Do Carbon Exchanges Make a Difference to Carbon Disclosure and Performance? Evidence from Indonesia

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Article

Do Carbon Exchanges Make a Difference to Carbon Disclosure and Performance? Evidence from Indonesia

Ayu Oktaviani [1,*], Syahrial Shaddiq [2] and Novika Rosari [3]

[1] Department of Accounting, Universitas Lambung Mangkurat, Banjarmasin, 70123, Indonesia
[2] Department of Economics and Development Studies, Universitas Lambung Mangkurat, Banjarmasin, 70123, Indonesia
[3] Department of Accounting, Universitas Lambung Mangkurat, Banjarmasin, 70123, Indonesia
* Correspondence: aoktaviani@ulm.ac.id

Abstract

The presence of the Indonesia Carbon Exchange (ICE), puts pressure on management to carry out its active role in reducing the potential of climate change through business strategies such as disclosure and improving carbon performance. This study seeks to prove the significant difference in carbon disclosure and performance after the launch of the ICE, as well as to reviews the profound differences in the increase in carbon disclosure and performance in the high and low polluting sectors in the population of companies listed on the Indonesia Stock Exchange for the 2022 and 2024 periods. The two research models used in formulating the results are the Wilcoxon Test and the Diference-in-Diference Model. The results of this study indicate a significant difference in carbon disclosure and performance after the launch of ICE, which illustrates the changing dynamics of environmental regulations encouraging companies to improve transparency and corporate carbon performance in an effort to maintain their legitimacy. This study show there was no significant difference in the comprehensiveness of carbon disclosure or the improvement in carbon performance between high and low-polluting sector after the launch of ICE.

Keywords: carbon disclosure; carbon performance; carbon accounting

1. Introduction

Climate issues are a topic that is often discussed and also a public consideration today [1,2]. This is inseparable from the increasingly massive disasters experienced by the community which is a signal that the current climate conditions are not good, such as droughts, floods, landslides, sea level rise, to the increase in the earth's surface temperature which has reached 1.36 degrees Celsius above the pre-industrial average temperature [3,4]. If the current environmental problems are not immediately and appropriately addressed by all levels of society, it will cause an even greater climate threat. In its report, IPCC [5] explained that if the earth's surface temperature rises to a point of 2 degrees Celsius above the pre-industrial average temperature, it will bring potential climate disasters that can disrupt life on earth such as the potential for sea level rise, the extinction of several species of living things, the spread of invasive species (pests and diseases), and various other climate risks. The magnitude of the threat from climate change has fostered concern and efforts from policy makers in dealing with the growing potential for climate change [6], namely by reducing the amount of emissions (also known as carbon emissions) which is the main factor in this environmental phenomenon [7].

One of the efforts of policymakers in various parts of the world can be seen from the international commitments or agreements, namely the Kyoto Protocol formulated by the United Nations Framework on Climate Change Conference (UNFCCC) [8,9]. Developed and developing

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countries have ratified the Kyoto Protocol to provide standards or guidelines for companies and other organizations in efforts to reduce Greenhouse Gas (GHG) emissions which are the main factors in climate change [10,11]. In this international agreement, there is one market mechanism that can accommodate countries that ratify this agreement by limiting or reducing the amount of GHG emissions released, this mechanism is referred to as carbon trading [12]. Carbon trading is a market-based approach that allows companies and countries to trade carbon permits or credits [13]. One of the ways governments or related agencies regulate and control emissions in this carbon trading mechanism is through a cap-and-trade system, where emission limits (caps) are set for all industries [14–16]. Companies can sell carbon incentives when the emissions they produce fall below a set threshold (cap) and buy them when the emissions they produce exceed the set limit [17,18]. Another system that can be applied in carbon trading is carbon offset, where offsets are carbon credits generated through corporate projects in reducing or absorbing carbon emissions such as reforestation and the use of renewable energy [19].

Quoting from data published by the Global Carbon Project [20], Indonesia is the eighth largest emitter-producing country in the world. This encourages governments to address the world's climate problems through the implementation and issuance of legal instruments that oversee environmental protection. The Indonesian government has shown its real action by participating in ratifying the Kyoto Protocol by issuing Law No. 17 of 2004 concerning the Ratification of the Kyoto Protocol to The United Nations Framework Convention on Climate Change [21]. Through Presidential Regulation No. 98 of 2021, the government seeks to regulate the carbon trading system and develop a sustainable green economy [22].

