

The Effect of Implementing the ISO 14001 on Stock Price Crash Risk Moderated by Firm’s Environmental Commitment among Indonesian Companies During the 2022-2024 Period

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Abstract. *This study aims to analyze the effect of ISO 14001 implementation on stock price crash risk with environmental commitment as a moderating variable among non-financial companies listed on the Indonesia Stock Exchange during the 2022–2024 period. This research employs a quantitative approach using panel data regression with the fixed effect model and robust standard errors. Stock price crash risk is measured using NCSKEW, DUVOL, and CRASH proxies, while environmental commitment is proxied by Scope 3 carbon emission disclosure. The results indicate that ISO 14001 implementation does not have a significant effect on stock price crash risk across all measurement proxies. Furthermore, Scope 3 disclosure and the interaction between ISO 14001 and Scope 3 are also not proven to moderate the relationship with stock price crash risk. This study is expected to contribute to the literature on environmental factors and stock price crash risk, as well as provide consideration for companies and regulators in improving environmental transparency.*

Keywords: ISO 14001, stock price crash risk, firm’s environmental commitment

INTRODUCTION

Indonesia’s economic growth has accelerated in recent decades alongside the expansion of industrial activities and investment. According to the Indonesian Central Bureau of Statistics (BPS), the national economy grew by 5.11% in 2025, higher than the 5.03% growth recorded in the previous year, while GDP per capita reached IDR 83.7 million or approximately USD 5,083.4 (BPS, 2025). Although this growth reflects increasingly dynamic economic activities, particularly in the service and export sectors, it has also intensified environmental pressures such as air and water pollution as well as natural resource degradation. This condition is further reflected in Indonesia’s relatively low environmental performance ranking. Based on the Environmental Performance Index (EPI) 2024, Indonesia ranked 163rd out of 180 countries globally, with a score of 33.6. These challenges have encouraged the government and institutions to develop various environmental management instruments, including mandatory mechanisms such as AMDAL and PROPER, as well as voluntary frameworks such as ISO 14001 and sustainability reporting based on the Global Reporting Initiative (GRI).

Among these instruments, ISO 14001 holds a more strategic role because it emphasizes the company’s internal environmental management system rather than merely disclosure and reporting. Unlike GRI, which focuses on sustainability transparency, ISO 14001 prioritizes operational processes and environmental control within corporate activities. Consequently, ISO 14001 is no longer viewed solely as a compliance tool but also as a strategic mechanism for improving operational efficiency and environmental performance.

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The standard provides guidance for companies to identify, control, and continuously improve their environmental impact while ensuring regulatory compliance and enhancing stakeholder engagement (International Organization for Standardization, 2015).

The implementation of ISO 14001 in Indonesia has shown an increasing trend despite some fluctuations. Data from Badan Pusat Statistik (BPS) indicate that the number of ISO 14001-certified companies increased from 2,197 firms in 2017 to 2,729 firms in 2021, although there was a temporary decline in 2018. This upward trend reflects growing corporate awareness of environmental sustainability and stronger pressure from regulators, investors, and stakeholders for greener business practices. However, the number of certified companies remains relatively small compared to the total number of businesses operating in Indonesia, indicating that ISO 14001 adoption is still uneven, particularly among small and medium-sized enterprises.

Corporate adoption of ISO 14001 is driven by multidimensional motivations involving economic efficiency, sustainability commitments, and corporate legitimacy. Internally, companies implement ISO 14001 to improve operational efficiency, optimize resource utilization, and reduce waste, which may ultimately enhance profitability (Song, Shin, & Sam, 2026). At the same time, ISO 14001 serves as a credible signal that strengthens corporate reputation, stakeholder trust, and competitive advantage in markets that increasingly emphasize sustainable business practices (Al-Kahlout, Al-Yaqout, & Khan, 2019). From a financial perspective, ISO 14001 certification may reduce debt financing costs and enhance firms' long-term financial performance by improving investor confidence and reducing environmental risk (Wu, An, Wu, Tsai, & Yang, 2020). Nevertheless, companies often encounter substantial initial implementation costs, including expenses related to consultancy, employee training, system development, certification, and internal resource allocation (Camilleri, 2022).

The dynamics of ISO 14001 implementation differ significantly across countries depending on institutional and economic contexts. In developed economies with strong environmental awareness, ISO 14001 is often associated with stronger market expectations and greater investor attention toward sustainable business practices. In contrast, in many developing countries, including Indonesia, implementation tends to be influenced more strongly by external pressures such as government regulations, export requirements, and global supply chain demands rather than domestic market awareness (Mariotti, Kadasah, & Abdulghaffar, 2014). These differences create varying institutional settings and motivations that may influence how ISO 14001 interacts with information asymmetry and corporate reporting practices.

This issue is closely related to stock price crash risk, which refers to the risk of extreme and sudden declines in stock prices that can generate substantial losses for investors within a short period. Indonesia's capital market has experienced several major crash episodes, including the Asian Financial Crisis in 1997–1998, the Global Financial Crisis in 2008, and the COVID-19 pandemic in 2020. In the current era of global uncertainty, stock price crash risk not only threatens investors but may also undermine financial market stability (Liang, Liang, Wang, & Zhao, 2025). Theoretically, stock price crash risk is rooted in information asymmetry and agency conflicts. Managers may engage in bad news hoarding by concealing negative information to protect personal incentives and career stability (J. B. Kim, Li, & Zhang, 2011b). When accumulated hidden information eventually becomes public, it may trigger a sharp stock price collapse.

The relationship between ISO 14001 and stock price crash risk remains theoretically ambiguous. From an agency conflict perspective, ISO 14001 may increase crash risk if managers exploit the certification as a form of greenwashing to conceal unfavorable information, especially in weak institutional environments (Alsadan, 2025). On the other hand, signaling and legitimacy theories argue that ISO 14001 can reduce crash risk by enhancing transparency, environmental credibility, and investor trust, thereby reducing information asymmetry and stabilizing stock prices (Li, Liu & Guo, 2025; Yang et. al, 2024). Therefore, the ultimate impact of ISO 14001 depends on which mechanism dominates, namely whether the certification is implemented substantively or merely symbolically.

Previous empirical studies on the relationship between ISO 14001 and stock price crash risk have produced inconsistent findings. Alsadan (2025) found a positive relationship driven by information hoarding behavior, while Yang et. al (2024) reported no significant direct effect because the relationship was mediated by environmental performance and firm visibility. These contradictory findings indicate that the causal mechanisms and moderating factors influencing the relationship remain insufficiently

understood. Therefore, this study offers significant novelty by specifically examining the relationship between ISO 14001 and stock price crash risk in the Indonesian context, which represents a developing market with unique institutional characteristics, regulatory environments, and capital market dynamics that differ substantially from those of developed countries or other large emerging economies.

