Operation and Development; 2015; Business for Social Responsibility, 2011). Furthermore, only 10% (1/10) of the Healthcare Providers and Services sector, which is facing increasing pressures of injuries, psychological impacts and vector borne diseases arising from the changing climate, had disclosures under all four TCFD themes (Climate and Health Alliance, 2018).

Moreover, just 16% (9/55) of the emission intensive Mining and Energy Production sector, which is a likely target for regulatory pressures such as government-imposed emission limits (FERNYHOUGH, 2018; MORTON, 2018), and 22% (5/23) of the Insurance and Financial Services sector, which is having to deal with the climate change risks that are being transferred over from other sectors (VINCENT, 2018; ACTUARIES INSTITUTE, 2016; YEATES, 2016), had addressed all four TCFD themes. Additionally, only 27% (3/11) of the Transportation and Tourism sector, which is highly susceptible to extreme weather which can cause infrastructure damages, vehicle damages and detrimental impacts on the viability of tourism hot spots (National Climate Change Adaptation Research Facility, 2018; United States Environmental Protection Agency, 2018; European Climate Foundation, 2013), had disclosures under all four TCFD

themes. In summary, with the exception of the Transportation and Tourism sector, over 75% of the companies across the other four sectors have failed to address all four TCFD themes.

According to Table 2 – Panel B, the highest percentages of companies with disclosures were observed under the two themes of Strategy and Risk Management, for the Agriculture, Food and Beverages sector (80% each; 12/15), Mining and Energy Production sector (60% each; 33/55) and Transportation and Tourism sector (63.64% each; 7/11). In comparison, the Insurance and Financial Services sector had the highest percentages of companies with disclosures under the Risk Management theme (56.52%; 13/23) whilst the Healthcare Providers and Services sector had the highest percentages of companies with disclosures emerging from the Risk Management and Metrics and Targets themes (30% each; 3/10). Furthermore, the lowest percentages of companies with disclosures were observed under the Governance theme for all sectors, with only 26.08% (6/23) of the Insurance and Financial Services sector, 6.67% (1/15) of the Agriculture, Food and Beverages sector, 20% (11/55) of the Mining and Energy Production sector, 18.18% (2/11) of the Transportation and Tourism sector and 10% (1/10) of the Healthcare Providers and Services sector producing disclosures. The Healthcare Providers and Services sector also had the lowest percentages of companies with disclosures under the Strategy theme (10%, 1/10).

In summary, the Risk Management theme, which demonstrates how the company “identifies, assesses, and manages climate-related risks”, was the most addressed theme by the companies. In contrary, Governance, under which the company should demonstrate how the board oversees and manages climate related issues, was the least addressed theme with less than 30% of companies in each sector producing disclosures under this theme. This is concerning since company directors in Australia have a “legal duty to act on climate change risk, include it in corporate strategies and report on it to shareholders”, and failure to do so can result in legal consequences (FERNYHOUGH, 2019, para. 1).

Table 2: Analysis of TCFD Themes Addressed

Panel A: Number of Themes Addressed

Number of themes covered	Insurance and Financial Services		Agriculture, Food and Beverages		Mining and Energy Production		Transportation and Tourism		Healthcare Providers and Services	
	<i>Entity count</i>	<i>Percentage</i>	<i>Entity count</i>	<i>Percentage</i>	<i>Entity count</i>	<i>Percentage</i>	<i>Entity count</i>	<i>Percentage</i>	<i>Entity count</i>	<i>Percentage</i>
0	9	39%	2	13%	19	35%	2	18%	6	60%
1	2	9%	2	13%	3	5%	2	18%	2	20%
2	3	13%	4	27%	8	15%	2	18%	1	10%
3	4	17%	6	40%	16	29%	2	18%	0	0%
4	5	22%	1	7%	9	16%	3	27%	1	10%
TOTAL	23	100%	15	100%	55	100%	11	100%	10	100%

Panel B: Counts of Companies with Disclosures Across Themes

Theme \ Sector	Insurance and Financial Services	Agriculture, Food and Beverages	Mining and Energy Production	Transportation and Tourism	Healthcare Providers and Services	TOTAL
Governance	6 (26.08%)	1 (6.67%)	11 (20%)	2 (18.18%)	1 (10%)	21
Strategy	11 (47.82%)	12 (80%)	33 (60%)	7 (63.64%)	1 (10%)	64
Risk Management	13 (56.52%)	12 (80%)	33 (60%)	7 (63.64%)	3 (30%)	68
Metrics & Targets	10 (43.48%)	7 (46.67%)	26 (47.27%)	4 (36.36%)	3 (30%)	50

4.1 ANALYSIS OF DISCLOSURES BY SECTOR

Table 3 presents an analysis of disclosures by sector. In the Insurance and Financial Services sector, the highest sentence count (565) and word count (13,194) was observed under the Risk Management theme. This theme also held the highest average sentence count (43.46) and word count per company (1,014.92), and the highest standard deviations for the sentence counts (46.44) and word counts (1082.43). Despite the high number of sentence and word counts observed in the Risk Management theme, the highest disclosure type score average was observed in the Metrics and Targets theme (3.54). The highest disclosure type score standard deviation was observed in the Strategy theme (0.64), whilst the lowest was observed in the Governance theme (0.23).

Within the Agriculture, Food and Beverages sector, the Risk Management theme had the highest sentence count (147), highest word count (3,450), and the highest averages for both sentence count (12.25) and word counts (287.5). The Risk Management theme was found to have the highest standard deviation of the word counts (277.16), whilst the Metrics and Targets theme had the highest standard deviation for the sentence counts. Additionally, the Risk Management theme had the highest average disclosure type score. The highest and lowest disclosure type score standard deviation was observed in the Metrics and Targets (1.21), and Strategy (0.22) themes, respectively.

In the Mining and Energy Production sector, the highest sentence count (749) and word count (16,587) is observed in the Risk Management theme. This theme also holds the highest averages for the sentence (22.7) and word counts (502.64), as well as the highest standard deviations for both the sentence (29.96) and word counts (645.86) in the Mining and Energy Production sector. However, the highest disclosure type score average was observed in the Metrics and Targets theme (3.58), which also holds the highest standard deviation of the disclosure type score (0.86) amongst the four themes. The lowest standard deviation (0.2) of the disclosure type score was observed in the Risk Management theme.

Table 3: Extent of Disclosures

Theme	Statistic	Insurance and Financial Services			Agriculture, Food and Beverages			Mining and Energy Production			Transportation and Tourism			Healthcare Providers and Services		
		Sentence count	Word Count	DT Score	Sentence count	Word Count	DT Score	Sentence count	Word Count	DT Score	Sentence count	Word Count	DT Score	Sentence count	Word Count	DT Score
Governance	Total	31	797	N/A	1	4	N/A	52	1110	N/A	11	236	N/A	2	64	N/A
	Average	5.17	132.83	1.81	1	4	1	4.73	100.91	1.53	5.5	118	1.94	2	64	1.5
	Minimum	2	30	1.5	1	4	1	1	13	1	2	67	1.89	2	64	1.5
	Maximum	14	382	2	1	4	1	13	278	2	9	169	2	2	64	1.5
	Standard Deviation	4.67	132.07	0.23	N/A	N/A	N/A	4.22	86.66	0.35	4.95	72.12	0.08	N/A	N/A	N/A
Strategy	Total	205	5160	N/A	120	2564	N/A	454	10450	N/A	127	2756	N/A	22	458	N/A
	Average	18.64	469.09	1.93	10	213.67	1.77	13.76	316.67	1.78	18.14	393.71	1.66	22	458	2.05
	Minimum	3	48	1.33	1	24	1.33	1	18	1	1	9	1	22	458	2.05
	Maximum	46	1381	3.2	32	511	2	59	1260	4	95	2042	2.54	22	458	2.05
	Standard Deviation	15.84	425.2	0.64	9.95	168.2	0.22	14.89	308.7	0.5	34.07	732.45	0.54	N/A	N/A	N/A
Risk Management	Total	565	13194	N/A	147	3450	N/A	749	16587	N/A	219	4487	N/A	8	147	N/A
	Average	43.46	1014.92	1.92	12.25	287.5	1.86	22.7	502.64	1.79	31.29	641	2.13	2.67	49	1.83
	Minimum	1	44	1.53	1	22	1.57	1	21	1.33	1	40	1.62	2	20	1.5
	Maximum	121	2830	2.5	37	744	2.45	135	2779	2.25	93	1750	2.67	4	98	2
	Standard Deviation	46.44	1082.43	0.24	11.49	277.16	0.28	29.96	645.86	0.2	38.5	757.46	0.39	1.15	42.67	0.29
Metrics & Targets	Total	310	5058	N/A	74	1328	N/A	454	6804	N/A	102	1782	N/A	29	224	N/A
	Average	31	505.8	3.54	10.57	189.71	3.1	17.46	261.69	3.58	25.5	445.5	2.85	9.67	74.67	3.39
	Minimum	4	39	2.75	1	16	1	1	11	1	3	48	2	4	23	3
	Maximum	79	1567	4.46	43	747	5	93	1435	5	50	980	3	18	107	4
	Standard Deviation	21.14	460.38	0.62	14.91	264.84	1.21	21.77	357.82	0.86	19.33	389.08	0.53	7.37	45.21	0.54

Within the Transportation and Tourism sector, the Risk Management theme had the highest sentence (219) and word counts (4,487) within the Transportation and Tourism sector. This theme also had the highest averages for both sentence (31.29) and word counts (641), as well as the highest standard deviations for both sentence (38.5) and word counts (757.46). In comparison, the highest disclosure type score average (2.85) is held by the Metrics and Targets theme. The highest disclosure type score standard deviation (0.54) is held by the Strategy theme, whilst the lowest (0.08) is held by the Governance theme.

In the Healthcare Providers and Services sector, the highest sentence count (29) was observed in the Metrics and Targets theme, whilst the highest word count (458) is observed in the Strategy theme. The strategy theme also had the highest average for sentence (22) and word counts (458), as only one company has produced disclosures under this theme. The Metrics and Targets theme had the highest standard deviation of the sentence (7.37) and word counts (45.21). The highest average disclosure type score (3.39) was also observed in this theme. The highest and lowest standard deviations of the disclosure type scores were observed in the Metrics and Targets (0.54) and Risk Management (0.29) themes, respectively.

The findings for sentence counts and word counts across all, but the Healthcare Providers and Services sector, demonstrate that a larger amount of information contained within the climate change risks and impact disclosures were addressing the theme of Risk Management. In the Healthcare Providers and Services sector, a larger amount of information was observed under the Metrics and Targets theme. Overall, standard deviations calculated for the sentence and word counts do not show a large dispersion of the number of sentences and words used by companies within industries. However, there are exceptions for this observation in the Transportation and Tourism and Healthcare Providers and Services sectors. The considerably large standard deviation scores observed within these two sectors should be interpreted with caution since these two sectors hold the second lowest and the lowest number of companies with disclosures addressing any of the TCFD themes.

4.2 TESTS FOR COMPANIES WITH DISCLOSURES - COMPARISONS WITHIN SECTORS (ACROSS THEMES)

Friedman tests conducted for each sector demonstrate the differences in sentence counts, word counts and disclosure type scores across all TCFD themes. According to Friedman test results

in Table 4, sentence counts and word counts difference across the four TCFD themes were significant ($p < 0.01$) for the Insurance and Financial Services sector, Agriculture, Food and Beverages sector, Mining and Energy Production sector, and the Transportation and Tourism sector. This observation can be explained as a pronounced depiction of the limited content disclosed by companies under the theme of Governance in comparison to the remaining TCFD themes. Furthermore, the results in Table 4 demonstrates that the disclosure type score differences across the four TCFD themes were significant ($p < 0.01$) for the Insurance and Financial Services sector, Agriculture, Food and Beverages sector, and the Mining and Energy Production sector. This observation can be attributed to the predominance of quantitative information observed in the Metrics and Targets theme in comparison to the disclosures of the three remaining TCFD themes that were predominantly qualitative. This is not unusual since quantitative information can be deemed essential for specifying metrics and targets. Again, it can be argued that the lack of numerical information observed across the remaining three TCFD themes could be a result of methodological difficulties associated with appraising the risks of climate change (e.g. difficulties associated with sensitivity analysis). Lastly, the absence of any significant results under the Healthcare Providers and Services sector should be interpreted with caution since only four companies in this sector had produced climate change risks or risk response disclosures.

Table 4: Friedman Test – Comparisons Within Sectors

	Insurance and Financial Services	Agriculture, Food and Beverages	Mining and Energy Production	Transportation and Tourism	Healthcare Providers and Services
Sentence Count	0.001**	0.000***	0.000***	0.006**	0.226
Word Count	0.001**	0.000***	0.000***	0.007**	0.265
Disclosure Type Score	0.003**	0.001**	0.000***	0.239	0.107

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3 TESTS FOR COMPANIES WITH DISCLOSURES - COMPARISONS WITHIN THEMES (ACROSS SECTORS)

Kruskal-Wallis Test results in Table 5 shows that, within the theme of Governance, the sentence counts, word counts, and the average disclosure type scores do not differ significantly

($p > 0.05$) across sectors. The limited amount of disclosures observed under the Governance theme may have contributed to this result. Table 5 also shows that, within the theme of Strategy, the sentence counts, and the word counts do not differ significantly ($p > 0.05$), whilst the average disclosure type score varies significantly amongst industries ($p < 0.05$). However, when significance is assessed at $p < 0.10$, the sentence counts, word counts, and the disclosure type scores within the theme of Strategy shows a significance difference amongst industries.

According to Kruskal-Wallis Test results in Table 5, the sentence counts, word counts, and the disclosure type scores within the theme of Risk Management do not vary significantly ($p > 0.05$). A similar result is observed in the Metrics and Targets theme in Table 5, which shows no significant difference ($p > 0.05$) in the sentence counts, word counts, and the disclosure type scores across industries.

Table 5: Kruskal-Wallis Tests – Comparisons Within Themes

	Governance	Strategy	Risk Management	Metrics & Targets
Sentence Count	0.523	0.097 ⁺	0.153	0.849
Word Count	0.522	0.088 ⁺	0.125	0.766
Disclosure Type Score	0.486	0.044 [*]	0.208	0.670

⁺ $p < 0.10$, ^{*} $p < 0.05$

According to the above, the only theme which demonstrated a significant difference ($p < 0.10$) in the sentence counts, word counts and disclosure type scores was Strategy, which contains disclosures on the actual and possible impacts of climate-related risks on the organization's "businesses, strategy, and financial planning" (TCFD, 2017, p. 21). It can be argued that the reason for this significance is the differences of climate change risks affecting different sectors. As an example, the Mining and Energy Production sector may face a high regulatory risk associated with greenhouse gas emissions which can have a notable impact on their business strategy. Conversely, the Healthcare Providers and Services sector may face a minimal or no regulatory risk associated with greenhouse gas emissions which would not have a considerable impact on their business strategy. Such differences in climate change risks are likely to have

caused the significant difference observed in sentence counts, word counts and disclosure type scores across the five sectors.

