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The impact of business strategy on the relationship between voluntary disclosure of carbon emissions and firm value

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Abstract: This research examines the influence of firms' voluntary disclosure of carbon emissions on their value in the Korean capital market, with a particular focus on the role of business strategy. This study employs data from Korean companies that are involved in the Carbon Disclosure Project to investigate the impact of these disclosures on the value of the firm. The research classifies firms into prospector, analyzer, and defender stages according to their business strategies. The research findings suggest that the voluntary disclosure of carbon emissions has a negative impact on the overall value of a company. When examining the relationship with business strategy, firms in the prospector stage are seen as actively adopting environmental responsibility for long-term sustainability by voluntarily disclosing information, which may improve the value of the firm.
Keywords: *Business strategy, Firm value, Voluntary disclosure of carbon emissions.*

1. Introduction

Climate change is no longer a distant future concern that will be addressed later. it is a current and urgent issue that has already had a significant impact on millions of people worldwide. The impacts of climate change have already shown to be catastrophic for ecosystems, communities, and the global economy, with estimated financial losses from climate change amounting to USD 10 trillion (IIGCC, 2021). Furthermore, these issues will only be worsened by increasing global temperatures. Undoubtedly, a rise in the Earth's average temperature by 1.5°C will have a substantial effect on water supplies, food security, quality of life, health, and global economies for both the present and future generations (NASA, 2019).

Studies have shown that risks associated with climate change have a substantial effect on the decision-making process of investors. Aligning with the trend of investing in renewable energy and making more environmental-friendly structures, current research has shown that implementing low carbon policies around the world can effectively decrease the risk of survival.

Specifically, studies on the environment are connected to CSR (Corporate Social Responsibility). Environmental concerns have always been a focal point of academic attention in the field of CSR research. Nevertheless, despite the increasing attention from investors towards climate risks associated with carbon emissions, there is still a lack of empirical study in the subject of accounting that examines the disclosure of information pertaining to carbon emissions and business strategies.

The objective of this research is to examine the potential influence of disclosing carbon emissions, as non-financial information, on the overall firm values in the Korean capital market. This will be accomplished by using up-to-date data from the Korean firms that have willingly reported carbon emission statistics via the Carbon Disclosure Project (CDP).

As carbon emissions is an issue at hand, integrating environmental concerns into firms' strategy might lead to investors evaluating the firm value in a positive manner. This research aims to examine the association between the voluntary disclosure of carbon emissions and company value, as well as the application of business strategy in relation to this correlation. The business strategy is derived on the research conducted by Bentley et al. (2013), which classifies firms into three stages: prospector,

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analyzer, and defender. Firms at the prospector stage exhibit a high degree of innovation, a propensity for taking risks, and are pioneers in their respective markets. Companies in the defender stage prioritize the achieving the goals of stability and efficiency. Analyzer firms have characteristics of both types.

This research contributes significantly to the existing body of literature. The present accounting literature on carbon emissions disclosure is significantly undeveloped, particularly in the Korean context. This investigation examining the link between firm value and the willingness to disclose carbon emissions data, as well as the influence of business strategy on this relationship, presents a novel approach. The research did find that firms make strategic decisions about whether or not to release carbon emissions information. The rest of article is organized in the following manner. Section 2 describes background and develops hypotheses. Then, the methodology for testing hypotheses are then described in Section 3, which also defines the main variables of data set. The results are illustrated in Section 4, and the conclusions are finally described in Section 5.

2. Background and Hypothesis Development

2.1. Voluntary Disclosure of Carbon Emission

Carbon emissions are widely recognized as the main culprit of global warming, and their recent rise causes a fundamental danger to the welfare of people worldwide (Romar, 2009). The responsibility for the significant rise in carbon emissions is often attributed to huge corporations, that are now under increasing pressure to transparently disclose and decrease their emissions (Galbreath, 2011). In order to discourage firms from emitting carbon carelessly or above specific thresholds, the capital market imposes fines. Despite the often-unfavorable perception of carbon emissions data for firms, many firms nonetheless choose to disclose this information. In addition, the effects of voluntary disclosure of firms inside information to the public are mixed. Despite the negative impact, there are a few firms willingly disclose information on carbon emissions. Voluntary disclosure reduces the information asymmetry between managers and investors and promotes the effective allocation of scarce resources (Healy and Palepu, 2001). Firms that provide accurate and trustworthy data on carbon emissions help to decrease uncertainty and convey information about potential future outcomes in this regard (Armstrong et al., 2010; Beyer et al., 2010). At the same time, disclosing firm-sensitive information to the public alleviates information asymmetry (Lang and Lundholm, 1996), lowers cost of debt (Sengupta, 1998), and increases firm value (Wang et al. 2014).

