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WHY DOES CARBON EMISSION DISCLOSURE MATTER? EXPLORING ITS IMPACT ON FIRM VALUE: EMPIRICAL STUDY OF SHARIA-COMPLIANT COMPANIES IN INDONESIA

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Abstract

The large amount of carbon emissions in Indonesia with a percentage reaching 4.1% of total global emissions has made Indonesia ranked 5th as a country that contributes the most CO2 emissions in the world during 1850-2021 and made the public encourage companies to disclose their carbon emissions. Disclosure of carbon emissions can then affect the company's image to investors which leads to its effect on the level of company value. Accordingly, this research seeks to investigate how the disclosure of carbon emissions influences the valuation of Islamic companies in Indonesia. Employing a quantitative methodology, the study analyzes secondary panel data using both panel data regression and cluster analysis techniques. The cross-sectional dataset consists of 30 companies registered with ISSI that publish sustainability reports, while the time-series dataset comprises annual data from 2016 to 2021. Four control variables are incorporated into the analysis: earnings per share (EPS), leverage, firm size, and investment opportunity set (IOS). The empirical findings indicate that, in partial tests, the carbon emissions disclosure variable significantly affects firm value, and when examined simultaneously with EPS, leverage, firm size, and IOS, these factors collectively exert a significant influence on firm value. These insights hold important implications for companies, policymakers, and investors regarding carbon emissions disclosure.

Keywords: *Cluster Analysis; Panel Data Regression Analysis; Indonesia Sharia Stock Index; Firm Value; Carbon Emissions Disclosure.*

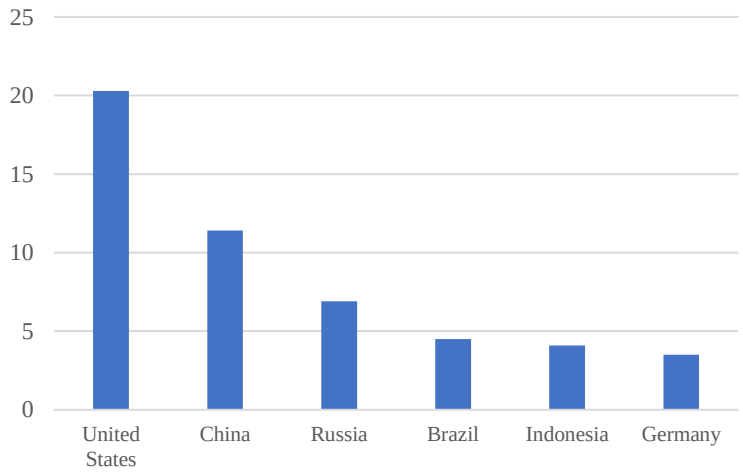
Introduction

Climate change is arguably one of the most significant challenges of the 21st century, with far-reaching consequences for both natural ecosystems and human societies.Global carbon emissions, a major contributor to climate change, have experienced significant fluctuations in recent years.For instance, data from the International Energy Agency (IEA) reported a substantial decline in emissions during 2020, primarily due to the unprecedented restrictions imposed during the COVD-19 pandemic. However, the subsequent year witnessed a precipitous rebound, with emissions reaching 36.3 gigatons of CO2—a 6% increase that not only set a new record but also underscored the resilience of fossil-fuel dependency (Canadell, 2007; Chen B, 2017).This volatile trend underscores the challenges of balancing economic growth with environmental sustainability, especially when industrial activities continue to accelerate without adequate mitigation measures.

This increase in carbon emissions has led to global concern and catalyzed international efforts to combat climate change.In 2015, more than 185 countries came together to sign the Paris Agreement, a landmark accord that set forth a collective commitment to reduce greenhouse gas emissions and transition toward a low-carbon economy (Blau, 2017).This agreement represents not only a policy milestone but also a strategic framework within which nations are expected to align their environmental and economic priorities. Despite the ambitious international targets established, the practical realization of emission reductions is complicated by the interplay between economic development and environmental stewardship. Many countries continue to face the dual challenge of fostering growth while adhering to stringent emission controls. Indonesia, a rapidly developing nation with a significant industrial base, exemplifies the complexities inherent in this global struggle. The nation has taken proactive measures to align itself with international climate goals, as evidenced by its active participation in the Paris Agreement and its notable achievement in reducing carbon emissions to 69.5 million tons of CO_2 equivalent (CO_2e) in 2021, an outcome that surpassed its target of 67 million tons.Nevertheless, this progress coexists with persistent challenges. Notably, Indonesia's industrial sector continues to be a major contributor to carbon emissions, and the nation's environmental performance is subject to ongoing public scrutiny and regulatory oversight.According to data from Carbon Brief, Indonesia ranks as the fifth largest contributor to global CO_2 emissions from 1850 to 2021, accounting for approximately 4.1% of total emissions.These statistics underscore the pressing need for Indonesia to align its industrial growth with sustainable environmental practices.