4.4 EFFECTS OF CORPORATE FINANCIAL AND CORPORATE GOVERNANCE FACTORS ON CLIMATE CHANGE RISK DISCLOSURES

Table 6 presents the descriptive statistics, the Pearson correlation matrix and the regression analysis results of the impacts of the company specific factors on climate change risk and risk response disclosures. Multicollinearity is unlikely as the correlation values of the independent variables are below the 0.8 cut-off specified by Judge et al. (1980).

Table 6: Analysis of the Impacts of Company Specific Factors on Climate Change Risk Disclosures

Panel A: Descriptive Statistics

	Minimum	Maximum	Mean	Median	Standard Deviation
ROA (Net income to total assets ratio)	-76.56	55.17	2.45	4.65	16.74
ROSF (Net income to total owners' equity ratio)	-132.36	65.06	5.55	9.65	27.05
Gearing (Debt to equity percentage)	-0.004	1403.40	86.95	30.69	172.50
Own_Concentration (Aggregate percentage of share ownership by those with >3% shares)	18.60	88.90	59.17	61.26	16.34
Non_Executive (Proportion of non-executive directors)	0.40	1.00	0.81	0.83	0.10
Female_Directors (Proportion of female directors)	0.00	0.55	0.20	0.20	0.12
Env_Committee (1 = Environmental committee present, 0 = absent)	0.00	1.00	0.31	0.00	0.46
Total_Assets_LN (Natural logarithm of total assets)	16.33	27.60	21.45	20.93	2.23
Sep_CEO_Chair (1 = Separate CEO and chair, 0 = Not separate)	0.00	1.00	0.97	1.00	0.16
Board_Meetings (Number of board meetings held during the 2016-2017 financial year)	16.33	27.60	21.45	10.00	2.23

Note: ROA = return on assets, ROSF = return on shareholder's funds/equity, Gearing = gearing/leverage, Own_Concentration = ownership concentration, Non_executive = proportion of non-executive directors on the board, Female_Directors = proportion of female directors, Env_Committee = presence of an environmental/sustainability committee, Total_Assets_LN = natural logarithm of total assets, Sep_CEO_Chair = presence of a separate CEO-chair structure, Board_Meetings = number of board meetings.

Panel B: Correlation Analysis of Company Specific Factors and Extent of Disclosures

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sentence Count	-												
2. Word Count	0.994***	-											
3. DT Score	0.448***	0.450***	-										
4. ROA	0.098	0.093	0.283**	-									
5. ROSF	0.168	0.162	0.312**	0.833***	-								
6. Gearing	0.272**	0.258**	0.037	0.007	0.003	-							
7. Own_Concentration	0.045	0.043	0.203*	0.318**	0.323**	-0.124	-						
8. Non_Executive	0.270**	0.270**	0.254**	0.016	0.252**	0.014	0.060	-					
9. Female_Directors	0.311**	0.310**	0.347***	0.303**	0.379***	0.171	0.143	0.303**	-				
10. Env_Committee	0.364***	0.362***	0.370***	-0.019	0.022	0.036	0.216*	0.161	0.183	-			
11. Total_Assets	0.668***	0.675***	0.503***	0.325**	0.421***	0.298**	0.202*	0.377***	0.541***	0.221*	-		
12. Sep_CEO_Chair	0.077	0.073	0.034	-0.006	0.004	0.064	-0.026	0.050	0.268**	0.111	0.081	-	
13. Board_Meetings	0.002	0.004	0.048	0.144	0.191	-0.082	-0.051	0.118	0.266**	-0.013	0.155	0.158	-
14. Sector	-0.134	-0.157	-0.055	-0.059	-0.094	-0.120	0.117	-0.228*	-0.076	0.193*	-0.245 ⁺	0.009	0.011

⁺p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Panel C: Regression Analysis

Number of observations	111 companies					
	Sentence count		Word count		Disclosure type score	
Adjusted R square	0.518		0.524		0.350	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
ROA	-0.105	0.427	-0.100	0.447	0.100	0.514
ROSF	0.028	0.845	0.006	0.964	-0.008	0.961
Gearing/Leverage	0.075	0.326	0.051	0.502	-0.080	0.367
Own_Concentration	-0.162	0.035*	-0.160	0.036*	-0.062	0.488
Non_Executive	0.002	0.981	-0.007	0.935	0.041	0.664
Female Directors	-0.015	0.868	-0.017	0.845	0.131	0.200
Env_Committee	0.157	0.046*	0.163	0.038*	0.189	0.039*
Total_Assets_LN	0.797	0.000***	0.810	0.000***	0.526	0.000***
Sep_CEO_Chair	0.035	0.616	0.031	0.663	-0.011	0.897
Board_Meetings	-0.080	0.265	-0.077	0.278	-0.061	0.466
Insurance_FS	0.007	0.954	0.046	0.698	-0.039	0.776
Agr_Food_Bev	0.227	0.034*	0.248	0.020*	0.296	0.018*
Mining_Energy	0.315	0.019*	0.325	0.015*	0.278	0.073 ⁺
Tansport_Tourism	0.121	0.213	0.133	0.170	0.111	0.326

⁺p < 0.10, *p < 0.05, ***p < 0.001

The correlation matrix in Table 6 – Panel B shows that sentence counts and word counts are positively and significantly related to gearing ($p < 0.01$), the proportion of non-executive directors ($p < 0.01$), the proportion of female directors ($p < 0.01$), the presence of an environmental committee ($p < 0.001$) and company size (measured by total assets) ($p < 0.001$). It also shows that the disclosure type scores are positively and significantly related to ownership concentration ($p < 0.05$), profitability (measured by return on assets and return on shareholders' funds) ($p < 0.01$), the proportion of non-executive directors ($p < 0.01$), the proportion of female directors ($p < 0.001$), the presence of an environmental committee ($p < 0.001$) and company size ($p < 0.001$).

Table 6 – Panel C shows the results of the regression analysis conducted to answer the six hypotheses. H1 suggests a positive relationship between profitability (represented by ROA and ROSF) and disclosures. The results observed for profitability do not support H1 since these results are insignificant and inconsistent, due to the depiction of a positive and a negative relationship between disclosures and the profitability indicators (i.e. ROA and ROSF). This observed inconsistency supports the findings in the literature since scholars have contradicting views on how profitability impacts disclosures, especially with Ho and Taylor (2007) and Smith, Yahya, and Amiruddin (2007) observing a significant negative association between profitability and company disclosures, whilst Cormier and Gordon (2001) and Cormier and Magnan (1999) have observed a significant positive association.

H2 suggests a positive relationship between gearing/leverage and the extent of disclosures. This hypothesis is not supported as the results are insignificant and inconsistent, as a positive relationship is observed with sentence and word counts, whilst a negative relationship is observed with disclosure type scores. This result is aligned with the heterogeneity in the relationship between gearing/leverage and the extent of disclosures observed in the literature. With reference to the literature, it can be argued that the positive relationship observed between gearing/leverage and the sentence and word counts may have been driven by the need for companies to address creditors' expectations and to assure that the company is likely to meet creditors needs' and unlikely to breach their debt covenant claims (Rankin, Windsor and Wahyuni, 2011; Haniffa and Cooke, 2005). In comparison, the negative relationship observed between gearing/leverage and disclosure type score implies that companies may be following avenues alternative to annual and sustainability reports to disclose information (Branco and Rodrigues, 2008).

H3 suggests a negative relationship between ownership concentration and the extent of disclosures. Results support H3 by demonstrating that ownership concentration is significantly ($p < 0.05$) and negatively associated with sentence counts and word counts, whilst the relationship with disclosure type scores is also negative, but insignificant. This observed negative relationship is consistent with Brammer and Pavelin's (2006) and Barako, Hancock and Izan's (2006) insights, and it can be explained with insights from Revette (2008) who argue that opportunistic management behaviour is likely to occur in companies with dispersed ownership (low ownership concentration) and therefore ownership distribution among many investors leads to increased pressure for companies to produce disclosures. Furthermore, it is

also likely that companies with dispersed ownership have produced extensive disclosures to counter adverse shareholder reactions such as environmental disclosure activism to reduce information asymmetry that arise from dispersed ownership (García-Meca and Sánchez-Ballesta, 2010; Brammer and Pavelin, 2006).

H4 suggests a positive relationship between the proportion of non-executive directors and the extent of disclosures. Results do not support H4 since these results are insignificant and contradictory. This result was unexpected since multiple researchers view non-executive directors to have a strong alignment with external stakeholder interests and as monitors of management's actions, which consequently creates the expectation of a positive relationship between their proportional representation and the extent of disclosures (Brammer and Pavelin, 2008, p. 125; Haniffa and Cooke, 2002).

H5 suggests a positive relationship between the proportion of female directors and the extent of disclosures. Results do not support H5 since these results are insignificant and contradictory. This result was also unexpected since previous findings suggests that females have a focus on "the needs of others and understanding the social demands on stakeholders", are more concerned with environmental issues when compared to males and may increase the "likelihood that the board understands the ethical and social demand of providing meaningful and transparent disclosures" (Hollindale et al., 2019, p. 281; Liao, Luo and Tang, 2015; Diamantopoulos et al., 2003).

H6 suggests a positive relationship between the presence of an environmental committee and the extent of disclosures. Results support H6 by demonstrating that the presence of an environmental committee is positively and significantly ($p < 0.01$) related to the extent of climate risk disclosures. This result is aligned with Peters and Romi's (2014) observation of a positive, significant association between the presence of an environmental committee and the propensity for companies to disclose their greenhouse gas emission accounting. Furthermore, this result is aligned with the use of environmental committees in the literature as a proxy for the board's inclination towards environmental accountability (Liao, Luo and Tang, 2015).

Regression analysis results observed for the control variables show that company size, which is represented by the natural logarithm of total assets, is positively and significantly ($p < 0.01$) related to the sentence counts, word counts and disclosure type scores. In comparison, gearing

and the presence of a separate CEO-chair structure does not have an influence on the extent of climate risk disclosures represented by the combined output of sentence counts, word counts, and disclosure type scores. Results however show that the number of board meetings (Board_Meetings) is negatively related to sentence counts, word counts and disclosure type scores. It also demonstrates that sentence and word counts are positively, yet insignificantly, related to the insurance and financial services, and transportation and tourism sectors. The disclosure type scores however show a negative insignificant relationship with the insurance and financial services sector and a positive insignificant relationship with the transportation and tourism sector.

5. CONCLUSION

This study aimed to understand the extent of climate change risks and risk responses disclosed by 114 Australian companies representing the Insurance and Financial Services sector, Agriculture, Food and Beverages sector, Mining and Energy Production sector, Transportation and Tourism sector, and the Healthcare Providers and Services sector. By utilising content analysis of annual and sustainability reports, the extent of climate change risks and response disclosures was assessed against the four overarching themes of the 2017 TCFD recommendations that can be considered as one of the best practice guidelines for disclosing climate-related risks. The results show that over a quarter of the companies across three sectors failed to address any of the TCFD themes. Specifically, it was noted that over 60% of companies in the Healthcare Providers and Services sector, and over 35% of companies in both the Insurance and Financial Services sector and the Mining and Energy Production sector failed to report climate change risks and risk responses by referring to any of the TCFD recommendations. Moreover, it was noted that over a quarter of companies across four sectors failed to produce disclosures on climate change risks and risk responses by addressing all four TCFD themes. Analysis on companies that had produced disclosures on climate change risks and risk responses show a lack of disclosures addressing the theme of Governance across all five sectors. Conversely, a considerable volume of disclosures had addressed the theme of Risk Management.

Friedman tests explored differences in disclosures across TCFD themes within each sector and found significant differences in sentence and word counts under all but the Healthcare Providers and Services sector. This can be explained by the predominant volume of disclosures

observed under the Risk Management theme in comparison to the Governance theme which had attracted a handful of disclosures. The disclosure type scores were significantly different across the TCFD themes under the Insurance and Financial Services sector, Agriculture, Food and Beverages sector, and the Mining and Energy Production sector. This can be attributed to disclosures under all themes except for Metrics and Targets lacking quantitative information. Moreover, Kruskal-Wallis tests that considered each TCFD theme and explored differences in disclosures across the five sectors, did not find any significant differences under three of the four themes. The only significant difference in sentence counts, word counts, and disclosure type scores were observed under the Strategy theme. This noted significance could be the result of differences in climate change risks and risk responses encountered by distinctive sectors. Furthermore, results from the regression analysis demonstrate that the extent of climate change risk and impact disclosures is significantly and negatively associated with ownership concentration, and significantly and positively associated with the presence of an environmental/sustainability committee.

To address the disclosure insufficiencies identified in this study, the following can be recommended. First, companies are strongly advised to improve their reporting on how the board oversees and manages climate related issues, since reporting under the TCFD theme of Governance has been overlooked by most of the sampled companies in this study. Call for companies to report climate change risks and risk responses is not unprecedented since studies such as Haque and Deegan (2010) have advocated for disclosures on governance by arguing that investors and other interest groups would have an interest in the governance practices implemented by companies to address climate change related issues.

Second, companies in the Healthcare Providers and Services, Insurance and Financial Services, and the Mining and Energy Production sectors are recommended to assess the climate change risks on their businesses, adaption costs and benefits associated with these risks and to disclose these risks with information on risk responses. This recommendation is put forward to counter the lack of climate change risks and risk responses disclosures observed within these three sectors, which would consequently assist stakeholders such as investors, creditors and underwriters to make well-informed decisions and also help directors to minimise their risk of legal liabilities associated with breaching their statutory duty of due care diligence.

Third, companies are recommended to move forward from pure qualitative disclosures, to incorporate quantitative elements into their disclosures. Quantifying the risks of climate change combined with a quantification of how the company will improve the level of disclosures produced. However, an adequate level of disclosure would contain numerical elements that provide comparisons (e.g. yearly comparisons), combined with an explanation of the numerical elements. Companies are encouraged to work towards producing disclosures aligned with these recommendations across all four TCFD themes.

Fourth, due to the positive significant relationship observed between the presence of an environmental/sustainability committee and the extent of climate change risk disclosures, companies are strongly encouraged to form an environmental/sustainability committee if it is not yet in place. Companies can also incorporate the responsibility of overseeing the assessment, management and reporting of climate change risks into an existing board committee (e.g. risk management committee). Fifth, regulators are strongly advised to place special emphasis on monitoring climate change risk and impact disclosures of companies with concentrated ownership, since results of this study suggest that these companies are likely to produce less extensive disclosures in comparison to other companies. This will help ensure that users of financial statements are not kept in the dark about the climate risks faced by companies.

