



XBRL role in ESG metrics and stock valuation: A case study in Indonesia stock market

El papel de XBRL en las métricas ESG y la valoración de acciones: un estudio de caso en el mercado bursátil de Indonesia

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Abstract

Problem Statement: The growing emphasis on Environmental, Social, and Governance (ESG) metrics and their integration into corporate reporting has heightened the need for transparency in financial and non-financial disclosures. While eXtensible Business Reporting Language (XBRL) is known to improve the transparency and accessibility of ESG information, its full impact on the relationship between ESG metrics, stock valuation, stakeholder perception, and financial performance is not fully understood, particularly regarding firm size and technological advancements. This study seeks to address this gap by examining how XBRL adoption influences ESG metrics, stock valuation, and stakeholder perception, focusing on its implications for capital market efficiency and corporate governance.

The aim: is to investigate the moderating role of XBRL adoption in the relationship between ESG metrics and financial performance, as measured by Tobin's Q and Z-Score, as well as stakeholder perception, proxied by shareholder fund turnover, and stock valuation. Additionally, this study seeks to explore how firm size impacts these relationships, and how public sentiment, gathered through netnographic observations, further influences the dynamics between ESG performance, financial outcomes, and stock valuation.

The methods: This research involves a two-phase approach: the Quantitative Phase uses statistical tools to analyze the impact of XBRL adoption on ESG metrics, stock valuation, and stakeholder perception

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using financial data and regression analysis. The Qualitative Phase employs netnographic research, including social media and Google Trends data, to assess stakeholder sentiment. Joint display analysis will integrate both quantitative and qualitative findings. Control variables, such as firm size, will be considered to evaluate their moderating effect.

The outputs: the identification of both the direct and moderating effects of XBRL adoption on the relationship between ESG metrics and financial performance. It will provide insights into how XBRL adoption influences stakeholder perception and stock valuation, offering a clearer understanding of its impact on capital market dynamics. The study will also develop a comprehensive framework for integrating XBRL into ESG reporting practices to improve transparency and facilitate better investor decision-making. Additionally, netnographic research will offer valuable insights into public sentiment on ESG practices, deepening our understanding of stakeholder engagement. Finally, the study will present recommendations for policymakers and firms on effectively adopting XBRL for ESG reporting to enhance market efficiency and corporate governance.

JEL Code: M41, G14, G34, G12, L25

Keywords: ESG; financial reporting; stock valuation; transparency; XBRL

Resumen

Planteamiento del problema: El creciente énfasis en las métricas Ambientales, Sociales y de Gobernanza (ESG) y su integración en los informes corporativos ha incrementado la necesidad de transparencia en las divulgaciones financieras y no financieras. Si bien el Lenguaje de Información Financiera Extensible (XBRL) es reconocido por mejorar la transparencia y accesibilidad de la información ESG, su impacto completo en la relación entre métricas ESG, valoración de acciones, percepción de los stakeholders y desempeño financiero aún no se comprende plenamente, en particular en lo que respecta al tamaño de la empresa y los avances tecnológicos. Este estudio busca abordar esta brecha examinando cómo la adopción de XBRL influye en las métricas ESG, la valoración de acciones y la percepción de los stakeholders, centrándose en sus implicaciones para la eficiencia del mercado de capitales y la gobernanza corporativa. Objetivo: Investigar el papel moderador de la adopción de XBRL en la relación entre las métricas ESG y el desempeño financiero, medido a través de Tobin's Q y Z-Score, así como la percepción de los stakeholders, representada por la rotación de fondos de los accionistas, y la valoración de las acciones. Además, este estudio busca explorar cómo el tamaño de la empresa impacta en estas relaciones y cómo el sentimiento público, recopilado mediante observaciones netnográficas, influye en la dinámica entre el desempeño ESG, los resultados financieros y la valoración bursátil.

Metodología: Esta investigación adopta un enfoque de dos fases: la fase cuantitativa utiliza herramientas estadísticas para analizar el impacto de la adopción de XBRL en las métricas ESG, la valoración de acciones y la percepción de los stakeholders a partir de datos financieros y análisis de regresión. La fase cualitativa emplea investigación netnográfica, incluyendo datos de redes sociales y Google Trends, para evaluar el sentimiento de los stakeholders. El análisis de visualización conjunta integrará los hallazgos cuantitativos y cualitativos. Se considerarán variables de control, como el tamaño de la empresa, para evaluar su efecto moderador.

Resultados esperados: La identificación de los efectos directos y moderadores de la adopción de XBRL en la relación entre métricas ESG y desempeño financiero. El estudio proporcionará información sobre cómo la adopción de XBRL influye en la percepción de los stakeholders y en la valoración de acciones, ofreciendo una comprensión más clara de su impacto en la dinámica del mercado de capitales. Asimismo, se desarrollará un marco integral para la integración de XBRL en las prácticas de reporte ESG, con el fin de mejorar la transparencia y facilitar una mejor toma de decisiones por parte de los inversionistas. La investigación netnográfica también brindará valiosas perspectivas sobre el sentimiento público hacia las prácticas ESG, profundizando en la comprensión del compromiso de los stakeholders. Finalmente, el estudio presentará recomendaciones para los responsables de políticas y las empresas sobre cómo adoptar eficazmente XBRL en los informes ESG para fortalecer la eficiencia del mercado y la gobernanza corporativa.

Código JEL: M41, G14, G34, G12, L25

Palabras clave: ESG; Informes financieros; Valoración de acciones; Transparencia; XBRL

Introduction

The adoption of eXtensible Business Reporting Language (XBRL) plays a crucial role in enhancing Environmental, Social, and Governance (ESG) metrics and stock valuation, significantly impacting academic research, societal awareness, and technological advancement. Postiglione (2024) noted how ESG–cost of capital relationships are now shaped by disclosure technologies like XBRL. XBRL facilitates the standardized reporting of financial and non-financial information, which is essential for integrating ESG factors into corporate reporting. This integration is vital as stakeholders increasingly demand transparency regarding corporate sustainability practices, which directly influences investment decisions and corporate valuations. This synthesis examines the impact of XBRL adoption on financial transparency and stock valuation based on multiple research studies. XBRL adoption is associated with a significant reduction in stock price synchronicity, indicating improved capital market information efficiency and better firm-specific information disclosure (Ruan et al.,2021).

XBRL filings enhance informational efficiency by making financial data easier to use and analyze, which reduces post-earnings announcement drift and mitigates market overreaction to earnings surprises (Efendi et al.,2014). XBRL adoption reduces stock return synchronicity and price delay for firms, with more pronounced effects for opaque and complex firms (Dong et al.,2016). XBRL adoption lowers stock return drift and facilitates information imputation into firm stock prices, reducing information asymmetry and improving information accessibility for investors therefore XBRL adoption lowers stock return drift and facilitates the incorporation of information into stock prices, thereby improving stock valuation (Luo et al.,2021). The adoption of XBRL generally improves financial transparency by reducing stock price synchronicity, enhancing informational efficiency, and increasing market liquidity. These improvements contribute to better stock valuation, although the overall impact on stock market development may vary depending on the implementation and stakeholder understanding.

XBRL's capacity to reduce information asymmetry is particularly noteworthy. By enabling more comprehensive and standardized disclosures, XBRL allows investors to access relevant ESG data, thereby decreasing the uncertainty associated with corporate performance and sustainability initiatives. Research indicates that increased transparency through XBRL can lead to a reduction in the cost of capital and an increase in a firm's stock price, as investors are more likely to demand shares from companies that provide clear and accessible ESG information (Yoon et al., 2011). This is supported by findings that suggest a

positive correlation between enhanced disclosure practices and improved economic performance, highlighting the importance of integrating sustainability into managerial reporting (Bãndoi et al., 2021).

