

The Role of Carbon Risk, Climate Change Exposure and Good Corporate Governance in The Cost of Capital

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ABSTRACT

This study examines the influence of carbon risk, climate change exposure, and good corporate governance on the cost of capital in manufacturing companies that go public on the IDX. This study uses a quantitative approach obtained from manufacturing companies that go public on the IDX. The sample consists of 100 observations of manufacturing companies that go public on the IDX, which were selected through purposive sampling. Data analysis was carried out using SPSS²⁶. Analysis techniques include descriptive statistics, classical assumption tests, multiple linear regression analysis, t-tests, F tests, and hypothesis testing. Partial results show that carbon risk, climate change exposure, and good corporate governance have a partial effect on the cost of capital in manufacturing companies that go public on the IDX. At the same time, carbon risk, climate change exposure, and good corporate governance affect the cost of capital in manufacturing companies that go public on the IDX. The study contributes to the accounting literature and provides practical implications for regulators, managers and investors.

Keywords: Carbon Risk; Climate Change Exposure; GCG; Cost of Capital

INTRODUCTION

In the current era of globalization, the level of competition between companies is getting higher, this is due to the rapid economic development of a country, including Indonesia. This situation requires companies to make improvements in their business fields, because only strong companies will survive and vice versa, companies that are unable to compete will experience bankruptcy. To maintain its business to continue operating, the company needs a large amount of capital. The capital comes from internal or external capital. Internal capital is capital from the results of the company's operational activities and capital from the company owner, while external capital is capital obtained by issuing debt securities or loans to creditors and other financial institutions. According to Fitriani & Syahfier (2018), if the source of funding used by the company comes from debt, it will cause a high level of leverage which will then increase the risk to the company. In financial research, the Cost of Capital variable cannot be measured directly, so it is necessary to use a proxy, namely Cost of Debt. This is the most commonly used proxy. Debt is an obligation of a company to a third party to pay it in the future. A company's debt is divided into two categories, namely debt based on transaction activities and debt based on its maturity period which consists of two types of debt, namely long-term and short-term debt (Zahro et al., 2018). This debt will later incur debt costs for the company. Cost of Debt or Cost Of Debt is the level of interest received by creditors as the required rate of return. Companies whose capital comes mostly from debt will be subject to the obligation to pay interest. Many factors affect the Cost of Capital using a proxy, namely Cost of Debt, such as: carbon risk, climate change exposure and corporate governance.

Carbon risks are multidimensional issues that affect business sustainability and financial stability. Companies in Indonesia, including in the energy and manufacturing sectors, need to urgently integrate carbon risk mitigation strategies to remain competitive in the global market. Do you want me to elaborate further with the example of the case in Indonesia (e.g. carbon tax policy or government program to reduce carbon emissions) Carbon risk is the potential financial or operational losses faced by companies due to the transition to a low-carbon economy, changes in environmental policies (such as carbon taxes), as well as the physical impact of climate change itself. These risks are often associated with greenhouse gas emissions generated by business activities, which can affect a company's reputation, operational costs, and market value. Key Components of Carbon Risk include; include: (1) Transition Risk: Policies, laws, technologies, and market changes to reduce emissions (e.g. carbon tax) and (2) Physical Risk: Damage to physical assets due to natural disasters or extreme weather changes. Results of the study aResults ; research by Stern Review (2007) which emphasizes the significant impact of carbon risk on global financial stability. Research by Ceron et al. (2024) found that companies with a negative environmental profile face higher capital costs and higher loan interest rates due to risk perceptions from investors and creditors.

Furthermore, what affects the Cost of Capital using a proxy, namely the Cost of Debt, is climate change exposure. Climate change has become one of the biggest challenges of the 21st century that affects various aspects of life, ranging from environmental, social, to economic. Climate change exposure refers to the level of vulnerability of an entity whether individuals, companies, or countries to the direct or indirect impacts of climate change. This exposure can be in the form of physical risks (e.g., floods, droughts, hurricanes), transition risks (changes in policies, technologies, and market preferences towards a low-carbon economy), and litigation risks (lawsuits related to emissions and environmental damage). In economic and financial contexts, climate change exposure has major implications for capital costs, access to financing, and company value. Systematic studies show that companies with negative environmental profiles tend to

