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# Do Greenhouse Gas Emissions Affect Financial Performance? – an Empirical Examination of Australian Public Firms

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ABSTRACT
Previous studies that have attempted to relate corporate environmental performance to financial performance have generated conflicting results. This paper presents the findings of a study on the relationship between greenhouse gas (GHG) emissions and the financial performance of Australian corporations. Using multiple regression models and data from a sample of 69 Australian public companies, this paper finds a positive correlation between GHG emissions and corporate financial performance. By testing the statistical significance of GHG emission factors in determining company Tobin's *q*, this study finds that a stronger Tobin's *q* often correlates with higher GHG emissions across all industry sectors. This finding is contrary to evidence found in previous studies conducted in other countries. The positive correlation found in this study could be explained with reference to the unique economic structure and development of Australia, particularly its dominant mining industry.


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## Introduction

IN THE PAST FOUR DECADES, MUCH RESEARCH HAS BEEN CARRIED OUT TO STUDY THE NATURE OF CORPORATE SOCIAL RESPONSIBILITY (CSR) and the relationship between corporate social performance (CSP) and corporate financial performance (CFP). However, no definitive consensus has been reached in a number of key areas such as CSR motivation, CSP measures and the relationship between CSP and CFP (Horváthová, 2010; McWilliams and Siegel, 2001; Orlitzky *et al.*, 2003).

Greenhouse gas (GHG) emissions are widely used as one type of measure of corporate environmental performances that fall into the broader scope of CSP. How GHG emissions might impact on CFP becomes of key interest

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in the academic literature as GHG emissions significantly influence the business environment and operations of corporations (Busch and Hoffmann, 2011). For example, the possible introduction of a carbon tax would impose additional cost and risk to business operations (Busch and Hoffmann, 2011). Corporate efforts to address climate change could constitute a driver for a systematic change in the business environment for two reasons. Firstly, climate change is becoming a major concern for major stakeholders of firms; namely, governments, customers and investors (Brinkman *et al.*, 2008). In order to operate legitimately within the eyes of these powerful stakeholders, corporate entities need to proactively address and manage their business along the lines of climate change (Sullivan, 2009). Secondly, carbon regulations, either in the form of an emission trading scheme in the European Union or a carbon tax in Australia, are expected to increase the cost for industry (Busch and Hoffmann, 2011). Undeniably, scarcity of fossil fuels, which in consequence leads to an increase in fossil fuel price (International Energy Agency, 2011), makes the carbon issue more cost relevant (Busch and Hoffmann, 2011).

While research efforts devoted to the identification of the GHG–CFP relationship are increasing (Busch and Hoffmann, 2011; Delmas and Nairn-Birch, 2011), previous studies have shown mixed results. The findings of some of these studies emphasize the economic benefits that could result from the reduction of GHG emissions by businesses (Boiral *et al.*, 2012). Others show that the GHG policies and measures actually implemented generally have limited direct outcomes (Ernst & Young, 2010; KPMG, 2008). Much of the previous research has been conducted with US, Canadian, European and Japanese data (Clarkson, 1995; Ziegler *et al.*, 2009). There are only few studies that focus on Australian corporations (Chapple *et al.*, 2013; Galbreath, 2006). Australian settings, characterized by a highly sensitive ecological system with the structure of the economy being heavy reliant on resource extraction industries and a small proportion of CSR investment, may show a different picture of how GHG emissions correlate with CFP. The findings based on Australian data would expect to provide an interesting insight into relationships between GHG emissions and CFP.

The interest of our research lies in there still being no unanimity in the results obtained in the literature with respect to how emission variation affects firm performance (Alvarez, 2012). Our study intends to establish a possible relationship between GHG emissions and financial performance (measured by Tobin's $q$) of Australian public listed companies by using econometric models. The introduction of a carbon tax from July 2012 by the Australian government necessitates this study as it offers empirical evidence of the interactions between GHG emissions and financial performance, which would help policy makers and business managers to address carbon issues and make business and CSR decisions. The ongoing heated debates about the economic implications of efforts to reduce GHG emissions tend to be based more on political or ideological positions than on empirical data (Boiral *et al.*, 2012). In this study, we provide empirical evidence for a positive relationship between GHG emissions and CFP, which helps improve our understanding of the motivations of businesses, the institutional context of their commitment, the type of commitment they make and the possible impacts in terms of reducing GHG emissions. Our study contributes to the growing body of literature by investigating the GHG emissions of Australian companies and provides new evidence on the relationships between GHG emissions and CFP, which is different from evidence recently found in Canada, Japan and Spain. Our findings provide counter argument to the ‘pays to be green’ literature and add extra evidence to the debate.

The remainder of the paper is organized as follows. We first review the literature on the relationship between GHG emissions and financial performance. We then develop our hypothesis. Following that we describe both the methodology and data and then present and analyze the results. The final section concludes with a summary of the findings, implications and research limitations.

## Literature Review

### Overall CSP–CFP Relationship

Since the first research published by Bragdon and Marlin in 1972, the relationship between the effort to manage CSP and CFP has generated a considerable amount of interest. While some work attempted to establish theoretical frameworks (Wood & Jones, 1995), others present empirical evidence using various sources of data (Konar & Cohen, 2001; KPMG, 2008).