However, there are other studies that demonstrate adverse consequences of voluntary disclosure. In the study of Byun, a Yi (2012), the effect of environmental disclosure was investigated by analyzing cumulative abnormal returns before and after the disclosure date of greenhouse gas-emitting companies. The result concluded that such disclosure lowers the firm value, which can be interpreted as the stock market regards the expenses associated with environmental improvement as a financial burden rather than a beneficial investment that encourages innovation and enhances productivity and profitability. Matsumura et al. (2014) performed research on S&P 500 companies to investigate the influence of carbon emissions on firm value. Their findings revealed a significant negative correlation between the amount of emitting carbon emissions and firm value. Furthermore, the research has verified that the market value of the firms that voluntarily disclose carbon emission information is significantly higher than that of non-disclosing firms. Oh, and Park (2021) suggested that voluntary disclosure increases inherent risk and causes delays in audit reporting, rather than eliminating information asymmetry. Kim (2023) concluded that companies that choose to report their carbon emissions data voluntarily may have the challenge of incorporating a greater variety and quantity of accounting information into their financial statements, which in turn increases the complexity of the audit process. Jung et al. (2016) analyzed the impact of carbon-related risks on cost of debt. Companies that did not respond to the Carbon Disclosure Project and with a high awareness of carbon risks showed higher borrowing costs. Based on the reasoning, the first hypothesis is established.

Hypothesis$_1$: Voluntary disclosure of carbon emission affects firm value.

Capital markets use environmental disclosure and liability information to evaluate the effectiveness of firms in managing their environmental risks (Barth and McNichols 1994, Campbell et al. 1998).

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Failure to include environmental issues into firm's strategy may result in investors assessing the future value of the businesses unfavorably (Matsumura et al. 2014). In other words, if firms fail to give attention to their sustainability, it will ultimately have a detrimental influence on their long-term profitability. Consequently, firms should respond to and oversee the alterations or risks associated with climate, leading to increased firm value.

Miles and Snow (2003) classify corporate strategies into prospector, analyzer, and defender types. Prospector typed firms operate in markets with no substitutes and in emerging product markets. At the same time, they are characterized as companies that pursue continuous innovation in both product and technology fields. Defender typed firms focus on efforts to improve profitability through cost reduction rather than bearing risks of technology innovation due to other substitutes in the market. Analytical strategy is defined as a strategy that includes both prospector and defender characteristics.

Bentley et al. (2013) and Higgins et al. (2015) categorized the firms into prospector, analyzer and defender strategies based on the study of Miles and Snow (2003) and examined the relationship between financial reporting behavior and tax avoidance behavior. According to the results of their studies, firms that chose prospector strategy tend to engage in more tax avoidance than those do not and show higher adaptability to risks based on positive prediction for future profitability. Choi et al. (2015) showed that the managers' strategic characteristics affects their approach to new product, market, and risks. The firms in prospector stage are likely to take opportunity for tax avoidance, since they are actively pioneering in the new market. Also, firms in prospector stage are likely to engage in discretionary accruals rather than real earnings management which may affect future profitability negatively through distorted use of resources (Choi et al. 2017). This aligns with the fact that even though firms disclose information voluntarily to outside stakeholders, information asymmetry increases (Park et al. 2013). Accordingly, it is presumable that firm's internal information decreases the future ambiguity and affects decision making process. However, managers have incentives to avoid unfavorable information and to disclose favorable information, sometimes exaggeratedly, leading to higher information asymmetry.

Since firms in prospector stage are characterized as innovative but are uncertain about the future (Higgins et al. 2015), such firms increase the frequency of voluntary disclosure. However, it is highly likely to disclose distorted information under circumstances while pursuing new market. Firms in defender strategy pursues efficiency by improving or maintaining quality in stable products and markets. They aim for high quality while maintaining existing markets and value the company's reputation and image, thus providing reliable information rather than distorted information. However, defensive companies face uncertainty due to their focus on stability and efficiency, which may hinder their ability to respond to rapid changes.

Information on carbon emissions conveys negative information, causing the market to assign firms a lower value than those that did not. Voluntarily disclosing carbon emissions reduces information asymmetry and enhances the effective allocation of resources (Healy and Palepu, 2001). Voluntarily disclosing carbon emissions conveys the possible future expenses linked to carbon emissions, hence decreasing uncertainty.

Nevertheless, allocating limited resources to the measurement and disclosure of carbon emissions may incur expenses for shareholders. The decision to disclose carbon emissions voluntarily might result in higher expenses, potentially leading to reduced cash flow. Furthermore, such disclosure may serve as basis for regulatory investigations and raise the likelihood of legal action from affected parties (Matsumura et al., 2014).

