Information Asymmetry and Greenwashing: The Moderating Role of Corporate Social Responsibility

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Abstract

Main Purpose: This study examines how information asymmetry influences greenwashing practices in Indonesian public companies and tests the moderating role of Corporate Social Responsibility performance in this relationship.
Method: The research analyzes unbalanced panel data from 95 companies listed on the Indonesia Stock Exchange for the period 2019–2023, comprising 411 observations, as ESG and CSR data for 2024 were not yet available at the time of data collection. A fixed effects regression technique is employed to test the relationships among information asymmetry, CSR, and greenwashing.
Main Findings: The results show that information asymmetry has no significant effect on greenwashing, while CSR significantly moderates this relationship. Firms with higher CSR performance exhibit lower greenwashing levels under conditions of information asymmetry.
Theory and Practical Implications: Regulators need to strengthen CSR frameworks as effective mechanisms for preventing greenwashing, while investors can use CSR performance as an indicator of genuine environmental commitment. Corporate managers should view CSR investments not merely as obligations, but as protective shields for corporate legitimacy that reduce long-term reputational risks.
Novelty: This study introduces a novel contribution by empirically demonstrating that CSR quality moderates the relationship between information asymmetry and greenwashing, a boundary condition that previous studies have not tested, particularly within emerging market environments.
Keywords: Corporate Social Responsibility, Greenwashing, Information Asymmetry, Emerging Markets, Indonesia Stock Exchange.

Abstrak

Tujuan Utama: *Penelitian ini mengkaji bagaimana asimetri informasi memengaruhi praktik greenwashing pada perusahaan publik di Indonesia serta menguji peran moderasi kinerja Corporate Social Responsibility dalam hubungan tersebut.*
Metode: *Penelitian ini menggunakan data panel tidak seimbang dari 95 perusahaan yang terdaftar di Bursa Efek Indonesia selama periode 2019–2023 dengan total 411 observasi. Data tahun 2024 tidak digunakan karena informasi ESG dan CSR belum tersedia pada saat pengumpulan data. Analisis dilakukan menggunakan regresi efek tetap untuk menguji hubungan antara asimetri informasi, CSR, dan greenwashing.*
Temuan Utama: *Hasil penelitian menunjukkan bahwa asimetri informasi tidak berpengaruh signifikan terhadap greenwashing, sementara kinerja CSR terbukti memoderasi hubungan tersebut. Perusahaan dengan tingkat CSR yang lebih tinggi cenderung menampilkan tingkat greenwashing yang lebih rendah ketika menghadapi kondisi asimetri informasi.*
Implikasi Teoretis dan Praktis: *Regulator perlu memperkuat kerangka CSR sebagai mekanisme yang efektif dalam mencegah greenwashing, sementara investor dapat memanfaatkan kinerja CSR sebagai indikator komitmen lingkungan yang autentik. Bagi manajer perusahaan, investasi pada CSR sebaiknya dipandang bukan sekadar kewajiban, tetapi sebagai perlindungan bagi legitimasi perusahaan yang dapat mengurangi risiko reputasi jangka panjang.*
Kebaruan Penelitian: *Penelitian ini memberikan kontribusi baru dengan menunjukkan secara empiris bahwa kualitas CSR memoderasi hubungan antara asimetri informasi dan greenwashing, sebuah kondisi batas yang belum diuji dalam penelitian sebelumnya, terutama di konteks pasar berkembang.*
Kata Kunci*: Tanggung Jawab Sosial Perusahaan, Pencitraan Hijau, Asimetri Informasi, Pasar Berkembang, Bursa Efek Indonesia.*

INTRODUCTION

Public awareness of the importance of protecting and maintaining environmental sustainability continues to grow alongside worsening global environmental conditions. Responding to this trend, companies have begun innovating by creating environmentally friendly products (Netto et al., 2020; Xu et al., 2025), which have been positively received by consumers who are even willing to pay more for these products (Miroshnychenko et al., 2017). Huyen et al. (2025) describes various positive impacts for companies that adopt green values in their products, ranging from competitive advantages, improved financial performance through consumer loyalty, long-term cost efficiency, to government support and strengthened corporate brand image.

However, corporate efforts to pursue profit have instead given rise to greenwashing practices (Ling et al., 2025), namely false or exaggerated claims made by companies regarding their environmental sustainability performance (Freshtriana & Kim, 2025; Meilani & Mutmainah, 2025; Shikha Daga, 2025). Companies engage in greenwashing to reduce costs that should be incurred if they truly implemented green technology, to create an environmentally friendly brand image, or simply to meet minimum regulatory requirements (Frendy et al., 2024; Liu et al., 2023). This practice is viewed negatively by stakeholders because although companies may gain short-term benefits and create an environmentally friendly image, consumers who receive misleading information will find that the products they purchase do not meet expectations, ultimately resulting in the loss of consumer trust (Buttigieg & Pulis, 2024; Yildirim, 2023). This loss of trust has broader impacts, such as hindering the development of truly green industries and harming companies that genuinely implement sustainable practices (Yang et al., 2020).

Greenwashing practices have been documented globally across major corporations. Specifically, consumer and environmental groups launched a formal complaint in November 2023 against Coca-Cola, Danone, and Nestlé before the European Commission over claims that their water bottles were 100% recycled or 100% recyclable (Pant, 2023; Worford, 2023). These claims were deemed misleading because they suggested endless circularity, which is technically impossible, and because actual European recycling rates for PET beverage bottles are estimated at only 55% for the bodies, with only about 30% becoming new bottles (Blenkinsop & Naidu, 2023; Pant, 2023). Furthermore, the claims failed to account for non-recycled components like lids and labels, or the common practice of adding virgin plastic to the bottle body (Pant, 2023; Qureshi, 2023). The use of green imagery insinuating environmental neutrality also contributed to the perception that these single-use plastics were a sustainable choice, thus warranting the halt of such greenwashing practices (Biard, 2023; Worford, 2023).