On the other hand, Sassi et al (2021), said that the adoption of XBRL has a negative impact on the development of stock markets which tends to create mixed effects on the market, so it requires several special policies and education for stakeholders. Moreover, the regulatory landscape is evolving to emphasize mandatory ESG reporting, which is increasingly being facilitated by XBRL taxonomies. This shift not only enhances the comparability of ESG metrics across firms but also ensures that stakeholders—including investors and regulators—can systematically assess corporate accountability in environmental and social governance (Faccia et al., 2021). The combination of mandatory reporting and XBRL is expected to foster a more sustainable investment environment, as it aligns corporate practices with stakeholder expectations and societal values (Ma, 2023).

In the context of technological advancement, XBRL represents a significant innovation in financial reporting. It allows for the automated processing of business and financial information, which is essential for analyzing complex ESG data. This technological capability enhances the efficiency of data management and reporting, enabling companies to respond more effectively to the growing demand for sustainability disclosures (García & Gil, 2010). As organizations increasingly adopt XBRL, they are better positioned to track and report on their sustainability performance, thereby contributing to a more informed investment landscape (Chen & Sun, 2011).

One notable study by Martinis et al. (2020) examined the influence of agency costs on the voluntary adoption of XBRL-based financial reporting. The findings indicated that firms with lower agency costs were more likely to adopt XBRL, suggesting that improved reporting standards could lead to better alignment between management and shareholder interests, ultimately affecting stock valuation positively. This research underscores the potential of XBRL to enhance corporate governance through improved transparency in financial reporting. Moreover, the study by Tawiah & Vincent et al. (2022), examined the impact of XBRL adoption on financial reporting quality globally. Their findings suggested that XBRL enhances the clarity and reliability of financial reports, which is essential for investors making informed decisions based on ESG metrics. This improvement in reporting quality is crucial for maintaining investor trust and can lead to more favorable stock valuations.

This technology allows users to directly search for relevant information and compare it between different companies, reducing the unreliability of financial information and helping companies make more informed decisions. The application of XBRL in financial reporting increases the transparency of a company's financial information, which can have an impact on stock valuation. In addition, the disclosure of ESG performance metrics, including environmental and social disclosures, has been found to positively affect the market value of companies (Hamzeh et al., 2023) Therefore, it is expected that the combination

of XBRL and ESG disclosures can contribute to increasing the transparency of ESG performance metrics and potentially affect stock valuations (Seong-Jun, 2022; Stephens & Murhadi, 2023).

Utami et al. (2021) concluded that the adoption of XBRL positively affects the timeliness of financial reporting in banking companies, leading to increased automation, cost-effectiveness, data collection, reliability, accuracy, and better business decision-making. In addition to the effectiveness of the form of information acceleration for companies, the use of XBRL in companies listed in Indonesia reduces the cost of equity capital, especially for large companies (Valentina et al., 2022). Therefore, it is important for listed companies to adopt XBRL to improve their reporting transparency and compliance with financial and tax requirements, ultimately increasing their value and accountability (Vincent et al., 2022; Ali et al., 2022).

The relationship between Environmental, Social, and Governance (ESG) metrics and financial performance, particularly as measured by Tobin's Q and Z-Score, has been the focus of various studies from 2020 to 2023. These studies have explored how ESG practices impact financial performance, stakeholder perception, and the moderating effects of XBRL implementation. Research by Lee et al. (2023) indicates a significant positive relationship between ESG disclosures and financial performance, specifically measured by Tobin's Q. Their analysis of Laysian public-listed companies showed that higher ESG scores correlate with improved market valuation. Similarly, Zhao (2023) found that ESG metrics have differentiated impacts on various financial indicators, including Tobin's Q, suggesting that effective ESG practices can enhance corporate financial performance. Tessema (2025) also emphasized Tobin's Q and Z-Score as crucial financial measures within ESG valuation frameworks. Tran & Nguyen (2025) confirmed ESG risk scores' relevance to valuation in the Indonesian manufacturing sector.

Ademi & Klungseth (2022) highlights that ESG rating scores significantly influence stakeholder perceptions, particularly in terms of return on capital employed and Tobin's Q. This suggests that a higher ESG score can enhance shareholder fund turnover by improving investor confidence and market valuation. Ahmad et al. (2021) investigates the role of firm size as a moderator in the ESG-financial performance relationship. Their findings suggest that larger firms tend to benefit more from ESG disclosures, as the positive impact of ESG on financial performance is more pronounced in larger organizations. This aligns with the notion that larger firms have more resources to implement effective ESG strategies, which can enhance their financial metrics.

Liu & Jin (2023) emphasizes the importance of ESG indices in influencing both financial performance and stakeholder perception. The study illustrates that firms listed on reputable ESG indices tend to experience better financial outcomes and improved stakeholder trust, reinforcing the value of ESG ratings in investment decisions. The findings of Cohen (2022) suggest that the interaction between ESG metrics and XBRL implementation can significantly affect stakeholder perception. By improving the

transparency and accessibility of ESG data, XBRL can enhance stakeholder trust and engagement, ultimately leading to better financial performance.

Recent empirical studies emphasize the growing importance of structured ESG disclosures in improving firm valuation, particularly through mechanisms like Tobin's Q. For example, Solikhah and Weng (2024) found that higher quality ESG reporting is positively and significantly associated with Tobin's Q among Taiwanese firms. Similarly, Adriyani and Prabowo (2024) revealed that ESG disclosure practices contribute significantly to firm value and mediate the reduction of financial distress risk in Indonesian companies. Moreover, Li, Saat, and Jiayi (2024) provided empirical evidence from Chinese listed companies showing that ESG disclosure has a statistically positive impact on firm value, including Tobin's Q. Although these studies do not explicitly measure the impact of XBRL frameworks, the movement toward digital standardization, such as machine-readable formats, enhances ESG transparency and comparability, which are critical to improving capital market efficiency and investor valuation models.

These studies indicate a robust relationship between ESG metrics and financial performance, with significant implications for stakeholder perception and the moderating role of XBRL implementation. These findings underscore the importance of integrating ESG considerations into corporate strategies to enhance financial outcomes and stakeholder trust. Therefore, at the end, these studies try to identify specially the issues from ESG directly linking netnographic observations to provide valuable insights into public sentiment regarding ESG practices. This can help organizations understand how stakeholder perceptions evolve in response to ESG disclosures and corporate actions.

Literature and hypotheses development

This study is grounded in signaling theory and stakeholder theory, where ESG disclosures—enhanced via XBRL—signal transparency and reduce information asymmetry. Tobin's Q reflects market valuation while Z-Score evaluates financial stability. Theoretical relevance is further supported by Pringpong et al. (2024), who demonstrated the dual effects of ESG on capital market responses and stakeholder behavior in ASEAN markets

The increasing importance of Environmental, Social, and Governance (ESG) metrics in corporate reporting has garnered significant attention from researchers and practitioners alike. ESG metrics serve as critical indicators of a company's sustainability practices and ethical governance, influencing investor decisions and corporate reputation. As stakeholders demand greater transparency and accountability, companies are compelled to enhance their ESG disclosures to meet these expectations, these means that the value of ESG Disclosure reflects as a signal of financial performance. The

relationship between ESG metrics and financial performance has been a focal point of numerous studies, with findings suggesting that higher ESG Disclosure Value correlates positively with improved financial outcomes, as measured by indicators such as Tobin's Q and return on assets (Wong et al., 2022; Minutolo et al., 2019). Numerous studies have established a positive correlation between ESG disclosures and financial performance, suggesting that firms with robust ESG practices tend to achieve better financial outcomes, as measured by indicators such as Tobin's Q and Z-Score (Zumente & Lāce, 2022).