The above-mentioned recommendations can be used by companies to ensure that their climate change risks and risk response disclosures meet stakeholder expectations. Furthermore, these recommendations can also be used by companies to help protect directors from breaching their statutory duty of due care and diligence that can result from inadequate climate change risk and impact disclosures. Moreover, these recommendations can be used by regulators to improve the effectiveness of their oversight and to minimise the incidence of investors being kept in the dark about the climate change risks faced by Australian companies. Aside from these practical contributions, the findings of this study shed light on the specific shortcomings of current climate change risks and risk response disclosures by Australian companies, which is a crucial research avenue left uncharted by researchers.

Lastly, it is worth noting the limitations of this study. First, this study is restricted to the Australian context, and this limits the generalisation of its findings. Hence, researchers are encouraged to replicate this study in different contexts to further highlight limitations in climate change risks and impact disclosures by companies. Second, although this study has identified

shortcomings in climate change risks and risk response disclosures, it has not explored why these shortcomings have occurred. Therefore, future studies are encouraged to conduct interviews with the preparers of the statements analysed in this study to obtain rich insights into why these companies have not adequately responded to stakeholder expectations through their climate change risks and impact disclosures. Furthermore, researchers are encouraged to replicate this study in the future to examine whether corporate climate change risks and risk response disclosures have improved over time.

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CHAPTER 4:

STUDY 3

Investor Reactions to Climate Change Risks and Risk Response Disclosures by Companies

Conference acceptance:

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ABSTRACT

This study examines (i) how investors react to varying disclosure levels of climate change risks faced by companies under long-term and short-term investment time horizons, and (ii) how investors' personality traits (specifically, degrees of extraversion and neuroticism) and belief in climate change influence their investment decisions. The study uses a survey experiment displaying three different levels of climate change risk disclosures in three company settings (represented by company Alpha, Beta and Delta, respectively). Based on the responses of 96 stock market investors, the study demonstrated that compared to company Alpha, which does not disclose any climate change risk information, investors allocate more money to company Beta, which discloses climate change risk information; and even more money to company Delta, which discloses information on both climate change risks and risk response efforts. Notably, the high investment amounts allocated to company Delta was observed for both short-term and long-term investment time horizons. Furthermore, it was found that the degree of neuroticism of an investor was positively associated with the investment amounts allocated to company Delta, while the degree of extraversion of an investor was positively related to investment amounts allocated to both company Beta and company Delta. Results also showed a negative relationship between investors' belief in climate change and their investment in company Alpha.

1. INTRODUCTION

Many companies in Australia are exposed to significant regulatory, physical and market risks arising from climate change. These risks can cause significant losses for companies and lead to negative financial implications for users of accounting information (Climate Council, 2019; Luo and Tang, 2016; The Climate Institute, 2006). Amongst these users, investors have a crucial need for information on the climate change risks faced by companies to make informed investment decisions (Linnenluecke, Birt and Griffiths, 2015). Yet, only a small number of companies sufficiently disclose the implications of climate change risks faced by their businesses (Market Forces, 2018). This is likely because climate change risk reporting is not widely required (Liesen et al., 2015). However, directors of Australian companies have a legal duty to “act on climate change risk, include it in corporate strategies and report on it to shareholders”, and failure to do so would attract legal consequences for the directors (Fernyhough, 2019, para. 1). Furthermore, listed companies in Australia are required to report material business risks imposed by climate change under section 299A (1) (c) of the Australian Corporations Act 2001 (Australian Securities and Investments Commission, 2018). Failure to report such risks and risk response information can lead to significant negative consequences for non-compliant companies and their directors (Fernyhough, 2019; Peel, Osofsky and Foerster, 2017). This was evident in recent media reports that show investors taking legal actions against companies for failing to adequately disclose information concerning climate change risks (Williams, 2018; Hutchens, 2017).

Although investors have sought legal actions for insufficient climate change risks and risk response disclosures, it is unclear how they react to the presence (absence, or insufficiency) of climate change risk disclosures when making investment decisions. The existing literature is ambivalent, suggesting on the one hand that negative environmental disclosures are “likely to turn investors off”, and on the other that negative disclosures “could signal proactivity and awareness of risk”, which is in turn “honoured by investors” (Reimsbach and Hahn, 2015, p. 220; Chan and Milne, 1999, p. 274). Aside from these mixed findings, the literature does not provide any insights into investors’ reactions to different levels of climate change risk disclosures by companies. This is a crucial gap in the literature, as it is important to understand how investors react to climate change risk disclosures when making investment decisions, especially at a time of rising investor demands for such disclosures and the severe financial and legal consequences for companies failing to disclose sufficient information. Also,

uncertainties surrounding how investors would allocate resources to companies that face climate change risks could prove problematic for investment firms, especially when determining the personnel that should manage investment funds which are exposed to climate change risks. Furthermore, since climate change is a highly controversial topic and since practices that deal with climate change are debateable (Porter, Kuhn and Nerlich, 2018), it is worth exploring how investor reactions to climate change risk disclosures would compare against the findings of existing literature on environmental disclosures.

This study addresses this gap in the literature by exploring investors' reactions to different levels of climate change risk disclosure (i.e., disclosing no climate change risk information, disclosing climate change risks only, and disclosing both climate change risks and risk response information) when considering short-term (i.e., up to one year) and long-term (i.e., exceeding two years) investment decisions. This study also examines how long-term investment decisions could be affected by investors' degree of extraversion, which is characterised by "an orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience" (American Psychological Association, 2019a, para. 1); and degree of neuroticism, which is characterised by "a chronic level of emotional instability and proneness to psychological distress" (American Psychological Association, 2019b, para. 1), and climate change belief as climate change is fiercely contested in Australia (Jang and Hart, 2015).

Using a between-subject survey experiment set in the Australian context, this study acknowledges Australia's high exposure and sensitivity to climate change and the inadequacy of climate change risk response disclosures by a number of large Australian companies (The Commonwealth Scientific and Industrial Research Organisation, 2019; Yeates, 2017; The Garnaut Climate Change Review, 2011). The survey experiment involved 96 experienced stock market investors, who were randomly divided into three hypothetical company settings named Alpha Ltd (Alpha) – with no climate change risk disclosures, Beta Ltd (Beta) – with climate change risk disclosures, and Delta Ltd (Delta) – with both climate change risk and risk response disclosures. After reviewing their respective company's statements, the participants were asked to invest up to AU\$30,000 in the company by separately considering a short-term and a long-term investment scenario.

The results show that company Alpha attracted the least amount of investment whilst company Delta received the most, depicting the importance for companies to disclose their climate

change risks and risk response information to maximise their potential for sourcing investments. Contrary to the expectations derived from the literature, it was found that company Delta, which disclosed its climate change risk and risk response information, received more investments under long-term and short-term investment decisions, when compared to company Beta, which only disclosed its climate change risk information. Additionally, the findings show that the degree of investors' neuroticism was positively related to the amount of long-term investments in company Delta, and negatively related to the amount of long-term investments in company Beta. Moreover, in contrast to expectations derived from the literature, it was found that the degree of investors' extraversion was positively related to long-term investments in both company Beta and company Delta. Finally, it was observed that higher degrees of climate change belief led to more investment in company Delta than company Beta.

Three important contributions emerge from this study. First, it contributes to the literature by being one of the first studies to investigate investors' attitudes towards corporate disclosures of climate change risks and risk responses specifically. Second, the findings of this study deliver a practical contribution for companies by demonstrating whether disclosing climate change risks only or disclosing them coupled with risk responses would be a better strategy in seeking to maximise the amount of resources from short-term and long-term investors. Third, the results of this study can help investment companies recruit personnel with suitable personality traits through psychometric tests to manage investment portfolios that are increasingly exposed to the impacts of climate change.

The remainder of this paper is organised as follows. Section 2 presents the literature review and hypotheses. The research method is presented in Section 3 and the empirical results are reported in Section 4. Section 5 offers a discussion of the results and Section 6 concludes the paper.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Understanding the impacts of environmental disclosures on investment decisions is an important aspect of the accounting literature because investors are increasingly putting weight on environmental issues in their resource allocation decisions (Deegan and Rankin, 1996). Capital market studies have contributed to this branch of the literature with some arguing that "more positive disclosures are associated with positive market reactions" (Holm and Rikhardsson, 2008, p. 540). Similarly, Flammer's (2013) study on shareholder reactions

revealed significant share price increases when companies reported responsible behaviour towards the environment, whilst suffering significant stock price decreases when negligent actions were revealed. Emblematic of this is Xu, Zeng and Tam (2012), which showed a decline in Korean firms' market value following the discovery of their non-compliance with environmental laws and regulations. Similarly, Bui, Moses and Houqe (2020) have found that the cost of capital reduces in the presence of extensive climate disclosures during high greenhouse gas emissions, suggesting that investors consider the joint impact of emissions and disclosures when assessing a company's riskiness. Additionally, Hyun, Park and Tian (2020) have observed that greenness information indicators such as the Climate Bonds Initiative (CBI) certificate reduces green bond premiums.

In addition to capital market studies that have primarily relied on archived data, experimental studies have also contributed to the understanding of the impact of environmental information on investment decisions. For example, Chan and Milne (1999) have observed strong negative investor reactions to information that shows weak or negative commitment to environmental issues. Companies that disclose poor environmental performance (with long-term risks and potential liabilities) are, according to Milne and Patten (2002), significantly less likely to attract long-term investments from investors. At the same time, Milne and Patten (2002) have also documented how positive legitimising disclosures lead to significant increases in the average amount invested in a poor environmental performer, implying that investors reward the company for having communicated its risk. Furthermore, Holm and Rikhardsson (2008) have documented that investors allocate more resources to companies that report positive environmental information, such as commitment to using environmental performance indicators (e.g. energy efficiency).

It is unclear whether these documented implications of investor reactions to environmental disclosures would apply to the context of climate change risk disclosures, since studies have shown a division in public concern about climate change (Engels et al., 2013). Several studies have attempted to examine the implications of climate change risks, with some focusing on the consequences of climate change along with the usefulness of voluntary disclosures on carbon performance for investment decisions (Bui, Moses and Houqe, 2020). As an example, Solomon et al. (2011) have observed that institutional investors are apprehensive about the climate change risks associated with regulation and taxes. Furthermore, Martin and Moser (2016) have found that potential investors' standardised bids for corporations are greater when managers

disclose their green investments to reduce carbon emissions. Moreover, Hong, Li and Xu (2019) have observed that stock markets are inefficient with respect to information about the risk of drought trends. Additionally, Painter's (2020) study on municipal bonds has noted that the market can price climate change risks regarding credit quality.

Since environmental disclosures (including climate change risk information) are not completely mandated or guided by a unanimously accepted standard (TCFD, 2017), disclosures of climate change risks may vary. This is evident in Cotter and Najah's (2012) study on global climate change disclosure practices, which observed lower risk disclosures and better emissions accounting disclosures, and Haque and Deegan's (2010) Australian study observing better research and development (e.g. low emission technologies) disclosures and no disclosures about the presence/absence of a board committee for climate change. These differences in climate change risk disclosures can be anticipated to cause implications for companies when sourcing investments, as environmental disclosures generally trigger investor reactions. However, studies are yet to explore the impact of climate change risks and risk response disclosures on investment decisions and there are calls by researchers to explore the implications of climate change risk disclosures (Ding, Daugaard and Linnenluecke, 2020). Acknowledging this call and the gap in the literature, this study explores how different levels climate change risk disclosures impact investment decisions.

With climate change risk disclosures largely remaining unmandated, it is worth exploring investors' reactions to climate change risk disclosure and non-disclosure. It is difficult to anticipate how investor reactions to non-disclosure and disclosure of climate change risks might differ since both can be less appealing for investors. Specifically, the literature suggests that non-disclosure of information can be less appealing to investors, since collection of information is costly (Cormier, Magnan and Van Velthoven, 2005), and this reasoning is well aligned with evidence of lower firm values associated with companies that do not disclose environmental information such as carbon emissions (Matsumura, Prakash and Vera-Munoz, 2014). On the contrary, the literature presented earlier shows that negative environmental information also attracts negative investor reactions (Milne and Patten, 2002; Chan and Milne, 1999), thus raising the possibility that climate change risk disclosures may deter investments. Whilst both disclosures and non-disclosures may attract negative investor reactions, evidence from the environmental accounting literature makes a strong case for negative reactions associated with disclosure inadequacy. This is evident in, Blacconiere and Patten's (1994)

study of the Bhopal chemical leak which shows that chemical firms with more extensive environmental disclosures endured a less negative market reaction compared to firms that disclosed less, suggesting that investors interpret the lack of environmental disclosures as a sign of greater vulnerability to both environmental risks and impending regulatory costs. Since disclosure inadequacy is also depicted through non-disclosure, an absence of disclosures can be expected to attract a more negative investor reaction when compared to the disclosure of climate change risk information. Based on this reasoning, the following hypothesis can be proposed:

H1a: Investors will allocate more funds to companies that disclose climate change risk information over companies that do not.

Additionally, Chan and Milne (1999) have noted positive investments in companies with better environmental performance without incurring excessive unnecessary expenditures, whilst Holm and Rikhardsson (2008) have observed that investors allocate more funds to companies with positive environmental disclosures over those who do not produce environmental disclosures. These support the argument that investors positively view companies that produce climate change risk and risk response disclosures, which seemingly signal their desire to reduce future risks and liabilities. As a result, such disclosures appear to indicate to investors that the company is (at least to some extent) in control of the specified climate change risks, creating a favourable impression among investors. The two key assumptions of decision usefulness in accounting - “good environmental performance creates value” and “environmental disclosures are rewarded by decision-makers and seen as sufficiently significant to be included as decision criteria”, also support this argument (Holm and Rikhardsson, 2008, p. 538). As a result, investors are expected to allocate more funds to companies that disclose climate change risks and efforts to manage them which may limit the company’s impending risks and liabilities over companies that only disclose climate change risks or do not disclose any risk information. This leads to the following related hypotheses:

H1b: Investors will allocate more funds to companies that disclose both climate change risk and risk response information over companies that do not disclose any climate change risk information.

H1c: Investors will allocate more funds to companies that disclose both climate change risk and risk response information over companies that only disclose climate change risk information.

Further, studies have demonstrated that when faced with long-term investment decisions, investors tend to favour good/positive environmental performers (Liyanarachchi and Milne, 2005; Milne and Patten, 2002). Epstein (1992) suggests that long-term financial investors behave this way because they anticipate that environmental problems could result in significant increases in costs, regulation and government fines. Extending Epstein's (1992) reasoning to the impacts of climate change that are expected to increase in severity in the long run, it can be argued that companies that fail to demonstrate positive environmental performance by acknowledging and responding to climate change risks could create serious financial concerns for long-term investors (Alembakis, 2019; National Aeronautics and Space Administration, 2019; BlackRock, 2016). Based on this reasoning, long-term investors are anticipated to favour companies that manage climate change risks over companies that do not. Accordingly, a second hypothesis is proposed.

