

When does the reputational capital of traditional accounting profession pay?--Evidence from the emerging GHG assurance market

Abstract

This study aims to identify factors significant in companies' choices between different assurance providers for their GHG emissions disclosures. Information cost theory and signaling theory suggest companies would only pay for the reputational capital of the accounting profession when the signaling effect of a reputable assurance provider is high, i.e. when the report being assured reaches a wider range of users. Therefore, this study tests the effect on the choice of assurance provider of the type of report within which the GHG the disclosures are made (i.e. general purpose reports prepared for a broad range of users, or special purpose reports prepared for regulators). Using a sample of 3017 companies drawn from the Carbon Disclosure Project (CDP) database 2007-2009, we find strong support for this hypothesis even after controlling for potential endogenous concerns using Heckman's two stage analyses. Our results suggest that the reputational capital of the accounting profession is one of their distinct advantages in this emerging assurance market currently dominated by other professions.

1. Introduction

The past two decades have witnessed a surge of corporate non-financial information disclosures. Most of these disclosures are made in the name of corporate social responsibility, or more recently, sustainability. Parallel to this trend is a proliferation of academic studies on non-financial information disclosures (Dhaliwal et al., 2011; Kolk and Perego, 2010; Plumlee et al., 2009; Simnett et al., 2009b; Margolis and Walsh, 2003; Orlitzky et al., 2003; Richardson and Welker, 2001). Most of these studies have been undertaken in the broad context of corporate sustainability reports, which are the non-financial equivalent to financial reports. Fewer, however, focus on the more specific, albeit, critical factor among non-financial information, i.e. GHG emissions disclosures. More recently, there has been a clear upward trend in studies addressing GHG reporting and assurance which coincides with the heightened awareness relating to global warming among investors, stakeholders and regulators (Chapple et al., 2011; Matsumura et al., 2011; Griffin et al., 2010; Stanny, 2010; Freedman and Jaggi, 2009; Reid and Toffel, 2009; Stanny and Ely, 2008; Freedman and Jaggi, 2005). Our study is not intended to replicate or develop any of these studies on GHG emissions disclosures; instead we focus on the emerging, yet rapidly developing assurance market on such disclosures, with a particular interest in examining companies' choices between different assurance providers in this market. As we will illustrate further, the GHG emissions assurance market presents a unique setting for our research interest to be explored, which not only contributes greatly to enhancing our understanding of this emerging assurance market,

but also has important regulatory implications on the issue of whether GHG emissions assurance falls into the domain of traditional accounting profession.

1.1 The dichotomous nature of the GHG emissions assurance market

One of the distinct features of the GHG emissions assurance market that sets it apart from the traditional financial statement audit lies in its' dichotomous nature. Such dichotomy manifests itself in two ways: First, unlike the traditional financial statement audit, which is dominated by the accounting profession, assurance engagements on GHG emissions are commonly also undertaken by practitioners outside the accounting profession with expertise in relevant fields, including professional engineers and environmental scientists (Nugent, 2008). Given this fundamental difference, questions have been raised as to the competitive advantage of the accounting profession in this market (Huggins et al., 2011; Simnett et al., 2009a), particularly given the relatively high cost of accounting firm assurance services¹ and the lack of documented benefit to date (e.g. in terms of cost of capital or share market effects) from having this higher cost assurance. Second, the dichotomous user groups for the GHG emissions assurance information sets it apart from the sustainability assurance market, which has gained impetus in recent years (Simnett et al., 2009b; CorporateRegister, 2008; KPMG, 2008). As noted by Simnett et al. (2009b), sustainability reports are the non-financial equivalent to general purpose financial reports, and are intended to meet the information needs of the general public (Simnett et al., 2009b, p.4). GHG emissions disclosures, however, can be prepared either for general public use, i.e. to be included as part of sustainability reports/annual reports, or they

¹ According to Simnett et al. 2009b, anecdotal evidence suggests that the assurance service from the accounting profession costs around three times more than such service from other professions such as specialist consulting firms.

could be prepared mainly for compliance use in response to certain Emissions Trading Schemes (ETSs)² or Emissions Reporting Schemes (ERSs)³. Importantly, Simnett et al. (2009b) has explicitly excluded other two major categories of non-financial information, i.e. special purpose reports which are primarily used for internal decision making or some reporting requirements from regulatory bodies as well as non-financial information disclosed in annual reports. While the exclusion of those two categories of non-financial information is warranted for the research purpose of the Simnett et al. (2009b) study, these exclusions have limited the sample in their study to general purpose reports only. This sample choice therefore does not allow for the possibility that the nature of the report itself could be one of the determining factors for the choice of the assurance provider on these reports.

Thus, the dichotomous nature of the assurance providers in the GHG emissions assurance market makes it a unique and rich setting for the assurance practices to be examined. In particular, such a research setting offers a rare opportunity for the dynamics among different types of providers to be studied. This is because, according to signaling theory and information cost theory, the nature of the report itself, which indicates the breadth of the audience of the report, could be one of the determining factors in the choice of assurance provider on the report particularly since signaling the credibility of the report is one of the major reasons for purchasing such assurance services (Simnett et al., 2009b).

However, this potential determining factor has long been ignored in academic studies

² Examples include European Union ETS (EC 2007), The New Zealand ETS (NZ 2009), The Regional Greenhouse Gas Initiative (RGGI 2008) in the US, The New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS 2009) in Australia.

³ Examples include the United States' Mandatory Reporting of Greenhouse Gases Rule (U.S. EPA 2009), California's Global Warming Solutions Act of 2006 (California ARB 2007), Alberta's Climate Change and Emissions Management Act 2003 (Government of Alberta – Environment 2009), Australia's National Greenhouse and Energy Reporting Act 2007 (Australian DCCEE 2009), and New Zealand's Climate Change Response Act 2002 (New Zealand PCO 2009).

mainly because of the limitation of the research setting. Our hypothesis development and empirical tests, therefore, focus on the effect of the nature of the GHG emissions report, i.e. whether it is general purpose or special purpose, on the decision of which assurance provider to choose for the report.

1.2 The characteristics of the two types of assurance providers in the GHG emissions assurance market

As previously mentioned, a distinctive feature of the GHG emissions assurance market is the co-existence of assurance providers from the accounting profession and from other professions such as specialist consulting firms. Each of these two major types of providers has its' own advantages and constraints. The accounting profession has an established history and reputation that is well known, which increases public confidence in the assurance reports signed off by accounting firm providers. Further, their global network is particularly beneficial when the assurance work needs to be undertaken in multiple locations for international companies (Huggins et al., 2011; Nugent, 2008). However, anecdotal evidence suggests that the non-financial information assurance from the auditing professions costs around three times the service from specialist consulting firms (Simnett et al., 2009b). Apart from being able to provide the assurance service at a much lower cost, other professions such as engineering and environmental science have also been argued to possess a higher level of subject-matter expertise (Huggins et al., 2011; Simnett et al., 2009a; Power, 1997). However, due to a lack of reputational capital, the signaling effect of adding credibility to the data by purchasing the assurance service is much eroded.

Although the arguments as to which assurance provider is superior in the GHG emissions assurance market have long been ongoing, there is a dearth of research, especially empirical evidence to support either side of the argument. Existing research examining user's perceptions of different types of assurance providers for non-financial information has documented mixed results as to which profession is the preferred assurance provider (Hodge et al., 2009; Knechel et al., 2006). In relation to GHG emissions assurance, while there has been no research specifically examining the relative importance of industry-specific knowledge and general domain knowledge, nor how this industry-specific knowledge and general domain knowledge can be combined for optimum efficacy, Huggins et al. (2011) and Green et al. (2011b) document that purchasers of GHG emissions assurance recognize the need for both types of knowledge.