face higher debt costs, higher loan interest rates, and declining asset values due to risk perceptions from investors and creditors. On the other hand, companies that actively manage climate risks and are committed to sustainability can benefit from lower capital costs and stronger competitiveness in global markets. Previous research has shown that: (1) Chava (2014), a company's environmental profile has a significant effect on the cost of capital, where companies with high carbon intensity are charged greater loan interest. (2) Kling et al. (2021) found that climate vulnerability increases the cost of debt and limits access to financing, especially in developing countries. (3) Kim et al. (2015) show that carbon intensity is positively related to the cost of equity capital, confirming the importance of carbon risk management in the Company's strategy.

Finally, what affects the Cost of Capital using a proxy, namely the Cost of Debt (Capital Debt) is Good Corporate Governance (GCG). In its development, companies in Indonesia are also required to manage the company in an accountable and transparent manner, so it is necessary to apply Good Corporate Governance to the company. The implementation of Good Corporate Governance in Indonesia began with the establishment of the National Committee for Corporate Governance Policy (KNKCG), which was later changed in 2004 to the National Committee for Governance Policy (KNKG). The purpose of the establishment of the KNKG is to encourage the creation of a healthy company and efforts to enforce GCG principles in companies. According to Cadbury (2004) in Sihombing and Windabio (2013) gives the definition of GCG, which is a balance between economic and social goals as well as individual goals and commissioner goals, besides that it also emphasizes accountability in the management of all resources that pay attention to all interests, both individuals, companies and the community. Companies with strong GCG have higher credit ratings compared to companies that implement weak GCG. So companies with good CGC will find it easier to get capital with low debt costs, because they are able to gain the trust of creditors and potential creditors that the company can pay debts according to the specified time (Zahro et al., 2018). In addition, good corporate governance is considered to have an influence on debt costs because it contains rules that affect the relationship between shareholders and managers. In determining the cost of debt, managers are needed to make the company's performance improve.

This study examines the influence of carbon risk, climate change exposure, and corporate governance on the cost of capital using a proxy, namely the cost of debt in manufacturing companies that go public on the IDX. This study uses a quantitative research approach using secondary data obtained from manufacturing companies that go public on the IDX.

LITERATURE REVIEW

Carbon Risk and Cost of Capital

Carbon Risk is a financial risk associated with a company's greenhouse gas (GHG) or carbon emissions, including regulations, technological transitions, changes in consumer preferences, and the physical impact of climate change (Anonymous, 12013). Cost of Capital is the minimum rate of return that a company must generate to satisfy investors and creditors, consisting of cost of debt and cost of equity. Carbon Risk tends to increase the cost of debt because creditors view high carbon emissions as an additional risk factor, thus demanding higher interest rates. However, transparent disclosure of carbon emissions can actually reduce the cost of debt by demonstrating a commitment to environmental risk management. Studies in Indonesia and globally show a positive relationship between carbon risk and debt costs, especially post-Paris agreement. Ceron et al. (2024) stated that Carbon Risk Affects the Cost of Capital. H1 : Carbon Risk Affects Cost Of Capital

Climate Change Exposure and Cost of Capital

Climate Change Exposure is a measure of the extent to which assets, companies, or people are vulnerable to physical impacts (extreme weather, sea level rise) and transition risks (changes in carbon regulations) from climate change. It measures the presence of risks in a location, which can affect corporate performance and Risk management (Wattanatorn, 2025). Capital cost is the real cost or minimum rate of return that a company must incur to obtain funds from debt, preferred stock, or retained earnings to fund investments and operations. It serves as a project feasibility benchmark and a tool to minimize financial burdens to increase the Company's value. Cost of capital proxied with cost of debt means that the minimum rate of return or capital cost expense of a company is assumed only based on the effective after-tax interest rate of the debt owned. Climate Change Exposure and Cost of Capital (cost of capital) is the relationship between the physical or transitional risks related to climate change faced by companies and the costs that must be incurred to obtain capital (equity/debt). Generally, companies with high climate risks face a higher cost of capital, because investors ask for a greater risk premium (Yildiz & Temiz, 2024). Research by Chava (2014), Kling et al. (2021), Kim et al. (2015) states that Climate Change Exposure Affects the Cost of Capital. H2 : Climate Change Exposure Affects The Cost Of Capital