In Indonesia, similar patterns of alleged greenwashing have emerged. Cases include bottled water companies that claimed to use organic and recyclable packaging despite Indonesia remaining one of the countries with the highest levels of plastic pollution in the oceans (Tempo, 2023). Furthermore, in 2025, the Indonesian Environmental Forum (WALHI) reported 47 cases of environmental crimes and natural resource corruption to the Attorney General's Office, with alleged state losses reaching 437 trillion rupiah (Putra, 2025). This phenomenon reflects weak supervision and enforcement of environmental regulations in Indonesia, which can result in the emergence of information asymmetry, as companies can selectively disclose environmental information to embellish or manipulate their environmental performance (Zheng & Li, 2024). Although 94% of companies on the Indonesia Stock Exchange have published Sustainability Reports in 2023, independent verification for ESG disclosure remains optional (Puspadini, 2025; Sukardi, 2023; Waluyo, 2025). OJK data also shows that only 37% of public companies follow ESG standards, indicating a significant gap between reporting and actual quality disclosure (Sudjono, 2023). This condition widens the space for information asymmetry, where sustainability claims are often not credibly verified. Therefore, research on CSR disclosure quality in moderating the relationship between information asymmetry and greenwashing becomes highly relevant in Indonesia.

The greenwashing cases described above, particularly involving major beverage and consumer goods manufacturers, underscore the relevance of examining this phenomenon in Indonesia's

manufacturing sector. Similar to the global cases, the complexity of manufacturing operations and supply chains creates substantial information asymmetry between management and external stakeholders. As evidenced by the difficulty in verifying recycling rates and material composition in the Coca-Cola, Danone, and Nestlé cases, stakeholders often lack the means to independently validate environmental claims, making this sector particularly vulnerable to greenwashing practices, especially in contexts like Indonesia where regulatory enforcement remains weak (Cherono et al., 2025; Hao et al., 2025; Netto et al., 2020; Şenyapar, 2024; Willy et al., 2023; Zervoudi et al., 2025).

Recent literature has advanced the understanding of the relationships between greenwashing, information asymmetry, and CSR. Prior studies establish that information asymmetry strongly contributes to greenwashing, as knowledge gaps enable firms to exaggerate environmental claims (Wu et al., 2020). Greenwashing is characterized as a deviation between positive environmental communication and actual environmental performance, a practice facilitated by information asymmetry (He et al., 2024). Empirical evidence shows that higher bid–ask spreads, used as proxies for information asymmetry, are associated with greater greenwashing behaviour (He et al., 2024). Furthermore, firms with higher information asymmetry exhibit a stronger negative relationship between ESG disclosure readability and greenwashing (Hu et al., 2024).

Research also highlights the complexity of greenwashing, showing that sustainability communication can involve both deceptive practices and genuine efforts (Dempere et al., 2024). At the same time, CSR disclosure has been shown to reduce information asymmetry and agency costs by increasing transparency and improving investment efficiency (Huang et al., 2023). High-quality sustainability reporting can further reduce information asymmetry through clearer accountability structures (Zhang & Liu, 2022). The systematic review by Zioło et al. (2024) identifies greenwashing as a barrier to circular economy implementation and sustainable development, while Yusif and Hafeez-Baig (2024) highlight the significant influence of stakeholder engagement on CSR disclosure decisions.

However, CSR plays a paradoxical role in corporate environmental communication. On one hand, CSR is viewed as a mechanism that enhances information environments and reduces greenwashing incentives (Dagestani et al., 2025; Junior et al., 2019). CSR engagement has been linked to reduced information asymmetry through improved transparency and stronger internal controls (Wang et al., 2024), and credibility improves when CSR committees are supported by genuine sustainability initiatives (Bosone et al., 2024). Internal stakeholders, including major shareholders and employees, also act as monitors that help prevent opportunistic behaviour such as greenwashing (Dagestani et al., 2025).

On the other hand, emerging evidence shows that voluntary CSR approaches may facilitate greenwashing. Bosone et al. (2024) find that CSR initiatives can be used strategically to conceal unsustainable behaviour. Standalone CSR reports are associated with impression management tactics and are positively related to future corporate misconduct (Reitmaier et al., 2024). Firms may also exaggerate CSR disclosures to improve their public image (Ma & Ahmad, 2024) or use CSR reporting as a legitimacy strategy without undertaking substantive actions (Lubloy et al., 2025).

Unlike earlier studies that focus on the consequences of greenwashing, such as its impact on consumer trust (Chen & Chang, 2013) or green skepticism (Promalessy & Handriana, 2024), this study positions information asymmetry as the central driver of greenwashing. This perspective aligns with agency theory, which argues that information gaps and conflicting interests between managers and stakeholders motivate firms to manipulate environmental communication to either hide poor environmental performance or secure legitimacy (Ghitti et al., 2024; Li et al., 2023). Recent findings by Tham (2023) Tham (2023) indicate that information asymmetry between managers and shareholders drives greenwashing, as unverifiable and low-cost ESG signals create conditions where firms cannot be distinguished before disclosure.

A major research gap remains in the limited empirical examination of CSR's moderating role in the relationship between information asymmetry and greenwashing. The novelty of this study lies in testing whether CSR disclosure quality can weaken the influence of information asymmetry on

greenwashing, thereby identifying the conditions under which CSR practices transform potentially misleading environmental communication into credible signals.

