R&D Intensity, Industrial Sensitivity, and Carbon Emissions Disclosure in Indonesia

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Abstract: This study examines the effect of R&D intensity and the type of industry on carbon emission disclosure (CED). The measurement of CED employs an index developed by Choi et al. (2013) based on the carbon disclosure project (CDP). The final data from this study comprise 264 company observations during the period of 2015–2018, sourced from a database of companies listed on the Indonesia Stock Exchange. The data were tested using ordinary least squares multiple regression. Results revealed that companies with lower R&D funding tend to disclose higher carbon emissions than those with higher R&D funding. Furthermore, companies whose operations are sensitive to carbon pollution are likely to disclose higher carbon emissions and vice versa. The findings indicate that there are more sensitive companies trying to fulfill their legitimacy to the public (stakeholders) compared to insensitive companies.

Keywords: carbon emissions disclosure, industrial sensitivity, legitimacy theory, R&D intensity, type of industry.

INTRODUCTION

At present the environmental issue is a very important topic of discussion. One of them is the topic of climate change, where the company is the biggest contributor to carbon emissions (Setiawan & Iswati, 2019; Daromes et al., 2020). Based on data released by the Global Carbon Project that during 2018, there was an increase in carbon dioxide emissions around the world around 2.1 percent, of which there were 37 billion tons of carbon dioxide in 2018 (CNN Indonesia, 2019). Thus, it can cause harm to humans and nature itself (Liu et al., 2015). This makes doubts that business plays an important role in delivering environmental performance results through production, operations and efforts to achieve product innovation and more sustainable practices (Praswati & Aji, 2017; Cherrafi et al., 2018; Fernando et al., 2019; Wong et al., 2020).

To reduce the rate of environmental damage, companies must reconsider their business practices by finding solutions to environmental damage problems and environmental externalities arising from company operations (Unerman et al., 2018; Eidelwein et al., 2018). Companies are required to design activities that show environmental concern, for example by implementing environmental management systems, pollution

prevention, re-use and recycling, energy efficiency, and carbon management (Lee & Min, 2015; Lindrianasari et al., 2018; Evana et al., 2019). Kemp & Pearson (2007) refer to innovative programs related to environmental management as eco-innovation that is defined as the production, exploitation of a product, production process, management or business methods that are new to the organization and that produce, throughout its life cycle, in reducing environmental risk, pollution and other negative impacts from resource use (García-Granero et al., 2020). The company must carry out environmental innovation by adopting methods to achieve environmental performance including the reduction of carbon emissions and a superior economy (Dangelico & Pujari, 2010; Costantini et al., 2017; Fernando & Wah, 2017). Choudhury et al. (2013) suggested in their research that companies need to hold open dialogue and communication between stakeholders to develop cooperation that can help companies develop new green products. These studies show the efforts made by companies to reduce the rate of environmental damage.

Some manufacturing has made environmental innovations by trying to develop green products or production that are supported by increased operational and energy efficiency (Dangelico, 2016; Xie et al., 2019). These environmental innovations are closely related to the company's investment in Research and Development (hereinafter referred to as R&D). Fu et al. (2020) provide empirical evidence that Corporate Social Responsibility (hereinafter referred to as CSR) is positively related to R&D intensity. The findings of Fu et al. (2020) are in-line with the results of Lee & Min (2015); Cheung et al. (2020); Engida et al. (2020) find related variables when studying the impact of CSR or environmental performance and other variables.

Gutowski et al. (2005) explain that the company's current environmental performance is used as a measure of the company's success in reducing its impact on the environment. Environmental performance referred to here includes efficient use of resources, reduction of waste and energy consumption, and reduction of environmental risks including the reduction of carbon emissions (Aragón-Correa et al., 2008). Therefore, it is necessary to do innovative actions, using environmentally friendly technology to reduce pollution and carbon emissions (Lee & Min, 2015). The relationship between the quality and volume of carbon emission disclosure (CED) was also found to be significant in British Higher Education Institutions (HEIs) (Saha et al., 2019). The study of Saha et al. (2019) at Higher Education Institutions (HEIs) shows that CED needs to be clearly disclosed to HEIs. Although there are definitely differences with profit-seeking companies, CED must be seen in the education industry disclosers. Saha et al. (2019) suggest that future research should investigate the impact of CED volume and quality on reputation.