The aim of this study is therefore to further our understanding of the emerging GHG emissions assurance market with a particular focus on the empirical tests for the choice of assurance provider given this unique research setting. Due to the fact that the assurance engagements on GHG emissions are commonly undertaken with other subject matters such as social factors under the name of sustainability report assurance, the driving forces behind companies' decision to have GHG emissions assured are considered to be similar to those driving sustainability report assurance. Further, since the research of Simnett et al. (2009b) and others (e.g. Kolk and Perego, 2010) has already provided an extensive understanding of the assurance decision model in this area, our study does not replicate the assurance decision model. Rather, we will provide descriptive information on the assurance practice of the GHG emissions assurance market as background information to our main analysis examining assurance provider choice through an assurance provider

choice model. As previously illustrated, the assurance services purchased on GHG emissions disclosures are mainly for two distinct user groups, i.e. regulatory bodies and the broad stakeholder group. Further, assurance services from the accounting profession have a much higher cost than those from other professions such as the specialist consulting firms. As such, drawing on information cost theory and signaling theory, the assurance service from the accounting profession is more likely to appeal to companies willing to pay for the benefit of signaling brought about by the reputational capital of the accounting profession. The magnitude of the signaling benefit, however, is directly dependent on the breadth of the audience. Thus, when there are distinct user groups for the assurance information, given the varying level of costs incurred, the breadth of the user group is hypothesized to be one of the determining factors in companies' choice between different assurance providers.

This study contributes to the assurance literature by bringing in an important determining factor into the assurance provider choice model which has rarely be tested due to the limitations of research settings. The empirical results for this determining factor could help us infer whether the reputation signaling benefit of the traditional auditing profession is valued in the emerging GHG emissions assurance market. This study also has timely regulatory implications as government regulators and national and international standard setters are currently addressing the issue of whether GHG emissions assurance engagements fall within the domain of pre-existing professional categorizations, as well as which professionals have the appropriate skills and competencies to sign off on these types of engagements (Huggins et al., 2011).

To test the hypotheses, information on GHG emissions assurance was hand collected for a sample of 3018 companies from 42 countries responding to the Carbon Disclosure Project (CDP)'s questionnaires during 2007 to 2009⁴. CDP is a not-for-profit organization collecting information on GHG emissions from the largest companies by market capitalization around the world. The CDP database is considered appropriate for this study because CDP offers a platform for information specific to GHG emissions to be collected from companies around the world. Such a platform of information on GHG emissions is especially important given the diversity in regards to GHG emissions reporting. Results of this examination provide evidence that in addition to factors affecting assurance of sustainability information (country of origin and industry) noted by Simnett et al. (2009b) the breadth of the expected audience of the GHG emissions disclosure is a significant factor in influencing companies' choice between different assurance providers. When GHG emissions information is disclosed as part of a report where the audience is a broader stakeholder group (a general purpose report), such as a sustainability report or an environmental report, the demand for an accounting firm provider as assurer is much higher compared to when GHG emissions is disclosed in a low public exposure (or special purpose) report targeted primarily for regulatory use, such as a report to the EU ETS or the Alberta scheme. Our results hold when we use Heckman's two stage analysis (Heckman, 1979) to control the potential endogenous decision to disclose GHG emissions in a general purpose report versus a special purpose report. The results also hold when we limit the sample to those companies with GHG emissions/environmental information as the single subject matter of their report. In

⁴ There is one year lag between the CDP questionnaire year and the requested information year, i.e. CDP2007-2009 in this study contains information on responding companies from year 2006-2008.

addition, while company size is the most significant determinant in the assurance decision, its' significance is replaced by company profitability in the assurance provider decision.

Overall, these results provide support to the arguments that the reputational capital brought into the assurance engagement by the accounting profession serves as a distinct advantage in the GHG assurance market. At the same time, the higher cost of engaging accounting firm providers seems to be a key constraint to them competing with other specialist consulting firm providers in this market.

The remainder of this paper is organized as follows: section two provides a review of the related literature and develops the testable hypotheses. Section three describes the sample and the research model; section four provides the results, and section five concludes the paper.

2. Literature Review and Hypothesis Development

Most of the studies researching non-financial information examine the broad sustainability issue. While many investigate the determinants (Brammer and Pavelin, 2004; Orlitzky et al., 2003; Cormier and Gordon, 2001) or the consequences (Dhaliwal et al., 2011; Plumlee et al., 2009; Richardson and Welker, 2001) of sustainability information disclosures, few have taken their analyses a step further to examine the assurance status on the disclosed information (Kolk and Perego, 2010; Simnett et al., 2009b). Recently, with the heightened awareness towards global warming, there has been an increase in studies focusing on the specific subject matter of GHG emissions disclosures. Similar to studies on sustainability information disclosure, most of the GHG

emissions studies try to identify the determinants (Stanny, 2010; Freedman and Jaggi, 2009; Reid and Toffel, 2009; Stanny and Ely, 2008; Freedman and Jaggi, 2005) or to quantify the economic consequences (Chapple et al., 2011; Matsumura et al., 2011; Griffin et al., 2010) of such disclosures without considering the assurance status on those disclosures. Among the few who endeavor to explore the assurance services on GHG emissions disclosures (Huggins et al., 2011; Green et al., 2011a; Green et al., 2011b; Simnett et al., 2009a;), even fewer have performed empirical tests using large data sets. Given the importance attached to the assurance on GHG emissions disclosures, this study therefore serves as a timely piece to fill the void. Since this study is particularly interested in the choice of assurance providers for GHG emissions disclosures, the following literature review and hypothesis development will focus on this specific area.

Current practice on the reporting of GHG emissions could either be mandated under some specific ETSs⁵ and ERSs⁶ or made voluntarily in sustainability reports, annual reports and those related to voluntary ETS⁷ and reporting schemes initiated by not-for-profit organizations⁸. The assurance on such disclosures, however, remains largely voluntary⁹. More importantly, the professional background of the assurance provider is never mandated. As noted by Huggins et al. (2011), government regulators and national and international standard setters are currently addressing the issue of the appropriate

⁵ Examples include European Union ETS (EC 2007), The New Zealand ETS (NZ 2009), The Regional Greenhouse Gas Initiative (RGGI 2008) in the US, The New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS 2009) in Australia.

⁶ Examples include the United States' Mandatory Reporting of Greenhouse Gases Rule (U.S. EPA 2009), California's Global Warming Solutions Act of 2006 (California ARB 2007), Alberta's Climate Change and Emissions Management Act 2003 (Government of Alberta – Environment 2009), Australia's National Greenhouse and Energy Reporting Act 2007 (Australian DCCEE 2009), and New Zealand's Climate Change Response Act 2002 (New Zealand PCO 2009).

⁷ For example Japan's Voluntary Emissions Trading Scheme (JVETS) (Ministry of environment 2009).

⁸ For example the GHG Disclosure Project (CDP).

⁹ The only existing scheme which mandates the assurance is the Alberta scheme in Canada. See Green et al. (2011a) for a summary on existing trading schemes.

skills and competencies needed by assurance professionals to sign off on these types of engagements. A comparison of the requirements for GHG emissions assurance providers in existing schemes throughout the world indicates that a wide range of such requirements exist (Simnett et al., 2009a; Green et al., 2011a). Green et al. (2011a) report the existence of a wide range of requirements for lead GHG emissions assurance providers. For example, the Alberta scheme specifies that a person is eligible to be a lead “third party auditor” if the person is registered as a professional engineer, a chartered accountant, or a member of a profession that has substantially similar competence and practice requirements as either of these professions, while other schemes have similar requirements with no professional membership specification. The main providers of GHG emissions assurance include specialist consultancies, certification bodies and Big N accounting firms (Simnett et al., 2009a; Nugent, 2008).

The provision of assurance for GHG emissions disclosures is a new and evolving area, and the factors influential in the decision to select an accounting or other provider are yet to be empirically examined. On the one hand, Nugent (2008) outlines a list of features relating to professional accountants in public practice that make them particularly well placed to deliver GHG emissions assurance services, including the education and experience benchmarks for entry to the profession, ongoing continuing professional development/life-long learning requirements and stringent investigative and disciplinary processes. Further benefits of engaging the auditing and assurance profession for these services include the high level of reputation capital brought to their engagements (Huggins et al., 2011; Simnett et al., 2009a) and the global reach of the international accounting firms. A counter argument in favour of specialist providers that are not

members of the auditing profession (such as environmental consultants) is that they may possess a higher level of subject-matter expertise. This latter argument is generally countered by the fact that such specialised expertise can always be bought or employed by audit firms (Simnett et al., 2009a). To date, there has been no research specifically examining the relative importance of industry-specific knowledge and general domain knowledge, nor how these two types of knowledge can be combined for optimum efficacy.