The Indonesia Carbon Exchange was officially launched on September 26, 2023 with the aim of facilitating a carbon trading mechanism between entities. This carbon trading mechanism is an instrument used by the Indonesian government to fulfill the Nationally Determined Contribution (NDC)[22], which is to minimize Greenhouse Gas (GHG) emissions by 26% and with international assistance of 41% by 2030, then achieve the net zero emission target by 2060. The existence of carbon exchanges and various legal instruments related to the environment shows that the increasing expectations of the public, especially the government, for companies to participate in building climate-friendly businesses. Y. He et al. [23] stated that government initiation through environmental policies shows that there are structural reforms in the business environment so as to encourage business people to implement proactive carbon policies. Companies are required to play an active role in mitigating climate change, and controlling GHG emissions that are essential for sustainability [24–26]. If an organization is unable to meet the demands and expectations of the community, it can make the company lose its legitimacy [27]. One of the ways companies maintain legitimacy behind the increasing pressure on management in a proactive carbon policy is to conduct carbon disclosure [4,28].

Carbon disclosure is a collection of quantitative and qualitative information related to a company's carbon emissions, including historical records and future carbon projections [28]. Carbon disclosures containing information on the climate risks incurred by companies can improve corporate governance in terms of risk mitigation, ultimately making a positive contribution to the long-term value of the company [3]. The comprehensiveness of carbon disclosure demonstrates the company's seriousness in meeting the expectations and demands of the community and the government in building a transparent business, regulatory compliance, and commitment to sustainability [29,30]. In terms of legitimacy, Jiang et al. [31] states that the disclosure of environmental activities such as carbon disclosure can maintain, recover and gain recognition or legitimacy from society and the government.

The launch of a carbon exchange makes transparency on carbon information increasingly important in building and increasing the legitimacy of companies. Thus, with the launch of the Indonesian carbon exchange, which is an emissions trading scheme as well as a legal instrument related to the environment, it should encourage management motivation to increase the disclosure of corporate carbon information. The regulatory pressures of this carbon trading scheme suggest that

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the legitimacy of a company increasingly depends on their compliance with a legal framework designed to address environmental degradation and promote more transparent business in the company's operations [32]. Cowan & Deegan [33] who analyzed the response to corporate emissions disclosure with the National Pollutant Inventory (NPI) and NGER Act 2007 regulations in Australia from the perspective of legitimacy theory, showed that there was a significant increase in annual report emissions disclosures which showed that environmental regulations can encourage changes in corporate environmental disclosure practices for the better. However, Luo [25] stated that carbon disclosure will not necessarily foster the legitimacy of the company, in a condition such as the amount of carbon emissions disclosed by the company so high that it can actually threaten the legitimacy of the company [26]. Therefore, in addition to increasing the comprehensiveness of carbon information disclosure, it is also necessary to reduce the amount of emissions disclosed by improving carbon performance [34].

Carbon performance is a managerial success in taking steps or processes in reducing emissions in the air as stated in quantitative information [35]. Houten & Wedari [21] explain that the lower the carbon emissions produced, the better the company's carbon performance. Good carbon performance indicates that the company's efforts in dealing with the environmental impact they generate from their operational activities [36], are acceptable to the public who in recent periods have shown increased concern over environmental conditions. Companies that succeed in meeting public expectations in reducing the negative impact of their operations in the form of emissions that are the source of current climate problems can strengthen their existence in the surrounding environment [37,38]. So that the suitability of corporate activities in the social construct and the demand for more attention to climate problems can build the company's legitimacy [23,39].

The launch of regulations and environmental mechanisms such as carbon exchanges should be responded to by companies to improve their carbon performance, so that the existence of this emissions trading scheme can be used by companies to increase their competitiveness such as selling their carbon credits on the carbon exchange and obtaining economic resources that support the company's activities [36]. Qian [40] mentioned that the reason for the companies with the highest pollution levels registered under the Australian NGER Act during 2009 and 2010 in improving carbon performance was not only due to regulatory compliance, but also to maintain legitimacy in the eyes of the public and stakeholders. Klaus et al. [41] also revealed that the increasing public attention to corporate ESG issues is driving the company's environmental performance, especially in reducing carbon emissions. This shows that there is pressure and demands from various parties such as investors and also the government through its regulations to encourage environmental performance, especially on the better carbon performance of a company. However, the results of research from Shevchenko [42] actually prove that the presence of legal instruments, namely penalties given to a company that violates environmental regulations, does not necessarily encourage them to improve their performance in environmental aspects.

The existence of a research gap in the form of differences in research results that discuss how environmental regulations or mechanisms encourage companies to improve carbon disclosure and performance motivates us to analyze carbon disclosure and performance before and after the launch of the Carbon Exchange in Indonesia. Previous research that often looks at the direct impact of a company's carbon disclosure and performance on the financial aspects of companies in Indonesia [21,22,29,43] or vice versa [28,44,45], is also the motivation for this research to bring a new perspective by analyzing how the launch of a regulation or environmental mechanism such as the launch of the Carbon Exchange in Indonesia encourages companies that listed on the Indonesia Stock Exchange to improve carbon disclosure and performance.