The long-term commitment of the company also needs to be done to adopt eco-innovation, especially in the form of research and development (R&D), which aims to identify production, environmental technology, improve energy efficiency and at the same time lead to the innovation of environmentally friendly products (Sambasivan et al., 2013). Because based on RBV theory, to maintain the natural environment and achieve long-term success the company needs to accumulate resources and manage capabilities with a long-term focus rather than a short-term focus (Wu et al., 2017; Lee et al., 2020). This theory highlights the relationship between environmental strategies, green capabilities, and competitiveness at the company level (Dangelico et al., 2017). As revealed by Lee & Min (2015), R&D activities in the environment seek to increase productivity and efficiency as well as reduce costs and environmental impacts, such as reducing energy consumption and carbon emissions reflected in CED. For companies that actively conduct R&D related to the environment, it becomes a positive signal for the market when they disclose this activity to the public. Therefore, the higher the intensity of R&D, the higher the tendency for companies to disclose carbon emissions. It is also a company as a form of corporate response to legitimacy, and consequently the company will get a positive response from stakeholders.

Studies by Ikram et al. (2019) show a positive relationship between R&D expenditure and environmental management systems, but R&D and pollution emissions are negatively related (Alam et al., 2021). Yu et al.

(2020) prove that CSR is positively related to R&D. Meanwhile, Padgett & Galan (2010) found that R&D intensity had a positive effect on CSR and that the relationship was significant in the manufacturing industry, whereas in the non-manufacturing industry it had no effect.

Referring to the research of López-Gamero et al. (2009), investment and the intensity of environmental problems will have an impact on the application of proactive environmental management to help improve the company's environmental performance. R&D activities need to be carried out in response to environmental issues, especially regarding carbon emissions. Industries that are intensive or sensitive to the environment are required to have higher R&D activities to reduce carbon emissions (Padgett & Galan, 2010), so that sensitive companies are under greater pressure (Choi et al., 2013). The positive relationship between the intensity of R&D and CED indicates the company's efforts in environmental responsibility, by reducing the level of environmental problems, including ozone depleting chemicals, substantial emissions and climate change reflected in the CED.

Research on the disclosure of carbon emissions as a development of environmental performance is still small and the results are still inconclusive. This research bridges the relationship by including industry type variables to see whether when an intensive company produces carbon emissions will carry out activities in an effort to reduce carbon emissions which is reflected in the disclosure of carbon emissions. A study conducted by Choi et al. (2013) explains that there are two types of industries namely intensive and non-intensive in producing carbon emissions. Intensive industries are assumed to have a greater responsibility for the environment than non-intensive industries (Brammer & Pavelin, 2006).

On the other hand, non-intensive companies are considered to be less sensitive to carbon emissions, such as banking, property development, and retail (Choi et al., 2013) so, that they have less R&D activities and less disclosure of carbon emissions. The findings of Choi et al. (2013); van de Burgwal & Vieira (2014) found that the type of industry influences the disclosure of carbon emissions.

This study offers the concept of R&D intensity to further investigate the company's environmental activities. Using industry type variables, this study predicts that environmentally sensitive companies will allocate higher R&D funds to produce sustainable and environmentally friendly products to participate in reducing carbon emissions. Whereas companies that are not sensitive may undertake lower R&D activities in line with the negative impact the company has on the environment. Choi et al. (2013) found empirical evidence that industry type influences Carbon Emission Disclosure (hereinafter referred to as CED), while Borghei-Ghomi & Leung (2013) found no effect. Because only a few specifically studied the direct impact of R&D on carbon emissions, this study aims to study the effect of R&D intensity on CED by including industry type as a moderating variable as a development from previous research that generally discusses environmental performance.

METHODS

The sampling method in this study is all the population of companies that are located in the Indonesia Stock Exchange. The sample selection criteria used were all companies that had the required data in this study. The data collection method uses the hand-collected method, through tracking company annual reports obtained on the company's own website and / or the Indonesia Stock Exchange website. Observations made in this study for the 2015-2018 period. Companies that have R&D data and disclose carbon emissions in financial reports during the study period are all objects of research. The analysis technique used in this research is Moderate Regression Analysis, for testing Hypothesis 1 and Hypothesis 2.