The survey studies on user's perceptions towards different assurance providers in regards to non-financial information assurance also produce mixed results. Knechel et al. (2006) found that accountants were more likely to be selected to provide a service when professional reputation and integrity were highly important and/or costliness and independence were less important, while engineering consultants were selected as the preferred provider of services related to non-financial environmental performance measures and ISO Certification¹⁰. A further relevant finding from this study is that the most frequently selected profession¹¹ was still picked by less than half of the respondents, revealing a potentially diverse demand for those types of services. In their survey study, Hodge et al. (2009) found that users place more confidence in sustainability reports when the level of assurance provided is reasonable and when such assurance is provided by a top tier accounting firm, compared to when the assurance is provided by a specialist consultant. However, no such difference is found when the level of assurance provided is limited for either type of assurance practitioner group.

¹⁰ The International Organization for Standardization (ISO) provides standards commonly used by practitioners external to the accounting profession who undertake GHG assurance engagements.

¹¹ These professions include Accountant, Attorney, Engineer consultant, IT consultant, Management consultant, NGO and own organization.

Although these studies do not directly test the associated benefits of engaging accounting firm providers for non-financial assurance engagements, their results suggest that the advantages of engaging the accounting profession in the non-financial information assurance market lie in reputational capital. This suggests the benefit of signaling to the market from engaging a reputable assurance provider would be evident when the assurance statements are targeted to a broader audience. On the other hand, since these benefits come with a cost, there will still be demand for other lower cost providers who are able to provide GHG emissions assurance services, albeit with less reputational capital.

Since companies in practice have the ability to choose different assurance providers for their GHG emissions disclosures, information cost theory suggests that companies purchasing assurance from high cost providers would have done so because the benefits outweigh the costs (Verrecchia, 1990; Dye, 1985). While the cost of engaging a more expensive provider can be easily calculated, the benefit is much harder to measure. One of the documented benefits associated with more reputable assurance providers is the signaling effect to the market. Signaling theory (Boulding and Kirmani., 1993; Beatty, 1989; Balvers et al., 1988; Titman and Trueman., 1986; Spence, 1974) suggests that the assurance statements accompanying GHG emissions disclosures serve as a signal that those disclosures are more credible and reliable than emissions disclosures without assurance statements. Further, assurance statements provided by more reputable providers, i.e. accounting firms, have a stronger signaling effect compared to those provided by lesser known providers.

This paper posits that the choice of assurer will thus be dependent on companies' cost benefit analysis in respect to the assurance provider and that the nature of, and thus the audience for the GHG emissions report will influence this analysis. Specifically, current GHG emissions disclosures are found in two types of reports, i.e. general purpose reports and special purpose reports. General purpose reports are prepared for the broader stakeholder groups and include sustainability reports and environmental reports. Special purpose reports are prepared for the compliance to specific ETSs and ERSs which usually come with pre-determined formats and therefore are not intended for broad stakeholder use. Such a dichotomous nature for the report containing GHG emissions disclosures is hypothesized to be one of the major drivers behind companies' choice of assurance provider in the market. The literature outlined above suggests that the choice of the more reputable accounting firms as assurer has a stronger signaling effect. The value of this signaling is thus important where the reports are intended for broad stakeholder group use, suggesting companies will be more willing to pay the premium to accounting firm providers on their GHG emissions disclosures.

On the other hand, the lower cost of less well known GHG emissions assurance service providers may better suit certain parts of the market. For example companies currently producing special purpose GHG emissions reports for regulators under various mandatory ERSs and ETSs will have a principle aim of achieving regulatory compliance, and thus may prefer assurance provided by the cheapest available assurance provider (i.e. assurance providers other than members of the accounting profession) (Huggins et al., 2011; Simnett et al., 2009b). This is because the value of the signaling through using an

assurance professional who is well known to the market with high reputation capital is eroded by the limited user group.

This discussion leads to the following hypothesis relating to the differential demand for accounting firm GHG emissions assurance providers:

H1: Companies reporting GHG emissions as part of a general purpose report are more likely to select an accounting firm as their assurance provider compared with companies reporting GHG emissions as part of a special purpose report.

3. Sample and Research Model

3.1 Sample

The sample for this study comes from the Carbon Disclosure Project (CDP) database. CDP is an independent not-for-profit organization that seeks information on the business risks and opportunities presented by climate change and GHG emissions data from the world's largest companies¹² on behalf of 551 institutional investor signatories with a combined \$71 trillion in assets under management. In February each year since 2003, CDP has sent out survey questionnaires to the largest companies by market capitalization from all over the world. The responses are finalized in May and published on CDP's website in September¹³. Since CDP sent out the first request for climate change information in 2003, the number of responding companies has grown steadily from 140

¹² It is claimed that the CDP website is the largest repository of corporate GHG emissions data (IGCC 2009).

¹³ The individual company's response can be obtained from CDP website in PDF format; however, there is a quota limit to the responses a user could search. The data this study come from the database purchased from CDP which contains all of the responding companies' responses in excel format which overcomes the search quota limitation.

in 2003 to 1137 in 2009¹⁴. The sample period of this study covers CDP2007 – CDP2009 for the following reason: CDP updates its' questionnaires regularly to reflect the most updated information requests from investors. For the first few years (CDP2003-2006), the questionnaires are much less developed with only 13 questions in total and most importantly they did not ask for information on GHG emissions assurance. CDP2007 - 2009 is the period when CDP started to gain its' popularity among companies and it is also the period when its' questionnaire was transformed into a comprehensive set of questions (28 in CDP2009) covering information on the risks and opportunities, GHG emissions accounting and assurance, GHG emissions reduction performance and the governance related to GHG emissions. The questionnaires stay qualitatively similar for the three years until CDP2010 when some major changes to the questionnaire were made. Thus, the sample period of CDP2007 - 2009 is considered appropriate in regards to its' representativeness and consistency. The decision to respond to CDP's questionnaires is completely voluntary and depending on the company's response, CDP marks the status of the companies as one of the following: (i) Decline to participate¹⁵ (ii) No response¹⁶ (iii) Response not publicly available¹⁷ (iv) Information provided¹⁸ and (v) Answered questionnaires¹⁹. For the purpose of this study, only companies with the "Answered questionnaires" status are included for further sample selection. As mentioned previously, the CDP questionnaire is a comprehensive one and the question of interest to this study is

¹⁴ Statistics drawn from the CDP database.

¹⁵ The organization declined to participate in the CDP project.

¹⁶ The organization did not respond to CDP's questionnaire.

¹⁷ The organization chose to make the response not for public use.

¹⁸ The organization did not answer the questionnaire but provided some information relevant to the questionnaire.

¹⁹ The organization answered some or all of the questions in the questionnaire.

the one on GHG emissions assurance²⁰, i.e. "Has any of the information reported in response to questions 10-15²¹ been externally verified/assured?" There are three responses to this question: Yes, No and No Information. For companies that did not provide any responses to this question, efforts were made to search their websites for any information on GHG emissions assurance and their status was updated accordingly. For companies who responded "Yes" to the question, some provided an attachment for the assurance statement. These assurance statements were downloaded and examined to retrieve information on the assurance providers, as well as the nature and the subject matter of the report for assurance. For those who did not provide the attachment, further efforts were exerted to search the companies' websites for GHG emissions assurance information. If no such information could be found on their websites, best efforts were made to examine the self-claimed comments made by responding companies to collect the required information. These companies were marked and excluded from the sample analysis as a sensitivity test.

Through this process, the final set of companies used in our analyses comprises 3017 companies from 42 countries. In our statistical tests of the provider choice model, we only include the subset of companies who purchased assurance services because only when companies decide to purchase the assurance service do they have to make the next decision as to which provider to choose from. Excluding companies with no information made available on the assurance providers, the sample for our provider choice model becomes 991. The financial data including sales, net income, total assets and long-term

²⁰ Question 18 in CDP2009 and Question 2(d) in CDP2007-2008.

²¹ These questions ask for the total and breakdown of GHG emissions.

debt were obtained from Worldscope²², and supplemented with hand collected financial data from company websites for 181 of these companies.²³ The derivation of the 991 companies included in the sample for this study is shown in Table 1. A diagram of the assurance status of our whole sample is provided in Figure 1.