LITERATURE REVIEW

ISO 14001 Certifications

ISO 14001 is an internationally recognized environmental management system (EMS) standard developed by the International Organization for Standardization to assist organizations in managing environmental impacts and improving environmental performance continuously. The standard was first introduced in 1996 following increasing global concern over environmental sustainability after the 1992 Earth Summit in Rio de Janeiro. ISO 14001 adopts a systematic management framework based on the Plan-Do-Check-Act (PDCA) cycle, enabling organizations to integrate environmental considerations into operational and strategic decision-making (ISO, 2015). Over time, revisions of ISO 14001, particularly the 2015 version, incorporated a risk-based approach and life-cycle perspective to strengthen sustainability practices and organizational resilience.

Previous literature highlights that ISO 14001 certification provides various operational and environmental benefits for organizations. Studies indicate that certified firms generally achieve better environmental performance, improved waste management, enhanced energy efficiency, and stronger compliance with environmental regulations (Ong, Teh, Ng, & Soh, 2016). In addition, ISO 14001 encourages organizations to establish structured environmental procedures and continuous improvement mechanisms, which may improve operational efficiency and reduce environmental risks. These benefits contribute to stronger organizational legitimacy and stakeholder trust, particularly among environmentally conscious investors and consumers.

Compared with broader sustainability measurements such as ESG (Environmental, Social, and Governance), ISO 14001 is considered more specific and verifiable because it focuses directly on environmental management practices and requires independent certification audits (da Fonseca, 2015). ESG ratings often differ across rating agencies due to variations in assessment methodologies and disclosure standards, whereas ISO 14001 follows standardized operational requirements. Consequently, several studies suggest that ISO 14001 more consistently reflects substantive environmental management implementation within firms (Tran, Lu, & Kweh, 2024). Furthermore, certification may improve international competitiveness and facilitate access to global markets (Silva, 2024).

The relationship between ISO 14001 and corporate financial performance has produced mixed empirical findings. Some studies report positive effects of ISO 14001 on profitability, return on assets, market value, and operational efficiency, particularly in developed countries with strong environmental awareness (Noh, 2019; Treacy, Humphreys, McIvor, & Lo, 2019). Investors may interpret ISO 14001 certification as a positive signal of sustainability commitment, effective governance, and lower environmental risk exposure (Lee, Noh, Choi, & Rha, 2017). However, evidence from several emerging markets shows that ISO 14001 implementation may initially reduce profitability due to high compliance and certification costs, limited institutional support, and operational adjustments required during implementation (Riaz, Saeed, Liedong, & Rajwani, 2022; Wang & Zhao, 2020). Therefore, the financial outcomes of ISO 14001 vary depending on firm characteristics, industry context, and institutional conditions.

Theoretical perspectives such as agency theory, signalling theory, and legitimacy theory provide explanations for the diverse impacts of ISO 14001. From an agency perspective, ISO 14001 may reduce information asymmetry and improve monitoring by strengthening transparency and environmental governance (Darnall, 2006). Signalling theory suggests that certification functions as a credible signal of environmental responsibility and sustainability orientation to investors and stakeholders (Riillo, 2025). Nevertheless, several studies warn that ISO 14001 may also be implemented symbolically as a greenwashing strategy without substantive environmental improvements, potentially reducing the

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credibility and effectiveness of the certification (Torelli, Balluchi, & Lazzini, 2019; Yang, Chen, et al., 2024).

Stock Price Crash Risk

Stock price crash risk refers to the probability of a sudden and significant decline in stock prices caused by the accumulation and delayed disclosure of negative information within firms. The concept is strongly associated with agency theory, which argues that managers may conceal unfavorable information from shareholders to protect personal interests such as compensation, reputation, and career stability (Jin & Myers, 2006). This behavior creates information asymmetry between managers and investors, increasing the likelihood of abrupt stock price corrections once the hidden information is eventually disclosed to the market. Therefore, bad news hoarding is widely recognized as a core mechanism underlying stock price crash risk.

Previous studies identify numerous determinants of stock price crash risk related to managerial incentives, corporate governance, financial reporting quality, and market conditions. Research indicates that tax avoidance practices, earnings management, aggressive accounting policies, and excess managerial perks may intensify crash risk by facilitating the concealment of bad news (Hutton, Marcus, & Tehranian, 2009; J. B. Kim, Li, & Zhang, 2011a). Conversely, strong governance mechanisms such as independent boards, high audit quality, and effective monitoring systems can improve transparency and reduce information asymmetry, thereby mitigating crash risk (Chae & Hwang, 2017). Market-related factors such as investor sentiment, stock liquidity, and economic uncertainty are also found to influence the probability of stock price crashes.

The measurement of stock price crash risk commonly relies on statistical indicators such as Negative Conditional Skewness (NCSKEW) and Down-to-Up Volatility (DUVOL). NCSKEW measures the asymmetry of stock return distributions toward extreme negative returns, while DUVOL captures the dominance of volatility during negative-return periods relative to positive-return periods (Chen, Hong, & Stein, 2001). These measures are widely adopted in empirical research because they effectively capture left-tail risk and sudden crash tendencies that may not be reflected in conventional volatility indicators. Studies further suggest that firms with higher information opacity and weaker governance structures tend to exhibit more negative skewness and higher crash risk persistence over time (Kim et al., 2011b).

More recent literature increasingly examines the relationship between sustainability-related factors and stock price crash risk. Corporate social responsibility (CSR), environmental disclosure, and ESG practices are often associated with lower crash risk because they improve transparency, reduce information asymmetry, and strengthen stakeholder trust (J. Jin, Liu, Zhang, & Zhao, 2022; Y. Kim, Li, & Li, 2014). Environmental performance and sustainability initiatives may also serve as positive signals that enhance investor confidence and corporate reputation. However, some studies argue that CSR and environmental initiatives can also be used opportunistically as symbolic legitimacy tools or greenwashing mechanisms to conceal poor performance, thereby potentially increasing stock price crash risk (Dumitrescu & Zakriya, 2021).

Research specifically examining the relationship between ISO 14001 and stock price crash risk remains relatively limited and produces inconsistent findings. Some studies report that ISO 14001 reduces crash risk by improving environmental transparency, governance quality, and stakeholder trust, particularly among heavily polluting firms (Liu, Binbin, & Qiao, 2024). In contrast, other studies find that ISO 14001 may increase crash risk when firms use certification symbolically without substantive environmental commitment, consistent with greenwashing arguments derived from agency theory (Alsadan, 2025). Additionally, several studies conclude that ISO 14001 may not directly affect crash risk but instead moderates the relationship between environmental performance and crash risk (Yang, Chen, et al., 2024). These contradictory findings indicate that the impact of ISO 14001 on stock price crash risk remains inconclusive and warrants further investigation, particularly regarding the role of corporate environmental commitment and governance quality.