This study also conducted an in-depth analysis to prove that companies included in the High-Polluting Sector have better carbon disclosure and performance after the existence of a carbon trading mechanism through Indonesian Carbon Foam compared to companies that fall into the Low-Polluting Sector category. This is based on a review of previous research such as Peng et al. [46] which reported that Chinese companies that are high-emission industries tend to be better at disclosing

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carbon emissions in terms of quality and quantity. Liu et al. [30] It also proves a similar result where companies with higher carbon emissions have a tendency to disclose more information as part of the process of communicating and maintaining their legitimacy in accordance with institutional pressures. Disclosures made by companies in the industrial intensive sector are also not only symbolic, but also substantial in the company's environmental performance [47,48].

Reviewed from previous research by Shi et al. [49] emissions trading schemes in China have even succeeded in encouraging a reduction in the environmental intensity of high-carbon companies by about 22.4%. This shows that the emergence of emission trading schemes has a different effect on the heavy pollutant industry than on light pollutants, where the pressure exerted by stakeholders through carbon trading schemes will be greater on industrial sectors that produce large emissions than sectors that are classified as smaller in emission production [50,51]. So that the company's response in disclosing and also improving its environmental performance will also differ in each industry [52]. These studies show that the impact of environmental policies will result in different responses between high and low pollution sectors/groups. However, not all studies directly compare high-polluting and low-polluting in the context of ETS or carbon exchanges in developing countries such as Indonesia. This is what drives a more in-depth analysis of carbon disclosure and performance in both sectors.

With this research, it is hoped that policy makers, namely the government, can assess the company's response to the Carbon Exchange policy and assess the government's success in its efforts to target Net Zero Emission. For company management, this research is an illustration for companies of how efforts in carbon disclosure and performance can be a means to achieve legitimacy.

2. Literature Review and Study Hypothesis

2.1. Literature Review

2.1.1. Legitimacy Theory

Legitimacy is the perception or assumption of the conformity of an entity's actions with the system of norms, values, beliefs, and meanings formed or constructed by social constructs [27]. In the business context, Ganda [53] said that the theory of legitimacy highlights that it is important for companies to be responsible in every action in overcoming problems faced by society in addition to considering their own interests. When the company's values are contrary to the social values of the community, it fosters a legitimacy gap that threatens the sustainability of the company [27,48,54]. To respond to this, companies need to take steps to reduce the legitimacy gap that occurs to maintain positive public perception and also public acceptance of the company [29,55]. One of the efforts that companies can make in improving their image and maintaining, restoring and gaining recognition or legitimacy of the company in the minds of the public is through environmental activities [1,56], such as carbon disclosure [6].

Legitimacy theory states that public pressure from various stakeholders in the social, political, and regulatory environment makes companies disclose their information through a disclosure process contained in annual reports [57]. Carbon disclosure is a tool for companies in filling the legitimacy gap arising from changes in social constructs and environmental regulations [34,54]. In addition to disclosure, the company's performance in controlling emissions is also a consideration for management in realizing legitimacy in the surrounding environment. Siddique et al. [4] revealed that carbon performance shows the company's efforts and commitment to maintain legitimacy and to meet the expectations of various stakeholders, especially in realizing the global goal of reducing carbon emissions.

2.1.2. Carbon Disclosure

Carbon disclosure is a collection of quantitative and qualitative information about a company's carbon emissions, including historical records and future carbon projections [1,22]. Although this

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disclosure is still voluntary, the initiation of this reporting actually shows that the company has a positive initiative in building an accountable and environmentally conscious business [58]. Carbon disclosure is considered to be able to describe a company's ability and readiness to deal with climate change issues [7]. Qian & Schaltegger [34] stated that comprehensive carbon disclosure can help increase management's visibility of the company's efforts to reduce the environmental impact caused, namely carbon emissions. Luo [25] explains that the reported information reflects management's commitment to carbon mitigation and allows stakeholders to assess the effects of carbon emissions of environmental conditions around the company. In the context of legitimacy, companies conduct environmental information disclosure in response to pressure from stakeholders to obtain and maintain their operating permits in community environments [7]. Companies that proactively engage in carbon disclosure aim not only to comply with regulations but also to leverage transparent practices to foster a positive corporate image, in line with the expectations of different walks of life [30]

2.1.3. Carbon Performance

Carbon performance is the success of management in managing carbon emissions generated in their activities [22,35]. Carbon performance aimed at reducing carbon emissions is an important aspect of corporate social responsibility [59]. By reducing carbon emissions arising from its activities, it can prevent companies from negative perceptions of pollution and regulatory sanctions that threaten the company's image. Thus, companies that are able to effectively manage their carbon emissions not only meet stakeholder expectations but also strengthen their competitiveness in an increasingly sustainability-oriented business environment [6]. The company's success in reducing carbon emissions shows that they are able to meet people's expectations of environmental concern, thus strengthening their legitimacy in the eyes of the public [36]. This is also confirmed by Luo [60] who also emphasizes that companies that actively improve carbon performance will face the risk of smaller legitimacy gaps when faced with various environmental regulations that make oversight transparent and carbon management. Houten & Wedari [21] explained that carbon performance can be seen in terms of carbon intensity, where the lower the carbon emissions produced per sale indicates that the company's carbon performance is better.