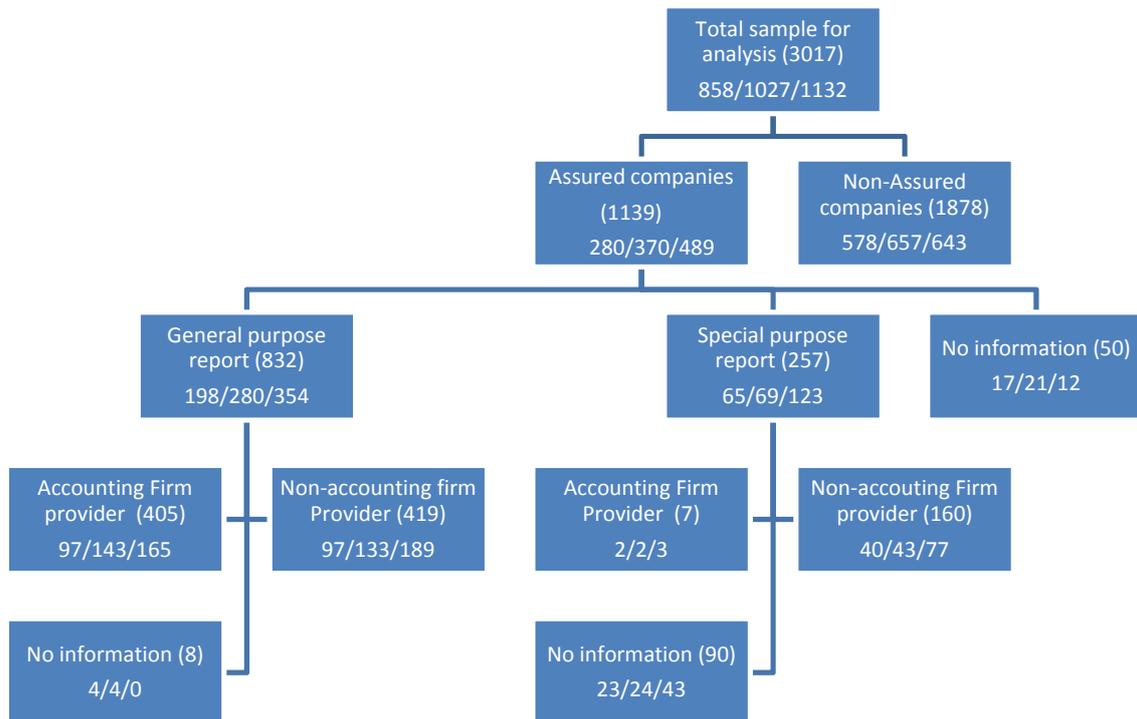
²²Worldscope produces fundamental data on the world's leading public and private companies representing over 95% of global market value. Worldscope provides annual and interim/quarterly historical financial statement content, per share data, hundreds of calculated pre-calculated ratios, pricing and textual information. Standardized formats are applied across various country standards for 57,000 companies in over 70 countries. Accessed from UNSW subscription.

²³ For those whose financial figures are in local currency, the Sales figure has been converted into US dollars using the exchange rate as at 31/12 each year.

. Table 1 - Derivation of Sample

	CDP2007	CDP2008	CDP2009	Total
<i>No. of responding companies in CDP database</i>	878	1058	1137	3073
<i>Less companies with missing financial data</i>	(18)	(25)	(5)	(48)
<i>Less companies with missing assurance info</i>	(2)	(6)	0	(8)
<i>No. of companies for analysis</i>	858	1027	1132	3017
<i>Less non-assured companies</i>	(578)	(657)	(644)	(1879)
<i>Less companies with no assurance provider info</i>	(44)	(49)	(54)	(147)
<i>No. of companies with assurance provider info</i>	236	321	434	991

Figure 1 - Sample Distribution Diagram



3.2 Research Model

The logit regression²⁴ used in Simnett et al. (2009b) was employed to test the hypotheses for this study. The model and variables included are defined as:

$$PROVIDER = \beta_0 + \beta_1 NATURE + \beta_2 STK + \beta_3 LEG + \beta_4 GHG_INTENSE + \beta_5 SIZE + \beta_6 ROA + \beta_7 LEV \quad (1)$$

PROVIDER (PROV): A dummy variable coded 1 if the assurance provider is from an accounting firm and 0 otherwise.

NATURE: A dummy variable coded 1 if the GHG emissions is disclosed in a general purpose report including sustainability reports, annual reports²⁵, environmental reports and reports to CDP²⁶, and 0 if disclosed in a special purpose report including reports to trading schemes (see Green et al. (2011a) for an overview of existing major schemes globally)²⁷.

SUBMAT: A dummy variable coded 1 if the report subject matter is sustainability and 0 if the report subject matter is GHG emissions or environmental information.

STK: A dummy variable coded 1 if the responding company is from a code law country and 0 if it is from a common law country, as prior literature has shown that the legal

²⁴ The impact of potential outliers was addressed by winsoring the highest and lowest 10 observations for continuous variables SIZE, ROA and LEV.

²⁵ This refers to a small number of companies integrating GHG emissions/sustainability information into their annual report. As a result, these companies have accounting firm providers by default. To eliminate the concern for the mandatory force here, these companies were dropped from the analysis as a sensitivity test. Our results stay robust to the test.

²⁶ A small number of companies made special effort to have their submissions to CDP assured separately. Since the reports to CDP are completely voluntary and made publicly available, these reports are classified as general purpose reports. But they were excluded from the analysis as a sensitivity test and the results stay qualitatively the same.

²⁷ It is noted that a small number of companies prepared both general purpose reports and special purpose reports on their GHG emissions. These companies were included as the general purpose report group and dropped out of the analysis as a sensitivity test, the results stay qualitatively similar.

system could have an impact on companies' assurance decisions (Kolk and Perego., 2010; Simnett et al., 2009b; Ball et al., 2000).

LEG: A score using the 'rule of law' measure developed by the World Bank (Kaufmann et al., 2007) which is used in Simnett et al. (2009b). The 'Rule of Law' score measures the extent to which agents have confidence in and abide by the rules of society. Results from previous studies (Choi and Wong., 2007; Durnev and Kim, 2005; Ball, 2001) reveal mixed correlation, supporting the arguments for both the complementary and substitution role of the independent audit.

GHG_INTENSE: A dummy variable coded 1 if the company belongs to a GHG intensive industry targeted by existing ETSs including Utilities, Energy, Materials and Capital goods.²⁸

ROA: Computed as net income scaled by total assets at year end. Profitability, as often proxies by ROA, has long been used in previous literature as one of the determinants of environmental information disclosure (Clarkson et al., 2008; Al-Tuwaijri et al., 2004; Roberts, 1992) and also as a determinant for the assurance decision (Cormier et al., 2005; Chow, 1982). Profitable companies are expected to be more willing to signal to the market their good performance through disclosure and assurance, at the same time, profitable companies have more capacity to do so.

LEVERAGE (LEV): Computed as long-term debt scaled by total assets at year end. Leverage has been argued to be positively related to both disclosure and assurance as highly leveraged companies are often more closely monitored (Cormier et al., 2005; Chow, 1982).

²⁸ The industry classification used in this study comes from the CDP database. For more detailed information on the industry classification of CDP, please refer to the Appendix.

SIZE: Measured by the natural logarithm of Total Assets²⁹ in USD. Prior environmental research has found a relation between company size and disclosure (Clarkson et al., 2008; Hossain and Reaz , 2007) as large companies are under higher scrutiny. Recent studies have also found a positive relation between company size and disclosure of GHG emissions (Stanny and Ely, 2008). This relationship has been confirmed in the assurance literature as well (Simnett et al., 2009b).

4. Results

4.1 Descriptive results

4.1.1 Demand for assurance

Although our research focus is not on the assurance decision, here we provide descriptive statistics on the assurance status of our sample as background information to our main analysis. Within the 3017 companies responding to CDP, 1138 (38%) of them have their GHG emissions disclosures assured (hereafter referred to as assurance companies compared to non-assurance companies). Among these 1138 assurance engagements, 832 (73%) of them are on general purpose reports including annual reports, sustainability reports and reports to CDP. Of the 832 (73%) assurances on general purpose reports, 627(75%) are on multiple subject matters. The sample used in this study consists of mostly medium to large companies with the natural log of total assets (SIZE) around 23 (\$11,000million). This is not an unexpected result since CDP sends out questionnaires to the largest companies around the world based on their market capitalization. Compared with the non-assurance companies, assurance companies are larger in size ($t^{30}=15.44$,

²⁹ Sensitivity tests were performed using the log of total sales instead. The results stay qualitatively similar.