Public awareness of environmental degradation in Indonesia has played a crucial role in driving regulatory reforms, with growing environmental concerns leading to increased pressure on companies to enhance transparency by disclosing their carbon emissions.This heightened demand for accountability prompted the Indonesian government to enact Law No. 40 of 2007, which transformed carbon emission disclosure from an optional practice into a mandatory obligation. The introduction of Presidential Regulation No. 71/2011, which established the National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK), served to reinforce the regulatory framework by identifying the industrial sector as a primary source of emissions and providing a structured pathway for emission reduction.These policy initiatives have been instrumental in fostering a culture of environmental accountability and have significant implications for corporate reputation and investor perceptions.

Figure 1. Top Carbon Emitters 1850-2021 (%)



Source: Carbon Brief (2022)

In parallel with regulatory developments, academic discourse has increasingly focused on the relationship between environmental disclosure and firm value. The prevailing notion is that transparent reporting on carbon emissions can enhance a company's credibility, thereby positively influencing investor confidence and overall market valuation. Some studies have found a statistically significant positive impact of carbon emission disclosure on firm value (Hardiyansah M, 2021), suggesting that companies that actively manage and disclose their environmental performance are rewarded by the market. However, the academic debate is far from settled. Other researchers caution that improved environmental performance or enhanced disclosure does not automatically translate into higher firm value (Anggraeni, 2015). Moreover, Hsu and Hwang argue that the costs associated with implementing rigorous environmental management practices might, in certain cases, reduce shareholder wealth by increasing operational expenses. This divergence in findings underscores the complexity of the relationship between environmental initiatives and financial performance, and points to the need for further empirical investigation.

Against this backdrop, the present study seeks to explore the nuanced relationship between carbon emission disclosure and firm value within the specific context of Islamic companies operating in Indonesia. Islamic equity benchmarks in Indonesia have evolved considerably, beginning with the launch of the Jakarta Islamic Index (JII) in 2000 (Bursa Efek Indonesia, 2002) and expanding through the introduction of the Indonesia Sharia Stock Index (ISSI) by the Financial Services Authority in 2011 (Otoritas Jasa Keuangan, 2021).

Moreover, OJK's Sustainable Finance Roadmap 2021–2025 mandates enhanced environmental risk management, including mandatory carbon emission reporting for all financial institutions (Otoritas Jasa Keuangan, 2021). Complementing these regulatory developments, the National Sharia Council of the Indonesian Ulema Council (DSN-MUI) issued Fatwa No. 110/DSN-MUI/2018 on Green Sukuk, endorsing Sharia-compliant instruments to finance environmentally sustainable projects and implicitly advocating greater transparency in carbon disclosures (Dewan Syariah Nasional–Majelis Ulama Indonesia, 2018). These layered governance and legal frameworks underscore the distinctive operational environment of Indonesian Islamic firms, which may uniquely shape how carbon emission disclosures influence firm value.

To address these gaps, this study adopts a robust methodological approach, combining panel data regression analysis with cluster analysis to examine the period from 2016 to 2021. This dual-method approach not only allows for a comprehensive evaluation of the direct effects of carbon emission disclosure on firm value but also facilitates the identification of distinct clusters of Islamic companies based on their disclosure practices. Previous studies have reported mixed findings regarding the impact of carbon emission disclosure on firm value, with some studies suggesting a positive relationship (e.g., Luo et al., 2012; Qian & Schaltegger, 2017), while others found no significant effect or even negative associations (e.g., Clarkson et al., 2013; Matsumura et al., 2014).

By acknowledging these inconsistencies, the research aims to provide deeper insights into how environmental transparency influences market performance in the context of Sharia-compliant businesses. The expected contributions of this study include clarifying the ambiguous relationship between carbon emission disclosure and firm value, offering practical implications for policymakers and corporate managers, and advancing the academic debate on sustainable finance within the framework of Islamic economics.

Literature Review

Legitimacy Theory

The basic legitimacy theory is the social contract in which all business entities, including companies that coexist with the community environment, have a social contract that is stated directly or indirectly (Mousa GA, 2015). Disclosure of carbon emissions has a reason to gain legitimacy from stakeholders, avoiding corporate threats resulting from greenhouse gas profits such as increased operating costs, decreased demand, reputational risks, legal proceedings, fines and penalties (Qian W, 2017).