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Business and society scholars have attempted to demonstrate an empirical link between CSP that has been defined and measured in different ways and CFP that has been evaluated using either accounting or market-based measurements. While some of them show a negative influence of pollution control efforts on financial performance (Chen and Metcalf, 1980), others find adverse market returns when there are announcements of corporate illegalities (Wallace and Worrell, 1988). Studies that reveal above average social performance to be linked with greater financial performance are often accused of having many deficiencies in their research methods, including the use of inappropriate social responsibility index, poor measures of financial performance or an inadequate statistical method (Wallace and Worrell, 1988).

It was not until the adaptation of stakeholder theory to company–society relationship studies (Clarkson, 1995) that the efforts linking CSP and CFP become more meaningful and constructive (Wood and Jones, 1995). It is suggested that measurements of CSP can only be correlated with those financial performance measurements with which a sound theoretical relationship can be established, rather than being based on the convenience of obtaining data (Griffin and Mahon, 1997). The mismatch between the performance measure and a theory appears to be able to explain contradictory results produced in the body of previous research (Orlitzky *et al.*, 2003). Indeed, measurements of CFP used in a study do have an impact on the final conclusion (Orlitzky *et al.*, 2003; Margolis *et al.*, 2007), resulting in contradictory findings, even within a given study (Busch and Hoffmann, 2011; Delmas and Nairn-Birch, 2011).

Attempting to control for a number of known deficiencies and establish an appropriate theoretical relationship, an increasing number of scholars have endeavored to uncover the possible non-negative impact of 'doing good' on shareholder value (Margolis *et al.*, 2008). For example, scholars have used meta-analysis to show a relationship between CSP and CFP and provide some evidence supporting a positive or at least a non-negative relationship (Margolis *et al.*, 2008; Orlitzky *et al.*, 2003).

### GHG Emissions and Financial Performance

GHG emissions have recently been used as one way to measure CSP (Busch and Hoffmann, 2011; Delmas and Nairn-Birch, 2011). The advance in technologies makes it possible to collect relevant GHG emission data, thus providing opportunities to conduct a CSP–CFP relationship study. Although GHG emissions are an integral part of CSP, they are distinct from other CSP measurements in various aspects. First, climate change, which is largely attributed to GHG emissions from industrial process (Griffiths *et al.*, 2007), has attracted increasing attention from many stakeholders of firms (Busch and Hoffmann, 2011; Sullivan, 2009). Governments, consumers and financial markets are all increasingly concerned about the carbon emission levels of firms (Brinkman *et al.*, 2008; Lee, 2012). GHG emissions have been a dominant topic in public debate and in the media from 1990s. Secondly, unlike other available CSP measures, GHG emissions are not specific to a particular region – they have the potential to impact every company, every sector and every country (Labatt and White, 2007). In the business environment, GHG emissions could possibly affect a company's bottom line when a price is introduced. They could also influence management's strategic choices and provide extra opportunities for the company as well as increase business risks (Busch and Hoffmann, 2007). Therefore it is important to analyze the company's carbon performance and investigate how it impacts on CFP (Busch and Hoffmann, 2011).

According to Boiral *et al.* (2012), the analysis of relationships between GHG emissions and financial performance is polarized around two main approaches: win–lose and win–win reasoning. The first approach, which appears to dominate in international debates about national commitments to reduce GHG emissions, is based on win–lose reasoning, suggesting that the efforts companies make to reduce their carbon emissions result in costs that could detract from their competitiveness. The second approach is based on win–win reasoning, arguing that efforts to reduce GHG emissions help improve corporate competitiveness (Boiral *et al.*, 2012; Pulver, 2007; Stubbs and Cocklin, 2008). This win–win logic is currently dominant in the literature and possibly justifies the current research focus on the economic motivations for efforts to reduce GHG emissions (Boiral *et al.*, 2012; Nishitani and Kokubu, 2012).

Findings from the previous studies concerning these two approaches are mixed. It is widely recognized that the measurements of financial performance adopted in a study play significant roles and they materially affect the final results (Horváthová, 2010; Margolis *et al.*, 2008). For example, using Tobin's $q$ (i.e. the market value of equity divided by replacement cost), a financial market-based measure of firm performance, Delmas and Nairn-Birch



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(2011) and Busch and Hoffmann (2011) find a negative impact of increased carbon emission amounts on CFP, whereas this impact would not be preserved when using accounting-based measurements, including return on asset (ROA) and return on equity (ROE). Delmas and Nairn-Birch (2011) reveal that firms are financially penalized for reducing GHG emissions when using ROA. Similarly, ROE is lower for firms with more processes in place to manage carbon performance (Busch and Hoffmann, 2011). Adding to the complexity, measurements used to represent GHG emissions could change the sign. For instance, using GHG emission intensity as a measurement, Busch and Hoffmann (2011) obtain different outcomes from using process-based measurement in their models. Tobin's *q* is positively related to an outcome-based measurement, but negatively related to a process-based measurement.