It is reasonable to presume that firms at specific phases of their operations may strategically utilize voluntary disclosure of carbon emissions, considering the current logic. Firms in the prospector stage, characterized by their proactive approach in exploring new market opportunities, adapting to dynamic environments, and assessing emerging trends, may choose to voluntarily disclose data on carbon emissions. This decision is driven by the recognition that such information aligns with the prevailing environmental concerns, ultimately enhancing firm value. Firms that adopt an analyzer strategy effectively reduce excessive risks and maintain a robust and flexible business model. As a result, firms are reluctant to voluntarily provide moderately risky data, specifically information about carbon emissions. Based on the reasons offered, the second hypothesis is established as follows.

Hypothesis$_2$: Business strategy affects the relationship between voluntary disclosure of carbon emissions and firm value.

3. Research Design and Sample Description

3.1. Research Design

3.1.1. Measuring Business Strategy

This model is grounded in the theoretical characteristics of business strategies as proposed by Ittner and Larcker (1997), and Miles and Snow (1978, 2003). To accurately assess the various dimensions of business strategies, Bentley et al. (2013) employed six characteristics to differentiate the attributes of various management techniques: research and development (R&D), growth, efficiency, marketing, corporate structure stability, and capital intensity. R&D refers to the mean value of R&D expenses to sales over five preceding years. Growth is assessed using the five-year average of the sales growth rate. Efficiency is calculated using the five-year average of the ratio of employees to sales. Marketing is assessed by calculating the average ratio of selling, general, and administrative (SG&A) expenses to sales over a period of five years. The stability of a corporate structure is quantified by calculating the standard deviation of the employee number over a period of five years. Finally, the five-year average of the ratio of tangible assets (excluding land and assets under construction) to total assets is used to measure capital intensity. Subsequently, the six metrics are categorized according to industry-year, using an intermediate classification in the KSIC code and distinguished by quintiles (with the greatest level receiving 5 points and the lowest level receiving 1 point). Unlike the other variables, capital intensity is an indicator of defenders when it is high and prospectors when it is low. Unlike the other metrics, capital intensity levels that are high imply defenders, while low values indicate prospectors. Thus, the low value for capital intensity is assigned 5 points, while the high value is assigned 1 point. The business strategy index is determined by summing the values of the six measures, resulting in a total score ranging from 6 to 30. Prior research has categorized company strategies as prospector, analyzer, and defender based on certain index ranges. A strategy falls into the prospector category if its index score is between 24 and 30 points, the analyst category if it falls between 13 and 23 points, and the defender category if it falls between 6 and 12 points.

3.1.2. Testing Hypothesis

This regression model is used to empirically analyze the impact of voluntary disclosure of carbon emissions information on the value of a corporation.

$$\begin{aligned}\mathrm{TobinQ_t} = {} & \alpha_1 + \beta_1\mathrm{VD_t} + \beta_2\mathrm{Size_t} + \beta_3\mathrm{Lev_t} + \beta_4\mathrm{Roa_t} + \beta_5\mathrm{Ocf_t} + \beta_6\mathrm{Roe_t} \\ & + \beta_7\mathrm{Beta_t} + \beta_8\mathrm{Vol_t} + \beta_9\mathrm{Da_t} + \beta_{10}\mathrm{Btm_t} + \mathrm{Ind} + \mathrm{Yr} + \varepsilon\end{aligned} \quad (1)$$

The definitions of the variables used in the model is described in <Table 1>. According to Lee and Jeon (2019), Tobin's Q is used as a proxy for firm value. Tobin's Q is calculated by dividing the sum value of book value of asset and market value of equity by book value of assets. In order to compute Tobin's Q for each firm, it is essential to assess the replacement cost of the company, which is used in the denominator. However, since direct measurement is usually unfeasible, the book value of total assets is often used as a substitute for the replacement cost (Chung and Pruitt, 1994). A higher Tobin's Q value indicates a higher market value relative to the replacement cost of the firm, suggesting a greater firm value. On the other hand, if this number is less, it indicates that the firm value is underestimated. VD is used to represent a value of 1 when a firm chooses to reveal information about its carbon emissions. The firm voluntarily disclose information of carbon emissions through the survey jointly developed by CDP and PWC. Size, Roa, Ocf, Roe, Beta, Vol, Da, and Btm are the control variable, which have been chosen based on previous research. The value of Da is derived from the discretionary accruals as defined by Kothari et al. (2005). Equation (2) is used to quantify the value of Da. The regression coefficient of the second equation is calculated for each industry year in the targeted data.

$$\frac{Ta_t}{A_t} = \alpha_0 + \beta_1 \frac{1}{A_t} + \beta_2 \left(\frac{\Delta Sales_t - \Delta Ar_t}{\Delta Ar_t}\right) + \beta_3 \frac{Ppe_t}{A_t} + \beta_4 Roa_t + \varepsilon_t \qquad (2)$$

where, Ta = Net income − cash flow from operation; A = Total assets; Sale = Sales revenue; Ar = Accounts receivables; Ppe = Plant, property, and equipment; Roa = Net income/total assets.