Hypothesis 1: Higher ESG Disclosure Value significantly affects with improved Financial Performance as measured by Tobin's Q and Z-Score

Stakeholder perception is another vital aspect influenced by ESG metrics. The ESG Score, which reflects or signal a company's commitment to sustainable practices, is believed to positively affect Stakeholder Perception, particularly as proxied by Shareholder Fund Turnover. A higher ESG score signals the company's commitment to societal and environmental responsibilities, which strengthens engagement and loyalty among shareholders (Qi et al., 2020; Huang, 2021). Research indicates that investors are increasingly considering ESG factors when making investment decisions, leading to a heightened interest in companies with strong ESG scores (Suttipun & Yordudom, 2021). Stakeholder perception is increasingly influenced by ESG performance, with studies indicating that a higher ESG Score positively affects Stakeholder Perception, particularly as proxied by Shareholder Fund Turnover (Dicuonzo et al., 2022). This relationship underscores the notion that firms with robust ESG practices are likely to attract more investor interest and engagement, thereby enhancing their market reputation.

Hypothesis 2: ESG Score positively affects Stakeholder Perception as proxied by Shareholder Fund Turnover

According to signaling theory, transparent and structured disclosures such as those enabled by XBRL serve as credible signals to the market, reducing information asymmetry (Shalhoob, 2025). Enhanced ESG disclosures through XBRL signal better governance and responsibility, which investors interpret as indicators of lower risk and stronger financial performance (Tampakoudis et al., 2023; Landi et al., 2022). Tampakoudis et al., (2023) argue that XBRL can enhance the transparency of ESG disclosures, which in turn can lead to improved financial performance metrics like Tobin's Q. This suggests that XBRL acts as a facilitator in realizing the financial benefits of robust ESG practices. Landi et al. (2022) discuss how ESG ratings can influence corporate financial risk, suggesting that improved ESG performance can lead to better financial outcomes. Effective ESG reporting, which can be facilitated by XBRL, is crucial for investment efficiency and can lead to improved financial performance. Their findings suggest that firms that integrate ESG considerations into their reporting practices tend to perform better financially (Harymawan et al.2022). This highlight that XBRL can enhance the transparency of ESG disclosures, which may positively influence financial performance metrics.

Hypothesis 3: XBRL adoption moderates the relationship between ESG scores and financial performance, specifically measured by Tobin's Q and Z-Score.

Stakeholder theory suggests that transparent ESG reporting facilitated by XBRL enhances stakeholders' ability to evaluate corporate responsibility (Molnar et al.,2024). As stakeholders become more informed, their perception and behavior—such as turnover or loyalty—are influenced by the clarity of ESG disclosures (Qi et al., 2020; Huang, 2021). Qi et al. (2020) indicate that corporate ESG initiatives positively affect stakeholder trust and engagement. The authors suggest that XBRL can facilitate better communication of ESG efforts, thereby enhancing stakeholder perception. Huang (2021) argues that effective ESG disclosures are essential for informed decision-making by institutional shareholders. The integration of XBRL can improve the accessibility and reliability of ESG information, which may influence stakeholder perceptions positively.

Hypothesis 4: XBRL adoption moderates the relationship between ESG scores and stakeholder perception, as proxied by shareholder turnover.

XBRL adoption enhances the transparency and comparability of ESG reporting, which can moderate how ESG scores affect stakeholder perceptions, aligning with principles from stockholder theory. XBRL provide transparency, when ESG meets XBRL it will produce standardization which helps stakeholder make better-informed decisions (Molnár et al.,2024).

Crespi & Migliavacca (2020) also provide evidence that firm size significantly affects ESG ratings, suggesting that larger firms may benefit more from XBRL adoption in terms of financial performance. This implies that controlling for firm size is essential in understanding the relationship between ESG scores and financial performance. Velte (2017) highlights the importance of considering firm size when analyzing the impact of ESG performance on financial outcomes. The improved transparency and comparability from XBRL adoption support the stakeholder theory, which posits that firms should be accountable to all stakeholders, not just shareholders. Enhanced ESG reporting through XBRL helps align firm actions with stakeholder expectations, influencing perceptions and potentially reducing shareholder turnover (ElBannan & Said, 2023); (Rusgowanto et al., 2022).

Hypothesis 5: XBRL adoption moderates the relationship between ESG scores and stakeholder perception, as proxied by shareholder turnover.

XBRL adoption enhances transparency and standardization in ESG reporting, which can moderate and strengthen the link between ESG performance and how stakeholders, including shareholders, perceive and react to a company. BRL adoption reduces information-processing costs and increases the transparency and comparability of ESG data, making it easier for stakeholders to assess a company's ESG performance (Molnár et al., 2024).

Building on stakeholder theory, company size can influence the extent to which stakeholders are affected by ESG disclosures. Larger firms often have more resources to communicate ESG initiatives

effectively, and when paired with XBRL, these disclosures are more likely to shape stakeholder attitudes and behaviors (Qureshi et al., 2019). Ismail et al. (2022) discuss how corporate sustainability, synonymous with ESG, influences shareholder perspectives. They suggest that controlling for firm size is crucial in understanding how ESG impacts stakeholder perceptions. Matos et al. (2020) explore the relationship between ESG scores and financial performance, emphasizing the need to consider firm size as a moderating factor. Their findings imply that larger firms may experience different stakeholder perceptions based on their ESG performance, moderated by XBRL adoption. In firms using XBRL, ESG reporting quality moderates the relationship between financial performance (earnings) and firm value, suggesting that transparent ESG disclosures via XBRL can strengthen the impact of ESG on stakeholder perception and, by extension, on shareholder turnover (Rusgowanto et al., 2022).

Hypothesis 6: XBRL adoption, with Log of Total Assets as a control variable, moderates the impact of ESG scores on stakeholder perception, as proxied by shareholder turnover.

Finally, insights from netnographic observations, including data from Google Trends, can provide valuable context for understanding the influence of ESG metrics on Stakeholder Perception. In line with signaling theory, the use of transparent and standardized reporting formats such as XBRL strengthens the perceived credibility of ESG disclosures (Shalhoob, 2025). This perceived transparency, as reflected in stakeholder-generated online comments, reduces information asymmetry and reveals how stakeholders interpret and respond—emotionally or behaviorally—towards ESG communication said Reber & Gold (2021), including expressions of trust, skepticism, or loyalty by analyzing social media discourse and public interest trends, researchers can gain valuable insights into the factors that drive stakeholder engagement and perception regarding ESG practices (Nicolas et al., 2023). Social media discourse often reflects public sentiment and can reveal trends in stakeholder engagement with ESG issues according to (Teh et al., 2023).