2.2. Study Hypothesis

Stakeholder concerns about environmental issues, such as global warming, prompt companies to disclose carbon emission information [29]. The need for carbon information is getting bigger with the launch of carbon trading schemes. From the management side, this information can be a strategic tool in making decisions to review the company's operational risks - activities that produce large emissions - [2], as it can negatively affect the company's cap or limit on the amount of emissions as applicable to emissions trading schemes [61,62]. This suggests that the regulatory pressures created by emissions trading schemes require companies to disclose comprehensive data on their carbon performance as a form of regulatory compliance [63]. From the external stakeholder side, the launch of an emissions trading scheme can lead to an increase in stakeholder expectations, encouraging companies to provide an actual picture of their emissions [64]

In the context of legitimacy, organizations disclose environmental information in response to social, environmental, political and economic pressures to obtain, maintain, or improve their permits to operate in the community environment [30,65]. When an industry has great potential to generate emissions, it encourages companies to disclose information describing their efforts in addressing and implementing good environmental performance, as evidence that the company's activities have complied with applicable norms [66,67]. Jiang et al. [31] also mentions that carbon disclosure can maintain, recover and gain recognition or legitimacy from society and governments. Hrasky [47] who examined the disclosure strategies of Australia's Top 50 ASX companies in 2005 and 2008, found that there is an increase in the disclosure of GHG emissions information in line with the increasing need for legitimacy in the face of increasing public awareness of climate change. The results of the previous

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research can be implied in the context of the Indonesia Carbon Exchange, namely the comprehensiveness of disclosure in the form of exposure to carbon information as the appropriate response for companies to face public pressure from stakeholder groups in the social, political, and regulatory environment [57,68]. Thus, there will be significant differences in the aspect of carbon disclosure after the launch of the emissions trading scheme contained in the Indonesia Carbon Exchange

H_1: There is a significant difference in carbon disclosure after the launch of the Indonesia Carbon Exchange

The launch of an emissions trading scheme through the Carbon Exchange can be a catalyst for improved carbon performance in various corporate sectors. This carbon trading scheme establishes a market-based framework within which companies can buy and sell carbon credits [69]. The existence of an emissions trading scheme contained in the launch of the Carbon Exchange encourages companies to improve their performance in reducing the intensity of emissions produced to avoid the potential for companies to exceed the emission limits set in the scheme [70]. In the economic aspect, companies that keep their emission intensity below the cap do not need to buy carbon credits to meet the emission limits in the applicable emissions trading scheme, they can instead sell their carbon credits, which can ultimately have a positive impact in the form of increasing capital resources for the company [71]. The economic pressures of these schemes ultimately encourage companies to invest in carbon reduction technologies and strategies to maintain lower emission levels [72], and this has more value for stakeholders who care about the company's environmental aspects. So improvements in carbon performance are often associated with improvements in better economic performance [56].

According to the theory of legitimacy [73,74], the organization will try to ensure that all its actions and policies do not conflict with the prevailing social values and norms in order to continue to gain public support and trust. The emergence of emissions trading schemes in a country's business climate sends a strong signal to the industry in reviewing the performance of companies in controlling carbon emissions as part of the new norm in the economic and social system. So that the aspect of company legitimacy is a strong driver for management to implement a proactive carbon strategy in maintaining its legitimacy [4,75,76]. Downar et al. [2] has proven that companies are working to reduce carbon intensity as a response to legislation requiring companies in the UK to disclose carbon information. The results of these findings can be implicated in the context of the launch of the Indonesia Carbon Exchange, where carbon intensity that indicates carbon performance is becoming increasingly important because companies that are able to reduce emissions not only show their commitment to sustainability but also align with the environmental targets set by the government [8]. These efforts build better relationships with policymakers and improve the company's image in the market, ultimately cementing their legitimacy in a business ecosystem that is increasingly driven towards sustainability [21]. Thus, that government regulations (such as the emissions trading scheme presented in the launch of the Indonesia Carbon Exchange) have the potential to have a substantial impact on companies' carbon strategies, activities, and activities [77–79]

H_2: There is a significant difference in carbon performance after the launch of the Indonesia Carbon Exchange

The launch of the Indonesia Carbon Exchange marks a pivotal moment in the regulatory landscape for companies, especially those classified in high-polluting sectors, such as the energy, industrial, basic materials, transportation and logistics, and infrastructure sectors. These sectors face greater scrutiny due to their significant contribution to climate change in the form of greenhouse gas emissions releases, which creates an urgent need for transparent reporting practices [34,80,81]. The magnitude of the influence of this sector on the environment also makes every activity of a company

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will invite a more sensitive perception than companies that are not included in the High-Polluting Sector if environmental information is not presented comprehensively and accountably [65,76]. Thus, companies will proactively manage their disclosures to reduce negative public perceptions [7,33].