Amidst a growing recognition of the harmful effects of greenhouse gases, disclosing such information is increasingly viewed not only as a demonstration of ethical responsibility but also as a strategic business approach to strengthen stakeholder relations and preempt potential risk ranging from heightened operational costs and reduced market demand to reputational and legal challenges tied to environmental concerns (Kalkanci B, 2016; Qian W, 2017). Consequently, revealing carbon emissions is critical not merely as a means of ensuring transparency but also as a genuine effort by companies to maintain legitimacy and mitigate environmental business risks, thereby serving as a pivotal strategy in advancing sustainable business practices.

Signal Theory

Signaling theory is an important framework in economics and business that highlights the role of information in shaping perceptions and actions. In the context of companies, signal theory emphasizes that the presentation of reliable financial and non-financial information can provide signals to stakeholders regarding the performance, strategy, and value of the company (Hamrouni AA, 2015). Audited financial statements, as a primary component of financial reporting, offer a clear depiction of an organization’s fiscal status. Conversely, non-financial disclosures such as initiatives in corporate social responsibility and product innovation provide valuable insights into the firm's broader commitment to performance and accountability (Chen L, 2016). The trust provided by this reliable information can generate benefits for the company indirectly, as it can increase stakeholder trust and confidence, which in turn can influence investment decisions, business cooperation, and market perceptions of the company.

However, it is important to remember that this signaling effect depends on stakeholders' trust in the veracity and

credibility of the information presented (Jacobson MR, 2018). If the information is deemed untrustworthy or manipulative, the signal effect can be reduced or even turned negative, with stakeholders losing trust and doubting the integrity of the company. Therefore, companies should ensure that the information presented is not only objectively reliable, but also relevant and transparent so as to provide a positive signal and strengthen the company's position in the market and society. Thus, signal theory not only highlights the importance of information presentation, but also emphasizes the importance of the quality, honesty and integrity of that information in building the company's reputation and trust.

Triple Bottom Line Theory

The Triple Bottom Line theory, introduced by Elkington in 1997, changed the conventional paradigm of measuring corporate success by introducing a more holistic approach. From this perspective, corporate success is defined by more than just financial performance; it encompasses broader economic factors, including the organization's effects on both the environment and society. Consequently, the Triple Bottom Line (TBL) framework advocates for evaluating performance across three essential dimensions: profit, planet, and people. The profit pillar refers to a company's financial performance, which remains an important aspect, while the planet pillar measures a company's environmental impact, including natural resource management and carbon footprint reduction. On the other hand, the people pillar evaluates a company's social and humanitarian contributions, such as corporate social responsibility (CSR), social justice, and local community development. The TBL approach provides a more comprehensive framework for companies to evaluate their performance and take into account the long-term implications of their business decisions on society and the environment, creating sustainable value for all stakeholders (Høgevold NM, 2019).

Company Value

The valuation of a firm essentially reflects investors' beliefs about the company a measure that is often mirrored in its share price (Komara A, 2019). Since these valuations are derived from stock market metrics, they are considerably affected by the range of available investment opportunities. Consequently, investors tend to view the company as not only performing strongly in the present but also possessing promising prospects for future growth (Afridi FEA, 2022).

Carbon Emission Disclosure

In Indonesia, the reporting of carbon emissions is largely limited to corporate environmental accountability reports, often omitting financial details such as the costs and funding strategies related to efforts in reducing these emissions. Over time, however, the disclosure of carbon emissions data has become increasingly significant for stakeholders especially investors who favor companies that transparently communicate their environmental initiatives (Damas D, 2021). Apart from investors, the public also tends to be concerned about the impact of carbon emissions, so managers play a role in handling legitimacy by disclosing more details about carbon emissions. This statement is also supported by Hardiyansah and Agustini in their research which shows that disclosure of carbon emissions has a positive and significant effect on firm value.

Previous Research

Hardiyansah and Agustini (2020) examined the role of environmental performance in the relationship between disclosure of carbon emissions and firm value. The study employed content analysis to evaluate carbon emission disclosure, utilizing a checklist adapted from the Carbon Disclosure Project (CDP). Firm value was quantified using Tobin's Q, while environmental performance was assessed through the Environmental Management Performance Assessment Program

(PROPER). The sample comprised 34 companies listed on the Indonesian Sharia Stock Index (ISSI) from 2014 to 2019. Moderated regression analysis (MRA) was utilized to test the hypotheses. The findings revealed that carbon emission disclosure has a positive and significant influence on firm value. Furthermore, environmental performance strengthens the relationship between carbon emission disclosure and firm value, indicating that participation in PROPER reflects a firm's commitment to mitigating environmental impact (Hardiyansah & Agustini, 2020).