The literature has also documented that country and its carbon regulation have the potential to play a major part in explaining the different results of previous studies (Ziegler *et al.*, 2009). In a market where there is a clear carbon regulation in place, namely the emission trading scheme (ETS) in the EU, for example, portfolios which have bought stocks of corporations with active responses to climate change and sold stocks of corporations with no climate change efforts incur more losses than in the USA, where there is no such market mechanism nationally (Ziegler *et al.*, 2009). In Australia, Chapple *et al.* (2013) investigated the impact of a possible ETS legislation on Australian securities market by using a combination of the event study and the Ohlson valuation model. Based on 58 samples of Australian listed firms in 2007, they found that the market penalizes those firms with greater carbon intensity. Since the study, the Australian government has experienced several changes on its positions towards an ETS (Griffiths *et al.*, 2007). The changes may have brought some distinct effects to Australian companies and modified the corporate behavior towards GHG emissions and ETS. No study has utilized any up-to-date data to revisit this relationship. Our study intends to fill this gap. Focusing on Australia we endeavor to investigate how corporate GHG emissions would affect its financial performance from a market perspective. Using econometric models with a larger sample size than those in previous studies (e.g. Chapple *et al.*, 2013), our study provides empirical evidence to clarify the relationship between the amount of GHG emissions and the financial performance of Australian public listed companies.

## Greenhouse Gas Emissions and Hypothesis

In this section, we develop the hypotheses based on the market-measure of financial performance, namely Tobin's *q*. Tobin's *q* integrates investors' expectations of a firm's future profitability under changing conditions. The calculation of Tobin's *q* incorporates the market value of a firm and is therefore able to reveal intangible effects of environmental influences (King and Lenox, 2001; Konar and Cohen, 2001). Although lower GHG emissions are found to be correlated with stronger financial performance in using international samples and data from other countries, Australia may provide different evidence due to the unique structure of its economy and ecological environment.

### Country Factor

The relationship between CFP and GHG emissions has been examined in the literature by analyzing either international data or a single-country case. With international data, Busch and Hoffmann (2011) took samples from the 2500 largest companies by market capitalization from the Dow Jones Global Index and found that when the amount of GHG emissions positively correlate to CFP, the carbon management efforts only negatively correlate to CFP. Country difference was acknowledged by factoring in three regions: Europe, Japan and North America. The result gained from their study is rather mixed as the nature of the relationship changes when CFP is measured differently. International studies normally benefit from large sample sizes; however, it also overlooked the differences between countries by trying to fit one line across the whole sample.

Other studies have been carried out using single-country data. Saka and Oshika (2010) studied the impact of $CO_2$ emissions on company market values in Japan under the context of the Global Warming Measures Law and emissions trading and found that the market value decreased when the emissions increased. However, participation in the emissions trading scheme would not alleviate the negative impact. In other countries, such as Norway, this



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relationship does not hold (Telle, 2006). When each country has its own unique regulatory and economy structure, it is reasonable to expect that the relationship between GHG emissions and CFP would vary across countries.

Australia differs from other countries in many ways. Australia's per capita GHG emissions are the highest of any OECD country and are among the highest in the world (DCC, 2008). The Australian economy relies heavily on emission-intensive industries (e.g. manufacturing and mining). Ranking as the second and third biggest contributors to Australian GDP, manufacturing and mining industries are also amongst the top sectors that emit the largest amount of GHG. Australia is also a highly ecological sensitive land mass. These factors are expected to have an effect on the relationship between GHG emissions and CFP.

### Cost of Regulation

The Australian government enacted the Australian National Greenhouse and Energy Reporting (NGER) Act in 2007; this makes carbon disclosure mandatory for high-polluting entities. Businesses with scope 1 and 2 emissions that are more than the threshold are obliged to submit a report to the Clean Energy Regulator (CER). The CER aggregates and publishes the data. This system aims to make the emissions information transparent and could underpin an emissions trading scheme in the future. The threshold decreases from 125 kilotonnes in 2008–09 to 50 kilotonnes in 2010–11. The NGER is widely regarded as a channel for the public to gain access to corporate GHG emissions information and as recognition of corporation emission status. This public disclosure is argued to be able to influence organizations in several ways (Wang *et al*., 2004). Firstly, market agents can change their consuming and investing behavior according to the GHG information. Consumers may avoid the products of firms that are known to be heavy polluters (Arora and Cason, 1996). This would have an effect on a company's profit, signifying a negative relationship between GHG emissions and CFP. Secondly, this disclosure provides an incentive for improved GHG emission performances when companies value their public image. The reputational advantage may bring financial benefits to a company. This would also construct a negative relationship between GHG emissions and CFP. Third, when a market mechanism (e.g. carbon tax) is discussed frequently with a high chance of being enforced, this disclosure provides an important channel for investors to assess an organization's possible exposure to this new regulation.

Based on the reviews above, the theories are quite contradictory about the nature is of the relationship between GHG emissions and CFP. Therefore, we would not make any assumptions at this point regarding the direction of the relationship.

## Data and Methodology

### Data Description

In order to measure the environmental performance of Australian public companies, we use GHG emission data reported by the Carbon Disclosure Project (CDP). The CDP is a not-for-profit independent organization that collects climate change information from thousands of companies and cities around the world (CDP, 2012). It is generally acknowledged that the CDP is the most important source of information on GHG emissions (Chapple *et al*., 2013).

For the purpose of this study, we obtain the GHG emission amount from the CDP's data on GHG emissions, energy and fuel use and trading. Both scope 1 and scope 2 emissions are used in our research. Scope 1 GHG emissions are direct emissions from GHG sources owned or controlled by an entity that complete the report. Scope 2 GHG emissions are indirect emissions. Also called ‘purchased electricity’, this part of emissions results from an entity's consumption of electricity, heat and cooling, rather than physically arising from the entity (CDP, 2012). Since both scope 1 and scope 2 emissions reflect an entity's efficiency of resource use, they are utilized as the environmental performance measurement in this research. When companies provide breakdowns of GHG emissions in different countries, only Australia's emission amount is considered. Otherwise, the total GHG amount is deemed to be emitted within Australia. A similar methodology was used by Chapple *et al*. (2013).