Datt et al. [68] reveals that in carbon-dense companies, management tries to disclose their carbon information more comprehensively to reduce the reputational risks associated with their operations. This is proven by Kouloukoui et al. [82] Through his study in the context of companies in Brazil that formulated results that broader disclosure of environmental information occurred in sectors that had a high profile and more attention to society compared to companies with lower pollution potential. The reason for this results lies in the dynamics of legitimacy theory, which suggests that organizations will increase their disclosure in response to perceived threats to their legitimacy. High-polluting companies, under the pressure of regulatory scrutiny and societal expectations, tend to adopt broader carbon disclosure practices to maintain legitimacy [83,84]. This is in contrast to companies in the low-pollutant sector, where limited exposure and lower emission burdens can make such disclosures less critical from a business perspective, resulting in less incentive or motivation for management to report carbon emissions information transparently.

The relationship between a company's classification as a high-polluting or low-pollution sector and its carbon performance after the launch of a carbon exchange is also relevant to understanding the effectiveness of regulatory mechanisms aimed at reducing greenhouse gas emissions. A market-based approach to carbon regulation through carbon trading schemes creates economic incentives for companies to reduce their carbon emissions [85]. This will motivate them to adopt more environmentally friendly practices [86]. High-polluting companies can benefit significantly from improving their operational efficiency, as emission reductions can be associated with cost savings and increased productivity [87]. Judging from the aspect of legitimacy, companies in high-polluting sectors face high expectations from stakeholders, including consumers to investors. This expectation can encourage companies to not only comply with legal standards, but also to realize a competitive advantage with carbon performance as a strategy to maintain legitimacy [88,89]. Thus, companies in high-polluting sectors will outperform other companies classified as low-polluting in carbon performance after the launch of an emissions trading scheme rooted in the interaction of regulatory pressures, economic incentives, and stakeholder expectations.

H_3: High-Polluting Sector Companies Reveal Carbon Emissions More Comprehensive After the Launch of the Indonesia Carbon Exchange Than Low-Polluting Sector Companies

H_4: High-Polluting Sector Companies Improve Carbon Performance Better After the Launch of the Indonesia Carbon Exchange Compared to Low-Polluting Sector Companies

3. Methods

3.1. Population and Sample

The population of this study is all companies listed on the Indonesia Stock Exchange for the 2022-2024 period. The sample selection in this study uses a non-probability sampling sampling technique, namely by using the purposive sampling method. In this sampling method, a sample is taken based on predetermined criteria so that the number of samples can be formulated as follows:

Table 1. Research Population and Sample.

No	Information	Sample
1	Companies listed on the Indonesia Stock Exchange in 2022 and 2024	767
2	Companies that do not consistently publish annual reports or sustainability reports consecutively for the 2022 and 2024 periods	(189)
Number of company samples		**578**
Year of observation		**2**

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Total sample data studied	**1.156**

3.2. Variable Operations

Table 2. Variable Operational.

Variabel	Measurement	Formula
Carbon Disclosure	The analysis of the content of the GRI standard in the company's sustainability report, especially on the 305 index with seven specific disclosures, was carried out to measure carbon disclosure [64]	$CD = \frac{Number\ of\ items\ disclosed}{Maximum\ number\ of\ disclosures}$
Carbon Performance	Carbon performance is measured by the carbon intensity approach, which divides the accumulation of emissions in scope 1, 2, and 3 GHG emissions by the amount of sales (in millions of rupiah) [90].	$CP = \frac{Scope\ 1 + Scope\ 2 + Scope\ 3}{Total\ Sales}$

3.3. Analytical Techniques

This study has two approaches in formulating four hypotheses, where hypotheses one and two regarding the significant differences in carbon disclosure and performance after the Indonesia Carbon Exchange will be tested through the Paired Sample t-test method (if the data is normally distributed) or the Wilcoxon Test (if the data is not normally distributed). To find out whether the data used is normally distributed or not, the Kolmogorov-Smirnov normality test is carried out. In formulating the results of hypotheses three and four, testing was carried out using the Diference-in-Diference (DiD) method, this method is relevant because it is able to compare the differences in changes between two groups of companies, namely High-Polluting Industry and Low-Polluting Industry, so as to capture the relative impact of the launch of ICE on the two groups of sectors. The formulation of the DiD model is as follows:

$$CD_{it} = \alpha + \beta 1 Post_t + \beta 2 High_i + \beta 3 (Post_t\ x\ High_i) + \varepsilon_{it}$$

$$CP_{it} = \alpha + \beta 1 Post_t + \beta 2 High_i + \beta 3 (Post_t\ x\ High_i) + \varepsilon_{it}$$