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Hypotesis Development

ISO 14001 represents a formal corporate commitment to implementing a standardized environmental management system. From the perspective of agency theory, ISO 14001 certification may reduce information asymmetry by improving environmental transparency, strengthening monitoring mechanisms, and encouraging more structured environmental management practices (Darnall, 2006). Firms that effectively implement ISO 14001 are expected to improve disclosure quality and reduce managerial incentives to conceal negative information, thereby lowering stock price crash risk. In addition, the certification may enhance corporate reputation and investor confidence because it signals environmental responsibility and compliance with sustainability standards (Riillo, 2025).

However, the effectiveness of ISO 14001 in reducing stock price crash risk remains debatable. Agency theory suggests that managers may use ISO 14001 symbolically as a legitimacy tool or greenwashing mechanism without implementing substantive environmental improvements. Under such conditions, managers may exploit the positive “green” image associated with ISO 14001 to conceal operational weaknesses or environmental problems from investors. This behavior increases information asymmetry and enables bad news hoarding practices, where unfavorable information is withheld until it reaches a critical level (Jin & Myers, 2006).

The accumulation of undisclosed negative information may eventually trigger sudden and significant stock price declines once the information becomes publicly available through environmental scandals, regulatory investigations, or negative media exposure (Hutton et al., 2009). The risk may become more severe in markets with weaker investor protection and lower monitoring quality, where firms have greater opportunities to engage in symbolic environmental practices. In this context, greenwashing practices associated with ISO 14001 may weaken investor trust and intensify stock price crash risk once discrepancies between environmental claims and actual performance are revealed (Wen & Wang, 2025).

Based on the theoretical arguments and empirical findings above, the relationship between ISO 14001 and stock price crash risk remains inconclusive. While ISO 14001 may improve transparency and reduce crash risk, symbolic implementation may instead increase information asymmetry and market distrust. Therefore, this study proposes the following hypothesis:

H₁: ISO 14001 has a significant effect on stock price crash risk.

Corporate environmental commitment reflects the extent to which firms integrate environmental sustainability into their governance, strategy, and operational activities (Gerged, Albitar, & Al-Haddad, 2023). Firms with stronger environmental commitment generally demonstrate better transparency, higher disclosure quality, and stronger governance mechanisms, thereby reducing information asymmetry and increasing investor confidence (Lemma, Lulseged, & Tavakolifar, 2021). In this context, ISO 14001 serves as an important environmental management framework that supports firms in implementing structured and sustainable environmental practices (Qi, Zeng, Li, & Tam, 2012). Therefore, the effectiveness of ISO 14001 in reducing stock price crash risk may depend on the extent of the firm’s actual environmental commitment.

One important indicator of environmental commitment is the disclosure and management of Scope 3 carbon emissions. Scope 3 emissions include indirect emissions generated across a company’s value chain, such as supplier activities, product distribution, product usage, and waste management, which often represent the largest portion of total corporate carbon emissions (Kayser, Schüder, Retsch, & Zülch, 2026). Because Scope 3 emissions are relatively complex to measure and disclose, firms that provide transparent and comprehensive Scope 3 reporting are generally perceived to have stronger environmental governance and greater accountability toward environmental risks (Ratti, Dell’Agostino, Arena, & Azzzone, 2025). From the perspective of signalling theory, broader Scope 3 disclosure may function as a credible signal that reduces information asymmetry and managerial incentives for bad news hoarding, which are commonly associated with stock price crash risk (Jin & Myers, 2006).

Accordingly, firms with high-quality Scope 3 disclosure and strong environmental commitment are expected to strengthen the effectiveness of ISO 14001 in reducing stock price crash risk by improving transparency and increasing investor trust in the credibility of environmental information. This argument is supported by prior studies showing that standardized sustainability disclosure can reduce information asymmetry and enhance the usefulness of sustainability information for investors (Nipper, Ostermaier, &

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Theis, 2025). In addition, Scope 3 reporting is considered important in strengthening stakeholder trust through greater transparency regarding firms’ environmental performance (Mohsen, 2025).

Conversely, firms with ISO 14001 certification but weak Scope 3 disclosure may face greater investor skepticism regarding the authenticity of their environmental commitment, potentially weakening the role of ISO 14001 in mitigating stock price crash risk. This is because inconsistent environmental disclosure may raise concerns over disclosure credibility and create doubts regarding firms’ actual sustainability performance (Ramaditya, Karim, Lusiana, & Qureshi, 2026).

From the perspective of signalling theory and legitimacy theory, the effectiveness of ISO 14001 in reducing stock price crash risk depends not only on the existence of environmental certification itself, but also on the credibility and transparency of firms’ environmental disclosure. High-quality Scope 3 disclosure may strengthen the signaling value of ISO 14001 by providing more comprehensive information regarding firms’ environmental commitment and carbon management practices. In contrast, weak Scope 3 disclosure may reduce the credibility of ISO 14001 certification and increase investor skepticism, thereby weakening its role in mitigating stock price crash risk.

Therefore, this study proposes the following hypothesis:

H₂: Scope 3 emissions moderate the relationship between ISO 14001 and stock price crash risk, either strengthening or weakening the relationship.

METHODS

Data and Sample

This study employs a quantitative research approach using secondary panel data that combines cross-sectional and time-series observations. The population consists of non-financial publicly listed companies on the Indonesia Stock Exchange during the 2022–2024 period. The sample is selected using purposive sampling based on several criteria: (1) companies actively listed throughout the observation period, (2) non-financial firms to avoid differences in financial regulations and reporting structures, (3) firms with complete financial statements and positive book equity values, (4) firms with stocks traded for at least 26 weeks annually to ensure market liquidity, and (5) firms with stock prices above IDR 50. Observations that do not meet the criteria are excluded, while extreme values are treated using winsorizing at the 1% level to minimize the effect of outliers.

The data is collected from several sources. ISO 14001 certification data are obtained from firms’ annual reports, while weekly stock price data and financial data are collected from Refinitiv Eikon and S&P Capital IQ Compustat Global Datastream. The data collected are processed using Stata 19.5 statistical software.

Variables and Measurement

Stock Price Crash Risk

This study measures stock price crash risk using three proxies commonly employed in prior literature, namely Negative Conditional Skewness (NCSKEW), Down-to-Up Volatility (DUVOL), and CRASH (Chen et al., 2001; J. B. Kim et al., 2011b). Following Kim et al.(2011b), the measurement of stock price crash risk begins by estimating firm-specific weekly returns using the expanded market model. The model is estimated for each firm-year observation as follows:

$$r_{i,t} = \alpha_i + \beta_1 r_{m,t-2} + \beta_2 r_{m,t-1} + \beta_3 r_{m,t} + \beta_4 r_{m,t+1} + \beta_5 r_{m,t+2} + \varepsilon_{i,t} \quad (1)$$

where $r_{i,t}$ represents the weekly stock return of firm i in week t , $r_{m,t}$ denotes the local market index return, and $\varepsilon_{i,t}$ is the residual return. The inclusion of lead and lag market returns follows Dimson (1979) to address nonsynchronous trading effects.