³⁰ Two tailed.

$p < .000$), similar in ROA ($t = .9542$, $p < .3401$) and slightly higher in leverage ($t = 2.8986$, $p < .0038$). Assurance companies are also more likely to come from countries with a code law system ($t = 8.7966$, $p < .000$). As for the country and industry distribution, the top five countries in terms of the percentage selecting assurance on their GHG emissions are UK (18.17%), US (16.77%), Japan (12.99%), France (7.02%) and Australia (5.44%). The top five industries for the assurance companies are Materials (14.75%), Energy (11.15%), Utilities (10.18%), Capital Goods (8.52%), Food, Beverage and Tobacco (6.32%). Overall, the country and industry frequencies are consistent with previous international studies on sustainability report assurance such as Simnett et al. (2009b) and the industry distribution for countries is reasonably balanced without concentration of certain industries for a specific country. We also ran logit regressions following Simnett et al. (2009b) to test the determinants for the assurance decision on GHG emissions disclosures. Results from the regression are very similar to those in Simnett et al. (2009b) with larger, more profitable companies from code law countries and environmentally sensitive industries being the ones more likely to have their GHG emissions disclosures assured. Such results also coincide with our expectation since a majority (55%) of the assurance engagements on GHG emissions were undertaken as part of the overall sustainability report assurance.

4.1.2 Demand for assurance Provider

Assurance providers in the GHG emissions market come from two major groups: accounting firm providers and other providers, including environmental consulting companies such as Corporate Citizenship and certification organization such as Société

Générale de Surveillance (SGS). The latter group is classified under Other Providers³¹ in the following analysis. Table 2 provides a breakdown of these two types of assurance services providers across the three sample years. Table 2 reveals that Big 4 accounting firms dominate the accounting firm GHG emissions assurance providers, with PWC and KPMG undertaking the majority of these engagements. The main other assurance providers are certification organizations SGS and DNV and consultancy companies ERM and Corporate Citizenship. Overall, these results are consistent with those for sustainability assurance found by Simnett et al. (2009b).

³¹ Google searches were performed for these providers to make sure that they are not accounting firm providers.

Table 2 - Breakdown of assurance services providers: Accounting and Other providers

Panel A - Accounting firm providers				
	CDP2007	CDP2008	CDP2009	Total
Deloitte	15	29	26	70
Ernst & Young	26	32	34	92
KPMG	28	34	40	101
PWC	29	47	62	138
Grant Thornton	0	1	1	2
BDO	0	0	1	1
Joint accounting firm	1	2	4	7
Total accounting firm providers	99	145	168	412
% of total sample	41.95%	45.17%	38.71%	41.57%
Panel B - Other providers				
	CDP2007	CDP2008	CDP2009	Total
Bureau Veritas	6	13	16	35
Corporate Citizenship	4	8	9	21
Det Norske Veritas (DNV)	10	15	15	40
Environmental Resources Management (ERM)	12	18	25	55
Lloyd's Register Quality Assurance(LRQA)	3	5	5	13
Netbalance	1	5	7	13
Société Générale de Surveillance (SGS)	10	10	17	37
Technischer Überwachungs Verein (TUV)	3	5	6	14
United Research Services (URS)	5	2	1	8
Others ³²	83	95	165	343
Total other providers	137	176	266	579
% of total sample	58.05%	54.83%	61.29%	58.43%
Total Sample	236	321	434	991

³² "Others" refers to the assurance providers with less than five observations. These assurance providers are mostly small country-specific environmental consulting companies.

The descriptive statistics for other variables used in this study are presented in Table 3. Compared with companies choosing other providers (Panel C), those choosing an accounting firm provider (Panel B) are larger in size ($t=4.4570$, $p<0.000$), similar in profitability ($t=0.8374$, $p<0.4025$) and have lower leverage ($t=2.6117$, $p<0.0091$). At the same time, those with accounting firm providers are more likely to come from countries with a code law system ($t=11.4223$, $p<0.000$) and to have GHG emissions disclosed within general purpose reports ($t=11.4253$, $p<0.000$). Panels D and E of Table 3 reveal that compared to companies disclosing GHG emissions within a special purpose report, companies disclosing GHG emissions within a general purpose report are larger in size ($t=4.3495$, $p<0.000$), similar in profitability ($t=0.0697$, $p<0.9444$), and lower in leverage ($t=4.9837$, $p<0.000$). Plus, they are more likely to come from code law countries ($t=7.1227$, $p<0.000$) and to choose accounting firm providers ($t=11.4253$, $p<0.000$).

4.1.3 Other variables

Pearson pair-wise comparisons (not reported) indicate small positive correlations between the choice of accounting firm provider and each of the following: the nature of the report containing GHG emissions disclosures (0.3415), report subject matter (0.3495) countries with code law systems (0.3262); GHG intensive industries (0.0897); company size (0.13).

4.2 Logistic Regression Results

4.2.1 Logistic regression results on H1.

Table 4 reports the logistic regression results on factors affecting the choice of assurance provider of GHG emissions information. The inferences are made based on coefficient standard errors clustered by country and year to take into account cross-sectional correlations among companies within the same country.

H1 hypothesized that companies with GHG emissions reported in "general purpose reports" are more likely to choose accounting firm providers for the assurance of the report because the reputational benefit of accounting firm providers is more significant under such circumstance. This hypothesis is strongly supported by the positive and significant coefficient on the variable NATURE for the pooled sample as well as for the three sample years (pooled sample: $z=6.810$, $p<0.000$; CDP2007: $z=4.460$, $p<0.001$; CDP2008 $z=3.140$, $p<0.000$; CDP2009 $z=4.540$, $p<0.000$).

Of the control variables, for the country level variables, countries with code law systems, denoted as country of origin STK were found to have a significant effect on assurance provider choice for the pooled sample and also across each of the three sample years (pooled sample: $z=4.390$, $p<0.000$; CDP2007: $z=2.760$, $p<0.000$; CDP2008: $z=3.140$, $p<0.000$; CDP2009: $z=4.540$, $p<0.000$). The other country variable, i.e. LEG, which measures the legal system stringency of countries, is found to be insignificant. For the industry level variable, the GHG intensive industries display a much higher chance of selecting accounting firm providers (pooled sample: $z=5.030$, $p<0.000$; CDP2007: $z=2.160$, $p<0.031$; CDP2008: $z=2.650$, $p<0.008$; CDP2009: $z=3.940$, $p<0.000$). In terms of company fundamentals, company size is positively and significantly related to the provider choice for the pooled sample ($z=2.980$, $p<0.003$) and two of the three sample years, (CDP2007: $z=2.390$, $p<0.017$; CDP2009: $z=2.080$, $p<0.037$). Profitability (ROA)

is found to be positive and significant for the pooled sample ($z=2.150$, $p<0.031$) and two of three sample years, (CDP2007: $z=1.670$, $p<0.094$; CDP2008: $z=2.150$, $p<0.031$). Company leverage (LEV) is found to be insignificant in the choice between accounting firm providers for GHG emissions information.

In summary, these results on the choice of assurance provider reveal that the nature of the report containing GHG emissions disclosures, country origin and the industry are the major factors behind companies' choice of GHG emissions assurance provider.

Although the GHG emissions assurance market provides a perfect research setting to examine the signaling effect of accounting firm providers, there are two possibilities which could potentially confound our findings: First, the decision to disclose GHG emissions within either a general purpose report or a special purpose report could be endogenous. If this is the case, our results for the effect of the nature of the report on the choice of assurance providers will be biased. The second concern is the multiple subject matters included in general purpose reports, which are mostly sustainability reports. Since sustainability reports usually entail multiple subject matters including social, environmental and governance, it is possible that the higher demand for accounting firm providers from companies disclosing GHG emissions within a general purpose report is driven by these additional subject matters.

In view of these two possibilities which could present concerns to our empirical tests, the following measures have been taken to ameliorate those concerns. To address the endogeneity concerns on our variable of interest, Heckman's two stage analysis was performed. As to the second concern caused by multiple subject matters, we repeated our main analysis without those companies having GHG emissions disclosures assured

among other subject matters, conducting our tests on companies only reporting and assuring GHG information.