4. Results and Discussion

4.1. Result

4.1.1. Statistic Descriptive

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Table 3. Statistic Descriptive Table.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Carbon Disclosure	1156	0.00	1.00	0.2848	0.29295
Carbon Performance	1156	0.0000	163.8403	0.303812	5.0733499

The results of the descriptive statistical table show that the coverage of carbon disclosure values (CDs) ranges from 0.00 to 1.00 which indicates that there are still companies that do not disclose their carbon information at all and there are also companies that comprehensively disclose all emission information items listed in GRI 305 in their annual reports or sustainability reports. The mean values and standard deviations show values of 0.2848 and 0.29295. In the carbon performance variable (CP), the minimum value indicates the number 0.000 which can be interpreted to mean that there are

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companies that do not produce or do not disclose information related to carbon intensity (Number of scope 1, 2, and 3 emissions and company sales) in its annual reports and sustainability reports. Meanwhile, the maximum value of CP shows a figure of 163.8403 which can be interpreted as a company that produces carbon emissions of 163 tons of CO2eq per one million sales. The values of the mean and standard deviation of the CP show the numbers 0.303812 and 5.0733499.

4.1.2. Normality Test

Table 4. Normality Test.

Variabel	Information	Kolmogorov-Smirnov (Sig.)	Shapiro-Wilk(Sig.)
CD_PRE_ICE	Carbon disclosure before (Pre) the launch of the Indonesia Carbon Exchange	0.000	0.000
CD_POST_ICE	Carbon disclosure after (Post) the launch of the Indonesia Carbon Exchange	0.000	0.000
CP_PRE_ICE	Carbon performance before (Pre) the launch of the Indonesia Carbon Exchange	0.000	0.000
CP_POST_ICE	Carbon performance before (Pre) the launch of the Indonesia Carbon Exchange	0.000	0.000

The normality test was not carried out in an effort to test the normality of the data on the DiD model because this study used more than 1,000 observations. As per the Central Limit Theorem, the residual distribution in large samples tends to be close to normal so that the normality test is not a crucial requirement [91,92]. Therefore, classical assumption testing is only carried out to formulate which difference test is appropriate to use in this research model. The results of the normality test with Kolmogorov-Smirnov and Shapiro-Wilk showed that all variables (CD and CP, both before and after the launch of the Indonesia Carbon Exchange) had a significance value of < 0.05. Thus, the data is not distributed normally. Therefore, hypothesis testing with different tests is carried out using the non-parametric Wilcoxon Test.

4.1.3. Differential Test (Wilcoxon-Test)

Table 5. Wilcoxon Test.

Variable	Z-value	Sig. (2-tailed)	Conclusion
CD (PRE–POST ICE)	-12.620	0.000	Hypothesis 1 is accepted
CP (PRE–POST ICE)	-7.469	0.000	Hypothesis 1 is accepted

The results of the test differed from the Wilcoxon Test showed that there was a significant difference in carbon disclosure ($Z = -12,620$; $p < 0.001$) between the period before and after the launch of the Indonesia Carbon Exchange. Similarly, there was a significant difference in carbon performance ($Z = -7.469$; $p < 0.001$) between the period before and after the launch of the Indonesia Carbon Exchange. Thus, hypothesis 1 and hypothesis 2 are accepted.

4.1.4. Classic Assumption Test – For DiD Models

In the multicollinearity test, the Tolerance value of all variables in each model was more than 0.1 and VIF less than 10. These results show that the data are free from multicollinearity problems. As for the heteroscedasticity test, model 1 shows no symptoms of heteroscedasticity as evidenced by a

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scatterplot graph spreading from point 0. However, in model 2, the distribution pattern does not look perfectly random, as residual points tend to be concentrated below. So that in model 1 it will continue in the DiD test, while in model 2 the Robust test will be carried out. The autocorrelation test using the Durbin-Watson Test showed that both models were free of autocorrelation, as the value of the DW on each model was in the range of -2 to +2.

4.1.5. Diference-in-Diference Model 1

Table 6. DiD Model 1.

Model	Coefficient	Std. Error	T	Sig.
Constant	-12.620	0.000	12.871	.000
$High_i$	0.089	0.025	3.617	.000
$Post_t$	0.130	0.021	6.280	.000
$High_i x Post_t$	-0.003	0.035	-.077	.939

In the DiD test, the test results of the third hypothesis can be reviewed from the results of the HighixPostt interaction regression test. In the table above, it is shown that the prob value is more than 0.05 (0.939) which can be concluded that the third hypothesis, namely High-Polluting Companies tends to reveal better than Low-Polluting after the launch of the Indonesia Carbon Exchange is rejected.

4.1.6. Diference-in-Diference Model 2

Table 7. DiD – Robust Test – Model 2.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Carbon Disclosure	1156	0.00	1.00	0.2848	0.29295
Carbon Performance	1156	0.0000	163.8403	0.303812	5.0733499

Based on the DiD - Robust test table, the High × Post interaction variable had a negative coefficient (-0.680) but not significant (p = 0.175). This shows that companies in high-polluting sectors do not have significantly better carbon performance compared to companies in low-pollution sectors after the launch of the Indonesia Carbon Exchange.