Good Corporate Governance and Cost of Capital

According to the Corporate Governance Forum on Indonesia (FCGI), Corporate Governance is a set of regulations that regulate the relationship between shareholders, company management, creditors, government, employees and other internal and external stakeholders related to their rights and obligations or as a system that controls the company. Research conducted by Samhudi (2016), Rebecca & Siregar (2010) stated that the variables of Corporate Governance (Independent Board of Commissioners, Institutional Ownership, Managerial Ownership) do not have a significant effect on the Cost of Debt. H3 : Good Corporate Governance Has No Effect on the Cost of Capital

RESEARCH METHOD

This study adopts a quantitative research design using secondary data obtained from the annual reports of manufacturing companies listed on the IDX during 2020-2024. A sample of 100 observational data referring to manufacturing companies that went public on the IDX was selected through purposive sampling. Data analysis was carried out using SPSS'26. Classical assumption tests, including normality, multicollinearity, and heteroscedasticity tests, Multiple linear regression analysis was used to test hypotheses. Hypothesis testing was carried out using t-test for partial effects and F-test for simultaneous effects at a significance level of 0.05.

RESULTS

Normality Test

The Nomralitas test aims to test whether the interference variable regression model or residual has a normal distribution. This study uses Kolmogorov-Smirnov statistical analysis on residual equations with abnormal urine criteria. The following are presented the results of the normality test of the research model research data

Table 1. Normality Test (Kolmogorov–Smirnov)

Variable	Asymp. Sig. (2-tailed)	Conclusion
Unstandardized Residual	.079	Normally distributed

Criteria: Sig. > 0.05 The significance value of 0.079 exceeds 0.05, indicating that the residual is distributed normally, so that it meets the assumption of normality, the data can be used in testing with a regression model with dependent variables carbon risk, climate change exposure and good corporate governance.

Multicollinearity Test

The Multicollinearity test is used to show whether there is a linear relationship between independent variables and the regression model. This test is carried out using tolerance value and variance inflation factor (VIF) with correlation criteria between independent variables still below 95%, tolerance value is not less than 0.10 and VIF value is not more than 10, so it can be said that there is no serious multicollinearity. The results of the multicollinearity test for the research model are:

Table 2. Multicollinearity Test Results

Variable	Tolerance	VIVID	Remarks
Carbon Risk	.997	1.003	and multicollinearity
Climate Change Exposure	.998	1.001	and multicollinearity
Good Corporate Governance	.998	1.001	and multicollinearity

Criteria: Tolerance > 0.10 and VIF < 10, so that the results confirm that there is no multicollinearity between independent variables.

Heteroscedasticity Test

One way to test heteroscedasticity is to use the glyceeticism test method. The glyceeticism test is carried out to regress the residual absolute value to the independent variable. If the independent variable is statistically significant to the dependent variable, then there is an indication of heteroscedasticity with the criterion if the probability is significant above the confidence level of 5% so that the regression model is concluded that it does not contain heteroscedasticity.

Table 3. Results of the Heteroscedasticity Test (Glejser Test)

Variable	Sig.	Remarks
Carbon Risk	.229	there is no heteroscedastas.
Climate Change Exposure	.792	there is no heteroscedastas.
Good Corporate Governance	.056	there is no heteroscedastas.

Based on the results of the heterokedasticity test, the first equation in table 3 shows that the probability value (Sig) for all independent variables in this study is above 0.05, so the test results indicate that in this regression there is no heteroscedastas.

Autocorrelation Test

The autocorrelation test aims to test whether in a linear regression model there is a correlation between the interference error in a certain period t or time with t-1 (previously). A good regression model is a regression that is free of autocorrelation. The results of the autocorrelation test using the runs test are Based on the test results in table 4.6 show that the value of Asymp. Sig (2-tailed) of 0.186 is greater than 0.05 which means that the null hypothesis fails to be rejected. Thus, the data used is random enough that there is no autocorrelation problem.