Table 1.
Variable definition.

$\mathbf{TobinQ_t}$	**(Book value of asset + market value of equity)/book value of assets**
VD_t	If firms voluntarily disclose the information of carbon emission is equal to 1, and 0 otherwise
$Size_t$	Log (Total asset)
Lev_t	Total liabilities/Total assets
Roa_t	Net income/Total assets
Ocf_t	Cash flow from operation/total asset
Roe_t	Net income/Total equity
$Beta_t$	Systematic risk
Vol_t	Standard deviation of stock return
Da_t	Discretionary accruals measured by the model in Kothari et al. (2005)
Btm_t	Book to market ratio
Ind	Industry dummy
Yr	Yr dummy

The third equation is to test the impact of business strategy on the relationship between voluntary disclosure and firm value. The process of measuring business strategy is explained in detail in section. The interaction term of voluntary disclosure of carbon emissions and business strategy ($VD_t \times BS_t$) is of interest.

$$\begin{aligned} TobinQ_t = {} & \alpha_1 + \beta_1 VD_t + \beta_2 BS_t + \beta_3 VD_t \times BS_t + \beta_4 Size_t + \beta_5 Lev_t \\ & + \beta_6 Roa_t + \beta_7 Ocf_t + \beta_8 Roe_t + \beta_9 Beta_t + \beta_{10} Vol_t + \beta_{11} Da_t + \beta_{12} Btm_t \\ & + Ind + Yr + \varepsilon \end{aligned} \qquad (3)$$

where, BS = business strategy index computed by the six factors, R&D, growth, efficiency, marketing, corporate structure stability, and capital intensity, based on Bentely et al. (2013)

In order to examine the impact of business strategy on the relationship between voluntary disclosure of carbon emissions and firm value, the initial sample that participated CDP survey, from Korea Stock Exchange (KSE) and Korean Securities Dealers Automated Quotation (KOSDAQ) from 2011 to 2021, excluding financial institutions, was obtained. The final observation is obtained by eliminating firms with lacking financial information. The CDP reports are essential for quantifying carbon emissions and overseeing companies' actions in response to climate change. The CDP reports collect answers via questionnaires, which are then used to enhance the firm's commitment to addressing climate change. Assessing the level of voluntary participation in the CDP is a valuable method for evaluating the environmental effects of companies (Kumar and Dua, 2022). At the same time, the information provided by CDP is considered as highly reliable (Choi and Noh, 2016). Winsorization is applied to the upper and lower extremes of control variables in order to reduce the impact of outliers.

Table 2.
The data selection process.

CDP surveyed firms with December year-end in the years 2011–2021	**6.337**
Less:	
No financial data	2.255
Final observation	4.082

4. Empirical Results

4.1. Descriptive Statistics

Table 3 displays the descriptive statistics of the variables of this study. The mean value of $TobinQ_t$ is 1.374. The mean value of voluntary disclosure of carbon emissions is 0.302. This suggests that the number of firms voluntarily releasing carbon emissions information is lower than the number of firms that do not disclose such information. The mean and median values of the business strategy is 12.598 and 12.000, respectively.

Table 3.
Descriptive statistics.

Variables	Q1	Q3	Std	Mean	Median
$TobinQ_t$	0.792	1.502	1.389	1.374	1.034
VD_t	0.000	0.000	0.160	0.302	0.000
BS_t	10.000	15.000	2.894	12.598	12.000

Note: See Table 1 for definitions of the variables.

Table 4 presents the correlation among the main variables used in this research. The correlation between firm value ($TobinQ_t$) and voluntary disclosure of carbon emissions (VD_t) is positively correlated, but not statistically significant. The correlation between business strategy (BS_t) and firm value ($TobinQ_t$) are positive. However, validating the hypothesis only based on a simple correlation is challenging. Therefore, a multivariate analysis will be conducted to examine the impact of control variables employed in this research.

Table 4.
Pearson correlation.