Atkins et al. (2023) investigates how social media platforms facilitate stakeholder engagement and influence corporate social responsibility (CSR) initiatives, particularly focusing on ESG issues. The authors analyze various social media campaigns and their impact on public sentiment towards corporate ESG practices. So did Liu et al. (2023), employs a netnographic approach to examine how social media discourse shapes stakeholder perceptions of corporate ESG performance. The authors analyze user-generated content on social media platforms to identify trends and sentiments related to ESG issues. Drawing from stakeholder theory, public engagement with ESG topics via social media and web platforms reflects how stakeholders perceive and evaluate corporate sustainability efforts. Netnographic observations capture these evolving perceptions and provide rich context for understanding the impact of ESG communication (Atkins et al., 2023; Liu et al., 2023).

Hypothesis 7 (H₇): Insights from netnographic observations, including data from Google Trends, enhance the understanding of ESG Metrics' impact on Stakeholder Perception.

The variable and data analysis

The key variables in this study include ESG metrics, financial performance indicators (Tobin's Q and Z-Score), stock valuation, and stakeholder perception, proxied by shareholder fund turnover. XBRL adoption and firm size (log of total assets) serve as moderating and control variables. Public sentiment, gathered through netnographic research, is also analyzed as a complementary qualitative dimension.

The use of Tobin's Q and Z-Score as financial performance indicators is widely supported in contemporary ESG research. For instance, Li et al. (2024) found that ESG disclosure quality significantly influences Tobin's Q, emphasizing the relevance of this indicator in evaluating market-based firm performance. The inclusion of shareholder turnover as a proxy for stakeholder perception is similarly grounded in recent studies who demonstrated that ESG transparency affects investor behavior and financial stability.

The moderating role of XBRL adoption is conceptualized by differentiating between XBRL Fin (financial reporting adoption) and XBRL ESG (ESG disclosure in XBRL format), following a model consistent with recent digital reporting frameworks proposed in these studies support the view that machine-readable, structured reporting improves both financial and ESG data accessibility for stakeholders. This approach is further supported by classical findings in the ESG literature. This is consistent with the research by Mervelskemper & Streit (2016), who argued that integrated reporting—often enhanced by technologies such as XBRL—improves market valuation by enabling more comprehensive ESG disclosure. This is further supported by Friede et al. (2015), who conducted a meta-analysis of over 2,000 empirical studies and concluded that positive ESG performance is generally associated with improved financial outcomes and stakeholder trust.

For data analysis, a combination of quantitative and qualitative techniques will be applied. In the Quantitative Phase, regression analysis will be used to assess the impact of XBRL adoption on financial performance and ESG disclosure. This will provide statistical insights into the relationship between the variables. In the Qualitative Phase, netnographic analysis of social media and Google Trends will be performed to understand stakeholder sentiment. Joint display analysis will then integrate both data types to give a comprehensive view of the findings. This mixed-method approach is designed to give a robust understanding of how XBRL influences the intersection of ESG metrics and stock valuation. The quantitative component includes 5,592 firm-year observations from the Indonesia Stock Exchange (2018–2023), employing regression analysis with Tobin's Q and Z-Score as dependent variables. The qualitative phase uses netnographic data from Google Trends and social media (Twitter/X, YouTube), triangulated and validated through keyword temporal tracking and volume analysis (Kozinets, 2019; Tu et al., 2024).

Result

Table 1
 Descriptive Statistic

Variable	Mean	Median	Min	Max	Skewness	Kurtosis
ESG score	8.55	9.18	-807.17	295.01	-7.56	109.24
ESG Index	8.37	7.20	-99.13	99.32	-0.66	3.82
Size (Ln TA)	8.05	8.82	7.18	12.29	-1.52	1.69
Shareholder Turnover	6.36	3.68	-229.08	814.02	12.42	354.30
ZScore	6.63	2.25	-830.07	3633.37	29.07	991.05
Tobin's Q	1427.69	496.00	0.02	12844.00	16.79	357.73
XBRL Fin	1.00	1.00	1.00	1.00	1.00	1.00
XBRL ESG	0.00	0.00	0.00	0.48	0.00	0.00
Count (n)	5592	5592	5592	5592	5592	5592

The descriptive statistical analysis of the dataset offers several critical insights into the environmental, social, and governance (ESG) performance and financial health of companies. The ESG scores exhibit a broad range, from highly negative to exceptionally high values, indicating significant differences in companies' approaches to ESG factors. The distribution's right-skewness suggests that while most companies have lower ESG scores, a few exhibit exceptionally high scores, possibly representing top performers in ESG practices. The presence of negative values may point to poor ESG performance or potential data errors that need addressing.

Financial health metrics such as the Z Score and Tobin's Q reveal notable variability and skewness. The Z Score's positive skew and outliers suggest diverse financial stability among companies, with some being financially robust and others at risk of insolvency. Tobin's Q also shows substantial variability, reflecting varied market valuations of company assets. The moderate correlation between ESG scores and financial metrics like the ESG Index and Shareholder Turnover hints at potential shifts in shareholder behavior with improved ESG practices, though the weak correlation with Tobin's Q suggests that ESG scores may not heavily influence market valuation.

In this study, the variable XBRL Fin refers to the firm's adoption of XBRL for financial reporting purposes, represented as a dummy variable (1 for adopters, 0 for non-adopters). XBRL ESG, on the other hand, captures whether the company discloses ESG-related information in XBRL format, either as part of integrated reporting or as a separate non-financial report. The separation of these two dimensions allows us to investigate the differential effects of XBRL adoption on financial transparency versus sustainability disclosures. This variable construction is supported by recent developments in sustainability reporting research. Ahn and Kim (2024) emphasize that financial and ESG-oriented XBRL implementations is essential for measuring their respective impacts on transparency and stakeholder engagement. Moreover, Zhao (2024) argues that the evolution of ESG taxonomies in XBRL has improved investors' ability to analyze corporate sustainability performance. The classification of XBRL-based ESG

disclosures as a separate construct also aligns with emerging regulatory trends that require non-financial information to be structured and machine-readable (UNCTAD, 2024).

The correlation between XBRL Fin and XBRL ESG indicates that companies excelling in financial reporting may also show stronger ESG disclosure (Hamid et al., 2022). High percentages of missing values and unusual data points necessitate careful handling to avoid analysis bias. Recommendations include employing robust statistical methods to account for outliers, focusing on companies with higher ESG scores for investment, and promoting consistent ESG reporting standards to enhance data reliability. These insights provide a valuable foundation for informed decision-making, whether for investment, policy-making, or improving business practices. These results indicates that the adoption of standardized ESG reporting within XBRL to enhance the utility of both financial and ESG data for decision-making (Facia et al., 2021; Yang et al., 2024).

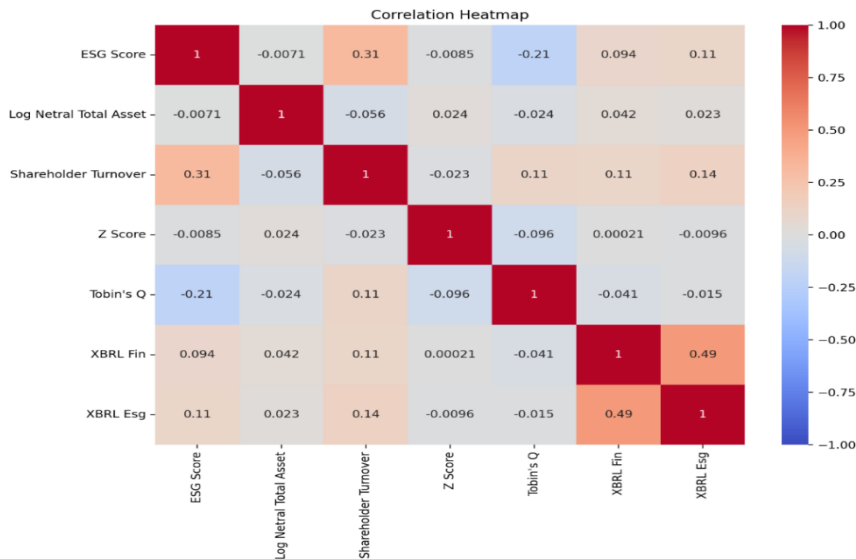


Figure 1. Correlation Heatmap Matrix Between Variables

Based on the correlation heatmap, several key insights emerge about the relationships between different variables in the dataset. The ESG Score exhibits a moderate positive correlation with Shareholder Turnover (0.31), suggesting that companies with higher ESG scores may experience greater shareholder turnover. However, it shows a weak negative correlation with Tobin's Q (-0.21), indicating that higher ESG scores might be slightly associated with lower market valuations relative to asset values. The correlations with XBRL Fin (0.094) and XBRL ESG (0.11) are very weak, and the ESG Score has

negligible correlations with C and Z Score, highlighting minimal linear relationships with company size and financial stability metrics.