This study uses CSR as a moderating variable to understand the conditions under which the relationship between information asymmetry and greenwashing can be strengthened or weakened. High-quality CSR serves as a monitoring and transparency mechanism that influences the intensity of this relationship. When companies implement transparent CSR disclosure, the incentive to engage in greenwashing under high information asymmetry decreases because stakeholders have better access to information to verify corporate environmental claims (Junior et al., 2019; Zhang & Liu, 2022). Without CSR moderation, it is difficult to explain why some companies with high information asymmetry still refrain from greenwashing, which is addressed through the moderating role of CSR disclosure quality.

The main contribution of this study is to develop a deeper understanding of how CSR moderates the relationship between information asymmetry and greenwashing. It integrates agency, signaling, and legitimacy theories, which are relevant in emerging markets with weak regulatory enforcement. Theoretically, this study extends agency theory by showing that information asymmetry not only creates agency conflicts but also promotes opportunistic behavior such as greenwashing, while CSR acts as a boundary condition that determines when information asymmetry leads to greenwashing. Practically, it provides guidance for managers to use CSR disclosure as a strategy to reduce reputation risks and helps investors and stakeholders identify potential greenwashing. From a policy perspective, this study offers recommendations for Indonesian regulators to strengthen CSR disclosure standards and third-party assurance to minimize information asymmetry and greenwashing practices.

LITERATURE REVIEW

Signaling Theory

Signaling theory, introduced by Spence (1973) Spence (1973), explains how companies communicate information to stakeholders to reduce information gaps about their true qualities. In this research context, signaling theory clarifies how companies use environmental disclosures or CSR reports as signals to demonstrate environmental commitment. However, when the cost of sending such signals is low or unverifiable, companies may issue misleading signals that do not reflect actual environmental performance. This condition allows greenwashing to occur, where companies send positive environmental messages that differ from their real actions (Connelly et al., 2011). Therefore, signaling theory helps explain how information asymmetry enables firms to manipulate stakeholder perceptions through green communication.

Legitimacy Theory

Legitimacy theory posits that companies aim to align their operations with societal norms and expectations to maintain social acceptance. When facing stakeholder pressure on environmental responsibility, companies may engage in symbolic actions rather than substantive improvements to preserve legitimacy. Greenwashing is one such symbolic practice, allowing firms to appear environmentally responsible without real performance changes (Seele & Gatti, 2017). Lubloy et al. (2025) further explain that CSR reports are often used as legitimacy tools to build a socially responsible image. In this research, legitimacy theory provides the rationale for understanding how companies use CSR disclosure to maintain legitimacy while potentially masking poor environmental performance.

Agency Theory

Agency theory, developed by Jensen and Meckling (1976), describes the relationship between principals (investors or stakeholders) and agents (managers), where conflicts of interest arise due to information asymmetry. Managers possess more information about company activities than external stakeholders, which allows them to act opportunistically, including engaging in greenwashing to protect or enhance the firm's image. CSR, in this framework, can function as a monitoring and transparency mechanism that reduces agency conflicts by improving information flow between

managers and stakeholders. Thus, agency theory underpins this study's assumption that information asymmetry drives greenwashing, while CSR can moderate this relationship by enhancing transparency and accountability.

Information Asymmetry

Information asymmetry represents a fundamental imbalance in corporate governance where management possesses superior information compared to external stakeholders. Fasihat et al. (2023) explain that information asymmetry is a condition where company management has more information than stakeholders, creating challenges in corporate oversight and accountability. Wang and Ke (2025) confirm that under these conditions, agents may make decisions based on information unavailable to principals, leading to potential conflicts of interest. This information gap becomes particularly pronounced in environmental reporting where technical complexity, lack of standardized metrics, and limited stakeholder access to operational data create significant verification challenges. Kathan et al. (2025) emphasize that stakeholders frequently lack sufficient information to verify the authenticity of corporate sustainability disclosures.

Corporate Social Responsibility

Corporate Social Responsibility (CSR) represents a company's commitment to manage business operations in ways that produce positive impacts on society and the environment. Chulkov and Wang (2021) describe CSR as a strategic investment through which companies build reputations and establish enhanced information environments. The quality of CSR commitment varies significantly across organizations, ranging from genuine programs with substantial resource allocation and measurable outcomes to symbolic activities that prioritize appearance over substance. Junior et al. (2019) observe that companies with authentic CSR commitment increase transparency in their reporting practices. However, Ma and Ahmad (2024) identify patterns where companies engage in CSR primarily for image enhancement, while Lubloy et al. (2025) explain that some organizations instrumentalize CSR reports as legitimacy strategies without corresponding substantive commitment.

Greenwashing

Greenwashing represents deceptive corporate practices where organizations present misleading information about their environmental performance. Companies engage in greenwashing to reduce costs, create favorable brand images, and respond to stakeholder pressure without substantive environmental improvements (Frendy et al., 2024; Liu et al., 2023). Zheng and Li (2024) observe that companies often engage in selective disclosure practices, strategically choosing environmental information while omitting less favorable data. The consequences extend beyond individual reputation, as consumers experience trust erosion (Buttigieg & Pulis, 2024; Yildirim, 2023), and Yang et al. (2020) emphasize that this creates negative spillover effects harming genuinely sustainable industries.

Hypothesis Development

In line with the theoretical framework, information asymmetry emerges as a key driver of greenwashing, enabling firms to distort their environmental image through selective disclosure. It provides conditions in which managers can exploit information gaps to exaggerate or misrepresent environmental performance, particularly when self-regulatory mechanisms fail to ensure transparency (Bernini & La Rosa, 2023; Bosone et al., 2024). This allows the use of impression management strategies, where companies selectively highlight favourable indicators or use vague sustainability narratives to shape stakeholder perceptions (Leonhardt & Guertler; Lubloy et al.; Sneideriene & Legenzova).