4.2. Discussion

4.2.1. There Is a Significant Difference in Carbon Disclosure After the Launch of the Indonesia Carbon Exchange

The first hypothesis test showed that there was a significant difference in carbon disclosure after the launch of Indonesia's carbon exchange. This shows that the existence of schemes or regulations from the government in an effort to improve the environment, especially in overcoming carbon emissions, has succeeded in encouraging companies to increase the comprehensiveness of carbon information disclosure. These results are in line with the results of a study from Cowan & Deegan [33] which proves that there is a significant increase in annual report emissions disclosure after the National Pollutant Inventory (NPI) regulation in Australia which suggests that environmental regulation can encourage changes in corporate environmental disclosure practices for the better. Likewise, the results of research from Jaggi et al. [93] which outlines that the establishment of an emissions trading scheme encourages managers to implement reporting policies that increase the scope and transparency of carbon information. In the economic context, Nyahuna and Doorasamy [26] revealed that carbon disclosure has a strong correlation with improved financial performance, where companies need to control and supervise the surge in emissions they produce so that they can be the basis for economic decisions in the form of selling carbon credits. So that the existence of a

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carbon exchange can be a strategic step to attract a market that increasingly considers the environmental value of companies through green financing or investment from green investors [58].

Viewed from the theoretical aspect of legitimacy, the increasing expectation for companies for transparency of environmental information and more detailed sustainability practices not only responds to regulatory demands, but also aligns with societal values regarding environmental responsibility that need to be reviewed by management. As a result, legitimacy-driven organizations have significantly increased the depth of reporting their carbon information to stakeholders [94,95]. Research shows that the launch of a carbon exchange in Indonesia is forcing organizations to revisit their approach to carbon emissions disclosure. As highlighted by Nada and Győri [96] that legitimacy theory supports the idea that businesses must actively communicate their environmental performance and strategies to achieve public acceptance of the businesses they run. The findings show that by adhering to public expectations for transparency regarding carbon emissions, companies not only comply with the legal framework set by policy makers, but also create value through enhanced legitimacy [47,97].

4.2.2. There Is a Significant Difference in Carbon Performance After the Launch of the Indonesia Carbon Exchange

The results of the study show that the second hypothesis is accepted or can be interpreted that there is a significant difference in carbon performance after the launch of the Indonesia Carbon Exchange. These findings indicate that the presence of carbon exchanges, which also present an emissions trading scheme in Indonesia's business climate, has succeeded in encouraging companies to improve their carbon performance. These results are in line with the research of Zhang et al. [98] and Zheng et al. [75] which found that the implementation of the Emission Trading Scheme (ETS) in the business environment has been proven to reduce the production of carbon emissions. The results of this study are also consistent with research conducted by Orazalin et al. [99] which emphasized that regulatory pressures through carbon trading mechanisms are able to encourage companies to integrate climate mitigation strategies in their business activities. Thus, the presence of carbon exchanges can be seen as an effective policy instrument to drive the transformation towards low-carbon business practices [70]. The reason behind these results is that carbon emissions have the potential to affect the company's future revenue and cash flow. Companies with high levels of emissions need to make modifications or adjustments in their production processes to avoid a spike in emission production that risks sanctions that impact the company's finances in the future [100]. On the other hand, companies that are able to reduce their emission intensity can take advantage of new economic opportunities, namely selling carbon credits on the carbon market, thereby obtaining additional financial resources.

Judging from the regulatory aspect, companies that are able to reduce the amount of carbon emissions can reduce the potential sanctions given to companies that have poor environmental performance. Thus, regulatory pressures and stakeholder demands also play an important role in encouraging improved carbon performance. In terms of legitimacy, these results also provide theoretical support for the research of Galán-Valdivieso et al. [24] which shows that companies are under threat of losing legitimacy if they do not demonstrate commitment to emissions management, so involvement in sustainable initiatives and environmental performance disclosure is a way to maintain legitimacy. In line with that, Lewandowski [72] emphasized that carbon performance is now increasingly recognized as a material business issue influenced by stakeholder dynamics, where transparency of emissions and environmental performance play a role in maintaining good relations with the market and increasing company value. Thus, the existence of carbon exchanges in Indonesia that carry schemes and regulations related to emission control has succeeded in encouraging industry players to improve their carbon performance.