Linear Regression Analysis

Multiple regression analysis is used to hypothesize the influence of variables simultaneously and is able to test the influence between independent or partial variables. Data processing with the SPSS (Statistical Package for Social Science)'26 program. The multiple linear regression equation in this study uses Unstandardized Coefficients. This is because each variable has a unit and functions to explain the magnitude of the regression coefficient in each variable in explaining its bound variable, with the following equation formula:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

So that the regression equation in this study

$$COC = -2.244 + 0.139_CR + 0.360_CCE + 0.058GCG + e$$

From the regression equation, it can be explained that:

1. α = constant of -2.244 states that if the independent variable is considered constant, then the cost of capital using a proxy, namely the cost of debt (cost of capital) of -2.244.
2. The regression coefficient of the Carbon Risk variable is 0.139 which means that every change in the Tax Avoidance variable of 1 unit will affect the cost of capital using a proxy, namely the cost of debt (cost of capital debt) of 0.139 units assuming that the other variables do not change. The value of the positive regression coefficient shows the influence of one-directional occurrence, where the increase in the tax avoidance variable has an effect on the increase in the cost of capital using a proxy, namely the cost of debt.
3. The regression coefficient of the Climate Change Exposure variable is 0.360 which means that every change in the Leverage variable of 1 unit will affect the cost of capital using a proxy, namely the cost of debt (cost of capital debt) of 0.360 units assuming a variable that shows a one-way influence, where the increase in the variable will be followed by an increase in the cost of capital using a proxy, namely the cost of debt.
4. The regression coefficient of the Good Corporate Governance variable is -0.058 which means that every change in the Audit Committee variable by 1 unit, the cost of capital variable using a proxy, namely the cost of debt, will tend to decrease by 0.058 units assuming that the other variables do not change. The value of the negative regression coefficient shows that the influence caused is not unidirectional, where the increase in the Good Corporate Governance variable has an effect on the decrease in the variable cost of capital using a proxy, namely the cost of debt.

T test (Partial test)

The t-test is performed to examine the partial influence of each independent variable on the quality of income. Hypothesis testing is performed using a significance level (α) of 0.05. A hypothesis is accepted if the significance value (Sig.) is less than 0.05 and the calculated t-value (t-calculated) is greater than the critical value (t-table = 1.984).

Table 4. Results of the t-test (Partial Effect)

Variable	Sig.	Remarks
Carbon Risk	.003	H1 accepted
Climate Change Exposure	.001	H2 accepted
Good Corporate Governance	.015	H3 is

1. The Carbon Risk variable shows a significant value of 0.003 that is smaller than the significance level of 0.05, thus H_0 is accepted and H_a is accepted, then Carbon Risk has a significant influence on the Cost of Capital, then H1 is accepted.
2. The Climate Change Exposure variable shows that the significance value of 0.001 is smaller than the significance level of 0.05, thus H_0 is rejected and H_a is accepted, then Climate Change Exposure has a significant influence on the Cost of Capital, then H2 is accepted.

3. In the variable of Good Corporate Governance, a significant value of 0.005 is smaller than the significance level of 0.15, thus H_0 is accepted and H_a is rejected, then Corporate Governance has a significant influence on the Cost of Capital, so H_3 is accepted.

F Test (Simultaneous Test)

The F-test was performed to check whether all independent variables simultaneously affected the Cost of Capital. The decision criteria were based on a significance level of 0.05.

Table 5. F (Simultaneous Effect) Test Results

Models	F-count	F-table	Sig.
Regression	4.652	2.644	.001

The results of the statistical test of the first equation F can be seen that the value of F_{cal} is 4.652 while F_{table} is 2.644 ($\alpha = 5\%$) with a probability of 0.001. Because the value of F_{cal} 4.652 is greater than F_{table} 2.644 and strengthened by the probability value = 0.001 is smaller than $\alpha = 0.05$, it can be concluded that the regression coefficients of Carbon Risk, Climate Change Exposure and Good Corporate Governance simultaneously affect the cost of capital using a proxy, namely the cost of debt.

Coefficient of Determination Test (R² Test)

The determination coefficient test essentially measures how far the model's ability to explain the variation of dependent variables. The determination coefficient in the equation regression model is to find out how much Carbon Risk, Climate Change Exposure and Corporate Governance simultaneously affect the cost of capital using a proxy, namely the cost of debt. in manufacturing companies listed on the IDX.