Empirical studies support this reasoning. Zheng and Li (2024) and Lubloy et al. (2025) find that firms with high information asymmetry are more likely to engage in selective disclosure to project a positive image. Kathan et al. (2025) further emphasize that limited stakeholder access to verifiable information fosters an environment conducive to greenwashing. Consistent with agency theory, (He et al., 2024), Duchin et al. (2025), and Wang and Ke (2025) reveal that weak monitoring and greater

information asymmetry enable managers to pursue personal interests through symbolic environmental reporting, often resulting in poorer operational and stock performance. Based on this theoretical and empirical foundation, the following hypothesis is proposed:
Hypothesis 1: Information asymmetry has a positive effect on greenwashing.

The role of CSR in the relationship between information asymmetry and greenwashing presents a complex moderating dynamic that warrants careful examination. Junior et al. (2019) provide foundational evidence that companies seeking to avoid greenwashing allegations strategically increase transparency in their CSR reporting. This transparency serves as a critical mechanism for building stakeholder trust and ensuring alignment between sustainability claims and actual practices. When CSR activities are characterized by high transparency and information accuracy, they can effectively reduce the negative impact of information asymmetry on greenwashing by establishing more reliable communication channels between companies and stakeholders. The argument is further supported by Chulkov and Wang (2021) who demonstrate that genuine CSR investments enable companies to build stronger reputations and reduce information asymmetry through enhanced information environments.

However, empirical evidence also reveals CSR's potential to amplify greenwashing under certain conditions. Ma and Ahmad (2024) reveal how companies motivated by image enhancement tend to exaggerate their CSR reports, transforming what should be a transparency mechanism into a tool for deception. Feghali et al. (2025) identify this pattern as increasingly common, noting that CSR has evolved into a strategic response for companies facing greenwashing allegations. Lubloy et al. (2025) contextualize this behavior within legitimacy theory, explaining that companies instrumentalize CSR reports as legitimacy strategies to project an image of social responsibility without substantive commitment. In such cases, low-quality or symbolic CSR can serve as a vehicle to disguise greenwashing practices and exacerbate the adverse effects of information asymmetry.

This dual nature of CSR suggests that its moderating effect depends critically on quality and transparency. High-quality CSR characterized by genuine commitment and transparent disclosure can weaken the positive relationship between information asymmetry and greenwashing by providing stakeholders with credible information to assess environmental claims. Conversely, low-quality or symbolic CSR may strengthen this relationship by providing additional cover for misleading environmental communications. Based on this nuanced understanding of CSR's dual potential, the researcher formulates the following hypothesis:
Hypothesis 2: CSR can moderate the effect of information asymmetry on greenwashing.

RESEARCH METHOD

This study employs a quantitative approach with a causal associative research design that aims to examine the effect of information asymmetry on greenwashing with CSR as a moderating variable. The population of this study consists of manufacturing companies listed on the Indonesia Stock Exchange (IDX) during the period 2019–2023, as ESG and CSR disclosure data for 2024 were not yet available in the Bloomberg database at the time of data collection. The selection of the manufacturing sector is based on the industry's significant environmental impact, which makes it more prone to greenwashing practices and subject to greater stakeholder pressure to disclose sustainability information.

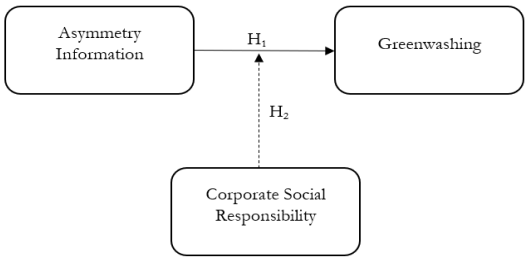

Figure 1. Research Framework

The sampling technique used is purposive sampling with the following criteria: manufacturing companies listed on the IDX during the research period 2019-2023, publishing annual reports, having active stock trading activities for information asymmetry calculation, possessing required financial and non-financial data, and not experiencing delisting during the observation period. This study uses unbalanced panel data which does not require companies to have complete data every year but allows missing observations in some periods, resulting in 411 observations from the five-year research period. According to Baltagi (2021), unbalanced panels occur when some entities are not observed in all time periods, and these are commonly found in empirical research where data collection may face practical constraints.

Table 1. Operational Variable

Variable	Measurement	Source
Information Asymmetry	$Spread_{i,t} = \frac{Ask_{i,t} - Bid_{i,t}}{1/2\left(Ask_{i,t} + Bid_{i,t}\right)}$	Chen and Smith (2024) and Baruffaldi et al. (2024)
Greenwashing	$\text{Greenwashing Score}_{i,t} = \left(\frac{ESG_{Dis\,i,t} - \overline{ESG}_{Dis}}{\sigma_{Dis}}\right) - \left(\frac{ESG_{Real\,i,t} - \overline{ESG}_{Real}}{\sigma_{Real}}\right)$	Yu et al. (2020) and Freshtriana and Kim (2025)
CSR	$CSR_{i,t} = \frac{Jumlah\ item\ yang\ diungkapkan}{Jumlah\ total\ item} x100\%$	García-Sánchez et al. (2022)

The data used in this study are secondary data obtained from company annual reports, sustainability reports, and financial databases from IDX and Bloomberg. The analysis is conducted using panel data regression with Stata software. The model estimation involves Common Effect, Fixed Effect, and Random Effect models, with the most appropriate model determined based on the Chow test, Hausman test, and Lagrange Multiplier (LM) test. Prior to the main analysis, several classical assumption tests are performed, including multicollinearity, heteroscedasticity, and autocorrelation tests (Baltagi, 2021). The main analysis examines the moderating effect of CSR on the relationship between information asymmetry and greenwashing using interaction terms with 5% significance level.