4.2.2 Heckman's two stage analysis

The Heckman's two stage analysis and the results are reported as follows:

First stage model:

The probit model used in the first stage is as follows:

$$NATURE = \beta_0 + \beta_1 ETS + \beta_2 STK + \beta_3 LEG + \beta_4 GHG-INTENSE + \beta_5 SIZE + \beta_6 ROA + \beta_7 LEV \quad (2)$$

Except for ETS, all other variables are the same as those in our main analysis, the definitions of which were explained earlier. The variable ETS is a new country variable introduced into the first stage model as the exclusion restriction. ETS is an indicator variable with the value of one if there is an ETS³³ in the country where the company domiciles and zero otherwise. The rationale for choosing this variable as the exclusion restriction is that the existence of an ETS/ERS in the country where the company domiciles can be said to be unrelated to the company's choices over different assurance providers on their GHG emissions report because the professional background of the assurance provider is never mandated in the ETS/ERS. However, the existence of an ETS/ERS in the country where the company domiciles could mean that the company is more likely to be involved in such schemes, therefore, more likely to prepare special

³³ Countries that had an ETS/ERS during our sample period include Australia (NSW Greenhouse Gas Abatement Scheme); Brazil (Chicago Climate Exchange); Canada (the Alberta Scheme; California Climate Action Registry); European Union (EU ETS); Japan (Japan Voluntary ETS); Mexico (Chicago Climate Exchange); United States (Regional Greenhouse Gas Initiative; Chicago Climate Exchange; Environmental Protection Agency; California Climate Action Registry).

purpose reports on their GHG emissions. As such, the variable ETS serves as a proper exclusion restriction to perform Heckman's two stage analysis³⁴.

Results from first stage model:

The results from first stage model are reported in Table 5, Panel A. Again, the inferences are made based on coefficient standard errors clustered by country and year. The exclusion restriction ETS is negative and significant ($z = -4.01$, $p < .000$) which confirms the appropriateness of the variable chosen. All other variables are significant at .07 and above, except for the profitability variable ROA. Overall, results from the first stage support the validity of the model.

Second stage model:

The probit model used in the second stage is as follows:

$$PROVIDER = \beta_0 + \beta_1 NATURE + \beta_2 IMR + \beta_3 STK + \beta_4 LEG + \beta_5 GHG_INTENSE + \beta_6 SIZE + \beta_7 ROA + \beta_8 LEV \quad (3)$$

The new variable IMR is the Inverse Mills Ratio calculated from first stage. All other variables have the same definition as those explained earlier.

Results from second stage model:

The results from second stage model are reported in Table 5, Panel B. Our main variable of interest, NATURE is still positive and significant ($z=2.39$, $p < 0.017$) which corroborates our main analysis. The IMR is shown to be negative, but insignificant, suggesting no endogeneity concerns. Nonetheless, as Lennox et al. (2012) recommends,

³⁴ We understand that it is recommended that we use alternative exclusion restrictions to test the robustness of the model; however, due to the fact that the assurance on GHG emissions disclosures is such an emerging and evolving area, there is very limited theoretical support for other suitable exclusion restrictions to be identified. We acknowledge this limitation.

such results should be interpreted with caution as the insignificant IMR coefficient could be the result of multicollinearity among other dependent variables.

In summary, the results using Heckman's two stage analysis provide further support to our hypothesis that the intended audience of the GHG emissions reports being assured is a significant factor in companies' choice over assurance providers on such reports.

4.2.3 The multiple subject matter concern

The other concern for our study is that most (55%) of the GHG emissions assurance was performed with other subject matters under the more general sustainability reports assurance. This could be a confounding factor if the decision on the assurance provider is affected by subject matters other than GHG emissions. In order to address the concern, we repeat the logit regression of our main analysis without those companies whose GHG emissions assurance were part of other subject matters. The exclusion of multiple subject matter companies leaves us with a sample size of 372 single subject matter³⁵ companies with 205 being general purpose reports and 167 being special purpose reports. Table 7 reports the logistic results on companies with single subject matter of assurance. Our main variable of interest, NATURE remains positive and significant ($z=4.70$, $p<0.000$) which adds to our confidence that our main results are not driven by sustainability reports assurance. An interesting finding emerges when comparing the drivers for the two sub-groups of companies: i.e. one with sustainability as the report subject matter, the other with GHG as the single subject matter. Other than country variables and industry variables, SIZE ($z=2.980$, $p<0.000$) is the only company variable that is significant in assurance provider's choice for companies with sustainability as the report subject matter.

³⁵ The subject matter is GHG emissions specifically or environmental information in general (23). As a sensitivity analysis, we excluded those with environmental information and results stay qualitatively similar.

On the other hand, ROA ($z=2.330$, $p<0.020$) is the only significant company variable for companies with GHG emissions as the single subject matter. This result suggests that the higher cost of accounting firm providers seems to be the main impediment to them competing with other providers in the GHG emissions assurance market.

4.2.4 Other variables

Besides the nature of the report being assured, other variables positively significant in affecting the assurance provider choice include STK ($z=4.390$, $p<0.000$); GHG_INTENSE ($z=5.03$, $p<0.000$); SIZE ($z=2.980$, $p<0.003$) and ROA ($z=2.150$, $p<0.031$). All these variables retain their sign and significance after using the Heckman's two stage analysis.

In summary, our hypothesis has been found to be strongly supported, even after we control for the potential endogeneity issues and the alternative explanations arising from multiple subject matters. The nature of the GHG emissions reports, which represents the breadth of the audience of such reports, is found to be a significant factor in companies' choices over different assurance providers on those reports. Or in other words, our results provide evidence that the reputational capital of accounting firm providers serves as a distinctive advantage in competing with other lower cost assurance providers in the GHG emissions assurance market. The co-existence of these two types of assurance providers is therefore a result of the dichotomous nature of this assurance market. The characteristic of each type of provider determines which segment of the market that they appeal to. Such dynamics could only be tested using the GHG emissions assurance market where there are distinct assurance providers as well as distinct segments of the market.

4.3 Sensitivity analysis

4.3.1 Effect of low levels of assurance in US

Prior research (Simnett et al., 2009b) reports that the effect of the law system, i.e. STK variable on the sustainability assurance decision is largely attributable to the inclusion of US companies in their sample since US companies have a far lower rate of assurance on their sustainability reports compared to other countries. As a sensitivity analysis in the current study, US companies were excluded to see if the results for this study remained quantitatively similar. The exclusion of US companies did not change the results for most of the variables, suggesting that the reported regression results are not driven by US companies. The variable STK still remains positive and significant for the pooled sample ($z=5.87$, $p<0.000$) with other variables also largely the same.

4.3.2 "Financials" companies

Companies in the Financials industry, i.e. banking and investment industries, usually have different assets and liabilities structures compared to companies in other industries. To address the concern that such a difference may drive some of our results these companies were dropped from the analysis for a sensitivity test. Results remain qualitatively similar.

4.3.3 "Self-claimed" companies

As mentioned in the methodology section, for companies whose assurance statements are not available for examination, the information required for this study including provider, the nature and the subject matter of the report containing GHG emissions was retrieved based on the responding companies' comments to the CDP questionnaire. These

companies were dropped from the analysis to test whether our results stay robust. The test results confirm that dropping these companies does not affect our results.

5. Conclusions

The voluntary and diversified nature of the GHG emissions assurance market has sparked a debate as to which provider (i.e. accounting firm and consulting firm) is superior given the distinct advantages and constraints for both types of providers in this market. To date, the empirical evidence addressing this question remains sparse. This study provides important empirical evidence shedding light on this debate. Instead of directly testing the consequences of choosing different assurance providers, this study highlights the distinct segment of the GHG emissions assurance market where accounting firm providers have found their niche; that is, where the reported emissions will be provided to a broader audience through general purpose reports. The appeal of accounting firm providers to this segment of the market coincides with the expectation that the reputational capital of an accounting firm provider offers them a distinct advantage in the GHG assurance market. A sample of 3017 companies with 991 assured GHG emissions disclosures were drawn from the CDP databases 2007 to 2009. The GHG emissions disclosures for this sample of companies were coded according to the nature of the report containing the disclosures: i.e. general purpose or special purpose, the definition of which depends on the breadth of the intended audience of the report. In view of the distinct advantage of accounting firm providers in this market, i.e. high level of reputational capital, this study hypothesizes and finds that the nature of the report, which represents the breadth of the intended audience, is a significant driver in the choice of accounting firm providers. These results are