Firm-specific weekly returns ($W_{i,t}$) are then calculated as the natural logarithm of one plus the residual return using the following equation:

$$W_{i,t} = \ln (1 + \varepsilon_{i,t}) \quad (2)$$

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The calculation of firm-specific weekly returns aims to capture the idiosyncratic component of stock returns that reflects firm-level crash risk (DeFond, Hung, Li, & Li, 2015). The logarithmic transformation also helps produce a more symmetric distribution and facilitates the identification of extreme negative return events (Hutton et al., 2009).

Negative Conditional Skewness (NCSKEW)

NCSKEW measures the negative skewness of firm-specific weekly return distributions within a fiscal year. This proxy captures the extent to which stock returns are concentrated in extreme negative outcomes, reflecting the likelihood of sudden stock price declines. A more negative NCSKEW value indicates greater left-tail risk and a higher probability of stock price crash risk. (Chen et al., 2001). NCSKEW is calculated as follows:

$$NCSKEW_{i,t} = \frac{-[n(n-1)^{3/2} \sum W_{i,t}^3]}{[(n-1)(n-2)(\sum W_{i,t}^2)^{3/2}]}$$

(3)

where n is the number of trading weeks for firm i in year t, and $W_{i,t}$ represents firm-specific weekly returns.

Down-to-Up Volatility (DUVOL)

DUVOL measures the asymmetry of volatility between negative-return weeks (down weeks) and positive-return weeks (up weeks). Firm-specific weekly returns are divided into down weeks and up weeks depending on whether the returns are below or above the annual average return. DUVOL is calculated as the natural logarithm of the ratio between the standard deviation of returns during down weeks and the standard deviation during up weeks (Chen et al., 2001):

$$DUVOL_{i,t} = \ln \frac{(nu - 1) \sum \text{down } W_{i,t}^2}{(nd - 1) \sum \text{up } W_{i,t}^2}$$

(4)

CRASH

CRASH represents the likelihood of extreme stock price decline at the firm-year level. Following Alsadan (2025), a crash event occurs when firm-specific weekly returns fall more than 3.2 standard deviations below the mean annual weekly return. The CRASH variable is measured using a dummy variable coded 1 if the firm experiences at least one crash event during a fiscal year and 0 otherwise. This proxy is used to capture the occurrence of extreme negative stock return events.

Independent Variable: ISO 14001

The independent variable in this study is ISO 14001 certification status. Following Yang et al. (2024), this variable is measured using a dummy variable coded 1 if the firm is certified under ISO 14001 and 0 otherwise. ISO 14001 certification reflects the implementation of a formal environmental management system within the company.

Moderating Variable: Scope 3 Emissions Disclosure

The moderating variable is Scope 3 emissions disclosure, which reflects the firm's environmental commitment and transparency regarding indirect carbon emissions across the value chain. Following Alsadan (2025), this variable is measured using a dummy variable coded 1 if the firm discloses Scope 3 emissions and 0 otherwise.

Control Variables

Control variables in this study include historical crash risk measured using the previous year's NCSKEW, DUVOL, and CRASH values to capture the persistence of stock price crash risk. SIGMA refers to stock return volatility measured by the annual standard deviation of firm-specific weekly returns, while RETURN represents the mean weekly stock return during the fiscal year. MBR captures firm growth opportunities

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measured by the market-to-book ratio. LEV refers to firm leverage calculated as total liabilities divided by total assets, and ROA represents firm profitability measured by net income divided by total assets. SIZE captures firm size measured by the natural logarithm of total assets. DTURN refers to the change in stock turnover calculated as the difference between the average weekly stock turnover in year t and year $t-1$. ABACC represents information opacity measured by the absolute value of abnormal accruals estimated using the modified Jones model. CASH captures firm liquidity calculated as operating cash flow divided by total assets, while TANGI reflects firm tangibility measured by the proportion of net fixed assets to total assets.

Data Analysis Technique

Several statistical techniques are employed in this study. Descriptive statistics are first used to provide an overview of the characteristics and distribution of the data. Pearson correlation analysis is conducted to examine the relationships among variables. Furthermore, classical assumption tests consisting of multicollinearity, autocorrelation, and heteroskedasticity tests are performed to ensure the validity of the regression model. Multicollinearity is examined using the Variance Inflation Factor (VIF), autocorrelation is tested using the Durbin-Watson and Breusch-Godfrey tests, while heteroskedasticity is tested using the Modified Wald test. Robust standard errors are applied if heteroskedasticity is detected.

The primary analysis in this study uses panel data regression with the Fixed Effects Model and clustered robust standard errors to estimate the relationship between ISO 14001 and stock price crash risk. The clustered robust standard errors approach is applied to produce more reliable estimations by correcting potential heteroskedasticity and within-firm serial correlation problems. Although Ordinary Least Squares (OLS) regression is initially used as a baseline estimation approach, the Fixed Effects Model serves as the main analytical method because it is more capable of controlling for unobservable firm-specific characteristics that may bias the estimation results.

To ensure the robustness of the findings and minimize selection bias, this study also applies Propensity Score Matching (PSM). The matching procedure uses a logit model based on firm characteristics and applies nearest neighbor matching (3:1) with a specific caliper threshold. The treatment effects are then estimated using Average Treatment Effect (ATE) and Average Treatment Effect on the Treated (ATT).

RESULTS AND DISCUSSION

This study examines the relationship between ISO 14001 certification and stock price crash risk among non-financial firms listed on the Indonesia Stock Exchange during the 2022–2024 period. Stock price crash risk is measured using three proxies: Negative Conditional Skewness (NCSKEW), Down-to-Up Volatility (DUVOL), and CRASH. The analysis also incorporates Scope 3 emissions disclosure as a moderating variable, along with several firm-specific control variables.