RESULTS

This study uses panel data consisting of manufacturing companies listed on the Indonesia Stock Exchange (IDX) during the period 2019 to 2023. The initial population comprises 228 manufacturing companies. After applying purposive sampling based on data availability and research criteria, several companies were excluded due to incomplete information. Furthermore, observations with spread values equal to zero were removed to maintain data validity. The final sample consists of 95 companies, resulting in 411 firm year observations. The panel data structure is unbalanced, with 58.95 percent of companies having complete data for the entire research period and an average of 4.33 years of observations per company.

Tabel 2. Descriptive Statistical Result

Variable	N	Min	Max	Mean	Std. Deviation
Greenwashing	411	-3.023	2.836	0.002	0.555
Information Asymmetry	411	0.0002	45.918	37.649	17.517
CSR	411	0	70.053	12.532	21.292

Source: Data Processed, 2025

Table 1 presents a summary of descriptive statistics for all research variables. The greenwashing variable has a mean value of 0.002 with a standard deviation of 0.555, indicating that most companies in the sample are not involved in extreme greenwashing practices. The information asymmetry variable (spread) has a mean of 37.649 with a standard deviation of 17.517, indicating that the majority of companies face relatively high levels of information asymmetry. The CSR score variable shows a mean of 12.532 with a standard deviation of 21.292, indicating considerable variability in CSR activities among companies in the sample.

Tabel 3. Multicollinearity Test

Variable	Collinearity Statistic		Decision
	Tolerance	VIF	
Information Asymmetry	0.998	1.002	No Multicollinearity
CSR	0.998	1.002	

Source: Data Processed, 2025

Before interpreting the regression results, this study conducted classical assumptions tests to ensure the validity of the model used. The classical assumptions tests performed include multicollinearity test, autocorrelation test, and heteroscedasticity test. The multicollinearity test was conducted to detect the presence of high correlation among independent variables in the regression model. This test uses Variance Inflation Factor (VIF) values and tolerance as indicators. According to Ghozali (2020), a regression model is considered free from multicollinearity problems if the VIF values are less than 10 and tolerance values are greater than 0.10. The multicollinearity test results show that all independent variables have VIF values below 10 and tolerance values above 0.10. Specifically, the CSR variable has a VIF value of 1.002 with tolerance of 0.998, while the AI variable has a VIF value of 1.002 with tolerance of 0.998. These results indicate that there are no serious multicollinearity problems in the research model.

Tabel 4. Autocorrelation Test

Durbin Watson			Decision
Du	**DW**	**Du**	
1.78	1.851	2.22	No Autocorrelation

Source: Data Processed, 2025

The autocorrelation test aims to examine whether there is correlation between error terms at period t and error terms at period t-1 (previous period) in the linear regression model (Ghozali, 2020). The autocorrelation test in this study uses the Durbin-Watson test. The Durbin-Watson test results show a value of 1.851. With 411 observations (n) and 2 independent variables (k), the upper critical value (dU) from the Durbin-Watson table at 5% significance level is approximately 1.78. Since the calculated DW value of 1.851 is greater than dU (1.851 > 1.78) and less than 4-dU (1.851 < 2.22), it falls within the no autocorrelation region. Therefore, the regression model in this study is free from autocorrelation problems, meaning the assumption of independence among residuals is met.

Tabel 5. Heteroscedasticity Test

Test Method	Value	Sig.	Decision
Modified Wald Test	80,002.52	0.00	Heteroscedasticity detected

Source: Data Processed, 2025

The heteroscedasticity test was conducted to examine whether there is inequality of variance from residuals between one observation and another in the regression model. Based on the analysis results using the Modified Wald Test for fixed effects model, significant heteroscedasticity problems were found with a chi-square value of 80,002.52 and p-value of 0.0000 ($p < 0.05$). This indicates that error variance is not constant across company observation units, which is a condition that often occurs in panel data due to heterogeneous company characteristics. To address this heteroscedasticity problem, this study uses cluster-robust standard errors approach. The use of cluster-robust standard

errors represents a cornerstone of robust statistical inference in empirical analysis, explicitly addressing methodological challenges like heteroscedasticity (Baltagi, 2021). This method was chosen because it does not change the regression coefficients but provides consistent and valid standard errors despite the presence of heteroscedasticity, ensuring the reliability of statistical inference in the presence of complex error structures commonly found in panel data (Abadie et al., 2023; Imbens & Kolesár, 2016).

Tabel 6. Hausman Test

Effect	Statistic	Sig	Decision
Cross Section Random	134.64	0.00	Fixed Effect

Source: Data Processed, 2025

After completing the classical assumption tests, to ensure that the data meet the requirements for regression analysis, the next step is to determine the most suitable model for panel data estimation. The data are processed using Stata software, which enables analysis across companies and time periods. In panel data analysis, three possible models can be applied, namely the Common Effect Model, the Fixed Effect Model, and the Random Effect Model. Model selection is usually based on several specification tests, such as the Chow Test to compare the Common Effect and Fixed Effect models, and the Hausman Test to select between the Fixed Effect and Random Effect models. However, in this study, the Chow Test was not conducted because the characteristics of the data indicate the presence of firm-level differences that make the Common Effect Model unsuitable (Abadie et al., 2023; Baltagi, 2021). The Hausman Test result shows a probability value of 0.0000, which is smaller than the significance level of 0.05, indicating that the Fixed Effect Model is the most appropriate model for this research.