	$TobinQ_t$	VD_t	BS_t
$TobinQ_t$	1.000	0.011	0.145
		0.281	<.0001
VD_t		1.000	-0.113
			<.0001
BS_t			1.000

Note: (1) See Table 1 for definitions of the variables.

4.2. Main Findings and Discussion

Table 5 describes the result of the regression analysis testing the first hypothesis. After accounting for factors that may impact firm value, the coefficient of VD_t is -0.543, which is statistically significant at a 1% level. The result implies that firms that release information of carbon emissions voluntarily diminish their value. Publicly revealing unfavorable or risky information voluntarily poses significant difficulties and may be seen as an extra financial burden that companies must bear. This aligns with the Altruistic Liability Theory, which states that firms that generate pollution are accountable for cleaning up and bearing the additional costs associated with it. Consequently, when companies choose to disclose information about their carbon emissions, it reduces their overall worth since it highlights a negative perception of the company.

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Table 5.
Regression result of the first hypothesis.

Variables	Estimates	t-value
Intercept	-3.547	-12.990***
VD_t	-0.543	-6.670***
$Size_t$	0.197	18.850***
Lev_t	0.001	0.960
Roa_t	-0.021	-0.560
Ocf	-0.017	-1.330
Roe_t	-0.002	-0.680
$Beta_t$	0.058	1.630*
Vol_t	9.398	8.320***
Da_t	-0.208	-2.700***
Btm_t	-0.251	-23.200***
Ind	Included	
Yr	Included	
F-value	150.47***	
Adj R^2	0.206	
Observations	4,082	

Note: (1) * and *** indicate significance at the 10% and 1% levels, respectively. (2) See Table 1 for definitions of the variables.

Table 6 shows the results of regression analysis testing the second hypothesis. The interest variable in this test is the interaction term between voluntary disclosure of carbon emissions and business strategy, denoted as $VD_t \times BS_t$. The coefficient of $VD_t \times BS_t$ is 0.687, statistically significant at 5 % level. The result of this can be interpreted as follows.

Firms in prospector stage are regarded as they seek for new market, adapt themselves into variable environments, and respond to competitors actively. By taking pre-emptive action through voluntary disclosure of information on carbon emissions in environmentally challenging conditions, such firms are perceived as willingly taking risks associated with conflict with regulatory agencies (Heal, 2005), which in turn lead to higher firm value. At the same time, disseminating environmental information on carbon emissions can be understood as taking responsibility of environmental issues which is crucial for ensuring long-term sustainability. Simultaneously, the dissemination of environmental information regarding carbon emissions can be interpreted as acceptance of environmental responsibilities, which is essential for guaranteeing long-term sustainability.

Table 6.
Regression result of the second hypothesis.

Variables	Estimates	t-value
Intercept	-3.192	-8.180***
VD_t	-1.898	-2.360*
BS_t	0.429	6.100***
$VD_t \times BS_t$	0.687	2.040**
$Size_t$	0.137	11.120***
Lev_t	0.002	1.160
Roa_t	0.017	0.460
Ocf	-0.013	-0.900
Roe_t	-0.002	-0.690
$Beta_t$	0.002	0.040

Vol_t	7.378	5.300***
Da_t	0.012	0.130***
Btm_t	-3.192	-8.180
Ind	Included	
Yr	Included	
F-value	62.090***	
Adj R^2	0.163	
Observations	4,082	

Note: (1) *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively. (2) See Table 1 and equation 3 for definitions of the variables.

5. Conclusion

In this study, we utilized information released by the CDP from 2011 to 2021 to explore the relationship between the voluntary disclosure of carbon emissions and firm value. Furthermore, such relationship is examined under the circumstances of the firms, based on the method suggested by Bentley et al. (2013). After regressing 10,000 firms in Korean stock market, the negative relationship between voluntary disclosure of carbon emissions and firm value is found. This can be assumed that negative information emitted to the public lowers firm value since the cost of disclosing voluntarily is perceived as an additional problem that the firms must solve. However, when the firms in prospector stage strategically use the voluntary disclosure of carbon emissions, which in turn yield higher firm value.

Climate change poses a significant hazard to the whole human race, with carbon emissions being a primary cause. Many countries have already suffered serious damage because of catastrophic weather events triggered by climate change, which has a substantial effect on the operations of businesses. Firms are also required to deal with climate change in a manner that aligns with the preferences of consumers and firm value.

This study contributes to existing literature. This research is the first conducted in Korea specifically to investigate how business strategy decisions affect voluntary disclosure of carbon emission. By evaluating the impact of different businesses' voluntary disclosure and determining which ones are more difficult to reproduce or copy, this article offers suggestions on how businesses might react to their rivals.

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