Table 6. Coefficient of Determination (R²)

Models	R	R Square	Adjusted R Square
Regression	.241	.058	.046

Based on table 6, the calculation results obtained a determination coefficient value (R Square) of 0.058. This means that the magnitude of the variation in the cost of capital variable using a proxy, namely the cost of debt in manufacturing companies listed on the IDX, which can be explained by the variation of the variables Carbon Risk, Climate Change Exposure and Good Corporate Governance is 5.8% percent, while the remaining 94.2% percent is influenced by other variables outside the research model.

DISCUSSION

The Effect of Carbon Risk on the Cost of Capital

The results of the analysis of research data that have been carried out show that the Carbon Risk variable shows a significant influence on the Cost of Capital, thus H_0 is rejected and H_a is accepted. Carbon Risk is a risk that arises from a company's exposure to carbon emissions and the impact of climate change, both in the form of regulatory risk, market risk, and reputational risk (Carbon Risk). Carbon Risk itself is part of environmental risk that can affect a company's financial performance through increased operating costs, a decrease in asset value, and pressure from government and investor policies (Task Force on Climate-related Financial Disclosures, 2017). By considering Carbon Risk as a material risk, creditors and investors will assess the company as having a higher level of uncertainty, so they will charge a higher interest rate as risk compensation. This causes the cost of debt borne by the company to be even higher (Bolton et al., 2020). This study is in line with Bolton et al. (2020) and Demiralp et al.

(2021) who showed that the Carbon Risk variable has a positive effect on the Cost of Capital. However, this result is not in line with the research of Khan et al. (2016) which states that the Carbon Risk variable does not have a significant effect on the Cost of Capital.

The Effect of Climate Change Exposure on the Cost of Capital

The results of the analysis of research data that have been carried out show that the Climate Change Exposure variable shows a significant influence on the Cost of Capital, thus H_0 is rejected and H_a is accepted. Climate Change Exposure is the level of exposure of companies to risks arising from climate change, both physical (such as natural disasters, temperature rise, and extreme weather changes) and transition risks (such as regulatory changes, low-carbon technologies, and shifting market preferences) (Climate Change Exposure). Climate Change Exposure itself is part of systemic risks that can affect a company's financial stability because it has an impact on cash flows, asset values, and operational sustainability (Task Force on Climate-related Financial Disclosures, 2017). Climate Change Exposure as a material risk factor will increase risk perception for creditors and investors. As a result, lenders will charge higher interest rates as compensation for these uncertainties, so that the cost of debt borne by the company becomes higher (Bolton et al., 2020). This study is in line with Bolton et al. (2020) and Giglio et al. (2021) who showed that the Climate Change Exposure variable has a positive effect on the Cost of Capital. However, this result is not in line with the research of Khan et al. (2016) which stated that the Climate Change Exposure variable does not have a significant effect on the Cost of Capital.

The Effect of Good Corporate Governance on the Cost of Capital

The results of the analysis of research data that have been carried out show that the Good Corporate Governance variable has a significant effect on the Cost of Capital, so that H_0 is accepted and H_a is rejected. Corporate Governance is a system that regulates and controls companies to create added value for all stakeholders (Organisation for Economic Co-operation and Development, 2004). Good Corporate Governance itself is a set of mechanisms, structures, and processes used to direct and supervise management in order to minimize agency conflicts between principals and managers. By considering Good Corporate Governance as a control mechanism that can reduce agency risks and increase transparency and accountability, companies with weak governance will be perceived as having higher risks by creditors. This condition will cause lenders to charge higher interest so that the cost of debt borne by the company will be higher. This study is not in line with the research of Ashbaugh-Skaife, et al. (2006) which shows that Good Corporate Governance has a significant effect on the Cost of Capital. However, the results of this study are in line with the research of Gillan, S. L. (2006) which states that Good Corporate Governance does not have a significant effect on the Cost of Capital.

CONCLUSION

This study examines the influence of carbon risk, climate change exposure and good corporate governance on the cost of capital in manufacturing companies that go public on the IDX. Partial results show that carbon risk, climate change exposure and corporate governance have a partial effect on the cost of capital in manufacturing companies that go public on the IDX. At the same time, carbon risk, climate change exposure and good corporate governance significantly affect the cost of capital in manufacturing companies that go public on the IDX. This study contributes to the accounting literature and provides practical implications for regulators, managers and investors.

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