Tabel 7. Regression Test Result

Variables	Direct Effect	Moderation Effect
Information Asymmetry	-0.002	0.000
CSR	-	0.056
IA*CSR	-	-0.0002
Model Statistic		
R^2 (Within)	0.003	0.332
F-Statistic	0.82	51.90
Prob>F	0.366	0.000
Model Type		Fixed Effect

Source: Data Processed, 2025

The direct effect model shows that information asymmetry does not significantly influence greenwashing. The coefficient is −0.002 with a probability value of 0.366, indicating that the effect is statistically insignificant. The within R squared of 0.003 also suggests that the model has very low explanatory power. These findings imply that information asymmetry alone is not sufficient to explain variations in greenwashing behavior among companies.

In contrast, the moderation model provides stronger results. The interaction between information asymmetry and corporate social responsibility has a coefficient of −0.0002 with a probability value of 0.017, showing a significant moderating effect. This indicates that corporate social responsibility reduces the influence of information asymmetry on greenwashing. The model's explanatory power increases substantially, with the within R squared rising to 0.332. The F statistic of 51.90 with a probability value of 0.000 confirms that the moderation model is statistically significant. Since the estimation uses the fixed effect model, the results are consistent with the presence of firm-specific characteristics that need to be controlled.

DISCUSSION

The first hypothesis predicts that information asymmetry has a positive effect on greenwashing. This prediction is grounded in the premise that company management typically possesses broader access to information compared to stakeholders (Fasihat et al., 2023; Wang & Ke, 2025). Such information gaps theoretically create opportunities for greenwashing practices, as stakeholders lack direct capability to verify environmental claims made by companies (Kathan et al., 2025). Information asymmetry can erode corporate transparency, making it difficult for stakeholders to distinguish between authentic sustainability commitments and merely symbolic marketing strategies (Geetha et al., 2024; Liu et al., 2023). However, the test results in Table 5 show a spread variable coefficient of -0.00186 with a p-value of 0.366 (> 0.05), indicating that information asymmetry does not significantly affect greenwashing. Even the direction of the coefficient shows a negative relationship that contradicts the hypothesis prediction. Therefore, the first hypothesis in this study is rejected.

The rejection of the first hypothesis, despite its theoretical foundation, can be explained through the interplay of three complementary theoretical perspectives that highlight the changing dynamics of corporate transparency and accountability. According to Signaling Theory developed by Spence (1973), the contemporary business environment has fundamentally shifted the cost-benefit calculus of exploiting information asymmetry. In today's digital and social media era, environmental claims can be easily verified and widely shared by various stakeholders (Forliano et al., 2025), significantly increasing the reputational risks of being caught greenwashing (Liang & Gao, 2025). This transformation encourages companies to prioritize credible, verified signals over opportunistic exploitation of information gaps to protect their long-term reputation. This statement aligns with research from Lin et al. (2025) demonstrate that while greenwashing may yield short-term benefits such as enhanced brand image or increased market share, these practices inevitably result in severe long-term consequences including legal liabilities, reputational damage, and financial instability. Similarly, Cheng (2025) reveals that companies engaging in greenwashing may achieve transient financial gains, but the ultimate costs, manifested through brand deterioration, diminished shareholder returns, and heightened legal risks, far exceed initial expectations.

Agency Theory (Jensen & Meckling, 1976) further illuminates why information asymmetry fails to drive greenwashing in the Indonesian context. Strengthened monitoring mechanisms by stakeholders and regulators have considerably raised the agency costs of engaging in greenwashing practices. In Indonesia specifically, sustainability reporting regulations such as OJK Regulation No. 51/POJK.03/2017 on the Implementation of Sustainable Finance and POJK No. 60/POJK.04/2017 on the Implementation of Sharia Principles in Capital Markets for Sharia Securities establish robust monitoring frameworks. Within this regulatory architecture, where monitoring costs are minimal and detection probability is elevated, rational managers are deterred from engaging in behavior that could personally harm their professional standing and credibility (Jensen & Meckling, 1976; Wang & Ke, 2025).

Complementing these perspectives, Legitimacy Theory (Suchman, 1995) suggests that in an institutional environment increasingly focused on environmental and sustainability issues, companies direct their legitimacy-building efforts toward real actions rather than superficial image management based on information asymmetry. Legitimacy gained from genuine environmental efforts tends to be more lasting and resilient than that obtained through information manipulation (Suchman, 1995). This assertion is supported by recent studies showing that although companies often use misleading disclosures to build a favourable image and gain legitimacy, such strategies are unstable and easily undermined (Forliano et al., 2025; Santos et al., 2023). Liang and Gao (2025) also find that greenwashing weakens organizational legitimacy, leading to lower stakeholder trust, reputational harm, and negative financial outcomes. Similarly, Munaier et al. (2022) report that consumers quickly withdraw their trust and reduce purchase intentions once they discover that supposed sustainability claims are actually greenwashing, with these reputational effects lasting beyond short-term sales (Ibrahim Nnindini & Dankwah, 2024). Furthermore, Indonesian firms operating globally face increasing

pressure from international standards such as the Global Reporting Initiative (Angrist & Pischke, 2009) and Sustainability Accounting Standards Board (SASB) which require comprehensive and verified disclosure (Crossley et al., 2021; Emma et al., 2024; Sun et al., 2022).

The results of this study are consistent with several recent findings showing a declining tendency for companies to engage in greenwashing regardless of information asymmetry levels. Forliano et al. (2025) found that less sophisticated forms of greenwashing are declining due to increased stakeholder awareness and new monitoring technologies. Liang and Gao (2025) show that institutional pressure creates significant regulatory oversight of companies that are excessive in stating environmental commitments.