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As GHG data are normally available with a significant delay, we chose 2010 as the year of our research interest since there are more published data for 2010 than for 2011 when this research commenced. For 2010, there were 69 Australian public companies for which data were reported in the CDP. The final sample contains 69 firms. The Jarque–Bera test shows that emissions are not normally distributed, therefore we logarithmically transformed them to get normality. The transformation would work with these positively skewed data. In addition, this transformation is considered to be benefit significantly correlation and regression analysis (Osborne, 2010). CFP data, share prices and share quantities were collected from the Morningstar database. Accounting data were collected from the Dun & Bradstreet (Australia) database and 2010 annual reports of individual companies.

## Methodology

Multiple regression analysis is applied here to test and quantify a relationship between Tobin's $q$ and GHG emissions.

### Dependent Variables

Firm financial performance is the dependent variable in this regression model. Scholars use both accounting measures and market measures to quantify financial performances. Accounting measures used include ROA (e.g. Russo and Fouts, 1997), net income (Kagan *et al.*, 2003) and ROE (e.g., (Alvarez, 2012). However, accounting data are generally based on historical information and are more vulnerable to manipulation. For example, companies have incentives to choose depreciation profiles to minimize tax liabilities (Wernerfelt and Montgomery, 1988). Different depreciation methods can lead to different accounting profits. Instead, market measures, such as stock market returns and price-to-earnings (P/E) ratio are commonly used to measure a firm's financial performance (e.g. (Feldman *et al.*, 1996). Compared with purely backward-looking accounting measures, market-based variables take into account market expectations and financial risk.

Tobin's $q$ is the variable that is mostly used in measuring the market-based financial performance of a firm (Horváthová, 2010). Since James Tobin initially proposed the $Q$ ratio in 1968, it has gained popularity as a widely recognized measurement of CFP. A firm's $Q$ is measured as the ratio of its market value to invested capital at replacement cost (Tobin and Brainard, 1977). It essentially looks at a firm's efficiency in utilizing its assets and whether further investment should be made. Tobin's $q$ is employed in studies relating to topics such as the relationship between managerial and other block-holder ownership of a firm's common stock and its market value (e.g. Chen *et al.*, 1993), the impact of the announcement of dividend changes on market value (e.g. Denis *et al.*, 1994) and the relationship between CSR and financial performance (e.g. Dowell *et al.*, 2000; Guenster *et al.*, 2011; Nishitani and Kokubu, 2012). When Tobin's $q$ is equal to 1, the market value of a firm exactly matches its replacement cost. In this research, the simplified approximate $q$ proposed by Chung and Pruitt (1994) is adopted.[1] A similar approach is taken by King and Lenox (2001).

In this paper, Tobin's $q$ is calculated as:

$$\text{Tobin's } q = \frac{\text{MC} + \text{PS} + \text{DEBT}}{\text{TA}},$$

where MC is the market capitalization of a firm, which is its share price times the number of common stock shares outstanding as at the end of the accounting period, PS is the liquidating value of the firm's outstanding preferred stock, DEBT is the sum of its net current liability and book value of the firm's long-term debt, and TA is the book value of total assets of the firm.

### Independent Variables

Hart and Ahuja (1996) tested the link between environmental and financial performance, controlling several firm-specific factors. These controlling factors are known to be related to Tobin's $q$, including: (i) firm size calculated as

[1] An elaborated version of Tobin's $q$ calculation can be found in Lindenberg and Ross (1981). Chung and Pruitt (1994)'s calculation is only marginally different from Lindenberg's but it is much simpler. The data required are also much more accessible. At least 96.6% of the variability of Tobin's $q$ is explained by approximate $q$.



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the log of the company's assets; (ii) capital intensity measured as capital expenditures divided by sales; (iii) growth, percentage in sales; (iv) leverage quantified as the ratio of its debt to assets; (v) research and development (R&D) intensity measured as R&D expenditures divided by total assets. Following a similar methodology, Dowell *et al*. (2000) investigated the relationship between environmental performance and financial performance in a multinational setting, with two extra control variables: advertising expenditures and multinationality.[2]

In the initial design, our study attempt to incorporate all these variables. When doing further analysis of the data, three variables were removed from the models, including multinationality, advertising and R&D expenditures. As only Australian firms are used in this study, multinationality has little significance as a control variable in the model. Also in our sample we find that advertising and R&D expenditures are mostly not readily accessible. Therefore, the advertising and R&D expenditures variables are removed from our final model. However, our least-square regression model has one additional variable, total emissions, which is taken as a proxy of environmental performance. This addition is expected to isolate the incremental effect of emissions on firms' Tobin's $q$.

As suggested by Margolis *et al*. (2008), industry, firm size and risk are the most common control variables used in studying the relationship between CSP and CFP. In our study an industry dummy is added to capture the effect it has on Tobin's $q$ as sample firms are across several industries. A single dummy variable is adopted to indicate whether a particular company is in an emission-intensive industry or non-emission-intensive industry. From our data, the top two industries with greater industry average emissions are: material and energy with average industry emission of 10.83 million and 2.19 million tonnes respectively. Companies involved in resource extraction activities such as coal mining and oil extraction are captured in either one of these industries. Traditionally heavy emitters such as BHP, Rio Tinto and Santos are within this group. Twenty-one companies in these two industries account for 30% of the sample. These two industries are thus classified as emission intensive and the other ones as non-emission intensive. The dummy variable takes the value of one if the company is emission intensive and zero otherwise.