Similarly, Damas et al. (as cited in Anggraeni, 2015) provided empirical evidence on the effects of eco-efficiency, green innovation, and carbon emission disclosure on firm value. Their study focused on manufacturing companies participating in PROPER between 2014 and 2019, selecting 25 companies through purposive sampling and generating 144 observations. Using multiple linear regression analysis, the results showed that eco-efficiency has a significant negative effect on firm value, whereas green innovation and carbon emission disclosure have significant positive effects. Moreover, environmental performance was found to moderate the relationship between eco-efficiency and firm value, but not between green innovation or carbon emission disclosure and firm value (Anggraeni, 2015).

Almuaromah and Wahyono (2022) investigated how environmental performance, institutional ownership, managerial ownership, profitability, and leverage affect carbon emissions disclosure among mining companies listed on the Indonesia Stock Exchange from 2016 to 2020. Employing purposive sampling and multiple linear regression analysis, they examined seven mining companies. The results revealed that institutional ownership and profitability positively influence carbon emissions disclosure, while environmental performance, managerial ownership, and leverage have no significant effect (Almuaromah & Wahyono, 2022).

In a related study, Irwhantoko and Basuki (2016) analyzed factors determining carbon emissions disclosure by assessing company size, profitability, competition, growth, debt-to-equity ratio, and the reputation of public accounting firms. The extent of disclosure was measured using a checklist from the CDP guidelines. The study sampled 19 manufacturing firms listed on the Indonesia Stock Exchange during 2012–2013 using purposive sampling. Findings indicated that only the debt-to-equity ratio significantly and negatively affects carbon emissions disclosure, while other factors do not show a statistically significant effect (Irwhantoko & Basuki, 2016).

Research Method

The approach used in this research is a quantitative approach. Quantitative research can be interpreted as a type of research that produces findings obtained by a series of statistical processes that emphasize number analysis to determine the relationship between the variables studied (Watson, 2015). The present study employs a panel data approach that integrates both time series and cross-sectional components for data collection. Secondary data were sourced from the official websites of the respective companies, the Indonesia Stock Exchange (www.idx.co.id), and Yahoo Finance (www.finance.yahoo.com). The research population consists of all companies listed on the Indonesian Sharia Stock Index (ISSI) during the 2016–2021 period. In particular, the cross-sectional data sample includes 30 Islamic companies on the ISSI, while the time series component spans from 2016 to 2021, based on the availability of each company’s annual and sustainability reports. The sample size was determined following Roscoe’s recommendation, which advocates for a sample size greater than 30 and less than 500.

The sample was selected using a purposive sampling method, a technique that applies specific criteria to identify a representative subset of the population in line with the research objectives. The criteria for selecting the sample were as follows:

This research conducts a data collection process that is pooled data or panel data which is a combination of time series and cross section data. This study uses secondary data from the official websites of related companies, the Indonesia Stock Exchange (www.idx.co.id), and yahoo finance (www.finance.yahoo.com). The population used as the object of research is all companies listed in the Indonesian Sharia Stock Index (ISSI) during the 2016-2021 period. The number of samples from cross section data includes 30 Islamic companies listed on the ISSI (Indonesian Sharia Stock Index), while the sample of annual time series data takes the time span of 2016-2021 according to the availability of annual report data and sustainability reports from each company sampled. The sample size is based on the opinion of Roscoe which states that the sample size should be greater than 30 and less than 500.

Sample selection was carried out using purposive sampling method. This method is a sample selection technique with certain criteria in a population. The purposive sampling technique is used to obtain a representative sample and in accordance with what the researcher needs in order to be adjusted to the research objectives. The criteria determined by the researcher in determining the sample are as follows:

1) Companies listed on ISSI from January 2016 to December 2021
2) Companies that published annual reports and sustainability reports during the period 2016 to 2021.

Within this study, firm value is designated as the dependent variable, with Tobin's Q ratio employed as its proxy. Tobin's Q assesses firm value by juxtaposing the market valuation determined by the closing stock price with the aggregate book values of assets and liabilities reported in the financial statements. The calculation is expressed as follows:

$$\text{Tobin's Q} = \frac{Total\ Market\ Value + Total\ Book\ Value\ of\ Liabilities}{Total\ Book\ Value\ of\ Assets}$$

In this study, carbon emission disclosure (CED) is utilized as the independent variable. Data for CED is gathered via an index featured in both the annual and sustainability reports, where each disclosure element is scored using a binary system. This index is organized into five thematic categories related to climate change and carbon emissions, comprising a total of 18 items (Choi BB, 2013). Each item is given a score of 1 and a score of 0 for items that are not disclosed, so that if the company fully discloses then the company's score is 18.