consistent with information cost theory and market signaling theory which suggests that more reputable accounting firm providers are preferred by the segment of the market where the breadth of the intended audience of the GHG emissions disclosures are broader. It is acknowledged, however, that the results could be biased by two major concerns: First, the decision to disclose GHG emissions within general purpose reports or special purpose reports could be endogenous. Second, the significantly higher demand for accounting firm providers from companies disclosing GHG emissions in general purpose reports may not be attributed entirely to GHG emissions information because it is common practice for some of these companies to include other non-financial factors such as social and governance data into the report. To address the first concern, we performed Heckman's two stage analysis to control for the potential endogeneity. As for the second concern, we excluded those companies with multiple subject matters being assured. Our results stay robust to those measures with the nature of the GHG emissions reports being assured significantly and positively associated with the assurance provider choice. Furthermore, in contrast to the results for companies with multiple report subject matters and also to the results from previous studies, company size is no longer a deciding factor in the provider choice for companies with single report subject matter. Profitability (ROA) is the only significant fundamental that drives these companies to choose an accounting firm provider. Such a result is not surprising given the major constraint for accounting firm providers, i.e. the higher cost. Overall, the results provide support for the signaling effect due to higher level of reputational capital, suggesting this is the major advantage of accounting firm providers in this market. At the same time, the major constraint for

accounting firm providers, i.e. the higher cost is suggested to be the main impediment for them being dominant in the GHG emissions assurance market.

This study greatly enhances our understanding of this emerging assurance market with its distinct market segments and distinct assurance providers. Our empirical results provide evidence as to which segment of the market the two different assurance providers appeal to, given their own advantages and constraints. With the market currently dominated by other assurance providers such as environmental consulting firms and engineering firms, this study provides insights as to when and why the assurance service from accounting firm providers would be preferred. As such, this study adds to both the literature on GHG emissions assurance and to the literature on demand attributes for different assurance providers. The results from this study could also be useful to regulators who are addressing the issue on the role played by accounting firm providers in this market.

The results of this study must be interpreted in the light of the following potential limitations. The data source for this study is the CDP database. This database has limitations in that it is a voluntary disclosure scheme where all data collected are self-reported by responding companies which may bias the reported results. However, the due diligence exerted to examine the assurance statements partially alleviates this concern. Second, this study only includes those responding companies who chose to make their responses publicly available. Those requesting their responses not to be made publicly available may bring some response bias to the results.

Appendix: Industry Group classification by CDP

Industry Group	Sub-sector
Auto	Automobiles, Auto components
Biotechnology	Biotechnology, Pharmaceutical
Capital Goods	Building, Building Products, Construction and Engineering, Construction and Farm machinery, Construction Materials, , Diversified industrial, Industrial, Industrial conglomerates, Industrial machinery, Industrial products and services, Industrial renewable
Technology hardware and equipment	Electrical equipment, Electrical equipment and instruments, Computers and peripherals, Communications equipment,
Energy	Energy, Gas distribution, Integrated oil and gas, Oil and gas, Oil and gas exploration and production, Oil and gas refining and marketing
Financials	Banks, Diversified financials,
Insurance	Insurance, life insurance
Software	Internet software and services, Software, Software and computer services,
Semiconductor	semiconductor equipments and products,,
Material	Steel, coal, Chemicals, Commodity chemicals, Diversified chemicals, Speciality chemicals, Paper and frost products. Metals and mining, materials
Media	Advertising, Media and Photography, Movies and Entertainment, Publishing
Household	Household and personal products, Household durables, personal care and household, Containers and packaging.
Healthcare	Health care equipment and supplies, health care providers and services,
Food	Beverage and Tobacco, Food products, Food and drug retaining,
Real Estate	Property, Real estate, Real estate management and development, Hotels, restaurants and leisure, Home Building, Real Estate Investment Trust
Retail	Multiline retail, Speciality retail, Leisure entertainment and hotels, Leisure equipment and products
Consumer durables	Textiles, Apparel and Luxury Goods,
Consumer Services	Environmental services, Human resources and employment services, Support services, consumer, Services
Commercial services and supplies	Commercial services and supplies, financial services, IT consulting and services, Energy equipment and services
Telecom	Integrated telecommunications services, Telecommunication services, Telecommunications, Wireless telecommunication services, in termed and durables, Broadcasting and cable TV,
Transportation	Airports, Airlines, Air Freight and Logistics, Aerospace and Defence, Surface Transport, Transportation, Trading Companies and Distributors
Utilities	Electric Utilities, Gas Utilities, Multi-utilities and unregulated power, Utilities, Water utilities, Electric power companies

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Table 3 - Descriptive Statistics: Full Sample and Sub-Sample Groups

Panel A - Full sample					
<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
PROV	991	0.417	0.493	0.000	1.000
SUBMAT	991	0.550	0.498	0.000	1.000
NATURE	991	0.732	0.443	0.000	1.000
STK	3017	0.417	0.493	0.000	1.000
LEG	3017	1.482	0.562	-0.970	2.010
GHG_INTENSE	3017	0.358	0.480	0.000	1.000
SIZE	3017	23.149	1.783	18.802	28.414
ROA	3017	0.056	0.077	-0.409	0.364
LEV	3017	0.193	0.150	0.000	0.714

Panel B - Companies choosing accounting firm providers						Panel C - Companies choosing other providers					t-stat
<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	
SUBMAT	412	0.825	0.380	0.000	1.000	579	0.481	0.500	0.000	1.000	11.763
NATURE	412	0.983	0.129	0.000	1.000	579	0.724	0.448	0.000	1.000	11.425
STK	412	0.732	0.444	0.000	1.000	579	0.391	0.488	0.000	1.000	11.422
LEG	412	1.412	0.576	-0.580	2.010	579	1.523	0.465	-0.930	2.010	-3.379
GHG_INTENSE	412	0.475	0.500	0.000	1.000	579	0.389	0.488	0.000	1.000	2.759
SIZE	412	24.100	1.752	18.802	28.414	579	23.627	1.611	18.802	28.414	4.457
ROA	412	0.056	0.073	-0.384	0.364	579	0.052	0.078	-0.409	0.364	0.837
LEV	412	0.187	0.136	0.000	0.714	579	0.211	0.154	0.000	0.714	-2.612

Panel D - Companies disclosing GHG in general purpose reports						Panel E - Companies disclosing GHG in special purpose reports					t-stat
<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	
PROV	824	0.492	0.500	0.000	1.000	167	0.042	0.201	0.000	1.000	11.425
SUBMAT	824	0.754	0.431	0.000	1.000	167	0.000	0.000	0.000	0.000	30.639
STK	824	0.575	0.495	0.000	1.000	167	0.342	0.475	0.000	1.000	7.123
LEG	824	1.481	0.498	-0.580	2.010	167	1.540	0.468	-0.850	2.010	-1.798
GHG_INTENSE	824	0.388	0.488	0.000	1.000	167	0.567	0.496	0.000	1.000	-5.459
SIZE	824	23.881	1.719	18.802	28.414	167	23.409	1.343	20.131	28.229	4.350
ROA	824	0.052	0.076	-0.409	0.364	167	0.052	0.077	-0.409	0.322	-0.070
LEV	824	0.194	0.145	0.000	0.714	167	0.242	0.145	0.000	0.626	-4.984

Variables Definitions

PROV	a dummy variable coded 1 if the assurance provider is from an accounting firm and 0 otherwise.
SUBMAT	a dummy variable coded into 1 if GHG emissions are assured with other subject matters and 0 if GHG emissions are the single subject matter of assurance.
NATURE	a dummy variable coded into 1 if GHG emissions are disclosed within general purpose report and 0 if disclosed within special purpose report.
STK	a dummy variable coded 1 if the responding company is from a code law country and 0 if it is from a common law country
LEG	a score using the “rule of law” measure developed by the World Bank (Kaufmann et al. 2007) which measures the extent to which agents have confidence in and abide by the rules of society
GHG-INTENSE	a dummy variable coded 1 if the company belongs to a GHG intensive industry targeted by existing ETSs including Utilities, Energy, Materials and Capital goods.
SIZE	natural logarithm of Total Assets in USD
ROA	net income scaled by total assets at year end
LEV	long-term debt scaled by total assets at year end

Table 4 - Tests of H1: Logit regression results for factors affecting companies' choices between different assurance providers