Conversely, while Cao et al. (2022) found that information asymmetry can drive greenwashing strategies, the results of this study show that in the Indonesian regulatory context, information asymmetry does not automatically drive greenwashing practices. This difference in findings indicates that the influence of information asymmetry on greenwashing is highly dependent on specific institutional and regulatory contexts. The regulatory framework in Indonesia, including sustainability reporting requirements, may create conditions where companies are more cautious in exploiting information asymmetry for greenwashing purposes due to potential reputational and regulatory risks.

The second hypothesis predicts that CSR moderates the effect of information asymmetry on greenwashing. This prediction builds on the understanding that CSR's moderating role is complex and context-dependent. While high-quality CSR with strong transparency can reduce information asymmetry and build stakeholder trust (Junior et al., 2019; Mhiri et al., 2025), CSR can also be employed as a legitimacy strategy to disguise greenwashing practices when implemented symbolically (Feghali et al., 2025; Lubloy et al., 2025; Ma & Ahmad, 2024). Therefore, CSR quality and transparency become critical determining factors. Companies with substantial CSR investments typically develop stronger governance mechanisms and face greater stakeholder monitoring (Anwar & Idris, 2025), which consequently increases the reputational risks of engaging in deceptive environmental claims (Cao et al., 2022). The test results reveal that CSR plays a significant moderating role in this relationship. The interaction coefficient (AI × CSR) is -0.000192 with a p-value of 0.017 (< 0.05), indicating that CSR significantly moderates the effect of information asymmetry on greenwashing. Specifically, CSR weakens this relationship in a negative direction, suggesting that higher CSR performance reduces the tendency of firms to exploit information asymmetry for greenwashing. Thus, the second hypothesis in this study is supported.

The acceptance of this hypothesis can be explained through the interplay of three complementary theoretical perspectives that highlight CSR's role as a protective mechanism against opportunistic greenwashing behaviour. From Signaling Theory (Spence, 1973), companies with high CSR investments have transmitted credible signals to stakeholders regarding their authentic commitment to sustainability. This statement aligns with the findings of Mhiri et al. (2025), Pinto and Gaio (2025), and Anwar and Idris (2025) who demonstrate that enhanced CSR initiatives and strong ESG performance can mitigate information asymmetry and agency costs. Such efforts generate reputational capital that is costly and time-consuming to build. Consequently, firms that have invested substantially in credible CSR signaling face high opportunity costs when engaging in greenwashing, as it risks eroding their reputation and stakeholder trust.

Agency Theory (Jensen & Meckling, 1976) explains that substantial CSR investments create agency mechanisms that discourage managers from engaging in greenwashing. Anwar and Idris (2025) find that CSR reduces information asymmetry and agency conflicts by improving transparency and ethical conduct. Specifically, CSR investments generate sunk costs that would be lost through greenwashing, foster stronger governance structures such as sustainability committees and external audits (Jensen & Meckling, 1976; Wang & Ke, 2025) and align managerial incentives with stakeholder interests through sustainability-linked compensation.

Legitimacy Theory (Suchman, 1995) further explains these findings through the logic of legitimacy maintenance. Companies with strong CSR commitments gain moral and pragmatic legitimacy from stakeholders, making them less willing to risk this legitimacy capital through

greenwashing. Cao et al. (2022) how that CSR functions as an effective governance mechanism by reducing information asymmetry and improving corporate transparency. Recent research also finds that firms with high CSR performance face severe "hypocrisy penalties" when they engage in greenwashing, as stakeholders react more strongly to such inconsistencies than they do toward low-CSR firms. These reputational effects often extend beyond short-term market performance (Spaniol et al., 2024). Persakis et al. (2025) emphasize that transparency and authenticity are crucial to rebuild trust and support genuine sustainability efforts. Therefore, companies with substantial legitimacy capital tend to protect their legitimacy by avoiding greenwashing practices.

These findings align with recent research. Pinto and Gaio (2025) found that overall corporate ESG performance reduces information asymmetry, with environmental and social pillars independently contributing to this significant relationship. Spaniol et al. (2024) reinforces these findings by showing that companies with strong environmental commitments face higher reputational risks when engaging in symbolic actions without substance.

Collectively, these studies demonstrate that CSR functions as a protective mechanism against greenwashing through multiple pathways. Companies with substantial CSR investments face higher costs when engaging in greenwashing, both economically and reputationally, as they risk losing accumulated legitimacy capital and face intensified stakeholder scrutiny. This protective effect operates through internal mechanisms such as enhanced monitoring and accountability systems, as well as external mechanisms including stakeholder expectations and reputational consequences. The consistency of these findings across different theoretical frameworks strengthens the conclusion that CSR effectively moderates the relationship between information asymmetry and greenwashing.

Robustness Test

Tabel 8. Heteroscedasticity Test Result

Test Method	Value	Sig.	Decision
Modified Wald Test	80,002.52	0.00	Heteroscedasticity detected

Source: Data Processed, 2025

To ensure the reliability of the main findings, the researchers conducted a series of robustness tests using alternative estimation approaches. This step is important given that the Modified Wald test detected significant heteroscedasticity in the fixed effect model (chi square = 80,002.52; $p < 0.001$), consistent with findings from other panel data studies using firm level data (Petersen, 2008). The presence of heteroscedasticity indicates that error variance is not constant across firms, thus standard errors need to be corrected to produce valid statistical inference (White, 1980).