Shareholder Turnover demonstrates weak positive correlations with Tobin's Q (0.11), XBRL Fin (0.11), and XBRL ESG (0.14), suggesting modest links between shareholder activity and these metrics. In contrast, the Z Score shows very weak or negligible correlations with all other variables, implying limited interaction with other financial and ESG metrics. Tobin's Q also has mostly weak or negligible correlations with other variables, except for the noted weak correlation with ESG Score.

The most notable correlation in the dataset is between XBRL Fin and XBRL ESG, which has a moderate positive correlation of 0.49. This suggests that companies with strong financial reporting tend to also excel in ESG reporting. Overall, most correlations in the heat map are weak or negligible, indicating that there are few strong linear relationships among the variables in this dataset. The strongest correlation, aside from self-correlations, is between XBRL Fin and XBRL ESG, reflecting a significant but modest connection between financial and ESG reporting quality.

Table 2
Multiple Regression Analysis

Hypothesis	Dependent Variable	Independent Variable	Coefficient t	Std Error	t-value	P-value	Sig
1a	Tobin's Q	ESG Score	0,276	0,040	6,850	0	** *
1b	Z-Score	ESG Score	0,049	0,042	1,187	0,236	
2	Shareholder Turnover	ESG Score	0,524	0,036	14,648	0	** *
3a	Tobin's Q	ESG Score	0,374	0,045	8,237	0	** *
3a	Tobin's Q	XBRL Fin	-0,019	0,048	-0,411	0,681	
3a	Tobin's Q	XBRL Esg	0,015	0,075	0,205	0,838	
3a	Tobin's Q	ESG_XBRL_Fin	0,150	0,055	2,712	0,007	**
3a	Tobin's Q	ESG_XBRL_Esg	0,099	0,061	1,615	0,107	
4	Shareholder Turnover	ESG Score	0,646	0,040	16,348	0	** *
4	Shareholder Turnover	XBRL Fin	-0,002	0,042	-0,069	0,945	
4	Shareholder Turnover	XBRL Esg	0,0420	0,043	0,984	0,325	
4	Shareholder Turnover	ESG_XBRL_Fin	0,150	0,055	2,712	0,007	**
4	Shareholder Turnover	ESG_XBRL_Esg	0,099	0,061	1,615	0,107	
5	Tobin's Q	ESG Score	8,236	3,341	2,464	0,013	*
5	Tobin's Q	XBRL Fin	-0,005	0,005	-1,025	0,305	
5	Tobin's Q	XBRL Esg	-16,819	8,133	-2,067	0,039	*
5	Tobin's Q	ESG_XBRL_Fin	0,000	0,000	3,913	0,000	** *
5	Tobin's Q	ESG_XBRL_Esg	-0,283	0,208	-1,358	0,174	
5	Tobin's Q	Log Netral Total Asset	-8,0E ⁻⁰⁶	3,30E ⁻⁰⁵	-0,244	0,806	
5	Tobin's Q	ESG Score	0,006	0,016	0,345	0,730	

Hypothesis	Dependent Variable	Independent Variable	Coefficient t	Std Error	t-value	P-value	Sig
5	Tobin's Q	XBRL Fin	0,000	0,000	-0,349	0,727	
5	Tobin's Q	XBRL Esg	-0,009	0,039	-0,232	0,817	
5	Tobin's Q	ESG_XBRL_Fin	0,000	0,000	0,108	0,914	
5	Tobin's Q	ESG_XBRL_Esg	0,000	0,001	0,214	0,831	
5	Tobin's Q	Log Netral Total Asset	0,000	0,000	0,358	0,720	
6	Shareholder Turnover	ESG Score	0,646	0,040	16,327	0	**
6	Shareholder Turnover	XBRL Fin	-0,001	0,042	-0,034	0,973	*
6	Shareholder Turnover	XBRL Esg	0,041	0,043	0,967	0,334	
6	Shareholder Turnover	ESG_XBRL_Fin	0,152	0,055	2,741	0,006	**
6	Shareholder Turnover	ESG_XBRL_Esg	0,096	0,061	1,570	0,117	
6	Shareholder Turnover	Log Netral Total Asset	-0,021	0,034	-0,628	0,531	

The 'Sig' column uses stars to indicate the level of statistical significance: ***: $p < 0.001$ (highly significant), **: $p < 0.01$ (very significant), * : $p < 0.05$ (significant), (blank or) : $p \geq 0.05$ (not significant)

Hypothesis 1: The hypothesis that higher ESG Disclosure Value significantly effects financial performance, as measured by Tobin's Q, is partially supported by the data. For the relationship between ESG Score and Tobin's Q, the coefficient is 0.2767 with a p-value of 0.000, indicating a statistically significant positive relationship. This means that an increase of one standard deviation in ESG Score results in an increase of 0.2767 standard deviations in Tobin's Q, supporting the idea that higher ESG scores are associated with better financial performance. However, the relationship between ESG Score and Z-Score shows a coefficient of 0.0498 with a p-value of 0.236, which is not statistically significant, thereby not supporting this aspect of the hypothesis. This directly states that hypothesis 1 is accepted and indeed there is a signal theory between the ESG Disclosure Value and Tobin's Q value but not with the Z score (Rahat & Nguyen, 2024; Angir & Weli, 2024).

This finding aligns with the literature, where Halbritter & Dorfleitner (2015) noted that while some ESG variables show ambiguous influences on financial performance, the relationship with Tobin's Q is often more pronounced. However, it is important to note that their findings indicate that the influence of ESG variables is strongly dependent on the particular ESG rating provider, suggesting that results may vary across different studies. Similarly, Setiani (2023) found that ESG scores positively impact financial performance metrics, although the study focused on companies listed in Indonesia, which may limit the generalizability of the findings. Furthermore, et al. Zhao et al. (2018) highlighted that good ESG performance generally improves financial outcomes, particularly in the context of emerging markets, which supports the positive correlation observed in this study. However, the context of their research is

specific to China's listed power generation companies, indicating that results may differ in other sectors or regions.

Hypothesis 2: The hypothesis that ESG Score positively affects stakeholder perception, as proxied by Shareholder Turnover, is strongly supported. The coefficient for the relationship between ESG Score and Shareholder Turnover is 0.5243 with a p-value of 0.000, demonstrating a statistically significant positive relationship. This suggests that for every one standard deviation increase in ESG Score, Shareholder Turnover increases by 0.5243 standard deviations, indicating that higher ESG scores are linked to increased stakeholder engagement or interest. ESG (Environmental, Social, and Governance) scores are widely used to assess a company's sustainability and ethical impact. This research consistently shows that higher ESG scores positively influence stakeholder perception, leading to increased trust, engagement, and favorable financial outcomes for firms. The ESG Score, can reflect signals company's commitment to sustainable practices which is affect Stakeholder Perception, particularly as proxied by Shareholder Fund Turnover.