Firm size is represented in several ways in the literature, such as total assets (e.g. Delmas and Nairn-Birch, 2011), total revenues (e.g. Alvarez, 2012), total number of employees (e.g. Nishitani and Kokubu, 2012; Wahba, 2008) and market value (Busch and Hoffmann, 2011). Here we use market capitalization to control for firm size as the samples are all listed companies. We also used the logarithmic form for the sake of normality. In addition, sales revenue is considered as a control variable based on the proven evidence that it is normally statistically significant (Russo and Fouts, 1997).

It is well recognized that a company's financial performance is greatly impacted by its systematic risk. Beta, the well-known risk measure is used in our study as a control variable to capture the risk impact. Beta is calculated as regression coefficient of an individual stock's return on the market return. Previous relevant studies (e.g. Hillman and Keim, 2001) used beta to control for systematic risk.

Emission ($E$), as a proxy for environmental performances, calculated as the logarithm of total emissions, is used in this study as a control variable. That is,

$$E = \log(\text{total company emissions}).$$

This is an attempt to isolate any possible financial impact that firms' GHG emissions may have.

Carbon emission data were collated from the CDP. In 2010, the CPD requested information from the 100 largest Australian companies listed on the Australian Securities Exchange (measured by market capitalization); 72% of these companies responded (CDP, 2011).

In this study, the financial performance proxy, i.e. Tobin's $q$, is regressed on the following independent variables: (i) firm size, calculated as the logarithm of a company's market capitalization, (ii) sales, (iii) capital intensity, expressed as capital expenditures divided by sales, (iv) growth, represented by 1-year sales change in percentage, (v) leverage, measured as the ratio of a company's debt to assets, (vi) $\beta$, proxies of risk, calculated using historical stock price and the ASX 200 market index, (vii) industry, and (viii) log of emissions. Other data are obtained from morningstar.com and annual reports of individual companies.

[2]However, the adjusted $R^2$ of Dowell *et al*. (2000) has decreased by 10% compared with Hart and Ahuja's (1996) model. This might be due to a reduced sample size.



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To be precise, the equation can be written as:

$$\text{Tobin's } q = \mathrm{f}(\text{Emissions}, Z) + e_i$$

where the vector $Z$ contains eight independent variables: firm size (SIZE), sales (SALES) capital intensity (CAPINTENSITY), growth (GROWTH), leverage (LEV), risk (RISK), carbon emissions (EMI), and industry (IND). Additionally, $e_i$ is the mean-zero disturbance term.

In order to establish a solid foundation to test whether the emission variable is statistically significant, we run the regression for two cases. Firstly, the significance of emissions is tested without including the industry dummy variable. Secondly, the industry dummy variable is included to the model to investigate if there is still any significant contribution from the emissions. That is, the following two regression models are adopted:

$$\begin{aligned}\text{Tobin's } q = {} & \alpha + (\beta_1 \times \text{SIZE}) + (\beta_2 \times \text{SALES}) + \left(\beta_3 \times \text{CAPINTENSITY}\right) \\ & + \left(\beta_4 \times \text{GROWTH}\right) + \left(\beta_5 \times \text{LEV}\right) + (\beta_6 \times \text{RISK}) + \left(\beta_7 \times \text{EMI}\right) + \varepsilon\end{aligned} \tag{1}$$

and

$$\begin{aligned}\text{Tobin's } q = {} & \alpha + (\beta_1 \times \text{SIZE}) + (\beta_2 \times \text{SALES}) + \left(\beta_3 \times \text{CAPINTENSITY}\right) \\ & + \left(\beta_4 \times \text{GROWTH}\right) + \left(\beta_5 \times \text{LEV}\right) + (\beta_6 \times \text{RISK}) + \left(\beta_7 \times \text{EMI}\right) + (\beta_8 \times \text{IND}) + \varepsilon.\end{aligned} \tag{2}$$

## Results and Analysis

### Descriptive Statistics

Table 1 presents mean, standard deviation, minimum and maximum for all the independent and dependent variables. Furthermore, Tobin's $q$, emissions and market capitalizations are given in Table 2 with industry breakdowns. Sixty-nine companies are across 9 industries with 30% of the samples from financial industries. No company from the information technology industry reported their GHG emissions to the CDP in 2010 due to the fact that there was only one company in this section in the ASX200 list. In total, 69 companies represent 39% of all the GHG emitted across Australia. Amongst them, energy and materials sectors with 21 companies in total account for 78% of all the emissions reported. This group, however, only contributes to 36% of the total market capitalization

| | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|
| Tobin's $q$ | 1.16 | 0.83 | 0.06 | 4.05 |
| SIZE | 8.45 | 1.48 | 5.68 | 11.93 |
| SALES | 6.39 | 0.78 | 4.88 | 7.76 |
| CAPINTEN | 0.14 | 0.28 | 0.001 | 1.42 |
| GROWTH | 0.05 | 0.19 | −0.45 | 0.76 |
| LEV | 0.52 | 0.22 | 0.097 | 0.97 |
| RISK | 0.96 | 0.36 | 0.03 | 1.78 |
| EMI | 5.32 | 1.09 | 1.36 | 7.66 |