Results and Discussion

The collected sample data is processed using STATA version 16 with panel data regression techniques to find answers to the hypotheses formulated. Furthermore, the sample data will be grouped according to their characteristics using SPSS version 26 with cluster analysis techniques. Before discussing the regression results and cluster analysis, the authors first conducted a descriptive analysis to explain the general description of the statistical data of the variables used in this study. These descriptive statistics include the mean value, lowest value, and highest value of each variable included. These values can provide information about the distribution of variable data in each period and observation unit.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
FV	2.21	3.07	0.39	23.29

CED	0.58	0.23	0.05	1.05
EPS	266.66	514.41	-154.32	3057.32
LEV	0.86	0.66	0.08	3.41
SIZE	25.34	30.12	0.7675	118.1
IOS	4.50	10.77	0.1325	82.01

Based on the descriptive statistics displayed, it can be seen that the average firm value is 2.21. The highest firm value is 23.29 achieved by Unilever Indonesia Tbk. in 2017. While the lowest company value was recorded by Polychem Indonesia Tbk. In 2019 with only 0.39. Nevertheless, the average company value from 2016 to 2021 amounted to 2.21. The data indicate that, on average, sharia-compliant companies exhibit a robust market valuation, as their value exceeds one. This suggests that these firms are valued higher than the book value of their assets. Additionally, the descriptive analysis of the independent variables shows that the mean level of carbon emission disclosure is 0.58. This figure indicates that Islamic companies are quite concerned about the provisions of carbon emission disclosure in line with Law No. 40 of 2007 concerning social responsibility and limited liability companies, by publishing 10 out of 18 carbon emission disclosure items.

Prior to carrying out regression analysis, researchers need to select the appropriate model—whether it be the Common Effect Model (CEM), Fixed Effect Model (FEM), or Random Effect Model (REM)—by executing a structured series of diagnostic tests. The first test conducted to select a model is the Chow Test. This test will produce a decision in the form of the best model choice between CEM or FEM. The way to determine the choice of model from the Chow Test results is:

1. Ha is rejected and H0 is accepted if the Prob. value > 0.05, meaning that CEM is preferred over FEM.
2. Ha is accepted and H0 is rejected if the Prob. value <0.05, meaning that FEM is preferred over CEM.

FV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CED	.6970368	.3223908	2.16	0.032	.0598445	1.334229
EPS	.0002817	.0001836	1.53	0.127	-.0000811	.0006445
LEV	-.821061	.1813689	-4.53	0.000	-1.179529	-.4625927
SIZE	-.0053097	.0054726	-0.97	0.334	-.016126	.0055066
IOS	.2737676	.0134753	20.32	0.000	.2471343	.300401
_cons	1.350308	.2811333	4.80	0.000	.7946593	1.905956
sigma_u	.93147247					
sigma_e	.52948183					
rho	.75579009	(fraction of variance due to u_i)				

F test that all u_i=0: F(29, 145) = 15.10 Prob > F = 0.0000

After conducting the Chow Test process, it is found that the probability value is 0.00. Because this value is lower than 0.05, Ha is accepted or the best choice is the fixed effect model. Furthermore, to ensure that the model is the best model, researchers conducted the Hausman Test to choose the best model between FEM and REM. How to determine the choice of model from the Hausman Test results is as follows

1. Ha is rejected and H0 is accepted if the Prob. value > 0.05, meaning REM is preferred over FEM.
2. Ha is accepted and H0 is rejected if the Prob. value <0.05, meaning that FEM is preferred over REM.

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	____ Coefficients ____			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CED	.6970368	.950572	-.2535351	.1235378
EPS	.0002817	.0002339	.0000478	.000076
LEV	-.821061	-.7418178	-.0792432	.1008982
SIZE	-.0053097	-.0040673	-.0012424	.0037272
IOS	.2737676	.2760534	-.0022858	.0080963

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 8.65
Prob>chi2 = 0.1238

The Hausman test indicates a p-value of 0.12—well above the 0.05 threshold—resulting in the acceptance of H0. This outcome suggests that the random effects model performs better than the fixed effects model. Nevertheless, based on these findings, it is concluded that the fixed effects model remains the most suitable option for researchers.