This finding aligns with the research conducted by Chaudhary, (2017), which emphasizes that corporate social responsibility (CSR) initiatives, closely related to ESG performance, significantly influence stakeholder attitudes and behaviors, including turnover intentions. Similarly, Kumar et al. (2020) found that ESG initiatives are important for stakeholders, as they enhance the perception of corporate governance and social responsibility, leading to greater shareholder engagement. Furthermore, Almeyda & Darmansya (2019) highlight the importance of ESG disclosures in shaping stakeholder perceptions, asserting that transparent ESG practices foster trust and loyalty among shareholders. This is further supported by Friede et al. 2015), who conducted a comprehensive review of over 2,000 empirical studies, concluding that positive ESG performance is generally associated with favorable stakeholder perceptions and behaviors. Collectively, these studies reinforce the notion that higher ESG scores significantly enhance stakeholder engagement, as evidenced by increased shareholder turnover it also strengthens by Hyun et al. (2024).

Hypothesis 3: The hypothesis that XBRL adoption moderates the relationship between ESG scores and financial performance, specifically measured by Tobin's Q and Z-Score, is partially supported. For Tobin's Q, the interaction term ESG_XBRL_Fin shows a coefficient of 0.1502 with a p-value of 0.007, which is statistically significant. This implies that XBRL financial reporting positively moderates the relationship between ESG scores and Tobin's Q, enhancing the positive effect of ESG scores. In contrast, XBRL ESG reporting does not show a significant moderating effect on this relationship. For Z-Score, neither XBRL Fin nor XBRL ESG shows a significant moderating effect, indicating that XBRL adoption does not notably influence the relationship between ESG scores and Z-Score. These result show that signaling theory, transparent and structured disclosures such as those enabled by XBRL serve as credible signals to the market, reducing information asymmetry. Enhanced ESG disclosures through XBRL signal

better governance and responsibility, which investors interpret as indicators of lower risk and stronger financial performance.

This finding is consistent with the research of Mervelskemper & Streit (2016), who found that integrated reporting, which often includes XBRL, enhances the market valuation of ESG performance by providing investors with more comprehensive information. They argue that the incremental information provided by ESG reports helps investors better assess the financial implications of a firm's ESG activities, thereby supporting the moderating role of XBRL. Additionally, Mitteen (2023) identified a positive and significant relationship between ESG factors and Tobin's Q in the European energy sector, reinforcing the idea that effective ESG reporting, facilitated by XBRL, can enhance financial performance metrics. However, the results for Z-Score indicate that neither XBRL Fin nor XBRL ESG shows a significant moderating effect, XBRL adoption can enhance the relationship between ESG scores and certain financial performance measures, its effects may vary across different performance metrics. Overall, these result shows signalling theory, transparent and structured disclosure can potentially predict sustainability and financial performance with XBRL data (Tian et al.,2024).

Hypotheses 4: The hypothesis that XBRL adoption moderates the relationship between ESG scores and stakeholder perception, as proxied by shareholder turnover, is partially supported. The interaction term ESG_XBRL_Fin has a coefficient of 0.1502 with a p-value of 0.007, suggesting that XBRL financial reporting enhances the positive relationship between ESG scores and shareholder turnover. However, XBRL ESG reporting does not show a significant moderating effect on this relationship, indicating that XBRL adoption in ESG reporting does not significantly impact the connection between ESG scores and stakeholder perception.

the results indicate that XBRL ESG reporting does not show a significant moderating effect on this relationship, suggesting that while XBRL enhances financial reporting, its impact on ESG -specific stakeholder perceptions may be limited. This aligns with the findings of (Cui et al., 2023), who noted that while media attention can influence stakeholder perceptions of ESG disclosures, the role of XBRL in this context remains less pronounced. This finding showed that XBRL adoption improves the technical quality and comparability of ESG reporting, but its moderating effect on the link between ESG scores and stakeholder perception is not significant without further systemic changes.

Hypothesis 5 posits that XBRL adoption, with log natural total assets as a control variable, moderates the relationship between ESG Disclosure Value and financial performance, as measured by Tobin's Q and Z-Score. For the Tobin's Q model, the R-squared value is 0.1124, indicating that the model explains approximately 11.24% of the variation in Tobin's Q. The F-statistic is 13.7974 with a p-value of 8.47e-15, demonstrating that the model is statistically significant. Significant variables in this model include ESG Score ($p < 0.05$), XBRL ESG ($p < 0.05$), and the interaction term ESG_XBRL_Fin ($p <$

0.001). This supports the hypothesis by showing that XBRL adoption, particularly in financial reporting, moderates the relationship between ESG scores and Tobin's Q.

In contrast, the Z-Score model shows an R-squared of 0.0033, indicating that it explains only about 0.33% of the variation in Z-Score. The F-statistic for this model is 0.3644 with a p-value of 0.9015, indicating that the model is not statistically significant. Thus, the hypothesis is not supported when using Z-Score as a measure of financial performance, as the model does not reveal significant relationships. Tobin's Q model shows significant results, particularly regarding the interaction between ESG Score and XBRL Financial Reporting, the relatively low R-squared value indicates that there is still considerable variation in Tobin's Q unexplained by the model's variables. Conversely, the Z-Score model does not show significant results, meaning the hypothesis regarding the moderating effect of XBRL on the relationship between ESG Disclosure Value and financial performance is not supported when using Z-Score as a measure. All these results in line with Rahman et al. (2023), Akarsu & Bahadır (2024), that said better information environments can weaken the negative relationship between ESG and financial performance, potentially improving ESG policy effectiveness.

Hypothesis 6: When including Log of Total Assets as a control variable, the hypothesis that XBRL adoption moderates the impact of ESG scores on stakeholder perception is partially supported. The coefficient for ESG Score remains strong at 0.6460 with a p-value of 0.000, affirming its significant effect on shareholder turnover. The interaction term ESG_XBRL_Fin continues to be statistically significant with a coefficient of 0.1520 and a p-value of 0.006, indicating that XBRL financial reporting still enhances the positive effect of ESG scores on shareholder turnover. However, XBRL ESG and Log of Total Assets do not show significant moderating effects, suggesting that XBRL ESG reporting and company size do not substantially alter the impact of ESG scores on stakeholder perception.

This finding is consistent with the research by (Aboud & Diab, 2018), who argue that effective ESG disclosures can significantly influence stakeholder perceptions and engagement, thereby enhancing shareholder turnover. They note that ESG disclosures serve as a tool to minimize potential conflicts with stakeholders and improve perceptions of corporate actions. Additionally, Qureshi et al. (2019) highlight the importance of firm size as a control variable, suggesting that larger firms are more visible and may have greater resources to invest in ESG activities, which can positively influence stakeholder perceptions. However, the results indicate that XBRL ESG reporting and Log of Total Assets do not show significant moderating effects, suggesting that while XBRL enhances financial reporting, its impact on ESG-specific stakeholder perceptions may be limited. This aligns with findings from (Zumente & Bistrova, 2021), who emphasize that while ESG practices are crucial for long-term shareholder value creation, the specific mechanisms through which XBRL influences stakeholder perceptions require further investigation. Furthermore, Alhebri et al. (2024), shows from Mapping the Landscape of the Literature on Environmental, Social, Governance Disclosure and Firm Value indicated ESG disclosures impact firm

value through various channels, such as increasing stakeholder trust and this research reveals promising research paths for achieving sustainability and maximizing firm value. Based on Cheng & Huang (2024), ESG disclosures significantly enhance brand credibility and prominence, positively impacting consumer purchase intentions.