***Table 1.*** Descriptive statistics



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| Industry | No. of companies | Size | Log(emissions) | Tobin's *q* |
|---|---|---|---|---|
| Energy | 8 | 8.28 | 5.94 | 1.53 |
| Materials | 13 | 8.65 | 6.13 | 1.47 |
| Industrials | 12 | 7.60 | 5.35 | 1.02 |
| Consumer Discretionary | 6 | 8.04 | 4.80 | 1.25 |
| Consumer staples | 2 | 9.23 | 5.74 | 1.52 |
| Health Care | 1 | 9.79 | 5.27 | 2.81 |
| Financials | 21 | 9.03 | 4.70 | 0.77 |
| Telecommunication | 2 | 8.94 | 5.14 | 1.30 |
| Utilities | 4 | 7.29 | 5.25 | 0.95 |
| Sample | 69 | 8.45 | 5.32 | 1.15 |

***Table 2.*** Industry descriptive data

of the sample. Note that the average Tobin's *q* of 0.77 for the financial industry was much lower than average of 1.16 for the whole sample. This could be due to the impact of the global financial crisis of 2008.

The Pearson's correlation matrix for the regression variables is presented in Table 3. It is worth mentioning that the correlation between sales and size is quite high (0.71) which is as expected. To check the possible multicollinearity issue, the variance inflation factor (VIF) for both of them needs to be assessed. The VIF of 2.15 for size and 4.21 for sales are both under the threshold value of 10, therefore no multicollinearity issue is present in the test. Another two high correlations are between emission and size (0.51) and between emissions and sales (0.63). The positive correlation indicates that firms with either large market capitalization or higher sales are likely to have higher GHG emissions. In addition, Table 3 shows a high correlation between EMI and INDUSTRY (0.45). However, this value is much lower than the threshold value of 0.8. The VIFs for EMI and INDUSTRY are 3.33 and 1.76, respectively, well below the threshold of 10 for VIF (Kutner *et al.*, 2004). Therefore, we can confirm that the multicollinearity issue would not be present in the regression models.

The average levels of emissions across different industry sectors are depicted in Figure 1. The materials industry has the highest level of emissions. The average emission by the materials industry is approximately 11 million tonnes equivalent of $CO_2$ in 2010. This is more than the total of emissions by all the other nine industries. The energy sector, which includes companies like Santos and Woodside petrol, emits the second largest amount of GHG on average. Industrials sector also emits 1.51 million tonnes of GHG on average. The consumer staples industry, in our sample, made up of only two companies – Woolworth and Metcash – also emits quite an amount of GHG on average. This is probably attributed to the large emissions reported by Woolworth. The rest of the industries are all quite low emitters with average emissions lower than 1 million tonnes.

| | Tobin's *q* | SIZE | SALES | CAPINTEN | GROWTH | LEV | RISK | EMI | IND |
|---|---|---|---|---|---|---|---|---|---|
| Tobin's *q* | 1 | | | | | | | | |
| SIZE | 0.08 | 1 | | | | | | | |
| SALES | −0.29 | 0.71 | 1 | | | | | | |
| CAPINTEN | 0.03 | −0.18 | −0.33 | 1 | | | | | |
| GROWTH | 0.25 | 0.16 | 0.06 | −0.34 | 1 | | | | |
| LEV | −0.43 | 0.19 | 0.39 | −0.16 | 0.16 | 1 | | | |
| RISK | 0.01 | −0.004 | −0.02 | 0.13 | 0.19 | −0.003 | 1 | | |
| EMI | 0.10 | 0.51 | 0.63 | 0.01 | 0.03 | −0.04 | 0.22 | 1 | |
| IND | 0.29 | −0.03 | −0.002 | 0.04 | 0.08 | −0.39 | 0.45 | 0.45 | 1 |

***Table 3.*** Correlation coefficient matrix



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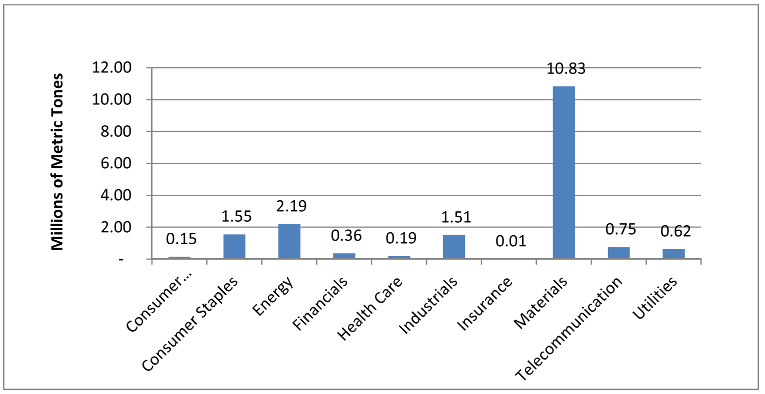


***Figure 1.*** Average industry emissions

## Regression Result

In total, the two regression models (1) and (2) are run and the results are reported in Table 4. Model (1) displays the result when the industry dummy variable is not included while model (2) includes the industry dummy variable.

For model (1), sales, size, growth, leverage and emissions are all statistically significant variables, with sales and emissions being significant at the 1% level and others at the 5% level. In model (2), all the significant variables in model (1) remain significant. Signs of all the coefficients are also the same as in model (1).