Descriptive Statistic

Table 1. Descriptive Statistic

Variable	Obs	Mean	Std. Dev	Min	Max
Dependent Variable					
<i>Crashrisk_{it}</i>					
NCSKEW	1,332	-0.2922	1.0273	-3.2136	2.4463
DUVOL	1,332	0.1362	0.6133	-1.5342	1.7405
CRASH	1,332	0.2020	0.4016	0	1
Independent Variable					
ISO 14001	1,332	0.3769	0.4848	0	1
Moderating Variable					
SCOPE3	1,332	0.1547	0.3617	0	1
Control Variable					
NCSKEW _{t-1}	1,332	-0.4090	0.9897	-3.4351	1.9796
DUVOL _{t-1}	1,332	0.2191	0.5985	-1.2007	1.7623
CRASH _{t-1}	1,332	0.1524	0.3595	0	1
RETURN	1,332	0.0009	0.0095	-0.0218	0.0362
SIGMA	1,332	0.0635	0.0408	0.0124	0.2371
MBR	1,332	2.2721	3.8852	0.1752	28.6039
LEV	1,332	0.2178	0.1835	0.0000	0.6725
ROA	1,332	0.0474	0.0839	-0.2462	0.3319
SIZE	1,332	28.6961	17.8426	24.6550	32.7516
TANGI	1,332	0.7076	0.4668	0.0068	2.3942
CASH	1,332	0.0766	0.0995	-0.1527	0.4401
DTURN	1,332	-0.0229	0.1902	-0.8143	0.8558
ABACC	1,332	0.0599	0.0593	0.0008	0.3221

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Table 1 presents the descriptive statistics of all research variables, including the dependent variables (NCSKEW, DUVOL, and CRASH), the independent variable (ISO 14001), the moderating variable (SCOPE3), and several control variables. The results show that the average NCSKEW value is -0.2922, while DUVOL also indicates relatively low downside volatility during the observation period. In addition, the CRASH variable has a mean value of 0.2020, suggesting that approximately 20.20% of firm-year observations experienced at least one stock price crash event. The relatively large standard deviations of NCSKEW and DUVOL indicate considerable variation in stock price crash risk across firms.

Regarding environmental variables, ISO 14001 has an average value of 0.3769, indicating that approximately 37.69% of sample firms have obtained ISO 14001 certification. Meanwhile, the average value of SCOPE3 is only 0.1547, implying that only 15.47% of firms disclose Scope 3 carbon emissions. These findings suggest that although environmental management certification has been increasingly adopted among Indonesian listed companies, comprehensive environmental disclosure practices, particularly Scope 3 emissions reporting, remain relatively limited.

The descriptive statistics of the control variables indicate that the average RETURN is 0.0009, while SIGMA has a mean value of 0.0635, suggesting relatively low stock returns with moderate volatility during the observation period. The average market-to-book ratio (MBR) is 2.2721, indicating that firms generally have market values exceeding their book values. In addition, the average leverage ratio (LEV) is 0.2178, showing that liabilities account for approximately 21.78% of total assets, while the average ROA is 0.0448, indicating moderate profitability levels. The average SIZE value of 28.6961 suggests that most sample firms are relatively large companies. Furthermore, TANGI and CASH have mean values of 0.7076 and 0.0766, respectively, indicating relatively high tangible asset proportions and moderate liquidity levels. The negative mean value of DTURN (-0.0229) reflects a slight decline in stock turnover, whereas the relatively low ABACC mean value of 0.0599 suggests limited earnings management practices among sample firms. Finally, the lagged crash risk variables indicate that previous stock price crash risk may persist and influence future crash risk.

Correlation Matrix

Table 2. Correlation Matrix

	NCSKEW	DUVOL	CRASH	ISO 14001	SCOPE3	RETURN	SIGMA	MBR	LEV	ROA	SIZE	TANGI	CASH	DTURN	ABACC	NCSKEW-1	DUVOL-1	CRASH-1
NCSKEW	1																	
DUVOL	-0.9055***	1																
CRASH	0.5481***	-0.4869***	1															
ISO 14001	0.0295	-0.0267	-0.0401	1														
SCOPE3	0.042	-0.0354	-0.1221***	0.1815***	1													
RETURN	-0.2948***	0.3607***	-0.1325***	0.0099	-0.0139	1												
SIGMA	-0.2796***	0.2313***	-0.0631**	-0.1568***	0.1371***	0.4241***	1											
MBR	-0.0197	0.0304	0.0009	-0.0489*	0.0717***	0.1755***	0.1271***	1										
LEV	-0.0082	0.0033	0.0249	0.0489*	0.0142	-0.0312	0.0822	0.0805***	1									
ROA	0.0481*	-0.0204	0.0146	0.1368***	0.1681***	0.2117***	-0.1591***	0.0674**	-0.3191***	1								
SIZE	0.0065	0.0225	-0.1002***	0.3149***	0.5883***	0.0248	-0.2729***	-0.0581**	0.1852***	0.2219***	1							
TANGI	0.0259	-0.0385	0.0237	0.1631***	0.0100	0.0048	-0.0059	0.0329	0.2144***	-0.0982***	0.0273	1						
CASH	0.0501*	-0.0408	-0.0045	0.1660***	0.1500***	0.1243***	-0.1482***	0.1568***	-0.1177***	0.6157***	0.1854***	0.2394***	1					
DTURN	-0.0602**	0.0548*	0.0065	0.0033	0.0250	0.1191***	0.1304***	0.0043	-0.0376	-0.0025	-0.0083	-0.0344	-0.0059	1				
ABACC	0.0328	-0.0292	0.0436	-0.0931***	-0.0297	-0.0159	0.0779**	0.1203***	-0.0079	-0.0245	-0.1216***	-0.0870***	-0.0091	-0.0001	1			
NCSKEW-1	0.0753***	-0.0835***	0.0136	0.0365	0.0442	0.0003	-0.1116***	0.0248	-0.0048	0.0079	0.0117	-0.0364	0.0206	-0.0143	-0.0079	1		
DUVOL-1	0.0060	0.0023	0.0202	0.1832	0.1072	0.0926	0.0000	0.3661	0.8605	0.7723	0.6693	0.1839	0.4534	0.6009	0.7732	0.4534	1	
CRASH-1	-0.0471*	0.0580**	-0.0365	-0.0304	-0.0255	-0.0262	0.0655**	-0.0437	0.7869	0.4403	0.0212	0.0115	0.0354	0.0079	-0.0005	0.0055	-0.8916***	1
	0.0857	0.0344	0.1830	0.2677	0.3530	0.3395	0.0168	0.1107	0.0169	-0.0124	-0.0812**	0.0061	0.0235	0.0090	0.0318	0.5040***	-0.4466***	
	0.1395	0.0724	0.1287	0.6937	0.0002	0.7939	0.0013	0.4789	0.5374	0.6503	0.0030	0.8233	0.3912	0.7431	0.2458	0.0000	0.0000	

***significant at the 1% level; **significant at the 5% level; *significant at the 10% level.

Table 2 presents the correlation matrix among the research variables, including the dependent variables of stock price crash risk (NCSKEW, DUVOL, and CRASH), the independent variables (ISO 14001 and SCOPE3), and the control variables. Overall, the correlation coefficients among the independent variables are below 0.80, indicating that there is no serious multicollinearity issue in the research model. The

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relationship among the crash risk proxies is statistically significant. NCSKEW has a strong negative correlation with DUVOL (-0.9055), reflecting that both variables measure stock price crash risk but use different calculation directions. In addition, CRASH is positively correlated with NCSKEW (0.5481) and negatively correlated with DUVOL (-0.4869), suggesting consistency among the three crash risk proxies in capturing stock price crash risk.