H2a: Long-term investors will allocate more funds to companies that disclose both climate change risk and risk response information over companies that only disclose the former.

Conversely, Milne and Patten (2002) have observed that short-term investors are likely to favour poor environmental performers over their environmentally-conscious counterparts when making investment decisions, since short-term investors are likely to perceive a company's (long-term) commitment towards environmentally responsible behaviour as excessive, unnecessary, or simply beyond the scope of the investment window. Milne and Patten (2002) also found that fewer funds were invested in a company with environmental disclosures (e.g. in compliance with the law) than in the absence of such disclosures. This company appears to have been 'punished' by investors for its expenditures on environmental actions that would not provide short-term returns. On this premise, companies that disclose risk response efforts would be less attractive than those that do not to investors considering short-term investments, leading to the following hypothesis:

H2b: Short-term investors will allocate more funds to companies that only disclose climate change risk information over companies that disclose both climate change risk and risk response information.

An individual's approach to risk has been an evolving discussion in the literature. When risks associated with investments are considered, researchers have sought to explain investors' choices in various ways, with some rooting their analysis in the principles of psychology (Mayfield, Perdue and Wooten, 2008). Existing studies suggest that investment decisions can be influenced by the personality traits of the investor. Two important traits are extraversion and neuroticism (Oehler et al., 2018).

Extraversion is associated with optimistic and excitement-seeking individuals who as a result would appear to pay less attention to negative information and be more willing to take risks to achieve higher investment returns (Oehler et al., 2018). Nevertheless, the literature reports mixed findings between extraversion and risk-taking behaviour of individuals. Terracciano et al. (2008) and Cook et al. (1998) identified a positive relationship between extraversion and risk-taking behaviour, whereas Vollrath, Knoch and Cassano (1999) found a negative association between the two. Lee and Ashton (2005) found no association whatsoever.

Some studies view extraversion as premised upon "biological systems that facilitate forward locomotion to obtain pleasurable rewards" (Weller and Tikir, 2011, p. 184). This perspective implicitly advances the argument that researchers must consider the rewards associated with risk-taking behaviour when examining the connection between extraversion and risk-taking behaviour. Translating this perspective to an investment context, individuals with a high degree of extraversion would appear to be less inclined to make long-term investments in a company that incurs costs to respond to its risks, since these costs may reduce the likelihood of a high return. Therefore, a positive (negative) relationship is expected between the degree of investors' extraversion and their investments in companies that do not respond to climate change risks (do respond to climate change risks), leading to the following hypotheses:

H3a(i): The higher the degree of an investor's extraversion, the more funds the investor will allocate to companies that only disclose climate change risk information.

H3a(ii): The lower the degree of an investor's extraversion, the more funds the investor will allocate to companies that disclose both climate change risk and risk response information.

One would expect to see the opposite results when looking at psychological traits that are at odds with extraversion. It so happens that individuals with a higher degree of neuroticism are depicted as near opposites to extraverts, who are more anxious, pessimistic, paying greater

attention to negative information and demonstrating a greater fear of uncertainty (Lommen, Engelhard and van den Hout, 2010; Noguchi, Gohm and Dalsky, 2006; Cloninger, 2000). Backing up this assessment in the financial realm, Oehler et al. (2018) have found that the higher the degree of neuroticism in an individual, the fewer risky assets the individual will hold. Therefore, investors that have a high degree of neuroticism would favour companies seeking to avoid uncertainties caused by climate change risks by implementing risk response efforts. Hence, the following hypotheses are proposed:

H3b(i): The lower the degree of an investor's neuroticism, the more funds the investor will allocate to companies that only disclose climate change risk information.

H3b(ii): The higher the degree of an investor's neuroticism, the more funds the investor will allocate to companies that disclose both climate change risk and risk response information.

In addition, investors' belief in climate change is also likely to play a major role in deciding the amount of investment funds allocated to companies that are impacted by climate change. This view is supported by Weber and Stern's (2011, p. 320) finding that risk assessment of physical and environmental processes is "strongly affected by perceived qualitative characteristics of the hazards, which can evoke affective reactions". When these views are combined with research evidence of the debate over climate change in Australia, there appears to be a pressing need to investigate whether belief in climate change influences Australian investors' resource allocation decisions (Jang and Hart, 2015; Engels et al., 2013). It can be anticipated that investors who believe in climate change would acknowledge its riskiness in comparison to those who do not, and hence would perceive companies that do not respond to climate change risks as being more exposed to negative financial and non-financial consequences over companies that do. Consequently, these investors are expected to favour companies that disclose climate change risk response information over those which do not. This leads to the fourth hypothesis:

H4: The more an investor believes in climate change, the more funds the investor will allocate to companies that disclose both climate change risk and risk response information.

3. METHOD

Following Holm and Rikhardsson (2008), Milne and Patten (2002), and Chan and Milne (1999), an experimental design was chosen for this study. This method enables the manipulation of the variable of interest, which is climate change risk disclosures.

To test the hypotheses, a survey experiment instrument consisting of three case scenarios was developed that described hypothetical accounting situations for three different companies named Alpha, Beta and Delta Ltd.⁸ All three companies represented the mining industry since it is highly exposed to climate change risks that include regulatory pressures, flooding, cyclones and wildfires. Participants assigned to Alpha were the control group whilst those assigned to Beta and Delta represented the two treatment groups. Alpha's statement only contained financial information, whereas Beta's statement contained financial information and climate change risk information. Delta contained financial information, climate change risk information and risk response information. To ensure the participants were not aware of the manipulation, a between-subject design was employed. The financial information of the instrument was consistent across the three companies and was adapted from Milne and Patten's (2002) research instrument. The climate change risk disclosures that were manipulated in this study were developed by reviewing annual and sustainability reports of 55 Mining and Energy Production companies, one of the highly climate change prone industries, on the S&P ASX (Australian Securities Exchange) 300 list (on 30th May 2018). The drafting of the disclosure relating to risk response information was guided by the Task Force on Climate Related Financial Disclosures (TCFD) framework. Not only does the TCFD framework currently represent one of the best practice guidelines for preparing climate change risk disclosures, its use in drafting the disclosure gains additional credence in light of its support by Australian financial regulators and over 450 companies worldwide that represent a combined market capitalisation of US\$7.9 trillion (TCFD, 2018).

The instrument also measured the degree of extraversion and neuroticism in the personalities of the participants and their belief in climate change. The Big Five Inventory 44-item (BFI-44) scale was adapted from Denissen et al. (2008) to measure investors' personality traits (extraversion and neuroticism). A five-point Likert scale ranging from 'strongly disagree' to 'strongly agree' was used. Climate change belief was measured by four items adapted from

⁸ Please see Appendix 2.1 for the survey experiment instrument.

Engels et al. (2013). These items were also presented on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Reverse coding and validation measures were used to control the quality of the responses.

The research instrument was pre-tested with five academic colleagues who have extensive experience in survey-based experiment studies. Following the pretest, 18 stock market investors participated in the pilot test through the Qualtrics Surveys online platform to evaluate feasibility, survey duration and the effectiveness of validation controls. The pilot study results confirmed that the participants comprehended and reacted as expected to the case scenarios containing different levels of climate change risk disclosures, suggesting that the manipulations were appropriate.

Participants for the experiment were recruited from the Qualtrics database by using simple random sampling. A total of 195 stock market investors were invited to participate in the survey. The participants were recruited through the Qualtrics, whose participant selection approach, combined with the capability of matching incentives to the complexity of the research instrument, "provides the researcher with significant flexibility that can be used to increase data quality and decrease participant attrition" (Brandon et al., 2013, p. 11). A screening question at the beginning of the survey experiment ensured that all participants had at least six months of stock market investment experience (Slovic, Fleissner and Bauman, 1972). Each participant was randomly assigned to one of the three company scenarios. The participants were instructed to review the company information they were assigned and allocate up to AU\$30,000 in that company under both short-term and long-term investment time horizons. The order of the time horizon scenarios was alternated to avoid order effects. With a response rate of 49%, 96 responses were obtained. The number of participants in this study is consistent with prior experimental studies on investment decisions, which typically had sample sizes ranging from 75 to 100 (e.g. 98 in Holm and Rikhardsson (2008), 76 in Milne and Patten (2002), and 83 in Chan and Milne (1999)). There were 32 usable responses each for Alpha, Beta and Delta as the sample selection was controlled to maintain an equal sample size across the groups.

Descriptive statistics and Maan-Whitney Z-score tests were performed to answer hypotheses H1 and H2, which tested different levels of climate change disclosure. A Kruskal-Wallis test was also performed to explore the differences in investment fund allocations across the three companies. Regression analyses were used to answer H3 and H4, which hypothesise the

impacts of investor personality traits and climate change belief on investment decisions. Long-term investments in Beta (LTI_{BETA}) and Delta (LTI_{DELTA}) were separately considered and regressed on the degree of extraversion (EXTRAVERT), the degree of neuroticism (NEUROTIC), and climate change belief (CC_BELIEF). Long-term investments were chosen because when investment time horizons are considered, long-term investors are more exposed to the risks and impact of climate change, and this consequently makes climate change a material investment risk for them (Alembakis, 2019; BlackRock, 2016). Also, the impacts of climate change are expected to increase in severity in the long run and this can create serious consequences for long-term investors (National Aeronautics and Space Administration, 2019). The relation between investors' personality traits and climate change belief was tested for long-term investments (LTI) in Beta and Delta by using the multiple linear regression model below.

$$LTI = \beta_0 + \beta_1 \text{EXTRAVERT} + \beta_2 \text{NEUROTIC} + \beta_3 \text{CC_BELIEF} + \beta_4 \text{EDU_LEVEL} + \beta_5 \text{GENDER} + \beta_6 \text{MAR_STATUS} + \beta_7 \text{BUS_EDU} + \beta_8 \text{PORTF_SIZE} + \beta_9 \text{CC_EXPOSURE} + \beta_{10} \text{RISK_BEHAV} + \varepsilon$$

This model also contains seven control variables. The first is the highest education level which is also assessed through a single choice option (i.e. No college/university education, Diploma/certificate or equivalent, Bachelor's degree or equivalent, Masters' degree or equivalent or Doctorate). The second is gender (GENDER), measured as a binary variable (i.e. Male or Female). The third is marital status (MAR_STATUS), assessed through a single choice option (i.e. Single, Married or Other). The fourth is business or commerce education or training (BUS

_EDU), assessed as a single choice option (i.e. having work experience/training or a university/college education relating to accounting/finance/actuaries, or not). The fifth is existing investment portfolio size (PORTF_SIZE), assessed as a single choice option (i.e. Under AUD \$50,000, or Between AUD \$50,000 and AUD \$250,000, or Over AUD \$250,000). Sixth, the climate change risk exposure (CC_EXPOSURE) of the existing portfolio was deemed high if the most stock market investment is in the Insurance and Finance sector, or the Agriculture, Food and Beverages sector, the Mining and Energy Production sector, the Transportation and Tourism sector, the Healthcare Providers and Services sector, due to their high climate change risk exposure. Seventh, the investors' general stock investment risk behaviour (RISK_BEHAV) due to their possible influence on the investment decisions (Oehler

et al., 2018; Mayfield, Perdue and Wooten, 2008). Investors' general stock investment risk behaviour was measured through a scale adapted from Weber, Blais and Betz (2002).

Prior to executing the regression analyses, reliability tests were performed to obtain the Cronbach's alpha reliability of the variables. Satisfactory Cronbach's alpha reliability values were obtained for the scales that measure extraversion ($\alpha = 0.868$), neuroticism ($\alpha = 0.903$), climate change belief ($\alpha = 0.934$), and general investment risk behaviour ($\alpha = 0.653$) (Taber, 2018). Factor analyses were also performed for these scales to establish the construct validity by ensuring that items that measure each variable have a minimum loading of 0.30 in order to provide interpretive value (Comrey and Lee, 1992). Manipulation checks were performed using t-tests. These t-tests assess the perceived importance of climate change risk and risk response disclosures recorded by participants in the control (Alpha) and manipulation (Beta and Delta) groups following their investment decisions. The results show that the participants' perceived importance of climate change risk and risk response disclosures was significantly ($p < 0.05$) greater for Delta (mean = 3.63) and greater for Beta (mean = 3.43) than Alpha (mean = 3.18). The results suggest that the manipulations have been effective.

4. RESULTS

Table 1 provides demographic information of the participants. There were 60 (62.5%) male and 36 (37.5%) female investors. On average, the participants had over 14 years of stock market investment experience.

Table 1: Demographic Information of the Participants

Demographic	Control Group (Alpha Ltd)	Treatment Group 1 (Beta Ltd)	Treatment Group 2 (Delta Ltd)
Sample size	32	32	32
<u>Gender</u>			
Male	17 (53.13%)	23 (71.88%)	20 (62.50%)
Female	15 (46.87%)	9 (28.12%)	12 (37.50%)
<u>Age</u>			
Under 30 years	3 (9.38%)	2 (6.25%)	1 (3.12%)
30-39 years	1 (3.12%)	3 (9.38%)	5 (15.63%)
40-49 years	3 (9.38%)	6 (18.75%)	4 (12.50%)
50-59 years	8 (25.00%)	4 (12.50%)	6 (18.75%)
Over 59 years	17 (53.12%)	17 (53.12%)	16 (50.00%)
<u>Marital status</u>			
Single	15 (46.87%)	9 (28.13%)	8 (25.00%)
Married	14 (43.75%)	22 (68.75%)	19 (59.37%)
Other	3 (9.38%)	1 (3.12%)	5 (15.63%)
<u>Education level</u>			
No college/university education	8 (25.00%)	10 (31.25%)	11 (34.37)
Diploma/certificate or equivalent	8 (25.00%)	7 (21.87%)	9 (28.13%)
Bachelor's degree or equivalent	13 (40.62%)	9 (28.13%)	8 (25.00%)
Masters' degree or equivalent	3 (9.38%)	5 (15.63%)	2 (6.25%)
Doctorate	0 (0.00%)	1 (3.12%)	2 (6.25%)
<u>Average stock market investment experience</u>	14.22 years	16.66 years	15.91 years
<u>Climate change risk exposure level of existing investment portfolio</u>			
High	29 (90.62%)	24 (75.00%)	27 (84.37%)
Low	3 (9.38%)	8 (25.00%)	5 (15.63%)

The first set of hypotheses propose that investors would allocate the most funds to companies that disclose both climate change risks and risk response efforts (i.e., Delta), the second most to companies that disclose climate change risks (only) (i.e., Beta), and the least to companies that do not disclose climate change risks at all (i.e., Alpha). Following Holm and Rikhardsson (2008) and Milne and Patten (2002), mean values were obtained for the investment funds allocated to Alpha, Beta and Delta. To test H1a, the investment funds allocated to Alpha and Beta were compared; to test H1b, the investment funds allocated to Alpha and Delta were

compared; and to test H1c, the investment funds allocated to Beta and Delta were compared, all using the Maan-Whitney Z-score test. As an additional analysis, investment funds allocated to Alpha, Beta and Delta were compared as a whole using the Kruskal-Wallis Test.