The result for model (2) shows that the industry dummy variable does not have a significant impact on Tobin's *q*. Thus whether a company is emission intensive is not significant for its financial performance. However, previous studies suggest industry is an important variable in predicting Tobin's *q* (Margolis *et al.*, 2008). To investigate the significance of the industry factor, we can introduce one dummy variable for each industry and run the regression with eight dummy variables. The results, which are not reported here, shows that all industry variables are insignificant and the overall goodness of fit has not been improved.

Although industry dummy variable (IND) is an insignificant variable in model (2), the correlation coefficient shows that it is significantly correlated with the emissions variable. In order to eliminate the possibility that the

| Variables | Model (1) | | Model (2) | |
|---|---|---|---|---|
| | Estimate | SE | Estimate | SE |
| CONSTANT | 3.67*** | 0.75 | 3.67*** | 0.85 |
| SIZE | 0.24** | 0.08 | 0.25*** | 0.08 |
| SALES | −0.84*** | 0.20 | −0.82*** | 0.21 |
| CAPINTEN | −0.27 | 0.33 | −0.23 | 0.34 |
| GROWTH | 1.11** | 0.47 | 1.10** | 0.47 |
| LEV | −0.93** | 0.43 | −0.83** | 0.45 |
| RISK | −0.29 | 0.23 | −0.37 | 0.25 |
| EMI | 0.30*** | 0.11 | 0.26** | 0.24 |
| IND | | | 0.17 | 0.23 |
| $R^2$ | 47.1% | | 47.6% | |
| Adj $R^2$ | 41.08% | | 40.66% | |
| *F*-test | 7.77*** | | 6.82*** | |

***Table 4.*** Regression coefficients
*Significance at the 10% level;
**significance at the 5% level;
***significance at the 1% level. SE, standard error.

industry variable distorts the estimation of the emissions variable, we compare the result in both models. When an industry dummy is deleted from the model, the emissions variable remains significant, the sign of coefficient is still positive and the coefficient is only slight increased from 0.26 to 0.3. Thus it appears that the industry dummy variable (IND) does not impact on the estimation of the coefficient for emissions to a great extent.

Note that the coefficient estimates for the emissions variable (EMI) in both models are positive. This implies that the larger the emissions variable is, the higher the Tobin's *q* is, holding other variables constant. Coefficients for all other variables changed only slightly between the two models, and their signs all remain the same. Amongst all these variables, size, growth and leverage are statistically significant at a confidence level of 5% for both models.

The overall goodness of fit for model (1) is 41.08%. Thus this implies that 41.08% of the variation in Tobin's *q* can be explained by the independent variables. This is higher than many previous similar regression studies (Hart and Ahuja, 1996; Russo and Fouts, 1997). Note that the adjusted $R^2$ for model (2) is 40.66%, which is only slightly less than that for model (1).

To further analyze the significance of the emissions and industry factors, we performed a hierarchical regression procedure instead of the simultaneous regression used above. Hierarchical regression would allow the examination of marginal change in $R^2$ when one or one set of extra control variables are added (Wampold and Freund, 1987). Following Wampold and Freund (1987), the following variables are taken as the first set of control variables: size, sales, capital intensity, growth, leverage and risk. These variables are shown to be closely related to Tobin's *q* in both model (1) and model (2). The emission variable (EMI) is taken as the second set and the industry dummy variable (IND) is taken as the third set. The hierarchical regression results are reported in Table 5. Clearly, Table 5 confirms that there is a positive correlation between GHG emissions and CFP.

## Australian Factor

The finding in this study affirms a positive relationship between GHG emissions and CFP in Australia and suggests that GHG emissions correlate with CFP positively. This is consistent with Galbreath's (2006) study using Australian data. The results can partly be explained by the current structure of the Australian economy, particularly its strong reliance on the resource industry. In Australia, the resource industry accounts for 89% of the total scope 1 and scope 2 emissions reported to the CDP in 2010. Most of them are from two corporate giants, Rio Tinto and BHP, which rank as the top two in the metal and mining sector based on market capitalization. With the high intensity of GHG emissions, these two companies also show strong financial performance and high growth, as illustrated by the data.

However, in drawing conclusions, one should take into consideration that most of the output from the mining industry in Australia is for export purposes. The large economy of scale in the mining industry is predominantly due to strong international demand. Coal, for example, is still preferred as a major source of energy over other more expensive renewable energies in many developing economies where the demand for coal has been increasing over the last few years. In addition, the low percentage and awareness of socially responsible investment (SRI) in Australia (Jones *et al.*, 2008) could also be a reason for this relationship. Only less than 2% of the total market capitalization of Australian firms listed on the Australian Securities Exchange is under SRI, which utilizes social screens during the investing process (Humphrey and Lee, 2011). When examining the previous works concluding

| Independent variable | Total $R^2$ | Increase in $R^2$ | $F$ for increase in $R^2$ | $P$ |
|---|---|---|---|---|
| SIZE, SALES, CAPINTEN, GROWTH, LEV, RISK | 40.9% | | | |
| EMI | 47.1% | 6.2% | 7.22 | 0.01 |
| IND | 47.6% | 0.5% | 0.57 | 0.45 |

***Table 5.*** Results of hierarchical regression tests. When the industry dummy variable is added to the model, there is an increase of $R^2$ of 0.5%, which is not statistically significant with a *P*-value of 0.45. However, addition of log(emissions) increases the explanatory power of the whole model by 0.06 to 47.1% and the change is statistically significant ($P < 0.05$). Therefore, we can confirm that log(emissions) is a statistically significant control variable in this model when explaining Tobin's *q*.