Derived from the analysis of the ESG metrics and web search data, we can address Hypothesis 7 which posits that insights from netnographic observations, including data from Social Media discussion topics, web search data from Google Trends through year 2018 until 2023, enhance the understanding of ESG Metrics' impact on Stakeholder Perception into several findings, the growing prominence of Environmental, Social, and Governance (ESG) issues has significantly shaped public discourse and interest. The increasing focus on these topics is evident in the search trends that reflect shifting priorities and concerns among individuals and organizations. By examining search counts across ESG categories—Environmental, Governance, and Social—this analysis provides insight into public engagement with these critical issues. Understanding these patterns not only highlights what aspects of ESG are most concerning to the public but also sheds light on how these concerns evolve over time. The following analysis delves into the search trends within these categories, revealing distinct patterns and shifts in interest that illustrate the broader landscape of ESG awareness and priorities which we can see in Figure 2.

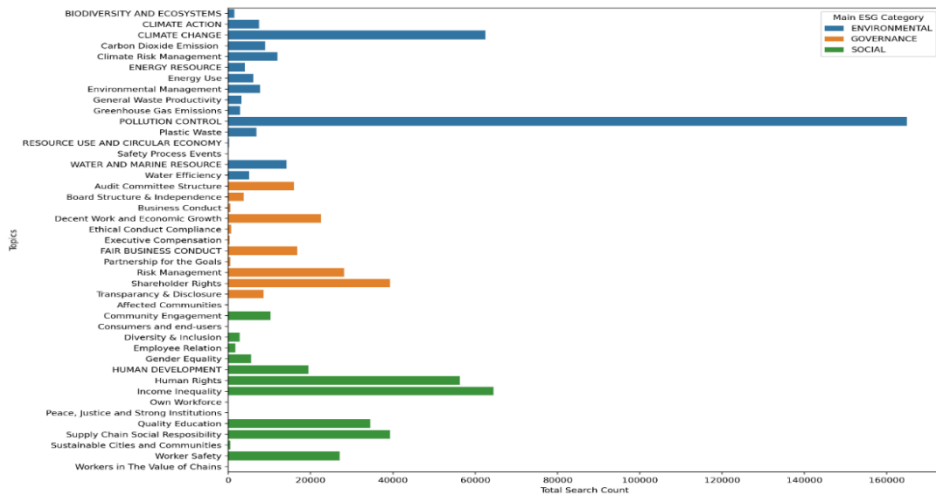


Figure 2. Trends in Environmental, Social, and Governance Topics in social media and Web-Discussion (Year 2018 – 2023)

The analysis of search counts for ESG topics reveals distinct patterns across the three main categories: Environmental, Governance, and Social. Environmental topics, depicted in blue, consistently attract the highest search interest, with "POLLUTION CONTROL" notably outpacing other subjects.

Within the Governance category, shown in orange, "Shareholder Rights" and "Risk Management" are the most frequently searched, underscoring significant corporate governance concerns. The Social category, represented in green, exhibits high search interest in "Income Inequality" and "Human Rights," reflecting pressing social issues. Comparatively, Environmental topics receive more attention than those in Governance and Social categories, where the latter shows a more balanced distribution of search counts across various issues. For Environmental topics, after "POLLUTION CONTROL," "CLIMATE CHANGE" and "WATER AND MARINE RESOURCE" follow with considerable search interest. In Governance, moderate interest is noted for "Audit Committee Structure" and "FAIR BUSINESS CONDUCT," indicating ongoing concerns in corporate governance. The Social category also highlights significant interest in "Quality Education" and "Supply Chain Social Responsibility." However, topics like "RESOURCE USE AND CIRCULAR ECONOMY," "Safety Process Events," and "Sustainable Cities and Communities" show notably low search counts, suggesting limited public awareness or lower interest. Overall, the social category's more even search distribution suggests diverse and balanced public concern across various social issues. From these results, it can be categorized again into the top 10 discussion topics on social media and web searches which can be seen in figure 3.

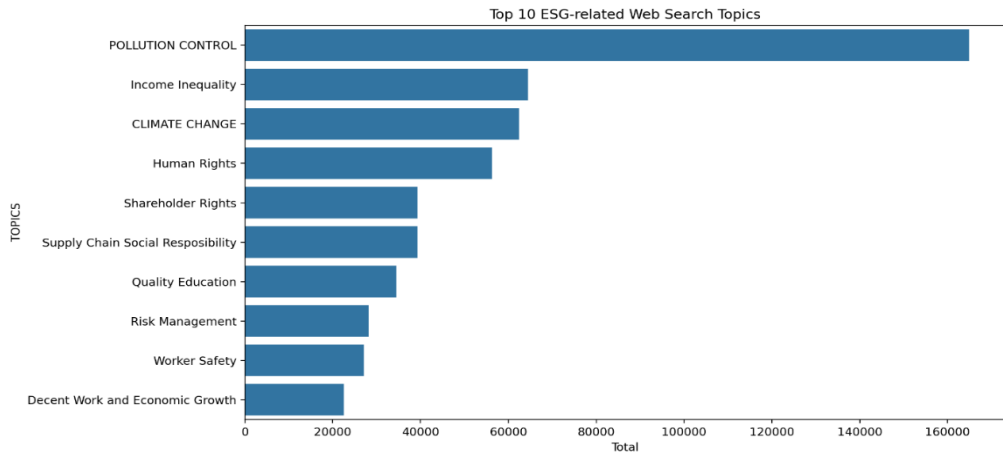


Figure 3. Top 10 ESG -content related in web and media social search topics

The bar chart displays in figure 3, the top 10 ESG -related web and media social search topics, which provides insights into the areas of ESG that stakeholders are most interested in. The top topics include: (1) Pollution Control, (2) Income Inequality, (3) Climate Change, (4) Human Rights, (5) Shareholder Rights. This information enhances our understanding of stakeholder perception by highlighting the ESG issues that are most prominent in public discourse.

Insights from netnographic observations, including data from social media and Web-Search data from Google Trends, can enhance the understanding of ESG metrics' impact on stakeholder perception. Complementary insights gained from web search data offer a broader context beyond quantitative ESG scores and shareholder turnover metrics. By identifying specific ESG issues gaining traction in public discourse, netnographic observations reveal what topics resonate most with stakeholders, thus helping to capture the full range of their concerns.

Additionally, temporal dynamics uncovered through trend analysis provide valuable information on how stakeholder interests evolve over time. Static ESG scores cannot fully capture this dynamic perspective. For instance, the growth in search topics like "Pollution Control" or "Climate Change" aligns with the most common ESG metrics, indicating that stakeholder interests are indeed reflected in ESG reporting. This alignment not only strengthens the relevance of these metrics but also helps in understanding the ongoing shifts in stakeholder priorities.