Table 2: Investment Allocations Under Both Investment Time Horizons

Panel A: Comparison of Allocations in Alpha Ltd and Beta Ltd

	Average	Minimum	Maximum	Mann-Whitney Test Sig.
Alpha Ltd	\$9,293.59	\$0.00	\$17,500.00	0.913
Beta Ltd	\$9,351.56	\$0.00	\$22,500.00	

Panel B: Comparison of Allocations in Alpha Ltd and Delta Ltd

	Average	Minimum	Maximum	Mann-Whitney Test Sig.
Alpha Ltd	\$9,293.59	\$0.00	\$17,500.00	0.042*
Delta Ltd	\$12,750.00	\$2,500.00	\$22,500.00	

Panel C: Comparison of Allocations in Beta Ltd and Delta Ltd

	Average	Minimum	Maximum	Mann-Whitney Test Sig.
Beta Ltd	\$9,351.56	\$0.00	\$22,500.00	0.014*
Delta Ltd	\$12,750.00	\$2,500	\$22,500.00	

Panel D: Comparison of Allocations in Alpha Ltd, Beta Ltd and Delta Ltd

	Average	Minimum	Maximum	Kruskal-Wallis Test Sig.
Alpha Ltd	\$9,293.59	\$0.00	\$17,500.00	0.036*
Beta Ltd	\$9,351.56	\$0.00	\$22,500.00	
Delta Ltd	\$12,750.00	\$2,500	\$22,500.00	

*p < 0.05

The results in Table 2 in general support the first set of hypotheses. Specifically, Table 2 panel A does not show a significant result to support H1a, despite illustrating that investors have allocated more funds to Beta (which disclosed climate change risk information) over Alpha (which did not). Panels B and C support H1b and H1c respectively. The results show that investors direct significantly ($p < 0.05$) more funds to Delta (which disclosed climate change risks and risk response information) compared to Alpha or Beta. Furthermore, the result in Panel D demonstrates a significant ($p < 0.05$) difference in investment fund allocations across all three companies.

When assessing the association between investment time horizons and investment decisions based on climate change risk information, investments in Beta and Delta were considered. H2a proposes that investors following a long-term investment strategy would allocate more money in companies that disclose both climate change risks and risk response information (i.e., represented by Delta) than companies that only disclose climate change risk information (i.e., represented by Beta). H2b proposes that for short-term investments, investors will direct more funds towards companies that only disclose climate change risk information than those that disclose both climate change risks and risk response efforts. Following Holm and Rikhardsson (2008) and Milne and Patten (2002), means and standard deviations were used for comparing the investments in Beta and Delta under different time horizons. Maan-Whitney Z-score tests were used to test H2a and H2b.

The results in Table 3 panel A provide marginal support ($p < 0.10$) for H2a, as it shows that for long-term investments, investors allocated more funds to Delta (which disclosed both climate change risk and risk response information) compared to Beta (which only disclosed climate change risk information). Contrary to expectation, Table 3 panel B illustrates that investors with a short-term investment strategy direct significantly ($p < 0.05$) fewer funds to Beta compared to Delta.

Table 3: Investment Allocations Under Each Investment Time Horizon

Panel A: Long Term Investment				
	Average	Minimum	Maximum	Mann-Whitney Test Sig.
Beta Ltd	\$10,531.25	\$0.00	\$30,000.00	0.090 ⁺
Delta Ltd	\$13,687.50	\$0.00	\$30,000.00	

Panel B: Short Term Investment				
	Average	Minimum	Maximum	Mann-Whitney Test Sig.
Beta Ltd	\$8,171.87	\$0.00	\$30,000.00	0.032*
Delta Ltd	\$11,812.50	\$0.00	\$30,000.00	

⁺ $p < 0.10$, * $p < 0.05$

H3a predicts that the degree of investors' extraversion would be (i) positively related to the amount of funds invested in companies that only disclose climate change risk information and (ii) negatively related to the amount of funds invested in companies that disclose both climate change risk and risk response information. In comparison, H3b predicts that the degree of

investors' neuroticism would be (i) positively related to the investment amount in companies that disclose both climate change risk and risk response information and (ii) negatively related to the investment amount in companies that only disclose climate change risk information. To test H3, Pearson correlation and multiple linear regression analyses were performed. Table 4 Panels A, B and C presents descriptive statistics, correlation matrices and regression analysis respectively.

The regression analysis results in Table 4 support H3a(i) and H3b(i). The results show that investors' investment amount in Beta (which only disclosed climate change risk information) is positively associated with investors' degree of extraversion and negatively associated with investors' degree of neuroticism. However, these results are not significant. Further, the result reported in Table 4 does not support H3a(ii), as the investment funds directed at Delta (which disclosed both climate change risks and risk response information) are positively associated with investors' degree of extraversion. In contrast, H3b(ii) is supported as the amount of funds invested in Delta is positively associated with investors' degree of neuroticism. Both H3a(ii) and H3b(ii) results are significant ($p < 0.05$).

Table 4 shows support for H4 as the results reveal that the higher the degree of investors' belief in climate change, the more likely they are to allocate funds to companies that have disclosed both climate change risks and risk response efforts (and the less likely they are to allocate funds to companies that have only disclosed climate change risk information). These results are significant ($p < 0.05$).

Table 4: Impact of Personality Traits and Climate Change Belief on Investment Decisions

Panel A: Descriptive Statistics

	Beta Ltd			Delta Ltd		
	Mean	Median	Standard Dev.	Mean	Median	Standard Dev.
Extraversion (1 = Low, 5 = High)	3.10	3.06	0.63	2.97	3.00	0.85
Neuroticism (1 = Low, 5 = High)	2.46	2.31	0.72	2.71	2.87	0.89
Climate change belief (1 = Low, 5 = High)	3.67	4.00	1.01	3.91	4.12	1.00
Education level (0 = No tertiary education, 1 = Diploma/Certificate, 2 = Bachelor's, 3 = Master's and above)	1.34	1.00	1.12	1.15	1.00	1.05
Gender (0 = Female, 1 = Male)	0.71	1.00	0.45	0.62	1.00	0.49
Marital status (0 = Single and Other, 1 = Married)	0.68	1.00	0.47	0.59	1.00	0.49
Business/commerce education or training (0 = No, 1 = Yes)	0.31	0.00	0.47	0.37	0.00	0.49
Portfolio size (1 = <\$50,000, 2 = \$50,000 to \$250,000, 3 = >\$250,000)	1.37	1.00	0.65	1.65	1.00	0.82
Portfolio climate change risk exposure (0 = Low, 1 = High)	0.78	1.00	0.42	0.84	1.00	0.36
General investment risk behaviour (1 = Low risk, 5 = High risk)	2.95	3.12	0.85	3.13	3.00	0.60

Panel B: Correlation Matrices

Beta Ltd

	1	2	3	4	5	6	7	8	9
1. Extraversion	-								
2. Neuroticism	-.260 ⁺	-							
3. Climate change belief	.130	-.190	-						
4. Education level	-.004	.169	-.212	-					
5. Gender	-.071	.218	-.096	.006	-				
6. Marital status	.077	-.235 ⁺	.409*	.027	.028	-			
7. Business/commerce education/training	-.104	.081	-.138	.461*	.272 ⁺	-.127	-		
8. Portfolio size	-.005	.029	-.394*	.168	.272	-.441**	.337*	-	
9. Portfolio climate change risk exposure	.530**	.107	-.132	-.109	.005	.133	.194	.073	-
10. General investment risk behaviour	.218	.359*	.190	.379*	-.035	-.058	.198	-.054	.286 ⁺

⁺p < 0.10, *p < 0.05, **p < 0.01

Delta Ltd

	1	2	3	4	5	6	7	8	9
1. Extraversion	-								
2. Neuroticism	-.556***	-							
3. Climate change belief	.079	-.283 ⁺	-						
4. Education level	.117	-.141	-.056	-					
5. Gender	-.159	-.101	.129	.117	-				
6. Marital status	.218	.224	-.137	.002	-.115	-			
7. Business/commerce education/training	.111	-.184	.149	.382*	.067	.115	-		
8. Portfolio size	-.156	-.250 ⁺	-.163	.398*	.386*	-.037	.406*	-	
9. Portfolio climate change risk exposure	.203	-.089	.159	.231	.067	-.005	.156	.135	-
10. General investment risk behaviour	.366*	-.283	.242 ⁺	.283 ⁺	-.179	-.037	.179	-.099	.168

⁺p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Panel C: Regression Analysis

	Beta Ltd		Delta Ltd	
Number of observations	32 companies		32 companies	
Adjusted R square	0.228		0.271	
	Coef.	Sig.	Coef.	Sig.
Extraversion	0.240	0.340	0.652	0.018*
Neuroticism	-0.183	0.380	0.868	0.003**
Climate change belief	-0.797	0.004**	0.407	0.050 ⁺
Education level	-0.726	0.014*	0.106	0.578
Gender	0.073	0.679	-0.297	0.121
Marital status	0.496	0.049*	-0.034	0.851
Business/commerce education or training	0.422	0.094 ⁺	-0.037	0.844
Portfolio size	-0.280	0.167	0.511	0.047*
Portfolio climate change risk exposure	-0.450	0.137	-0.532	0.006**
General investment risk behaviour	0.634	0.012*	-0.248	0.188

⁺ p < 0.10, *p < 0.05, **p < 0.01

5. DISCUSSION

The relatively lower investments in Alpha (which does not disclose any climate change risk information) compared to the other companies suggest that investors are concerned about the risks posed by climate change. Investors are likely interpreting the lack of climate change disclosures as a sign of greater vulnerability to environmental risk and impending regulatory costs (Blacconiere and Patten, 1994). Based on Holm and Rikhardsson's (2008) and Chan and Milne's (1999) findings, where investors had rewarded companies with positive environmental disclosures, the level of investment in Delta (which disclose climate change risk and risk response information) was predicted as its disclosures signal the company's potential for reducing future climate change risks and liabilities.

Furthermore, H1 results support Flammer's (2013) study by highlighting that investors positively react to companies (by investing more funds in them) that display environmental responsibility by disclosing both climate change risks and risk response efforts. At the same time, they negatively react to companies (through investing less funds) that are less environmentally responsible, either by not disclosing how climate change risks are managed or by not disclosing climate change risks at all. However, the slight preference of investors for Beta over Alpha demonstrates that even only disclosing climate change risks proves somewhat favourable for companies that seek to attract funds from investors when compared to the option of not disclosing any risk information at all. This is likely because companies with climate change risk disclosures are perceived by investors as more alert to impending risks whereas companies that fail to disclose any climate change risk information may seem oblivious about the risks that await them.

The result for H2a supports the findings of Liyanarachchi and Milne (2005) and Milne and Patten (2002) by showing that when faced with long-term investment decisions, investors tend to allocate more funds to environmentally conscious companies that have measures to manage climate change risks. Epstein (1992) suggests that long-term investors put more dollars into a company that responds its environmental risks, because when investors anticipate that environmental risks could result in significant increases in costs, regulation and government fines, they would favourably view a company would have prepared itself to minimise the risks and financial impacts of the anticipated environmental risks (thus reducing investment risk).

The results do not support H2b. Although the literature shows that short-term investors perceive companies' commitments towards environmentally responsible behaviour as excessive and unnecessary expenditures and that these investors would not prefer to invest in such companies when seeking short-term gains, the findings relating to climate change information does not support this premise. The H2b result shows that when compared to Beta (which has no risk responses in place), investors making short-term investment decisions allocate more funds to Delta, which would have incurred considerable short-term expenses by implementing risk management measures. This is an important observation since it suggests that investors appear to be more informed of the potential risks climate change poses and consequently they steer their investments even in the short term to reward the company that is responding to these risks, despite the associated (short-term) expenditures.

Supporting H3a(i) and H3b(i), the results demonstrate that investors' allocation of funds to Beta is positively associated with investors' degree of extraversion and negatively associated with investors' degree of neuroticism. This observation supports the finding in the literature which shows a positive relationship between extraversion and risk-taking behaviour (Terracciano et al., 2008; Cook et al., 1998), and suggests that individuals with a high degree of neuroticism are less likely to hold risky assets (Oehler et al., 2018).

Yet, the regression results do not support H3a(ii) but do support H3b(ii). The results show that investors' allocation of funds to Delta that has disclosed both climate change risks and efforts to manage them is positively and significantly ($p < 0.05$) associated with investors' degree of extraversion and neuroticism. This support for H3b(ii) was expected since neurotics are known to demonstrate a greater fear of uncertainty and hold fewer risky assets, and are therefore expected to invest more in companies that seek to avoid uncertainties caused by climate change risks by implementing risk response efforts (Oehler et al., 2018; Lommen et al., 2010; Noguchi et al., 2006; Cloninger, 2000). The results for H3a(ii) were unexpected since extraverts who take risks to achieve higher returns were not anticipated to invest more in companies that are implementing risk response efforts (Oehler et al., 2018).

The findings support H4, as the results demonstrate that the higher the degree of investors' belief in climate change, the more likely they are to allocate funds to companies that have disclosed both climate change risk information and risk response information (and the less likely they are to allocate funds to companies that have only disclosed climate change risk information). This result supports Weber and Stern (2011, p. 320), who argue that the

assessment of the riskiness of physical and environmental processes is “strongly affected by perceived qualitative characteristics of the hazards, which can evoke affective reactions”. This perspective is reflected in the results as investors who believe in climate change have acknowledged the riskiness it poses and consequently have invested more in Delta (which responds to its risks) over Beta (which does not).

6. CONCLUSION

This study presents findings on how investors react to varying disclosure levels of climate change risks faced by companies under long-term and short-term investment time horizons, and reveals how investors’ degrees of extraversion, neuroticism and belief in climate change influence their investment decisions. Using a survey experiment, this study shows that investors allocate more money to companies that disclose climate change risks when compared to those that do not, and even direct more money to companies that disclose both climate change risks and risk response efforts. The results also indicate that irrespective of the investment time horizon, investors are more likely to allocate funds to companies that disclose their climate change risks and risk response efforts when compared to companies that only disclose the former. This result deviates from the existing environmental accounting literature, which suggests that investors with a short-term investment horizon would reward poor environmental performers over better environmental performers. It is unclear whether altruistic motivations lead to larger short-term investments in the company that responds to their climate change risks, which can benefit a wide range of stakeholders including long-term shareholders and creditors through limiting the potential climate change losses of the company. This is an avenue for future research.