Tabel 9. Robustness Test Result

Variables	Main Model	Cluster-Robust SE	Driscoll-Kraay SE
Information Asymmetry	0.000	0.000	0.000
CSR	0.056	0.056	0.056
IA*CSR	-0.0002	-0.0002	-0.0002
Constant	-0.611	-0.611	-0.611

Source: Data Processed, 2025

In response to this issue, the researchers re estimated the research model with cluster robust standard errors at the firm level, following the recommendations of Colin Cameron and Miller (2015) for panel data. This approach allows for correlated error structures within the same firm over time, while simultaneously correcting for heteroscedasticity and autocorrelation problems (Angrist & Pischke, 2009). The estimation results show consistency with the main research findings. The coefficients and direction of relationships for key variables remain stable, although there are slight differences in statistical significance levels due to more conservative standard errors, which is common in heteroscedasticity correction (Wooldridge, 2010).

The researchers also employed the Driscoll Kraay standard errors method, which can correct for cross sectional dependence and autocorrelation in panel data (Driscoll & Kraay, 1998). This method is relevant for firm data that may experience similar shocks or industry trends during the same time period, which can cause error correlation across firms (Hoechle, 2007). The estimation results using Driscoll Kraay standard errors (lag 1) show findings consistent with the main model, particularly the moderating effect of CSR on the relationship between information asymmetry and greenwashing remains statistically significant.

Tabel 10. Marginal Effects of Information Asymmetry at Different CSR Levels

CSR Level	CSR Score	Marginal Effect of Spread	Interpretation
10th Percentile	0.00	0.0000	Stronger effect
25th Percentile	0.00	0.0000	Stronger effect
50th Percentile (Median)	0.00	0.0000	Moderate effect
75th Percentile	26.16	-0.0050	Weaker effect
90th Percentile	53.40	-0.0103	Much weaker effect

Source: Data Processed, 2025

To gain deeper understanding of the moderating effect of CSR, the researchers calculated marginal effects of information asymmetry at various levels of CSR disclosure, following the approach of Brambor et al. (2006) in interpreting interaction effects. The results reveal an interesting pattern: at low CSR levels (10th percentile: CSR = 0; 25th percentile: CSR = 0), the effect of information asymmetry on greenwashing is relatively stronger. As CSR disclosure increases (75th percentile: CSR = 26.16; 90th percentile: CSR = 53.40), the effect of information asymmetry on greenwashing becomes weaker. This finding provides more nuanced empirical evidence regarding the role of CSR as a mechanism that can reduce greenwashing practices amid high information asymmetry conditions, consistent with legitimacy theory arguments that better CSR disclosure increases transparency and reduces room for companies to engage in greenwashing (Cho et al., 2015; Suchman, 1995).

Overall, the various robustness tests conducted demonstrate that the main findings of this study are consistent and not sensitive to alternative model specifications. This consistency of results increases confidence in the validity of the findings that information asymmetry affects greenwashing, and that better CSR disclosure can weaken this relationship.

CONCLUSION

This study concludes that information asymmetry does not directly influence greenwashing behavior among Indonesian public companies, which contradicts the predictions of agency theory suggesting that information gaps should enable opportunistic disclosure practices. However, the findings show that corporate social responsibility significantly moderates this relationship. Firms with stronger commitments to corporate social responsibility are less likely to exploit information gaps for misleading environmental claims, as their reputational capital and governance practices increase the cost of deceptive behavior. These results contribute to the theoretical integration of agency, signaling, and legitimacy perspectives by demonstrating that the influence of information asymmetry on greenwashing depends on a firm's authentic engagement with social responsibility rather than functioning as an independent driver.

From a practical and policy standpoint, the findings emphasize the importance of strengthening genuine corporate social responsibility initiatives to mitigate the risk of misleading environmental disclosure. They also suggest that Indonesia's regulatory environment and market mechanisms may already limit direct opportunistic behavior, although enhancing the quality and verification of sustainability reporting could further reduce greenwashing practices. This study is limited by its reliance on secondary data and the availability of sustainability-related information, which may not fully capture the qualitative dimensions of corporate practices. The focus on manufacturing companies in Indonesia may also restrict the generalizability of the results. Future

research could incorporate additional industries, qualitative evaluations, or other moderating and mediating variables that shape the relationship between information asymmetry and greenwashing.

SUGGESTION

The findings of this study provide several practical implications. Regulators such as the Financial Services Authority and the Indonesia Stock Exchange are encouraged to introduce mandatory corporate social responsibility disclosure with clear and measurable environmental indicators, because firms with stronger corporate social responsibility commitments show lower tendencies toward greenwashing in the empirical results. Standardized metrics and independent verification would narrow the space for selective reporting. Investors can also incorporate corporate social responsibility performance into screening processes, as companies with stronger corporate social responsibility demonstrate more credible environmental behaviour. For corporate managers, strengthening corporate social responsibility programs and improving disclosure quality can reduce information asymmetry and lower reputational risks, given the moderating role of corporate social responsibility observed in this study.

From a theoretical perspective, the absence of a direct relationship between information asymmetry and greenwashing indicates that agency theory alone cannot fully explain corporate environmental behaviour. The significant moderating effect of corporate social responsibility suggests that environmental disclosure practices are better understood through an integrated framework involving agency, signaling, and legitimacy theory.

This study acknowledges several limitations. Greenwashing is measured using disclosure-based indicators, which may not capture actual environmental performance. Although mixed-method designs combining interviews, field assessments, or environmental audits could provide deeper insights, such approaches require extensive direct access to companies and data that were beyond the scope of this study due to time, resource, and accessibility constraints. The sample focuses only on Indonesian manufacturing firms, so the results may not apply to other sectors or countries with different regulatory environments. While a longer observation period may capture more structural changes in sustainability practices, this study was limited by the availability of consistent environmental disclosure data. Future research should therefore expand the dataset, include additional industries and countries, and employ more comprehensive methods when adequate data and access are available.

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