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4.2.3. There Is no Significant Difference in the Comprehensiveness of Carbon Disclosure in High-Polluting Sector Companies Compared to Low-Polluting Sector Companies After the Launch of the Indonesia Carbon Exchange

The results show that the hypothesis that companies in the high-polluting sector disclose carbon emissions more comprehensively than low-polluting sectors after the launch of the Indonesia Carbon Exchange has not been proven significant. This indicates that the launch of Indonesia's carbon exchange has not been able to create a difference in the disclosure behavior of the two sectors. These findings are consistent with a literature review by Bazhair et al. [101] which states that carbon disclosure practices do not always differ substantially between sectors. In addition, a study by Zha, Li, and Tang [102] that measured carbon proactivity among participating companies in the ETS scheme, showed that more proactive disclosure had more to do with whether or not companies participate in the emissions trading scheme than how high their emissions were. Moreover, high-emission companies may see disclosure as a potential reputational risk so they are more cautious. Thus, instead of expanding transparency, high-polluting companies often withhold detailed information to minimize reputational risks [103].

From the point of view of legitimacy, this result can also be interpreted as a form of symbolic strategy of the company. Legitimacy theory argues that companies will disclose environmental information not only because of regulatory pressures, but also to maintain the social legitimacy of various stakeholders [73]. Research Galán-Valdivieso et al. [24] found that companies often adjust the intensity of carbon disclosure with the goal of managing public perception, not because of differences in actual pollution levels. This is consistent with the findings of this study where both high-polluting and low-polluting companies pursue similar disclosure strategies to secure legitimacy in the eyes of regulators, investors, and the public, so that there is no significant differentiation between the high-polluting sector and the low-polluting sector.

4.2.4. There Is No Significant Difference in the Improvement in the Carbon Performance of High-Polluting Sector Companies Compared to Low-Polluting Sector Companies After the Launch of the Indonesia Carbon Exchange

The results of the hypothesis test show that the third hypothesis, namely High-Polluting Sector companies improves carbon performance better after the launch of the Indonesia Carbon Exchange than Low-Polluting Sector companies. This result is in contrast to the results of research by Klaus et al. [41] which revealed that changes in the dynamics of environmental regulations in the United States have brought better carbon performance in companies included in the carbon-intensive sector than other sectors. This can be due to the scope of the research sample which is only within a limit of one year before and after the launch of the Indonesian carbon exchange. In early implementation practices, high-polluting companies often face limited access to green financing that can be used to fund environmentally friendly technologies that lead companies towards carbon production efficiency [104]. On the other hand, low-polluting companies already have a lower emission structure so they do not require significant additional investment [105]. This explains why in the limited time span of one year before and after the launch of the Indonesia Carbon Exchange, the carbon performance gap between the two sectors has not shown a significant difference. In terms of legitimacy, these results are in contrast to Guenther et al. [106] which states that companies with higher emission intensities tend to improve their carbon performance better in addressing legitimacy issues related to their environmental impact. On the other hand, these results are in line with the view of Haque & Ntim [107] who assert that the pressure of legitimacy often encourages companies to adopt *symbolic management practices* — for example by displaying sustainability commitments in annual reports — without significant changes in production processes or carbon emission efficiency.

5. Conclusions

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This study brings some evidence of the influence of the launch of the Indonesian carbon exchange on the disclosure behavior and performance of companies in Indonesia. In general, there are significant differences in carbon disclosure and performance after the launch of the Indonesia Carbon Exchange. This result illustrates that there has been a change in the dynamics of environmental regulations with the implementation of an emissions trading scheme through the launch of the carbon exchange, which has succeeded in increasing the awareness of business people in increasing the transparency of carbon emission information which is considered increasingly substantial in various business decisions. In terms of carbon performance, the existence of this emissions trading scheme also encourages companies to continue to improve their carbon performance by reducing the intensity of emissions produced through various pro-environmental strategies. Thus, in general, the presence of the Indonesia Carbon Exchange has proven to be successful in bringing a more transparent and accountable business climate to carbon information and also succeeds in minimizing the intensity of emissions produced by the company which is in line with the government's goal of achieving net zero emissions. From a legitimacy theory perspective, companies are proven to strive to maintain the sustainability of their operations and a positive image in the eyes of the public and regulators by showing improvements in their transparency and carbon performance.

This study also brought more specific results by reviewing the comparison of carbon disclosure and performance in the high-polluting and low-polluting sectors which showed that there was no significant difference in the comprehensiveness of carbon disclosure or the improvement of carbon performance between high-polluting sector companies and the low-polluting sector. This finding can be explained through the legitimacy theory, which is that even high-emission companies are not fully encouraged to make greater legitimacy efforts than companies with low emission levels. This may happen due to the relatively short observation time, as well as the lack of optimal green investment support and incentive instruments that are able to encourage emission-dense companies to transform more aggressively in responding to the demands of public legitimacy.

With the limited time coverage of the sample that only reviewed one year before and after the launch of the carbon exchange, the researchers are expected to be able to review more time coverage of even the data population that can cover a wider area such as companies in the southeast. The next researcher is also expected to review the presence of other regulatory aspects such as carbon taxes to carbon pricing that have the potential to affect the company's carbon disclosure behavior and performance.

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