Contrary to expectations derived from the literature, this study found that the degree of investors’ extraversion is positively and significantly related to investment funds allocated to companies that disclose both climate change risks and risk response information. The results also show that the degree of investors’ neuroticism is negatively related to investment funds allocated to companies that only disclose climate change risks and positively related to companies that disclose both climate change risks and risk response information. This demonstrates that irrespective of the degrees of extraversion and neuroticism, investors are inclined to invest more in companies that respond to climate change risks. As expected, investors’ belief in climate change affects the amount invested based on the level of climate change risk disclosures. A higher degree of climate change belief led to more investment in the

company that disclosed both climate change risks and risk response information compared to that only disclosing climate change risks.

These findings address a crucial gap in the literature by providing insights into how investors react to climate change risk information. Furthermore, these results deliver a practical contribution by demonstrating that companies that choose not to disclose climate change risk information will be disadvantaged when seeking funding, as investors strongly favour companies that disclose both climate change risks and risk response information. This arguably demonstrates the significance of climate change as an investment risk in the current era and the heightened importance placed by investors on managing the risks it poses. These results are of significance to countries such as Australia where only a small number of companies sufficiently disclose the implications of the climate change risks they face (Market Forces, 2018). This study is timely in increasing businesses' awareness of how crucial it is to disclose climate change risks and efforts to manage them when seeking investments. It contradicts the existing view in the literature that negative environmental disclosures are "likely to turn investors off" and instead shows that these risk disclosures could signal an "awareness of risk" which is then "honoured by investors" (Reimsbach and Hahn, 2015, p. 220; Chan and Milne, 1999, p. 274).

Moreover, the investment allocations observed in this study can be used by regulators and accounting standard setters to make a strong case for mandating climate change risk and risk response disclosures, as the results show that disclosing this information helps companies attract more funds from investors. Mandating climate change risk and risk response information disclosures also enhance information transparency which will consequently benefit investors, as it will protect investors from having to make resource allocation decisions whilst being unaware of the impending climate change risks that can negatively affect their investments.

The results of this study also provide insights into how investors' belief in climate change influences their resource allocation in companies that are facing climate change risks. These insights will be of value to investment companies, especially when recruiting personnel to manage investment portfolios that are exposed to the increasing risks of climate change. Since climate change is anticipated to create billions of losses for Australian companies, individuals who understand the seriousness of climate change as a business risk and acknowledge the

importance of responding to its risks are needed to manage investment portfolios (Climate Council, 2019; The Climate Institute, 2006).

This study has several limitations. First, the results of the study are based on the responses of 96 stock market investors, which may limit the generalisability of the results. Researchers are encouraged to replicate this study by using a larger and more diverse sample to deliver more generalisable results. Second, the scenarios used in this study are based on three companies that represent the mining industry, and therefore researchers are encouraged to extend this study to other industries that are impacted by climate change and explore whether industry influences investors' reactions to climate change risks and risk response disclosures. Third, future research can expand this study by examining how other personal characteristics, such as ethnicity and political ideology, influence investors' reactions to varying levels of climate change risks and risk response disclosures.

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Pages 171-172 removed from Open Access version as they may contain sensitive/confidential content.

SECTION 1
Your Personal Profile

Please respond to the following questions.

Are you:

☐ **Male** ☐ **Female**

How old are you (in years)?

- ☐ **Under 30**
☐ **30 - 39**
☐ **40 - 49**
☐ **50 – 59**
☐ **Over 59**

What is your marital status?

☐ **Single** ☐ **Married** ☐ **Other**

How many dependent children do you have?

Please select your highest education level.

- ☐ **No college/university education**
☐ **Diploma / certificate or equivalent**
☐ **Bachelors' degree or equivalent**
☐ **Masters' degree or equivalent**
☐ **Doctorate**

Have you had any work experience/training or a university/college education relating to accounting, finance or actuaries?

- ☐ **Yes**
☐ **No**

What is your ethnicity?

For approximately how many years have you been investing on your own in the stock market?

In which of the following sector do you have the most stock market investment (please select one only)?

- ☐ Insurance and Finance
- ☐ Agriculture, Food and Beverages
- ☐ Mining and Energy Production
- ☐ Transportation and Tourism
- ☐ Healthcare Providers and Services
- ☐ Other (please specify) _____

How large is your current stock market investment portfolio?

- ☐ Under AUD \$50,000
- ☐ Between AUD \$50,000 and AUD \$250,000
- ☐ Over AUD \$250,000

SECTION 2

Investment Task

Assume you have been actively managing your own stock market investments. You are currently looking to expand your existing investment portfolio for which you are considering to invest in Alpha Ltd. Please review the attached information of Alpha Ltd prior to making your investment decision. All amounts are in Australian dollars.

ALPHA LTD

Summary of Our Company

We are one of the largest Australian based resources companies that produce major commodities. We have interests in oil, gas and minerals.

Results of Operations

Revenue for 2019 amounted to \$1,451 million, which is a 7.16% increase over 2018. The 2019 net income of \$147 million represent a 7.3% increase over 2018. Interest expense increased moderately during 2019 primarily due to slightly higher levels of long-term debt outstanding.

Financial Condition and Liquidity

Cash flow from the operating activities amounted to \$211 million in 2019 compared to the \$185 million in 2018. This cash flow, coupled with increased long-term borrowings of \$18 million during 2019, was used to fund capital expenditures for plant and equipment additions and repairs of \$105 million and cash dividend payments of \$80 million.

Financial Information	Alpha Ltd	
	2019	2018
	\$'000,000	
Income Statement		
Revenue	\$1,451	\$1,354
Cost of Goods Sold	\$638	\$593
Gross Profit	\$813	\$761
Expenses Excluding Finance Costs	\$572	\$534
Finance Costs	\$15	\$12
Income Before Taxes	\$226	\$215
Income Taxes	\$79	\$78
Net Income	\$147	\$137
Earning Per Ordinary Share		
Basic	\$2.30	\$2.14
Diluted	\$2.25	\$2.08
Cash Dividend Per Ordinary Share	\$1.20	\$1.15
Statement of Cash Flows		
Cash Flows from Operating Activities	\$211	\$185
Net Cash Flows from Investing Activities	\$(120)	\$(104)
Net Cash Flows from Financing Activities	\$(82)	\$(73)
Net Increase in Cash	\$9	\$8
Cash at Beginning of Year	\$40	\$32
Cash at End of Year	\$49	\$40

Financial Information (Cont'd)	2019	2018
	\$'000,000	
Balance Sheet		
<i>ASSETS</i>		
Cash and Equivalents	\$49	\$40
Net Receivables	\$242	\$235
Inventories	\$90	\$88
Other Current Assets	\$27	\$26
Total Current Assets	\$408	\$389
Property, Plant and Equipment	\$1,040	\$1,031
Less: Accumulated Depreciation	\$429	\$427
Net Property Plant and Equipment	\$611	\$604
Other Assets	\$411	\$390
Total Assets	\$1,430	\$1,383
<i>LIABILITIES AND SHAREHOLDERS' EQUITY</i>		
Accounts Payable	\$105	\$110
Income Taxes Payable	\$27	\$41
Other Current Liabilities	\$99	\$93
Total Current Liabilities	\$231	\$234
Long-Term Debt	\$315	\$297
Deferred Taxes	\$36	\$41
Other Long-Term Liabilities	\$165	\$152
Total Liabilities	\$747	\$724
Ordinary Shares	\$86	\$86
Retained Earnings	\$632	\$585
Accumulated Other Comprehensive Income/Loss	\$(35)	\$(12)
Total Shareholders' Equity	\$683	\$659
Total Liabilities and Shareholders' Equity	\$1,430	\$1,383

Other Financial Data	2019	2018
Share Price at 30 June	\$40.50	\$33.28
Current Ratio <i>(Industry benchmark)</i>	1.77 <i>(1.75)</i>	1.66 <i>(1.65)</i>
Net Profit Margin (After Tax) <i>(Industry benchmark)</i>	10.13% <i>(10.15%)</i>	10.12% <i>(10.13%)</i>
Return on Equity (After Tax) <i>(Industry benchmark)</i>	21.52% <i>(21.54%)</i>	20.79% <i>(20.80%)</i>
Return on Assets (After Tax) <i>(Industry benchmark)</i>	10.28% <i>(10.30%)</i>	9.91% <i>(9.92%)</i>
Debt/Equity Ratio <i>(Industry benchmark)</i>	109.37% <i>(109.40%)</i>	109.86% <i>(109.88%)</i>

Assume you are 35 years old, holding a secure management position in a multinational company with an annual salary of \$130 000 and that you have been investing in the stock market for a number of years.

Assume that you have set aside \$30,000 of your savings to expand your investment portfolio. Following your review of the preceding information of Alpha Ltd, please indicate how much of the \$30,000 you would invest in Alpha Ltd under each of the two independent scenarios presented below (i.e. you can allocate up to \$30,000 in Alpha Ltd under each scenario).

Scenario A

Please allocate an amount between \$0 and \$30,000 in Alpha Ltd as a **long-term** venture (an investment exceeding two years) with a goal of gain through growth.

_\$ _____

Scenario B

Please allocate an amount between \$0 and \$30,000 in Alpha Ltd as a **short-term** venture (an investment up to one year) with a goal of speculative gain.

_\$ _____

Please indicate how motivated you were to perform well on this investment decision on the following scale:

**Not at All
Motivated**

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderately Motivated

**Extremely
Motivated**

Please indicate how much effort you have expended on this investment decision on the following scale:

Very Little Effort

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderate Effort

**A Great Deal of
Effort**

SECTION 3

Factors that Impacted Your Investment Decisions

From the following list of items, please rank the importance of each item for your investment decisions in Section 2. Please indicate the importance with 1 being the most important item, 2 being the second most important, 3 being the third most important item, and so on, for each of the two scenarios.

Scenario A (Long-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks

Scenario B (Short-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks














SECTION 4

Your Personal Characteristics and Values

How well do the following statements describe you? Please select your answers on the scale below.

I see myself as someone who....





	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
	1	2	3	4	5
is talkative					
tends to find fault with others					
does a thorough job					
is depressed, blue					
is original, comes up with new ideas					
is reserved					
is helpful and unselfish with others					
can be somewhat careless					
is relaxed, handles stress well					
is curious about many different things					
is full of energy					
starts quarrels with others					
is a reliable worker					
can be tense					
is ingenious, a deep thinker					
generates a lot of enthusiasm					
has a forgiving nature					
tends to be disorganised					
worries a lot					
has an active imagination					
tends to be quiet					
is generally trusting					
tends to be lazy					
is emotionally stable, not easily upset					
is inventive					
has an assertive personality					

can be cold and aloof	
perseveres until the task is finished	
can be moody	
values artistic, aesthetic experiences	
is sometimes shy, inhibited	
is considerate and kind to almost everyone	
does things efficiently	
remains calm in tense situations	
prefers work that is routine	
is outgoing, sociable	
is sometimes rude to others	
makes plans and follows through with them	
gets nervous easily	
likes to reflect, play with ideas	
has a few artistic interests	
likes to cooperate with others	
is easily distracted	
is sophisticated in art, music or literature	





Please indicate the importance of the following values to you as an individual. Specifically, think about each value in terms of its importance to you as a guiding principle in your life. As you record your responses, consider each value in relation to all other values listed.

	<div>←—————→</div>						
	LEAST important 1			Neutral 4			MOST important 7
A comfortable life (A prosperous life)	1	2	3	4	5	6	7
Being helpful (Working for the welfare of others)	1	2	3	4	5	6	7
Compassion (Feeling empathy for others)	1	2	3	4	5	6	7
Wealth (Making money for myself and family)	1	2	3	4	5	6	7
Equality (Brotherhood, equal opportunity for all)	1	2	3	4	5	6	7
Loving (Being affectionate, tender)	1	2	3	4	5	6	7
Pleasure (An enjoyable life)	1	2	3	4	5	6	7





Please indicate the extent of your agreement/disagreement with the following statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	1	2	3	4	5
Climate change is currently occurring					
Climate change is caused by humans					
Climate Change is a serious problem					
There is a consensus in climate science that climate change is happening					

Please indicate the likelihood of your engagement in each activity or behaviour below.

	Very unlikely	Unlikely	Not sure	Likely	Very likely
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

Please indicate how risky you perceive each situation (we are interested in your gut level assessment of how risky each situation is).

	Not at all risky		Moderately risky		Extremely risky
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

**Please ensure that you have answered every question.
Missing questions will mean all your responses are unusable.**

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Thank you for your participation!

Pages 186-187 removed from Open Access version as they may contain sensitive/confidential content.

SECTION 1
Your Personal Profile

Please respond to the following questions.

Are you:

☐ **Male** ☐ **Female**

How old are you (in years)?

- ☐ **Under 30**
☐ **30 - 39**
☐ **40 - 49**
☐ **50 – 59**
☐ **Over 59**

What is your marital status?

☐ **Single** ☐ **Married** ☐ **Other**

How many dependent children do you have?

Please select your highest education level.

- ☐ **No college/university education**
☐ **Diploma / certificate or equivalent**
☐ **Bachelors' degree or equivalent**
☐ **Masters' degree or equivalent**
☐ **Doctorate**

Have you had any work experience/training or a university/college education relating to accounting, finance or actuaries?

- ☐ **Yes**
☐ **No**

What is your ethnicity?

For approximately how many years have you been investing on your own in the stock market?

In which of the following sector do you have the most stock market investment (please select one only)?

- ☐ Insurance and Finance
- ☐ Agriculture, Food and Beverages
- ☐ Mining and Energy Production
- ☐ Transportation and Tourism
- ☐ Healthcare Providers and Services
- ☐ Other (please specify) _____

How large is your current stock market investment portfolio?

- ☐ Under AUD \$50,000
- ☐ Between AUD \$50,000 and AUD \$250,000
- ☐ Over AUD \$250,000

SECTION 2

Investment Task

Assume you have been actively managing your own stock market investments. You are currently looking to expand your existing investment portfolio for which you are considering investing in Beta Ltd. Please review the attached information of Beta Ltd prior to making your investment decision. All amounts are in Australian dollars.

BETA LTD

Summary of Our Company

We are one of the largest Australian based resources companies that produce major commodities. We have interests in oil, gas and minerals.

Results of Operations

Sales for 2019 amounted to \$1,451 million, which is a 7.16% increase over 2018. The 2019 earnings of \$147 million are also a record and represent a 7.3% increase over 2018. Interest expense increased moderately during 2019 primarily due to slightly higher levels of long-term debt outstanding.