ISO 14001 shows relatively weak relationships with the crash risk proxies. Specifically, ISO 14001 is positively correlated with NCSKEW (0.0295) but negatively correlated with DUVOL (-0.0267) and CRASH (-0.0401), indicating that environmental certification alone does not exhibit a strong direct relationship with stock price crash risk. Meanwhile, SCOPE3 is positively correlated with ISO 14001 (0.1815), suggesting that firms with ISO 14001 certification are more likely to disclose Scope 3 carbon emissions. SCOPE3 also has a negative correlation with CRASH (-0.1221), implying that broader carbon emissions disclosure may be associated with lower crash risk, although the relationship is not consistent across all crash risk proxies.

The control variables show several notable relationships. RETURN is negatively correlated with NCSKEW (-0.2948) and CRASH (-0.1325), while positively correlated with DUVOL (0.3607), indicating that stock return performance is closely related to stock volatility and crash risk. SIGMA is positively associated with DUVOL (0.2313), suggesting that higher stock return volatility increases stock price instability. Furthermore, SIZE is positively correlated with ISO 14001 (0.3149) and SCOPE3 (0.5883), indicating that larger firms are more likely to adopt environmental certification and disclose carbon emissions. SIZE also shows a negative relationship with CRASH (-0.1002), suggesting that larger firms tend to have lower crash risk. Lastly, the lagged crash risk variables are significantly associated with current crash risk measures, indicating the persistence of stock price crash risk over time.

Multicollinearity Test

Table 3. Multicollinearity Test Result

Variable	NCSKEW		DUVOL		CRASH	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
ISO 14001	1.16	0.8602	1.16	0.8598	1.16	0.8613
SCOPE3	1.61	0.6214	1.61	0.6219	1.61	0.6212
ROA	2.11	0.4732	2.11	0.4728	2.11	0.4736
SIZE	2.00	0.4989	2.00	0.4988	2.01	0.4983
CASH	1.95	0.5132	1.95	0.5134	1.95	0.5128
SIGMA	1.51	0.6628	1.50	0.6677	1.51	0.6628
RETURN	1.42	0.7048	1.42	0.7036	1.42	0.7047
LEV	1.31	0.7624	1.31	0.7622	1.31	0.7612
TANGI	1.26	0.7920	1.26	0.7918	1.26	0.7938
MBR	1.12	0.8915	1.12	0.8908	1.12	0.8918
ABACC	1.05	0.9567	1.05	0.9567	1.05	0.9559
DTURN	1.03	0.9720	1.03	0.9719	1.03	0.9714
Crash risk _{t-1}	1.03	0.9741	1.02	0.9797	1.03	0.9666
Mean VIF	1.43		1.43		1.43	

The multicollinearity test employs the Variance Inflation Factor (VIF) to examine whether high correlations exist among the independent variables in the regression model. The results indicate that all variables have VIF values below the common threshold of 10, with a mean VIF value of 1.43, suggesting a low level of multicollinearity. Several variables, such as lagged crash risk, DTURN, and ABACC, show particularly low VIF values ranging from 1.02 to 1.05 across all models. In addition, the correlation matrix reveals that no correlation coefficient among the independent variables exceeds 0.80, consistent with the criterion proposed by Gujarati and Porter (2009). Therefore, the regression models are considered free from serious multicollinearity issues.

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Heteroskedasticity Test

Table 4. Heteroskedasticity Test Result

Model	Chi2	Prob > chi2	Decision	Conclusion
NCSKEW	6,678,345	0.0000	Reject H0	Heteroskedasticity occurs
DUVOL	4,134,034	0.0000	Reject H0	Heteroskedasticity occurs
CRASH	2,900,000,000	0.0000	Reject H0	Heteroskedasticity occurs

The heteroskedasticity test uses the Modified Wald test to determine whether the error variances remain constant across the regression models. The findings reveal that all models exhibit heteroskedasticity, as indicated by probability values below the 5% significance level. Specifically, the NCSKEW model reports a chi-square value of 6,678,344 ($p = 0.0000$), while the DUVOL and CRASH models report chi-square values of 4,134,034 and 2,099,000,000, respectively, both with probability values of 0.0000. These results reject the null hypothesis of homoskedasticity, indicating that the residual variances are not constant across observations.

Autocorrelation Test

Table 5. Autocorrelation Test Result

Model	F-statistic	Prob > F	Decision	Conclusion
NCSKEW	16.262	0.0001	Reject H0	Autocorrelation occurs
DUVOL	18.631	0.0000	Reject H0	Autocorrelation occurs
CRASH	53.260	0.0000	Reject H0	Autocorrelation occurs

The Wooldridge test for panel data is applied to identify the presence of autocorrelation within the regression models, including all moderating and interaction variables. The results indicate that all models experience autocorrelation, as shown by probability values below the 5% significance level. The NCSKEW model produces a probability value of 0.0001 ($F = 16.262$), whereas the DUVOL and CRASH models report probability values of 0.0000 with F-statistics of 18.631 and 53.260, respectively. These findings suggest the existence of serial correlation within the panel data structure.

Hausman Test

Table 6. Hausman Test Result

Model	Chi-square	Prob > chi2	Decision	Selected Model
NCSKEW	572.61	0.0000	Reject H0	<i>Fixed Effect</i>
DUVOL	524.13	0.0000	Reject H0	<i>Fixed Effect</i>
CRASH	486.19	0.0000	Reject H0	<i>Fixed Effect</i>

The Hausman test was employed to determine the most appropriate model between the Fixed Effects Model (FEM) and the Random Effects Model (REM) by examining the p-values. A p-value below 0.05 indicates rejection of the null hypothesis, suggesting that the Fixed Effects Model is more suitable. The results in Table 4.6 show that the NCSKEW, DUVOL, and CRASH models all have probability values below the 5% significance level. Therefore, the null hypothesis is rejected, and the Fixed Effects Model is selected as the appropriate model for this study.