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a positive relationship between CEP and CFP, it can be found that they were mostly carried out in the US, Canada and Europe, where SRI occupies a much higher percentage of investment (Eurosif, 2010).

## Conclusion

This study focuses on the relationship between GHG emissions and financial performance in Australia. Based on the 2010 GHG emission dataset from 69 Australian public firms listed on the ASX 200, we propose new linear regression models to investigate the relationship between GHG emissions and Tobin's $q$. After carefully controlling for the effect of a number of variables on firm-level financial performance, we find that Tobin's $q$ is positively related to GHG emissions in Australia. Such a positive relationship between CFP and GHG emissions advocates the win–lose reasoning argued in the literature that money spent on GHG reductions would possibly harm firm competitiveness. This finding is different from the results of previous studies by Boiral (2005) and Nishitani and Kokubu (2012) in the case of Canada and Japan, respectively, wherein they show a win–win relationship between the commitment to reduce GHG emissions and financial performance. Our finding is also different from those of Alvarez (2012) and Hart and Ahuja (1996) revealing no relationship between GHG emissions and corporate performance in times of economic crisis.

Our study contributes to the growing body of literature by providing new evidence on the relationships between GHG emissions and CFP, which is different from evidence recently found in other studies. Our finding provides a counter argument to the 'pays to be green' literature and adds extra evidence to the debate, which can help us better understand the commitment of businesses in terms of reducing GHG emissions, the level of commitment they will make and resulting impacts.

Climate change is a major social issue that is of increasing concern to governments, the public and businesses, especially for those industries considered to be large emitters of GHGs (Pätäri *et al.*, 2012). Our finding has several implications for corporate executives and for public policy makers on GHG emissions. Firstly, for business executives it is critical to assess the economic impacts of efforts to reduce GHG emissions. Our finding implies that companies with high GHG emissions are still able to generate more profit under market conditions when a carbon tax is not enforced. Companies with low GHG emissions would not benefit financially. The results of this study may help predict the likely effects of businesses making a commitment to reduce GHG emissions. As noted by Boiral *et al.* (2012), however, the growing media coverage of climate change, its impacts and the efforts that must be made to substantially reduce GHG emissions is expected to focus ever greater attention on corporate responsibilities and GHG emissions. Failure to take these issues into account will expose companies to risks that can no longer be ignored by business executives (Lash and Wellington, 2007; Kolk and Pinkse, 2007).

For policy makers, the positive correlation indicates that there is a long way to go in fostering a carbon constrained economy as suggested by this study in terms of the economic risks of efforts to reduce GHG emissions, particularly in terms of corporate competitiveness and financial consequences. More efforts are needed to raise the awareness of GHG emissions and ensure that GHG emissions data are available and made more user-friendly for businesses and market agents. Market mechanisms such as the carbon tax would assist in bringing the climate change dimension to business operations, although the long-term consequence of such tax imposition remains to be studied. While the uncertainties in climate change policy are the key barrier to companies taking a more proactive approach to reducing their emissions (Sullivan, 2009), the results of this study suggest that policy makers should push companies and resources sectors harder to consider the long-term consequences of the impact of GHG emissions on business and commit to tackling climate change. We recommend that businesses take a long-term view of the consequences of GHG emissions and address the issue from broader perspectives of corporate governance and strategy.

Although the positive correlation is different from the findings of previous studies conducted in other developed economies, it is not a total surprise for this to happen in Australia for a number of possible reasons: historical heavy reliance on the metal and mining industries which are emission intensive; strong lobby groups from emission-intensive industries; more concern for economic development than environmental deterioration; less stringent regulations in Australia compared with other developed economies; and a less developed market



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mechanism in stimulating companies to improve their environmental performance. A research report by Ahammad *et al*. (2006), published by the Australian Bureau of Agricultural and Resource Economics (ABARE) in 2006, hypothesizes six possible scenarios by which GHG reduction could be achieved. The critical aspect shared among all six scenarios is to reduce the reliance on coal-generated electricity and increase the use of renewable energy. However, the positive relationship found in our study seems to imply that the market does not necessarily believe in this transition. The strong financial performance of BHP and Rio Tinto, the biggest producers of coal, demonstrates that the market still believes in its growth in the future. Yet, with the implementation of the carbon tax from July 2012, this perception could be changed. It will be very valuable to conduct a similar study in the future and evaluate whether this national-level market mechanism changes the underlying CEP and CFP relationship.

Although this study enhances our knowledge of the challenges and consequences associated with corporate responses to GHG emissions and climate change, the results should be interpreted with several limitations in mind. The unique characteristics of the Australian economy and policies on these matters are likely to influence some of the relationships found in the current study. Therefore, the conclusions found here might not be applicable in other countries, which limits the generalization of this finding. Among the possible limitations of this study are the temporal aspect of this research and a small sample of firms. Using only 2010 data on a cross-sectional basis with a sample of 69 firms could only give a snapshot of the interactions between GHG emissions and financial performance, without considering the development and changes over time and the whole picture of all the industries and the economy. When more data become available, particularly after the carbon tax enforced in late 2012, our research will continue with more relevant data to compare and contrast. More years of data would also make it possible to utilize time-series analysis.

In conclusion, compared with other countries, the Australian market seems to react differently to how firms are dealing with climate change issues. Given the recent introduction of a carbon tax and mounting debate on climate change and GHG in Australia, more research in this field will be expected. This paper has made an attempt in this direction.

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