The intensity of research and development (R&D) can be measured by dividing the total R&D expenditure by total sales (Padgett & Galan, 2010). However, in this study the intensity of R&D refers to the research of Hubbard et al. (2017) which divides the research and development burden on the total assets of the company.

$$R\&D = \frac{R\&D\ Expense}{Total\ Assets}$$

Industrial types are divided into two categories namely sensitive and insensitive industries. Sensitive industries, those industries whose operations produce carbon emissions, vice versa. The type of industry is measured by a dummy variable where the industry which is intensive in producing carbon emissions is given a value of 2 while the non-intensive industry is given a value of 1.

Table 1 Carbon Emission Disclosure Index

Category	Item	Description
Climate change	CC1	Assessment/description of risks related to climate change and the actions taken or actions to be taken to address the risks.
	CC2	Current (and future) assessment/description of the financial implications, business implications, and opportunities of climate change
Calculation of GHG Emissions	GHG1	Description of the methodology used to calculate (calculate) GHG emissions (Greenhouse gases)
	GHG2	Existence of verification from external parties in measuring the amount of GHG emissions
	GHG3	Total GHG emissions produced
	GHG4	Disclosure of scope 1 and 2, or scope 3 of GHG emissions
	GHG5	Disclosure of GHG emission sources
	GHG6	Disclosure of facilities or segments of GHG
	GHG7	Comparison of GHG emissions with the previous year
Energy consumption	EC1	Total energy consumed
	EC2	Quantification of energy used from renewable sources
	EC3	Disclosures by type, facility or segment
GHG costs and reductions	RC1	A detailed plan or strategy to reduce GHG emissions
	RC2	The specifications of the target level / level and year to reduce GHG emissions
	RC3	Emission reductions and costs or savings achieved today as a result of carbon emission reduction plans
	RC4	Costs of future emission costs calculated in capital expenditure planning
Accountability for Carbon Emissions	ACC1	Indications from the committee of the committee responsible for actions related to climate change
	ACC2	Description of the mechanism by which the board reviews the company's progress on climate change

Source: Choi et al. (2013)

Carbon emissions disclosure is measured using an index developed by Choi et al. (2013) as shown at Table 1. The assessment is done by checking the index on the Carbon Disclosure Project (CDP) information request sheet. If the company discloses the items as specified, a score of 1 will be given, whereas if the specified item is not disclosed, it will be given a score of 0. If the company discloses in full, a score of 1 will be obtained and

then the company's total CED value is divided by the total CED index (i.e. 18 points), so that the final value for this variable will be obtained by adopting a ratio.

The analysis technique in this study began with descriptive analysis and statistical analysis. Descriptive statistical analysis is used to provide an overview of the research variables regarding the phenomenon or characteristics of the data. Then the classic assumption test is performed to ensure that the data used is feasible using OLS test equipment.

RESULTS AND DISCUSSION

The final data of this study were 264 companies in the 2015-2018 observation period. This research has not been able to enter data in 2019 due in April 2020 the data is not available. Existing company data is processed using multiple linear regression because it suffices for large sample requirements. Table 2 shows the descriptive statistics of the data used in this study.

Table 2 shows the mean values for costs associated with research and development in reducing carbon emissions released by companies. Value of 0.3% shows the comparison of R&D costs with the total assets owned by the company. This data shows the low intensity of companies in conducting research and development related to carbon reduction. The low value of the intensity of research and development can also be due to the lack of detail in disclosing research and development funds related to carbon emissions reductions. This is due to the absence of mandatory rules that require companies to disclose information on carbon emissions, environmental costs, and the like (Lindrianasari et al., 2018). In research conducted by (Lindrianasari et al., 2018) found low disclosure by companies in Indonesia related to costs relating to environmental transactions compared to other countries in the ASEAN region (i.e. Malaysia and Thailand).

Table 2 Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
RnD_Intensity	0	0.34	0.0036	0.03095	264
Industry	1	2	1.822	0.38326	264
CED	0.09	1.55	0.5487	0.36709	264
Valid N (listwise)					264

Table 3 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.234[a]	0.055	0.048	0.21776
a. Predictors: (Constant), Industry, RnD_Intensity				
b. Dependent Variable: CED				

Table 4 Model Testing

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.72	2	0.36	7.592	.001[b]
	Residual	12.376	261	0.047		
	Total	13.096	263			
a. Dependent Variable: CED						
b. Predictors: (Constant), Industry, RnD_Intensity						

The results of the model summary (Table 3) show the value of the relationship of this research variable at a value of 0.234 This figure shows that the independent variable of this study has a relationship of 23.4% on the dependent variable. For the research model, a score of 0.001 (<0.05) is obtained which indicates that the research model is good and can be continued to test the hypothesis (see Table 4).