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The Effect of ISO 14001 on Stock Price Crash Risk

Table 7. Fixed Effects Model Regression Results of Study 1

	NCSKEW		DUVOL		CRASH	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
ISO 14001	0.2111	0.3130	-0.1416	0.2210	0.0022	0.9750
Crash Risk t-1	-0.2984***	0.0000	-0.2624***	0.0000	-0.3639***	0.0000
RETURN	-29.3212***	0.0000	24.6111***	0.0000	-7.8812***	0.0000
SIGMA	-4.7951***	0.0000	1.0615*	0.1000	0.1111	0.8290
MBR	0.0368**	0.0200	-0.0159*	0.0820	0.0018	0.8090
LEV	-0.6557	0.3260	0.3054	0.4580	0.1615	0.5640
ROA	0.5384	0.4800	-0.3575	0.4160	0.3839	0.2430
SIZE	-0.0338	0.9080	0.0857	0.5780	0.0649	0.6090
TANGI	1.1281**	0.0210	-0.7022**	0.0110	0.6128***	0.0030
CASH	-0.0887	0.8600	-0.0334	0.9070	-0.2435	0.2900
DTURN	0.1564	0.2250	-0.0491	0.5730	0.0916	0.1390
ABACC	1.6366**	0.0260	-0.7574*	0.0790	0.7861***	0.0050
Constant	-0.0450	0.9960	-1.7710	0.6910	-2.1260	0.5610
F-statistic	23.62	0.0000	29.90	0.0000	16.05	0.0000
R ² (Within)	0.2407		0.2707		0.1628	
Observations	1,332		1,332		1,332	
Model	<i>Fixed Effect</i>		<i>Fixed Effect</i>		<i>Fixed Effect</i>	
Std. Error	<i>Robust Clustered</i>		<i>Robust Clustered</i>		<i>Robust Clustered</i>	

***significant at the 1% level; **significant at the 5% level; *significant at the 10% level.

The panel regression results using the Fixed Effects Model with clustered robust standard errors indicate that ISO 14001 does not have a significant effect on stock price crash risk measured by NCSKEW, DUVOL, or CRASH. In the NCSKEW model, ISO 14001 has a positive coefficient of 0.2111 with a probability value of 0.3130, indicating no significant relationship between ISO 14001 certification and stock price crash risk. Similarly, in the DUVOL model, ISO 14001 shows a negative coefficient of -0.1416 with a probability value of 0.2210, suggesting that although firms with ISO 14001 certification tend to have lower crash risk, the effect is statistically insignificant. In the CRASH model, ISO 14001 also does not significantly affect the likelihood of stock price crash events, as indicated by a coefficient of 0.0022 and a probability value of 0.9750.

The insignificant effect of ISO 14001 may occur because environmental management system implementation requires a relatively long period before its benefits are reflected in governance quality and investor perception. In addition, investors may still focus more on short-term financial performance than environmental sustainability considerations when making investment decisions. Consequently, ISO 14001 certification has not yet been able to directly reduce information asymmetry or mitigate bad news hoarding, which are considered the primary causes of stock price crash risk. These findings are consistent with Hutton et al. (2009) and Jin and Myers (2006), who argue that crash risk is more strongly influenced by the accumulation and concealment of bad news rather than symbolic certification or environmental signaling alone.

The regression results also show that the lagged crash risk variables significantly affect current stock price crash risk across all models. Lagged NCSKEW, DUVOL, and CRASH each have negative and statistically significant coefficients at the 1% level, indicating that previous crash risk influences subsequent crash risk. The negative coefficients suggest that after firms experience high crash risk, the market tends to adjust, thereby reducing the probability of future crash events. This condition may reflect improvements in corporate transparency or more cautious investor behavior following large stock price declines.

Regarding the control variables, several variables consistently influence stock price crash risk across the models. RETURN significantly affects all crash risk proxies, indicating that stock return performance is closely associated with crash risk dynamics. ABACC also shows significant effects across the models,

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suggesting that higher abnormal accruals and earnings management practices increase stock price crash risk. In addition, MBR, SIGMA, and TANGI significantly affect NCSKEW and DUVOL, while TANGI also positively affects CRASH. These findings imply that firm fundamentals, financial characteristics, and information quality continue to play important roles in determining stock price crash risk.

The Effect of ISO 14001 on Stock Price Crash Risk Moderated by Corporate Environmental Commitment

Table 8. Fixed Effects Model Regression Results of Study 2

	NCSKEW		DUVOL		CRASH	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
ISO 14001	0.1152	0.6000	-0.0800	0.5130	-0.0052	0.9440
SCOPE3	0.0728	0.7810	-0.1103	0.6280	0.0166	0.8800
ISO×SCOPE3	0.5026	0.2080	-0.3053	0.1940	0.0362	0.8320
<i>Crash Risk_{t-1}</i>	-0.2978***	0.0000	-0.2615***	0.0000	-0.3641***	0.0000
RETURN	-29.4205***	0.0000	24.6973***	0.0000	-7.8902***	0.0000
SIGMA	-4.8037***	0.0000	1.0631*	0.1000	0.1106	0.8300
MBR	0.0359**	0.0250	-0.0151*	0.1010	0.0017	0.8210
LEV	-0.6982	0.2980	0.3348	0.4170	0.1579	0.5740
ROA	0.5682	0.4580	-0.3795	0.3880	0.3864	0.2420
SIZE	-0.0205	0.9450	0.079	0.6100	0.0658	0.6060
TANGI	1.1465**	0.0190	-0.7136**	0.0100	0.6144***	0.0030
CASH	-0.0675	0.8920	-0.0479	0.8660	-0.2417	0.2940
DTURN	0.1677	0.1980	-0.0556	0.5260	0.0924	0.1410
ABACC	1.6350**	0.0250	-0.7566*	0.0780	0.7860***	0.0050
Constant	-0.4521	0.9580	-1.5497	0.7280	-2.1533	0.5580
F-statistic	22.32	0.0000	26	0.0000	13.84	0.0000
R ² (Within)	0.2420		0.2724		0.1628	
Observations	1,332		1,332		1,332	
Model	<i>Fixed Effect</i>		<i>Fixed Effect</i>		<i>Fixed Effect</i>	
Std. Error	<i>Robust Clustered</i>		<i>Robust Clustered</i>		<i>Robust Clustered</i>	

***significant at the 1% level; **significant at the 5% level; *significant at the 10% level.

The panel regression results using the Fixed Effects Model with clustered robust standard errors indicate that ISO 14001 does not have a significant effect on stock price crash risk measured by NCSKEW, DUVOL, or CRASH. In the NCSKEW model, ISO 14001 has a coefficient of 0.1152 with a probability value of 0.6000, while in the DUVOL and CRASH models the coefficients are -0.0800 and -0.0052 with probability values of 0.5130 and 0.9440, respectively. These findings suggest that ISO 14001 certification is not considered a major factor by investors in assessing the likelihood of extreme stock price declines. Similarly, SCOPE3 disclosure also does not significantly affect stock price crash risk across all proxies, indicating that investors may still prioritize short-term financial performance over sustainability-related information, particularly indirect carbon emissions disclosure.