	____ Coefficients ____			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CED	.6970368	.950572	-.2535351	.1235378
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Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 8.65
Prob>chi2 = 0.1238

According to the Hausman test, the p-value is 0.12—above the 0.05 threshold—which leads to accepting the null hypothesis and implies that the random effects model is preferable to the fixed effects model. Nonetheless, these findings are interpreted to conclude that the fixed effects model is the optimal choice for researchers. Following the selection of the appropriate panel data model, the subsequent phase of the study focuses on evaluating the impact of carbon emission disclosure on the valuation of Islamic companies in Indonesia. In this case, carbon emission disclosure acts as an independent variable as well as the researcher's variable of interest. In addition, researchers also use control variables consisting of earnings per share (EPS), leverage, company size, and investment opportunity set. Based on the test results in model selection, the model used in this regression is the random effect model (REM). The regression results are as follows.

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Random-effects GLS regression                   Number of obs     =         180
Group variable: NAMAPERUSA~N                    Number of groups  =          30

R-sq:                                           Obs per group:
     within  = 0.7833                                         min =           6
     between = 0.9077                                         avg =         6.0
     overall = 0.8938                                         max =           6

                                                Wald chi2(5)      =      814.77
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000

------------------------------------------------------------------------------
          FV |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         CED |    .950572   .2977822     3.19   0.001     .3669295    1.534214
         EPS |   .0002339   .0001671     1.40   0.162    -.0000936    .0005613
         LEV |  -.7418178   .1507124    -4.92   0.000    -1.037209    -.4464269
        SIZE |  -.0040673   .0040071    -1.02   0.310    -.0119211    .0037865
         IOS |   .2760534   .0107719    25.63   0.000     .2549409     .297166
       _cons |    1.10446   .2833597     3.90   0.000      .549085    1.659835
-------------+----------------------------------------------------------------
     sigma_u |  .84648099
     sigma_e |  .52948183
         rho |  .71877186   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

The regression results using the random effect model produce the following mathematical equation:

$$FVit = 1.10 + 0.95CEDit + 0.000167EPSit - 0.74LEVit - 0.004SIZEit + 0.27IOSit + \varepsilon$$

The results obtained from the regression analysis are subsequently used as a benchmark for evaluating the influence of the independent variable on the variations in the dependent variable. How to make decisions in the significance test is as follows

1. Ha is rejected and H0 is accepted if the Prob. value> 0.05, meaning that the value of Islamic companies is not significantly influenced by the independent variable.
2. Ha is accepted and H0 is rejected if the Prob. value <0.05, meaning that the value of Islamic companies is significantly influenced by the independent variable.

According to the regression analysis, the p-value for the carbon emission disclosure variable is 0.00, which is significantly lower than the 0.05 threshold. This finding supports the alternative hypothesis, indicating that disclosing carbon emissions exerts a statistically significant and positive impact on the valuation of Islamic companies. Additionally, the estimated coefficient for this variable is 0.95. This figure explains that every time the company increases its carbon emission disclosure by 1%, the company value will increase by 95%. These results are in line with the research of Damas et al. (2021) which found that disclosure of carbon emissions has a positive and significant effect on firm value.

Iskandar and Fran argue that companies openly sharing their environmental performance reports tend to attract greater investor interest, making transparency a critical factor in investment decisions. Hardiyansah and Agustini's research supports this view, showing that disclosing carbon emissions uniquely appeals to investors—as evidenced by the subsequent rise in stock prices among firms that do so. This finding aligns with legitimacy theory, which suggests that public reporting on carbon emissions not only bolsters a company's standing within its community but also enhances its market credibility, ultimately delivering economic benefits through increased revenue and an improved corporate reputation (Anggraeni, 2015). The results above show that if Islamic companies want to increase the value of the company, they need to increase their concern about disclosing carbon emissions. The results of this study can also be a recommendation for the government as a

regulator to further strengthen regulation and supervision of carbon emission disclosure.

Increasing the value of Islamic companies in Indonesia can occur through transparent and responsible disclosure of carbon emissions. In the context of a global market that is increasingly concerned with environmental issues, Islamic companies that are able to present clear carbon emissions reports can gain a competitive advantage. In a global economy that increasingly takes environmental impacts into account, investors and consumers tend to give preference to companies that demonstrate a commitment to sustainable business practices. Therefore, Islamic companies in Indonesia that openly publish their carbon emission data may gain more trust and support from stakeholders, which in turn may increase firm value.

Transparent disclosure of carbon emissions can also improve the reputation of Islamic companies in the eyes of investors and the public. In an increasingly connected and informed business environment, corporate reputation has a significant impact on firm value. By providing clear and measurable information about their carbon footprint, Islamic companies can build a strong image as an environmentally responsible entity. This can attract investors who prioritize ethical and environmental considerations and broaden the potential investor base for the company.