Financial Condition and Liquidity

Cash flow from the operating activities amounted to \$211 million in 2019 compared to the \$185 million in 2018. This cash flow, coupled with increased long-term borrowings of \$18 million during 2019, was used to fund capital expenditures for plant and equipment additions and repairs of \$105 million and cash dividend payments of \$80 million.

Impacts of climate change

The increasing incidence and severity of environmental disasters, such as cyclones, wildfires and flooding, which are attributable to climate change, continues to develop into a critical problem for the global resources sector in which we operate. Companies operating within this sector are expected to assess the climate change risks faced by the company, manage them effectively and disclose these risks in annual reports.

<u>Financial Information</u>	Beta Ltd	
	2019	2018
	\$'000,000	
Income Statement		
Revenue	\$1,451	\$1,354
Cost of Goods Sold	\$638	\$593
Gross Profit	\$813	\$761
Expenses Excluding Finance Costs	\$572	\$534
Finance Costs	\$15	\$12
Income Before Taxes	\$226	\$215
Income Taxes	\$79	\$78
Net Income	\$147	\$137
Earning Per Ordinary Share		
Basic	\$2.30	\$2.14
Diluted	\$2.25	\$2.08
Cash Dividend Per Ordinary Share	\$1.20	\$1.15
Statement of Cash Flows		
Cash Flows from Operating Activities	\$211	\$185
Net Cash Flows from Investing Activities	\$(120)	\$(104)
Net Cash Flows from Financing Activities	\$(82)	\$(73)
Net Increase in Cash	\$9	\$8
Cash at Beginning of Year	\$40	\$32
Cash at End of Year	\$49	\$40

Financial Information (Cont'd)	2019	2018
	\$'000,000	
Balance Sheet		
<i>ASSETS</i>		
Cash and Equivalents	\$49	\$40
Net Receivables	\$242	\$235
Inventories	\$90	\$88
Other Current Assets	\$27	\$26
Total Current Assets	\$408	\$389
Property, Plant and Equipment	\$1,040	\$1,031
Less: Accumulated Depreciation	\$429	\$427
Net Property Plant and Equipment	\$611	\$604
Other Assets	\$411	\$390
Total Assets	\$1,430	\$1,383
<i>LIABILITIES AND SHAREHOLDERS' EQUITY</i>		
Accounts Payable	\$105	\$110
Income Taxes Payable	\$27	\$41
Other Current Liabilities	\$99	\$93
Total Current Liabilities	\$231	\$234
Long-Term Debt	\$315	\$297
Deferred Taxes	\$36	\$41
Other Long-Term Liabilities	\$165	\$152
Total Liabilities	\$747	\$724
Ordinary Shares	\$86	\$86
Retained Earnings	\$632	\$585
Accumulated Other Comprehensive Income/Loss	\$(35)	\$(12)
Total Shareholders' Equity	\$683	\$659
Total Liabilities and Shareholders' Equity	\$1,430	\$1,383

Other Financial Data	2019	2018
Share Price at 30 June	\$40.50	\$33.28
Current Ratio <i>(Industry benchmark)</i>	1.77 <i>(1.75)</i>	1.66 <i>(1.65)</i>
Net Profit Margin (After Tax) <i>(Industry benchmark)</i>	10.13% <i>(10.15%)</i>	10.12% <i>(10.13%)</i>
Return on Equity (After Tax) <i>(Industry benchmark)</i>	21.52% <i>(21.54%)</i>	20.79% <i>(20.80%)</i>
Return on Assets (After Tax) <i>(Industry benchmark)</i>	10.28% <i>(10.30%)</i>	9.91% <i>(9.92%)</i>
Debt/Equity Ratio <i>(Industry benchmark)</i>	109.37% <i>(109.40%)</i>	109.86% <i>(109.88%)</i>

Environmental Disclosures of Beta Ltd

Due to climate change, the frequency and severity of cyclones and wildfires impacting our mining sites have been increasing over the years. Due to these extreme weather events, we have suffered losses of \$14 million in 2014, \$17 million in 2018 and \$15 million this financial year. \$10 million of this year's loss is attributed to the impacts of cyclones Dory and Marc. These cyclones brought upon operational and financial impacts on our company, causing our Queensland Hall Creek Mine and Western Australian Caple Mine to be closed for 5 and 6 weeks respectively during late 2018 due to flooding and infrastructure damage. The remaining \$5 million loss was due to wildfires that caused the operations of our Victorian Rawson mine to be halted for 3 weeks in February 2019. 20% of the repairs for the Hall Creek and Caple mines are still ongoing.

Assume you are 35 years old, holding a secure management position in a multinational company with an annual salary of \$130 000 and that you have been investing in the stock market for a number of years.

Assume that you have set aside \$30,000 of your savings to expand your investment portfolio. Following your review of the preceding information of Beta Ltd, please indicate how much of the \$30,000 you would invest in Beta Ltd under each of the two independent scenarios presented below (i.e. you can allocate up to \$30,000 in Beta Ltd under each scenario).

Scenario A

Please allocate an amount between \$0 and \$30,000 in Beta Ltd as a **long-term** venture (an investment exceeding two years) with a goal of gain through growth.

_\$ _____

Scenario B

Please allocate an amount between \$0 and \$30,000 in Beta Ltd as a **short-term** venture (an investment up to one year) with a goal of speculative gain.

_\$ _____

Please indicate how motivated you were to perform well on this investment decision on the following scale:

**Not at All
Motivated**

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderately Motivated

**Extremely
Motivated**

Please indicate how much effort you have expended on this investment decision on the following scale:

Very Little Effort

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderate Effort

**A Great Deal of
Effort**

SECTION 3

Factors that Impacted Your Investment Decisions

From the following list of items, please rank the importance of each item for your investment decisions in Section 2. Please indicate the importance with 1 being the most important item, 2 being the second most important, 3 being the third most important item, and so on, for each of the two scenarios.

Scenario A (Long-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks

Scenario B (Short-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks






SECTION 4

Your Personal Characteristics and Values

How well do the following statements describe you? Please select your answers on the scale below.

I see myself as someone who....





	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
	1	2	3	4	5
is talkative					
tends to find fault with others					
does a thorough job					
is depressed, blue					
is original, comes up with new ideas					
is reserved					
is helpful and unselfish with others					
can be somewhat careless					
is relaxed, handles stress well					
is curious about many different things					
is full of energy					
starts quarrels with others					
is a reliable worker					
can be tense					
is ingenious, a deep thinker					
generates a lot of enthusiasm					
has a forgiving nature					
tends to be disorganised					
worries a lot					
has an active imagination					
tends to be quiet					
is generally trusting					
tends to be lazy					
is emotionally stable, not easily upset					
is inventive					
has an assertive personality					

can be cold and aloof	
perseveres until the task is finished	
can be moody	
values artistic, aesthetic experiences	
is sometimes shy, inhibited	
is considerate and kind to almost everyone	
does things efficiently	
remains calm in tense situations	
prefers work that is routine	
is outgoing, sociable	
is sometimes rude to others	
makes plans and follows through with them	
gets nervous easily	
likes to reflect, play with ideas	
has a few artistic interests	
likes to cooperate with others	
is easily distracted	
is sophisticated in art, music or literature	





Please indicate the importance of the following values to you as an individual. Specifically, think about each value in terms of its importance to you as a guiding principle in your life. As you record your responses, consider each value in relation to all other values listed.

	<div>←—————→</div>						
	LEAST important 1			Neutral 4			MOST important 7
A comfortable life (A prosperous life)	1	2	3	4	5	6	7
Being helpful (Working for the welfare of others)	1	2	3	4	5	6	7
Compassion (Feeling empathy for others)	1	2	3	4	5	6	7
Wealth (Making money for myself and family)	1	2	3	4	5	6	7
Equality (Brotherhood, equal opportunity for all)	1	2	3	4	5	6	7
Loving (Being affectionate, tender)	1	2	3	4	5	6	7
Pleasure (An enjoyable life)	1	2	3	4	5	6	7





Please indicate the extent of your agreement/disagreement with the following statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	1	2	3	4	5
Climate change is currently occurring					
Climate change is caused by humans					
Climate Change is a serious problem					
There is a consensus in climate science that climate change is happening					

Please indicate the likelihood of your engagement in each activity or behaviour below.

	Very unlikely	Unlikely	Not sure	Likely	Very likely
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

Please indicate how risky you perceive each situation (we are interested in your gut level assessment of how risky each situation is).

	Not at all risky		Moderately risky		Extremely risky
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

**Please ensure that you have answered every question.
Missing questions will mean all your responses are unusable.**

Sammy (Samindi) Hewa
Department of Accounting and Corporate Governance
Macquarie Business School
Macquarie University
NSW 2109, Australia

Thank you for your participation!

Page 201-202 removed from Open Access version as they may contain sensitive/confidential content.

SECTION 1
Your Personal Profile

Please respond to the following questions.

Are you:

☐ **Male** ☐ **Female**

How old are you (in years)?

- ☐ **Under 30**
☐ **30 - 39**
☐ **40 - 49**
☐ **50 – 59**
☐ **Over 59**

What is your marital status?

☐ **Single** ☐ **Married** ☐ **Other**

How many dependent children do you have?

Please select your highest education level.

- ☐ **No college/university education**
☐ **Diploma / certificate or equivalent**
☐ **Bachelors' degree or equivalent**
☐ **Masters' degree or equivalent**
☐ **Doctorate**

Have you had any work experience/training or a university/college education relating to accounting, finance or actuaries?

- ☐ **Yes**
☐ **No**

What is your ethnicity?

For approximately how many years have you been investing on your own in the stock market?

In which of the following sector do you have the most stock market investment (please select one only)?

- ☐ Insurance and Finance
- ☐ Agriculture, Food and Beverages
- ☐ Mining and Energy Production
- ☐ Transportation and Tourism
- ☐ Healthcare Providers and Services
- ☐ Other (please specify) _____

How large is your current stock market investment portfolio?

- ☐ Under AUD \$50,000
- ☐ Between AUD \$50,000 and AUD \$250,000
- ☐ Over AUD \$250,000

SECTION 2

Investment Task

Assume you have been actively managing your own stock market investments. You are currently looking to expand your existing investment portfolio for which you are considering investing in Delta Ltd. Please review the attached information of Delta Ltd prior to making your investment decision. All amounts are in Australian dollars.

DELTA LTD

Summary of Our Company

We are one of the largest Australian based resources companies that produce major commodities. We have interests in oil, gas and minerals.

Results of Operations

Sales for 2019 amounted to \$1,451 million, which is a 7.16% increase over 2018. The 2019 earnings of \$147 million are also a record and represent a 7.3% increase over 2018. Interest expense increased moderately during 2019 primarily due to slightly higher levels of long-term debt outstanding.

Financial Condition and Liquidity

Cash flow from the operating activities amounted to \$211 million in 2019 compared to the \$185 million in 2018. This cash flow, coupled with increased long-term borrowings of \$18 million during 2019, was used to fund capital expenditures for plant and equipment additions and repairs of \$105 million and cash dividend payments of \$80 million.

Impacts of climate change

The increasing incidence and severity of environmental disasters, such as cyclones, wildfires and flooding, which are attributable to climate change, continues to develop into a critical problem for the global resources sector in which we operate. Companies operating within this sector are expected to assess the climate change risks faced by the company, manage them effectively and disclose these risks in annual reports along with the company's climate risk mitigation information to stakeholders.

<u>Financial Information</u>	Delta Ltd	
	2019	2018
	\$'000,000	
Income Statement		
Revenue	\$1,451	\$1,354
Cost of Goods Sold	\$638	\$593
Gross Profit	\$813	\$761
Expenses Excluding Finance Costs	\$572	\$534
Finance Costs	\$15	\$12
Income Before Taxes	\$226	\$215
Income Taxes	\$79	\$78
Net Income	\$147	\$137
Earning Per Ordinary Share		
Basic	\$2.30	\$2.14
Diluted	\$2.25	\$2.08
Cash Dividend Per Ordinary Share	\$1.20	\$1.15
Statement of Cash Flows		
Cash Flows from Operating Activities	\$211	\$185
Net Cash Flows from Investing Activities	\$(120)	\$(104)
Net Cash Flows from Financing Activities	\$(82)	\$(73)
Net Increase in Cash	\$9	\$8
Cash at Beginning of Year	\$40	\$32
Cash at End of Year	\$49	\$40

Financial Information (Cont'd)	2019	2018
	\$'000,000	
Balance Sheet		
<i>ASSETS</i>		
Cash and Equivalents	\$49	\$40
Net Receivables	\$242	\$235
Inventories	\$90	\$88
Other Current Assets	\$27	\$26
Total Current Assets	\$408	\$389
Property, Plant and Equipment	\$1,040	\$1,031
Less: Accumulated Depreciation	\$429	\$427
Net Property Plant and Equipment	\$611	\$604
Other Assets	\$411	\$390
Total Assets	\$1,430	\$1,383
<i>LIABILITIES AND SHAREHOLDERS' EQUITY</i>		
Accounts Payable	\$105	\$110
Income Taxes Payable	\$27	\$41
Other Current Liabilities	\$99	\$93
Total Current Liabilities	\$231	\$234
Long-Term Debt	\$315	\$297
Deferred Taxes	\$36	\$41
Other Long-Term Liabilities	\$165	\$152
Total Liabilities	\$747	\$724
Ordinary Shares	\$86	\$86
Retained Earnings	\$632	\$585
Accumulated Other Comprehensive Income/Loss	\$(35)	\$(12)
Total Shareholders' Equity	\$683	\$659
Total Liabilities and Shareholders' Equity	\$1,430	\$1,383

Other Financial Data	2019	2018
Share Price at 30 June	\$40.50	\$33.28
Current Ratio (Industry benchmark)	1.77 (1.75)	1.66 (1.65)
Net Profit Margin (After Tax) (Industry benchmark)	10.13% (10.15%)	10.12% (10.13%)
Return on Equity (After Tax) (Industry benchmark)	21.52% (21.54%)	20.79% (20.80%)
Return on Assets (After Tax) (Industry benchmark)	10.28% (10.30%)	9.91% (9.92%)
Debt/Equity Ratio (Industry benchmark)	109.37% (109.40%)	109.86% (109.88%)

Environmental Disclosures of Delta Ltd

Due to climate change, the frequency and severity of cyclones and wildfires impacting our mining sites have been increasing over the years. Due to these extreme weather events, we have suffered losses of \$14 million in 2014, \$17 million in 2018 and \$15 million this financial year. \$10 million of this year's loss is attributed to the impacts of cyclones Dory and Marc. These cyclones brought upon operational and financial impacts on our company, causing our Queensland Hall Creek Mine and Western Australian Caple Mine to be closed for 5 and 6 weeks respectively during late 2018 due to flooding and infrastructure damage. The remaining \$5 million loss was due to wildfires that caused the operations of our Victorian Rawson mine to be halted for 3 weeks in February 2019. 20% of the repairs for the Hall Creek and Caple mines are still ongoing.