There are two hypotheses that were built in this study. The first hypothesis states that R&D intensity has a positive effect on Carbon Emission Disclosure (CED). Meanwhile, the second hypothesis states that industry type has a positive effect on Carbon Emission Disclosure (CED). Table 5 shows the hypothesis testing. Each will be explained below with the results of the statistical test as follows.

Table 5 Hypothesis Testing

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.088	0.065		1.345	0.18
	R&D Intensity	-0.08	0.435	-0.011	-0.184	0.854
	Industry	0.137	0.035	0.235	3.896	0.000

The results of testing the first hypothesis are in line with the research findings of Cole et al. (2005) who found that R&D is negatively related to pollution emissions. Statistical test produces a t-value of -0.184 with a significance of 0.854. This value indicates that companies that have low intensity of allocation of R&D funds tend to disclose information on higher carbon emissions compared to companies with higher intensity of R&D fund allocation. These results also indicate that companies with R&D intensity in reducing carbon emission levels tend to try to provide information on higher carbon emissions, vice versa. The significance value of 0.854 indicates that there is no significant influence on the negative effect between R&D intensity on Carbon Emission Disclosure (CED). These results also at the same time place the first hypothesis of this study that cannot be supported.

However, the truth of the disclosure of carbon emissions can be trusted? Until now, researchers have not been able to assess the extent to which voluntary disclosure can be verified in honesty so as to guarantee the company's credibility in the long run. The study by Callery & Perkins (2021) explains that the lack of audit oversight and evaluation of company disclosures has created incentives to engage in misleading disclosure modes. All this time, all disclosures reported by the company have just been accepted by the market, without the power to trace the truth of disclosures released by the company. This explanation is in line with the signaling theory introduced by Ross (1977). Where managers have the urge to signal the information they have. This information is expected to provide managerial incentives and financial structure when information signals are released to the market, especially when companies are faced with information that is less profitable on the other side (in this case the low intensity of R&D).

Industries whose operations are sensitive to the creation of carbon pollution are thought to have a big push to disclose carbon emissions. The test results for this hypothesis indicate a t-value of 3,896 with a significance of 0,000. This value indicates that companies that in their activities will produce high carbon pollution tend to disclose information on higher carbon emissions, compared to companies that are not sensitive. This result also shows that sensitive companies try to fulfill their legitimacy to the community. This result also supports the second hypothesis of this study states that the type of industry has a positive effect on Carbon Emission Disclosure.

The results of this study support studies conducted by previous researchers. Choi et al. (2013); van de Burgwal & Vieira (2014) are some researchers who find that industries that are sensitive to the environment tend to disclose higher carbon emissions. This finding is also in line with the theory of legitimacy which demands a match between the company's activities and the community's needs. If the company which in its activities produce high carbon pollution, the environment around it will demand the activities of companies that can reduce the pollution (Hirunyawipada & Xiong, 2018). The company has responded to this demand through disclosure, one of which is related to the disclosure of carbon emissions.

CONCLUSION

This study concludes that companies with lower intensity of R&D fund allocation tend to disclose information on higher carbon emissions compared to companies with higher R&D fund allocation intensity. This finding can be explained by using the basic assumptions offered by the signaling theory in which managers have the urge to give a signal of positive information that they have to cover up other information that is less profitable for the company. The information released is expected to provide managerial incentives and financial structure to the company. In addition, this study also concludes that companies that are sensitive to produce carbon pollution in operational activities tend to disclose higher carbon emissions, vice versa. These results indicate that sensitive companies try to fulfill their legitimacy to the environment. This research has taken great care in collecting data, especially those related to voluntary disclosure of carbon emissions. However, as some researchers are concerned in the field of voluntary disclosure studies, as long as there are no audits and assessments or disclosures, companies may choose misleading disclosure modes. This is a major limitation of this type of research that is very difficult for all researchers to avoid. This research offers important implications for further researchers, namely to always side the numbers of financial statements that have been audited by reputable public accounting firms, in any research related to any voluntary disclosure. Because, if the voluntary disclosure made by the company has a biased variance, then the resulting research still contains reliable information on the audited financial statement figures.

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