In addition, disclosing carbon emissions can help Islamic companies in Indonesia to meet increasingly stringent environmental standards and regulations. With pressure from governments and international organizations to reduce environmental impacts, companies in Indonesia, including sharia-based ones, need to comply with stricter environmental regulations. By adopting good carbon emissions disclosure practices, Islamic companies can strengthen their compliance with environmental regulations, reduce legal risks, and avoid fines or sanctions that may arise from environmental violations. As a result, this can create further stability and trust among stakeholders, which in turn can support growth and increase the value of Islamic companies in Indonesia.

The role of the control variables involved in this study shows a significant value as the output of the regression. The leverage and investment opportunity set (IOS) variables each have a probability value of 0.00. Because 0.00 <0.05, the two control variables have a significant effect on firm value. In addition, other control variables, namely earnings per share (EPS) and company size, have a probability value of 0.16 and 0.31, respectively. Because the value of the two variables is more than 0.05, it can be concluded that earnings per share (EPS) and investment opportuniy set do not significantly affect firm value. Simultaneously, the independent variables, both interest variables and control variables, can be known through the F test. According to the regression analysis, the F-test produced a p-value of 0.00, which is below the 0.05 significance threshold.

Consequently, the alternative hypothesis is accepted, indicating that carbon emission disclosure, earnings per share (EPS), leverage, company size, and the investment opportunity set collectively exert a statistically significant influence on the valuation of Islamic companies in Indonesia. Furthermore, the model's R-squared value is 0.78, meaning that 78% of the variation in company value is explained by these factors.

After knowing the effect of carbon emission disclosure using panel data regression analysis, the next step is to try to know the clustering of sample data based on the dimensions of carbon emission disclosure using cluster analysis. Through this analysis, we can know the clustering of a data according to its characteristics. In contrast to the division of groups through the division of frequency distributions such as quartiles, deciles, and percentiles, this analysis emphasizes more on its grouping according to its characteristics so that the data in one cluster has high homogeneity

and the characteristics between clusters have high heterogeneity as well.

Table 2. Cluster Analysis Results

Company	Cluster	Company	Cluster
PT. Industri Jamu dan Farmasi Sido Muncul Tbk. (SIDO)	1	Unggul Indah Cahaya Tbk. (UNIC)	2
PT. Bukit Asam Tbk. (PTBA)	1	KMI Wire & Cable Tbk. (KBLI)	2
PT. Solusi Bangun Indonesia Tbk. (SMCB)	1	PT. Aneka Tambang Tbk. (ANTM)	3
PT. Indofood CBP Sukses Makmur Tbk. (ICBP)	1	PT. Adaro Energy Tbk. (ADRO)	3
PT. Kalbe Farma Tbk. (KLBF)	1	PT. United Tractors Tbk. (UNTR)	3
PT. Indocement Tunggal Prakarsa Tbk. (INTP)	1	Charoen Pokphand Indonesia Tbk. (CPIN)	3
PT. Semen Indonesia (Persero) Tbk. (SMGR)	1	Surya Toto Indonesia Tbk. (TOTO)	3
PT. Perusahaan Gas Negara Tbk. (PGAS)	1	Pelat Timah Nusantara Tbk (NIKL)	3
Japfa Comfeed Indonesia Tbk. (JPFA)	1	Tifico Fiber Indonesia Tbk. (TFCO)	3
Mayora Indah Tbk. (MYOR)	1	Astra Otoparts Tbk. (AUTO)	3
Timah Tbk. (TINS)	1	Kawasan Industri Jababeka Tbk. (KIJA)	3
Kimia Farma Tbk. (KAEF)	1	Wilmar Cahaya Indonesia Tbk. (CEKA)	3
Salim Ivomas Pratama Tbk. (SIMP)	1	Akasha Wira International Tbk. (ADES)	3
Unilever Indonesia Tbk (UNVR)	1	Voksel Electric Tbk. (VOKS)	3
Polychem Indonesia Tbk. (ADMG)	2	Indo-Rama Synthetics Tbk. (INDR)	3

This analysis uses sample data of 30 sharia companies listed in ISSI and carbon emission disclosure (CED) reports in 2021. The cluster analysis will divide 30 companies into 3 clusters, namely companies with high, medium, and low carbon emission disclosures. The following are the results of cluster analysis using the carbon emission disclosure dimension processed using SPSS version 26.