The moderating variable ISO×SCOPE3 also shows no significant effect on NCSKEW, DUVOL, or CRASH. The interaction term produces probability values above the 5% significance level across all models, suggesting that Scope 3 emissions disclosure does not strengthen or weaken the relationship between ISO 14001 implementation and stock price crash risk. These results are consistent with Hutton et al. (2009) and Jin and Myers (2006), who argue that stock price crash risk is primarily driven by information transparency and bad news hoarding rather than non-financial certifications or symbolic environmental disclosure.

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The lagged crash risk variables, namely $NCSKEW_{t-1}$, $DUVOL_{t-1}$, and $CRASH_{t-1}$, exhibit negative and significant effects across all models. This finding indicates that stock price crash risk in the previous period influences current crash risk, but the negative coefficients suggest that market adjustments occur after firms experience high crash risk. Investors may become more cautious, and previously hidden bad news may already be reflected in stock prices, reducing the likelihood of future crash events. These findings support previous studies by Chen et al. (2001) and Kim et al. (2011b), which highlight the persistence of crash risk over time due to the gradual release of accumulated bad news into the market.

Several control variables also significantly affect stock price crash risk across the models. RETURN consistently shows significant effects on all crash risk proxies, while ABACC significantly affects NCSKEW, DUVOL, and CRASH, suggesting that abnormal accrual practices and lower financial reporting quality increase crash risk. In addition, MBR, SIGMA, and TANGI significantly influence NCSKEW and DUVOL, whereas TANGI also positively affects CRASH. Differences across NCSKEW, DUVOL, and CRASH results may arise because each proxy captures different dimensions of crash risk. NCSKEW is more sensitive to negative return distribution, DUVOL better captures short-term volatility asymmetry, and CRASH specifically identifies extreme stock price decline events. Therefore, the use of multiple crash risk proxies provides a more comprehensive understanding of stock price crash risk.

Robustness Test

Table 9. Propensity Score Matching Result

Variable	Sample	Treated	Control	Δ (Difference)	S.E.	T-stat
NCSKEW	Unmatched	-0.2532	-0.3157	0.0625	0.0581	1.08
	ATT	-0.2555	-0.2764	0.0208	0.0752	0.28
DUVOL	Unmatched	0.1152	0.1490	-0.0338	0.0347	-0.97
	ATT	0.1162	0.1293	-0.0132	0.0450	-0.29
CRASH	Unmatched	0.1813	0.2145	-0.0332	0.0227	-1.46
	ATT	0.1811	0.2046	-0.0235	0.0297	-0.79

Table 10. Propensity Score Matching Sample

Treatment Assignment	Off Support	On Support	Total
Untreated	0	830	830
Treated	5	497	502
Total	5	1,327	1,332

The Propensity Score Matching (PSM) test was employed as a robustness analysis to reduce potential selection bias between firms with ISO 14001 certification (treated group) and firms without ISO 14001 certification (control group). The matching process used nearest neighbor matching with three neighbors, a caliper value of 0.05, and a logit approach. The results show that out of 1,332 observations, 1,327 observations fall within the common support area, while only 5 treated observations are outside the support area.

The PSM results consistently indicate that ISO 14001 does not have a significant effect on stock price crash risk across all proxies. In the NCSKEW model, the Average Treatment Effect on the Treated (ATT) is 0.0208 with a t-statistic of 0.28, indicating no significant difference in crash risk between ISO-certified and non-certified firms after balancing firm characteristics. Similarly, the DUVOL model reports an ATT value of -0.0132 with a t-statistic of -0.29, while the CRASH model shows an ATT value of -0.0235 with a t-statistic of -0.79. Although the coefficients in the DUVOL and CRASH models suggest a lower crash risk for ISO-certified firms, the effects remain statistically insignificant.

CONCLUSIONS

This study aims to examine the effect of ISO 14001 implementation on stock price crash risk with corporate environmental commitment, proxied by Scope 3 emissions disclosure, as a moderating variable among non-financial firms listed on the Indonesia Stock Exchange during the 2022–2024 period. Stock price crash risk is measured using three proxies, namely NCSKEW, DUVOL, and CRASH, to provide a more comprehensive understanding of firms’ crash risk. Based on panel data regression analysis using the Fixed Effects Model with clustered robust standard errors, the results indicate that ISO 14001 does not have a significant effect on stock price crash risk across all measurement proxies. Specifically, the probability values for ISO 14001 are 0.3130 in the NCSKEW model, 0.2210 in the DUVOL model, and 0.9750 in the CRASH model, indicating that ISO 14001 certification has not significantly influenced firms’ stock price crash risk. Consequently, the first hypothesis is rejected. In addition, the robustness test using Propensity Score Matching (PSM) produces consistent results, strengthening the conclusion that ISO 14001 has not become a primary factor considered by investors in assessing stock price crash risk.

The findings of the second research model also reveal that corporate environmental commitment, proxied by Scope 3 emissions disclosure, is unable to moderate the relationship between ISO 14001 and stock price crash risk. The interaction variable ISO×SCOPE3 does not show significant effects across all crash risk models, with probability values of 0.2080 for NCSKEW, 0.1940 for DUVOL, and 0.8320 for CRASH. These findings indicate that the combination of ISO 14001 certification and Scope 3 emissions disclosure has not strengthened nor weakened the effect on firms’ stock price crash risk. One possible explanation is that the level of Scope 3 disclosure in this study remains relatively low, averaging only 15.47%, and therefore may not adequately reflect firms’ overall environmental commitment or serve as a strong signal for investors in evaluating corporate risk. Accordingly, the second hypothesis is also rejected.

In addition, the results consistently show that lagged stock price crash risk variables have negative and significant effects on current stock price crash risk across all models, indicating the persistence of crash risk over time. Several control variables, including RETURN, SIGMA, MBR, TANGI, and ABACC, are also found to significantly affect stock price crash risk in several models. These findings suggest that stock price crash risk is more strongly influenced by firm fundamentals, market conditions, and financial reporting quality than by environmental certification or sustainability disclosure practices alone.

Despite these findings, this study has several limitations. First, the research focuses only on non-financial companies listed on the Indonesia Stock Exchange, limiting the generalizability of the results to financial sector firms or other countries. Second, environmental performance is measured only through ISO 14001 adoption and Scope 3 disclosure, which may not fully capture all dimensions of corporate environmental performance. Third, stock price crash risk is measured using three different proxies such as NCSKEW, DUVOL, and CRASH which may produce varying results across models due to differences in calculation methods. Finally, the study relies on secondary data from annual and sustainability reports, while Scope 3 disclosure practices in Indonesia remain incomplete and inconsistent across firms.

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