Full Sample					
<i>Dependent variable</i> PROV	Expected Sign	Coef.	Robust Std. Err.	z	P>z
<i>Variable of interest</i>					
NATURE	+	3.172	0.466	6.810	0.000
STK	+	1.291	0.294	4.390	0.000
LEG	?	-0.097	0.163	-0.600	0.551
GHG_INTENSE	+	0.728	0.145	5.030	0.000
<i>Control variables</i>					
SIZE	+	0.172	0.058	2.980	0.003
ROA	+	2.929	1.360	2.150	0.031
LEV	+	0.276	0.576	0.480	0.632
_cons		-8.383	1.633	-5.130	0.000
<i>Year indicator?</i>	yes				
Number of Obs		991			
Wald chi2(9)		188.640			
Prob > chi2		0.000			
Pseudo R2		0.201			
Log pseudo likelihood		-537.801			

<i>Dependent variable</i> PROV	Expected Sign	CDP2007				CDP2008				CDP2009			
		Coef.	Robust Std. Err.	z	P>z	Coef.	Robust Std. Err.	z	P>z	Coef.	Robust Std. Err.	z	P>z
<i>Variable of interest</i>													
NATURE	+	2.988	0.670	4.460	0.000	3.361	1.070	3.140	0.002	3.167	0.698	4.540	0.000
STK	+	1.323	0.480	2.760	0.006	1.505	0.487	3.090	0.002	1.104	0.520	2.120	0.034
LEG	?	-0.108	0.307	-0.350	0.726	-0.165	0.299	-0.550	0.581	-0.056	0.253	-0.220	0.824
GHG_INTENSE	+	0.692	0.321	2.160	0.031	0.717	0.270	2.650	0.008	0.777	0.197	3.940	0.000
<i>Control variables</i>													
SIZE	+	0.273	0.114	2.390	0.017	0.080	0.082	0.970	0.331	0.198	0.095	2.080	0.037
ROA	+	3.708	2.214	1.670	0.094	3.341	1.552	2.150	0.031	2.385	2.243	1.060	0.288
LEV	+	-0.363	1.004	-0.360	0.718	0.158	1.134	0.140	0.889	0.575	0.843	0.680	0.496
_cons		-10.571	2.887	-3.660	0.000	-6.276	1.953	-3.210	0.001	-9.132	2.682	-3.400	0.001
Number of Obs		236				321				434			
Wald chi2(9)		43.170				134.740				59.160			
Prob > chi2		0.000				0.000				0.000			
Pseudo R2		0.213				0.206				0.194			
Log pseudo likelihood		-126.372				-175.379				-233.494			

Variables Definitions

PROV	a dummy variable coded 1 if the assurance provider is from an accounting firm and 0 otherwise.
NATURE	a dummy variable coded into 1 if GHG emissions are disclosed within general purpose report and 0 if disclosed within special purpose report.
STK	a dummy variable coded 1 if the responding company is from a code law country and 0 if it is from a common law country
LEG	a score using the “rule of law” measure developed by the World Bank (Kaufmann et al. 2007) which measures the extent to which agents have confidence in and abide by the rules of society
GHG-INTENSE	a dummy variable coded 1 if the company belongs to a GHG intensive industry targeted by existing ETSs including Utilities, Energy, Materials and Capital goods.
SIZE	natural logarithm of Total Assets in USD
ROA	net income scaled by total assets at year end
LEV	long-term debt scaled by total assets at year end

Table 5 - Heckman's two stage analysis

Panel A - Stage One					Panel B - Stage Two				
<i>Dependent variable</i>		Robust			<i>Dependent variable</i>		Robust		
NATURE	Coef.	Std. Err.	z	P>z	PROV	Coef.	Std. Err.	z	P>z
<i>Variables of interest</i>					<i>Variables of interest</i>				
ETS	-1.040	0.259	-4.010	0.000	NATURE	1.791	0.749	2.390	0.017
STK	0.640	0.251	2.550	0.011	IMR	-0.056	0.451	-0.120	0.901
LEG	0.222	0.123	1.800	0.071	STK	0.754	0.220	3.430	0.001
GHG_INTENSE	-0.478	0.078	-6.100	0.000	LEG	-0.052	0.093	-0.560	0.578
<i>Control variables</i>					<i>Control variables</i>				
SIZE	0.073	0.028	2.650	0.008	GHG_INTENSE	0.446	0.125	3.580	0.000
ROA	0.021	0.495	0.040	0.965	SIZE	0.098	0.039	2.530	0.011
LEV	-0.633	0.243	-2.610	0.009	ROA	1.528	0.720	2.120	0.034
					LEV	0.122	0.389	0.310	0.753
Year indicator?	yes				Year indicator?	yes			
_cons	-0.344	0.704	-0.490	0.626	_cons	-4.748	0.892	-5.320	0.000
Number of Obs	991				Number of Obs	991			
Wald chi2(9)	131.56				Wald chi2(9)	216.38			
Prob > chi2	0				Prob > chi2	0			
Pseudo R2	0.1057				Pseudo R2	0.1977			
Log pseudo likelihood	-595.018				Log pseudo likelihood	-539.789			

Variables Definitions

PROV	a dummy variable coded 1 if the assurance provider is from an accounting firm and 0 otherwise.
NATURE	a dummy variable coded into 1 if GHG emissions are disclosed within general purpose report and 0 if disclosed within
ETS	a dummy variable coded into 1 if the company domiciles in a country with an ETS/ERS and 0 if otherwise
IMR	the Inverse Mills Ratio calculated from stage one analysis
STK	a dummy variable coded 1 if the responding company is from a code law country and 0 if it is from a common law
LEG	a score using the “rule of law” measure developed by the World Bank (Kaufmann et al. 2007)
	which measures the extent to which agents have confidence in and abide by the rules of society
GHG-	a dummy variable coded 1 if the company belongs to a GHG intensive industry targeted by existing ETSs including
SIZE	natural logarithm of Total Assets in USD
ROA	net income scaled by total assets at year end
LEV	long-term debt scaled by total assets at year end

Table 6 - Logit regressions for sub-sample companies with different subject matter of assurance

<i>Dependent variable</i> PROV	Panel A - Companies with GHG assured as the single subject matter				Panel B - Companies with GHG assured among multiple subject matters			
	Coef.	Robust Std. Err.	z	P>z	Coef.	Robust Std. Err.	z	P>z
<i>Variables of interest</i>								
NATURE	2.643	0.562	4.700	0.000	N/A ³⁶	N/A	N/A	N/A
STK	1.473	0.494	2.980	0.003	1.183	0.374	3.160	0.002
LEG	0.781	0.400	1.950	0.051	-0.405	0.186	-2.180	0.030
GHG_INTENSE	0.865	0.303	2.850	0.004	0.609	0.157	3.870	0.000
<i>Control variable</i>								
SIZE	0.057	0.107	0.540	0.591	0.197	0.066	2.980	0.003
ROA	4.855	2.086	2.330	0.020	2.034	1.671	1.220	0.224
LEV	-1.203	0.960	-1.250	0.210	0.781	0.761	1.030	0.305
Year indicator?	yes				yes			
_cons	-6.817	2.694	-2.530	0.011	-5.197	1.696	-3.060	0.002
Number of Obs	372				619			
Wald chi2(9)	35.450				67.220			
Prob > chi2	0.000				0.000			
Pseudo R2	0.245				0.105			
Log pseudo likelihood	-138.026				-381.544			

Variables Definitions

PROV	a dummy variable coded 1 if the assurance provider is from an accounting firm and 0 otherwise.
NATURE	a dummy variable coded into 1 if GHG emissions are disclosed within general purpose report and 0 if disclosed within
STK	a dummy variable coded 1 if the responding company is from a code law country and 0 if it is from a common law
LEG	a score using the “rule of law” measure developed by the World Bank (Kaufmann et al. 2007) which measures the extent to which agents have confidence in and abide by the rules of society
GHG-INTENSE	a dummy variable coded 1 if the company belongs to a GHG intensive industry targeted by existing ETSs including Utilities, Energy, Materials and Capital goods.
SIZE	natural logarithm of Total Assets in USD
ROA	net income scaled by total assets at year end
LEV	long-term debt scaled by total assets at year end

³⁶ According to the definition of NATURE, companies with GHG assured among other subject matters belong to general purpose report group by default because in our sample, GHG is only assured among other subject matters when it is disclosed in sustainability reports or annual reports.