Based on the results of the cluster analysis, it can be seen that there are 14 companies in cluster 1 (high), 3 companies in cluster 2 (medium), and 13 companies in cluster 3 (low). This figure illustrates that although many Islamic companies in Indonesia have a high level of carbon emission disclosure, this figure is also balanced by the number of Islamic companies that are low in disclosing carbon emissions. The benchmark is not only based on whether or not the company has disclosed its carbon emissions, but also the number of items published. This can refer to the research of Choi, et al. which describes 18 carbon emission disclosure items and divides them into 5 categories, namely climate change, greenhouse effect, energy consumption, carbon emission accountability, and greenhouse gas reduction.

Differences in the level of carbon emissions disclosure among Islamic companies in Indonesia may be caused by

several complex factors. First, there are differences in the capacity and resources of each company. Large companies with more resources may be better able to carry out a thorough carbon emissions disclosure process as they have access to the necessary infrastructure, technology and personnel to collect and analyze their emissions data. On the other hand, small or medium-sized companies may have limitations in terms of resources, which makes it difficult for them to carry out carbon emissions disclosure to the same extent as large companies.

In addition, the level of awareness and understanding of the importance of carbon emissions disclosure may also vary among Islamic companies. Companies that are more open to environmental issues and have a strong commitment to sustainability may be more likely to actively seek information and make carbon emissions disclosures. On the other hand, companies that pay less attention to environmental issues or consider them a lower priority may not feel the need to disclose carbon emissions as thoroughly or even at all.

Finally, cultural and regulatory factors may also influence the level of carbon emissions disclosure among Islamic companies in Indonesia. Corporate culture, management values, and leadership that support sustainability and environmental responsibility may encourage companies to be more active in carbon emissions disclosure(Choi BB, 2013). On the other hand, a lack of incentives or pressure from less stringent government regulations related to environmental issues may also be an obstacle for companies to voluntarily disclose carbon emissions. Therefore, these factors may collectively lead to differences in the level of carbon emissions disclosure among Islamic companies in Indonesia.

The results can serve as a recommendation for the government to not only encourage companies to disclose carbon emissions but also encourage Islamic companies to disclose their carbon emissions more comprehensively. This can be done through providing incentives and support to increase the awareness and capacity of Islamic companies in terms of measuring, reporting and reducing carbon emissions. In addition, the government could strengthen regulations that require companies to disclose carbon emissions in greater detail, including providing clear guidelines and standards that can be followed by all companies, including sharia-based ones. Doing so will not only improve the transparency and accountability of Islamic companies with regard to their environmental impacts but also enable stakeholders to make more informed and sustainable investment decisions.

Conclusion

Based on the findings, the study concludes that carbon emission disclosure positively and significantly influences the market value of companies listed on the Indonesian Sharia Stock Index (ISSI) from 2016 to 2021. In addition, the research incorporates variables such as earnings per share (EPS), leverage, firm size, and the investor opportunity set (IOS). Regression analysis reveals that both leverage and the IOS exert a substantial impact on firm value, whereas EPS and firm size do not demonstrate a significant effect. Furthermore, cluster analysis classifies the companies into three groups: Cluster 1 comprises 14 companies with high carbon emission disclosure capabilities, Cluster 2 includes 3 companies with moderate capabilities, and Cluster 3 consists of 13 companies with low capabilities.

The implications of these findings extend to three primary stakeholders: companies, government regulators, and investors. For companies, the results suggest that increasing attention to carbon emission disclosure may enhance corporate value and attract more capital inflows from investors. Additionally, for government regulators, the study underscores the necessity for more robust regulatory frameworks and oversight of carbon

emission disclosure, which could encourage companies to adopt more environmentally responsible practices. In this case, the government should not only encourage companies to disclose carbon emissions but also encourage Islamic companies to disclose their carbon emissions more comprehensively. Finally, investors are expected to consider sustainability reports, including carbon emission disclosure reports, because environmental performance can be an indicator of company value that investors can consider in order to obtain higher profits.

The study acknowledges several limitations. Firstly, the process of assigning a carbon emissions disclosure score on the index involves a degree of subjectivity. This subjectivity stems from the fact that a standardized numerical data proxy is not uniformly utilized by all companies featured in ISSI or presented in their sustainability reports. Secondly, the cluster analysis results in this study only include company names so that the range of analysis is still very limited. Therefore, future research is expected to be able to patch up these shortcomings by determining a more objective method of measuring carbon emission disclosure variables to increase the validity of the data used. In addition, it is expected that future research can deepen the cluster analysis by including the company's business sector so that it can be known which company sectors have good carbon emission disclosure capabilities and vice versa. This can clarify the direction of steps that can be taken by the government in supervising companies in relation to disclosure of carbon emissions.

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