However, our performance in natural disaster related losses is significantly better than our competitors in 2019 due to our climate risk mitigation initiative, through which controlled backburning was introduced in South Australia just before the early 2019 wildfire season. As a result, all our South Australian mines were spared from wildfire damage, saving us over \$7 million. We will expand this initiative by spending another \$13 million next year on property safeguards for both wildfires and cyclones, which includes a fire-resistant landscaping project, a stormwater management project and a structural improvement project for all our mines at risk. With this plan, we are targeting a natural hazard loss reduction of 75% over the next 5 years. This target would increase our profitability, and subsequently place us in a strong position compared to our competitors to create value for our shareholders and other stakeholders.

Assume you are 35 years old, holding a secure management position in a multinational company with an annual salary of \$130 000 and that you have been investing in the stock market for a number of years.

Assume that you have set aside \$30,000 of your savings to expand your investment portfolio. Following your review of the preceding information of Delta Ltd, please indicate how much of the \$30,000 you would invest in Delta Ltd under each of the two independent scenarios presented below (i.e. you can allocate up to \$30,000 in Delta Ltd under each scenario).

Scenario A

Please allocate an amount between \$0 and \$30,000 in Delta Ltd as a **long-term** venture (an investment exceeding two years) with a goal of gain through growth.

_\$ _____

Scenario B

Please allocate an amount between \$0 and \$30,000 in Delta Ltd as a **short-term** venture (an investment up to one year) with a goal of speculative gain.

_\$ _____

Please indicate how motivated you were to perform well on this investment decision on the following scale:

**Not at All
Motivated**

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderately Motivated

**Extremely
Motivated**

Please indicate how much effort you have expended on this investment decision on the following scale:

Very Little Effort

1
☐

2
☐

3
☐

4
☐

5
☐

6
☐

7
☐

Moderate Effort

**A Great Deal of
Effort**

SECTION 3

Factors that Impacted Your Investment Decisions

From the following list of items, please rank the importance of each item for your investment decisions in Section 2. Please indicate the importance with 1 being the most important item, 2 being the second most important, 3 being the third most important item, and so on, for each of the two scenarios.

Scenario A (Long-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks

Scenario B (Short-term investment scenario)

- ☐ Cash flow
- ☐ Growth trends
- ☐ Liquidity
- ☐ Price/earnings ratios
- ☐ Information on the company's governance around climate change risks
- ☐ Information on actual and potential impacts of climate-related risks on the company's business, strategy and financial planning
- ☐ Information on how the company assesses and manages climate-related risks
- ☐ Information on the metrics and targets used to assess and manage relevant climate-related risks



SECTION 4

Your Personal Characteristics and Values

How well do the following statements describe you? Please select your answers on the scale below.

I see myself as someone who....





	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
	1	2	3	4	5
is talkative					
tends to find fault with others					
does a thorough job					
is depressed, blue					
is original, comes up with new ideas					
is reserved					
is helpful and unselfish with others					
can be somewhat careless					
is relaxed, handles stress well					
is curious about many different things					
is full of energy					
starts quarrels with others					
is a reliable worker					
can be tense					
is ingenious, a deep thinker					
generates a lot of enthusiasm					
has a forgiving nature					
tends to be disorganised					
worries a lot					
has an active imagination					
tends to be quiet					
is generally trusting					
tends to be lazy					
is emotionally stable, not easily upset					
is inventive					
has an assertive personality					

can be cold and aloof	
perseveres until the task is finished	
can be moody	
values artistic, aesthetic experiences	
is sometimes shy, inhibited	
is considerate and kind to almost everyone	
does things efficiently	
remains calm in tense situations	
prefers work that is routine	
is outgoing, sociable	
is sometimes rude to others	
makes plans and follows through with them	
gets nervous easily	
likes to reflect, play with ideas	
has a few artistic interests	
likes to cooperate with others	
is easily distracted	
is sophisticated in art, music or literature	





Please indicate the importance of the following values to you as an individual. Specifically, think about each value in terms of its importance to you as a guiding principle in your life. As you record your responses, consider each value in relation to all other values listed.

	<div>←—————→</div>						
	LEAST important 1			Neutral 4			MOST important 7
A comfortable life (A prosperous life)	1	2	3	4	5	6	7
Being helpful (Working for the welfare of others)	1	2	3	4	5	6	7
Compassion (Feeling empathy for others)	1	2	3	4	5	6	7
Wealth (Making money for myself and family)	1	2	3	4	5	6	7
Equality (Brotherhood, equal opportunity for all)	1	2	3	4	5	6	7
Loving (Being affectionate, tender)	1	2	3	4	5	6	7
Pleasure (An enjoyable life)	1	2	3	4	5	6	7





Please indicate the extent of your agreement/disagreement with the following statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	1	2	3	4	5
Climate change is currently occurring					
Climate change is caused by humans					
Climate Change is a serious problem					
There is a consensus in climate science that climate change is happening					

Please indicate the likelihood of your engagement in each activity or behaviour below.

	Very unlikely	Unlikely	Not sure	Likely	Very likely
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

Please indicate how risky you perceive each situation (we are interested in your gut level assessment of how risky each situation is).

	Not at all risky		Moderately risky		Extremely risky
	1	2	3	4	5
Investing 10% of your annual income in a moderate growth mutual fund					
Investing 5% of your annual income in a very speculative stock					
Investing 5% of your annual income in a conservative stock					
Investing 10% of your annual income in government bonds (treasury bills)					

**Please ensure that you have answered every question.
Missing questions will mean all your responses are unusable.**

Sammy (Samindi) Hewa
Department of Accounting and Corporate Governance
Macquarie Business School
Macquarie University
NSW 2109, Australia

Thank you for your participation!

CHAPTER 5:

Conclusion

1. SUMMARY

Acknowledging that climate change is one of the significant challenges of the current time, and the dark shadow it casts over companies by threatening to put billions of dollars at risk within a period of five years, this thesis sought to address three crucial problems faced by Australian companies due to climate change (Australian Academy of Science, 2020; European Environmental Agency, 2020; Carbon Disclosure Project, 2019; Harvard Business Review, 2007). These crucial problems which consist of climate change risk response inadequacy of Australian companies, climate change risk disclosure inadequacy of Australian companies, and the ambivalence surrounding how investors react to climate change risk disclosures by companies, were addressed in this thesis through three self-contained studies. Specifically, these studies explored corporate climate change risk responses, corporate climate change risks and risk response disclosures, and implications of corporate climate change risks and risk response disclosures for investor's investment decisions.

The first study explored the extent to which Australian companies respond to their regulatory, physical and market risks arising from climate change, and whether these responses can be impacted by the top risk manager's climate change belief, strategic management factors (i.e. company strategy which is represented by the extent of organicity and company structure which is represented by the extent of cost leadership), and stakeholder factors (i.e. primary stakeholder pressure, secondary stakeholder pressure and external stakeholder interaction). Findings of this study showed that companies respond to regulatory risks to a greater extent than physical risks and market risks posed by climate change. It also showed that the top risk manager's climate change belief, cost leadership, secondary stakeholder pressure, external stakeholder interaction and are positively and significantly associated with the company's responses to regulatory, physical and market risks posed by climate change. Furthermore, organicity of company structure was positively and significantly associated with companies' regulatory risk response. Moreover, negative insignificant associations were observed between primary stakeholder pressure and company responses to the three climate change risks.

The second study extended the focus of the first study by exploring the extent to which climate change risks and risk response disclosures are produced by Australian companies with reference to the four themes of governance, strategy, risk management and metrics and targets that forms the Task Force on Climate Related Financial Disclosures (TCFD) framework. It also

explored how the extent of those disclosures could be impacted by corporate financial factors (consisting of profitability, gearing and ownership concentration), and corporate governance factors (consisting of the proportion of non-executive directors, the proportion of female directors and the presence of an environmental committee). This study found that one third (38/114) of the sampled companies have failed to disclose their climate change risks and impacts, along with a notable lack of disclosures addressing the TCFD theme of governance across all five sectors considered in the study. The study also found that over 60% of companies in the Healthcare Providers and Services sector, and over 35% of companies in both the Insurance and Financial Services sector and the Mining and Energy Production sector had failed to report climate change risks and impacts by referring to any of the TCFD recommendations. Furthermore, sentence counts, word counts and disclosure type scores of disclosures were found to be negatively and significantly related to ownership concentration, whilst the presence of an environmental committee was positively and significantly associated with sentence counts, word counts and disclosure type scores that were obtained for their climate change risks and impacts disclosures.

The third study extended the focus of the second study by exploring how investors react to the absence of climate change risk disclosures, disclosures limited to climate change risks and climate change risks and risk response disclosures, under short-term and long-term investment horizons. Second, it explored how investors' extraversion, neuroticism and climate change belief influence their investment decisions. This study found that the company with no climate change risk disclosures attracted the least amount of investment, and the company with climate change risk disclosures attracted the second highest amount of investment, whilst the company with climate change risk and risk response disclosures attracted the highest amount of investment. These findings emphasise the importance for companies to disclose climate change risks and risk response information to maximise their potential for sourcing investments. Inconsistent with prior findings, this result was observed for both long-term and short-term investment scenarios. In addition, results demonstrated that the degree of investors' neuroticism was positively related to the amount of long-term investments in the company that discloses both climate change risk and risk response information, and negatively related to the amount of long-term investments in the company that only discloses climate change risk information. Contrary to expectations derived from the existing literature, this study found that the degree of investors' extraversion was positively associated with long-term investments in the company that discloses both climate change risk and risk response information. It was also

found that a higher degree of climate change belief was associated with greater investments in the company that disclosed both climate change risk and risk response information, when compared to the company that only disclosed climate change risks.

2. CONTRIBUTIONS AND IMPLICATIONS

The first study which investigated the extent to which companies respond to risks posed by climate change delivers three contributions. First, this study fills a crucial literature gap by producing one of the first research insights into the extent to which Australian companies respond to regulatory, physical and market risks posed by climate change. Second, results of this study produce a practical benefit for Australian companies and their stakeholders by demonstrating how the choice of the top risk manager, strategic management factors (i.e. company strategy and company structure), and stakeholder factors (i.e. primary stakeholder pressure, secondary stakeholder pressure, external stakeholder interaction) that can be controlled by either the companies or their stakeholders can be used to improve the climate change risk responses of those companies. Third, findings of this study can be used by Australian regulators such as the Australian Securities and Investments Commission to identify companies that are likely to have inadequate climate change risk responses and make interventions as a regulator to ensure such companies address the shortcomings of their climate change risk responses.

The second study which investigated the extent of climate change risks and risk response disclosures by companies addresses a research problem that was yet to be addressed. This study which identified the shortcomings of corporate climate change risk disclosures has also produced recommendations for companies to follow in order to ensure that their disclosure of climate change risks and risk responses meet stakeholder expectations. These recommendations emphasise the importance of (i) improving and reporting board oversight and management of climate change risks and risk responses, (ii) assessing the climate change risks faced by the Healthcare Providers and Services, Insurance and Financial Services, and the Mining and Energy Production sectors, (iii) incorporating quantitative elements (e.g. targets, year to year comparisons of metrics) into climate change risks and risk response disclosures, and (iv) form an environmental/sustainability committee or incorporate the responsibility of overseeing the assessment, management and reporting of climate change risks into an existing committee (e.g. risk management committee). Additionally, regulators are strongly advised to

place special emphasis on monitoring climate change risk and impact disclosures of companies with greater ownership concentration. These recommendations can also help protect directors from breaching their statutory duty of due care and diligence that can result from inadequate climate change risk and risk response disclosures. Moreover, they can be used by regulators to improve the effectiveness of their oversight and to minimise the incidence of investors being left uninformed about the climate change risks faced by Australian companies.

The third study which investigated investor reactions to corporate climate change risks and risk response disclosures also makes four contributions. First, it fills a crucial gap in the literature by being one of the first studies to investigate investors' resource allocation decisions when faced with different company attitudes towards the disclosure of climate change risks specifically. Second, the findings of this study benefit companies by demonstrating whether disclosing climate change risks only or disclosing them coupled with risk responses would be a better strategy in seeking to maximise the amount of resources from short-term and long-term investors. Third, findings of this study benefits investment companies in recruiting personnel with suitable personality traits through psychometric tests to manage investment portfolios that are increasingly exposed to the impacts of climate change. Fourth, its findings can be used by regulators and policy makers to make a strong case for mandating climate change risk disclosures to ensure that investors can make informed decisions based on adequate corporate disclosures.

3. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

One of the limitations of the first study which explores the climate change risk responses of companies arises from this study being restricted to the Australian context. This creates a research avenue for scholars to replicate this study in other countries that are vulnerable to the risks of climate change. Second, this study was restricted to exploring the impact of only six factors on company responses to climate change risks. Hence, scholars are encouraged to explore whether other factors such as company culture, ethical climate, directors' leadership styles could impact company responses to regulatory, physical and market risks of climate change. Third, due to limitations associated with the survey method, this study has not obtained rich insights into reasons that may have driven companies to physical and market risk responses at a significantly lower level when compared to the regulatory risk responses. Future studies

can address this limitation by using interviews to explore the reasons that may have led to the significant differences in the climate change risk responses.

The second study which explored the climate change risks and risk response disclosures is also restricted to the Australian context, and this limits the generalisation of its findings. This creates an avenue for researchers to replicate this study in different contexts to further explore shortcomings in climate change risks and risk response disclosures by companies. Second, by following the recognition of limitations in climate change risks and impact disclosures, this study has put forward possible reasons for these limitations by gathering insights from the environmental accounting literature. Scholars are encouraged to obtain further insights into these shortcomings by conducting interviews with the preparers of annual and sustainability reports. Furthermore, scholars are encouraged to replicate this study in the future to examine whether corporate climate change risks and risk response disclosures have improved over time.

The third study which explored investor reactions to climate change risks and risk response disclosures contains three limitations. First, findings of this study were derived from the responses of 96 stock market investors, and this limits the generalisability of the findings. Therefore, scholars are encouraged to replicate this study by using a larger and more diverse sample to deliver more generalisable results. Second, the scenarios used to develop the survey experiment of this study were based on companies that represent the mining industry, and this raises the possibility that the respondents resource allocation decision could have been influenced by this industry choice. However, this creates an avenue for researchers to extend this study to other industries that are impacted by climate change and explore whether industry influences investors' reactions to climate change risk disclosures. Third, scholars are also encouraged to expand this study by examining how personal characteristics that were not considered for this study, such as ethnicity and political ideology, influence investors' reactions to varying levels of climate change risk disclosures.

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