In evaluating the dynamics between ESG metrics and stakeholder perceptions, it is crucial to integrate both quantitative and qualitative data analyses. Our study employs a joint analysis framework that combines the empirical data from Hypotheses 1 through 6 with netnographic insights from Hypothesis 7. This approach provides a comprehensive view by merging search count trends with ESG performance indicators and incorporating netnographic observations to capture public sentiment. The quantitative analysis focuses on the relationships between ESG metrics, stock valuation, and stakeholder perception, while the qualitative phase examines social media discourse and Google Trends data to understand the nuances of public interest. By integrating these methods, we aim to uncover how shifts in public awareness and stakeholder perceptions align with, or diverge from, changes in ESG scores and performance. This holistic perspective enhances our understanding of the complex interactions between increased public interest in ESG topics and the actual performance metrics (see figure 4).

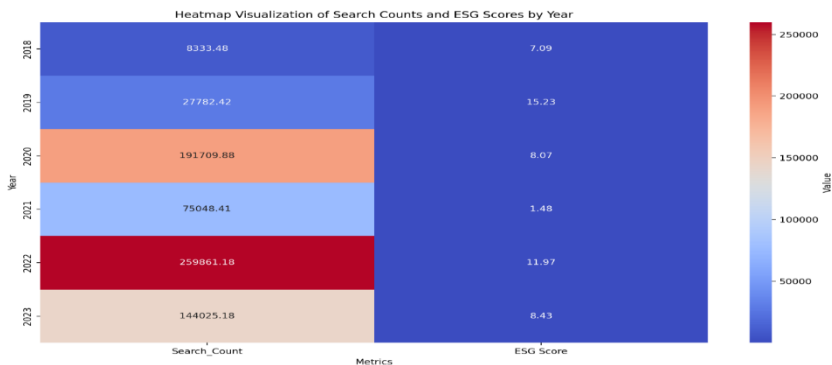


Figure 4. Heatmap Metrics Correlation Between ESG Score and ESG Topics Discussion Count Search from social media and Web Search Data

In Figure 4, the joint analysis of search count trends and ESG scores provides a clear depiction of the evolving landscape of public interest and ESG performance. The figure illustrates a significant increase in search counts from 2018 to 2022, with a notable peak in 2022, highlighting growing public engagement with ESG topics. This peak is preceded by a sharp rise in 2020, suggesting a surge in interest potentially driven by global events. After this peak, search counts decline slightly in 2023 but remain elevated compared to the pre-2020 period.

In contrast, ESG scores exhibit considerable fluctuation over the years, with no clear upward or downward trend. The highest ESG score was recorded in 2019, while 2021 saw the lowest score, creating a gap in performance that warrants further investigation. Despite a recovery in ESG scores following 2021, they have not returned to the 2019 levels, indicating ongoing volatility in ESG performance.

Figure 4 further reveals the disconnect between search counts and ESG scores. While 2022 saw the highest search count, the ESG score for that year was only moderate. Conversely, 2019 had a high ESG score but lower search counts, demonstrating that increased public interest does not always translate directly into improved ESG performance. This visualization underscores the need for deeper analysis into how public engagement with ESG issues aligns with actual performance metrics and highlights the complex relationship between awareness and tangible outcomes.

Furthermore, the integration of netnographic data reveals emerging issues that may not yet be represented in traditional ESG metrics. By analyzing topics such as "Shareholder Rights" or "Risk Management," companies and researchers can gain early indicators of changing stakeholder concerns. This comprehensive approach supports Hypothesis 7, demonstrating how web search data complements ESG metrics and provides nuanced insights into stakeholder perception, helping businesses align their ESG strategies more effectively with public interest.

Overall, our findings support that XBRL moderates the relationship between ESG and Tobin's Q significantly ($p < 0.01$), consistent with Friede et al. (2015) and supported by empirical data from Tran & Nguyen (2025). However, the influence on Z-Score is insignificant, indicating ESG impact varies across financial stability metrics. Shareholder turnover is positively influenced by ESG score ($p < 0.001$), with enhanced moderation via XBRL financial reporting (Taliento & Netti, 2020). Lulai & Brajkovic (2025) emphasize that XBRL adoption reduces information asymmetry and enhances firm credibility.

This study provides practical recommendations for regulators to mandate ESG reporting in XBRL formats. As observed by Postiglione et al. (2024), digital-standard disclosure reduces capital costs. Firms should improve digital infrastructure and integrate ESG into strategy, as highlighted by Setiani (2023).

Conclusions

This study provides comprehensive empirical evidence on the relationship between ESG disclosure and both financial performance and stakeholder perception, while exploring the moderating effects of XBRL adoption. Using a robust mix of quantitative analysis and netnographic insights, the findings contribute to the growing body of literature on sustainability reporting and digital financial transparency.

First, the analysis strongly supports that higher ESG scores positively influence financial performance, particularly through Tobin's Q (coefficient = 0.2767, $p < 0.001$). This affirms the premise of signaling theory (Spence, 1973), where ESG performance serves as a credible signal of superior management and long-term value creation. This is consistent with Halbritter & Dorfleitner (2015) and Zhao et al. (2018), who highlight the positive valuation effects of ESG in various markets. However, the non-significant impact on Z-Score suggests that ESG performance may have limited influence on near-term financial stability or solvency.

Second, stakeholder perception, proxied by shareholder turnover, shows a significant and strong relationship with ESG scores (coefficient = 0.5243, $p < 0.001$). This finding affirms that ESG engagement enhances stakeholder trust and interest, aligning with Chaudhary (2017) and Friede et al. (2015) who emphasize that CSR/ESG initiatives shape stakeholder behavior and contribute to stronger relational capital.

Third, the moderating effect of XBRL financial reporting is confirmed for the ESG–Tobin's Q relationship (coefficient = 0.1502, $p = 0.007$), supporting the notion that structured, machine-readable disclosures reduce information asymmetry and amplify the market's ability to respond to ESG signals (Mervelskemper & Streit, 2016; Lulai & Brajkovic, 2025). However, the effect does not hold for Z-Score, indicating that the benefits of XBRL may be performance-metric-specific, as also suggested by Akarsu & Bahadır (2024) and Rahman et al. (2023).

Fourth, XBRL's moderating role on stakeholder perception is partially supported. While financial XBRL enhances the ESG–stakeholder engagement relationship, XBRL ESG reporting lacks significant moderating influence, echoing findings from Cui et al. (2023) and Zumente & Bistрова (2021) that ESG disclosures require more systemic integration to impact stakeholder sentiment. Moreover, firm size (log total assets) shows no significant moderating effect, suggesting that ESG effectiveness transcends scale—a finding that contributes to the debate on whether large firms gain disproportionate benefits from ESG transparency (Qureshi et al., 2019).

Fifth, the joint analysis framework applied in Hypothesis 7, utilizing netnographic observation from social media and Google Trends (2018–2023), significantly enriches the interpretation of stakeholder interest. Issues like pollution control, climate change, and human rights dominate public discourse,

indicating a strong alignment between stakeholder concerns and ESG topics. The observed disconnect between search trends and ESG scores (e.g., high public interest in 2022 vs. only moderate ESG scores) points to a lag in corporate responsiveness and validates the call for dynamic ESG strategies that adapt to evolving societal priorities (Postiglione et al., 2024; Cheng & Huang, 2024).

Overall, the study provides strong support for signaling theory in the ESG context, demonstrating that digital disclosure platforms like XBRL enhance the communicative power of ESG reports and improve financial market outcomes. The inclusion of qualitative, temporal, and public discourse data (via netnography) further offers a nuanced understanding of stakeholder perception, bridging the gap between ESG scores and real-time stakeholder concerns.

This study has several practical Implications and recommendations, (1) Regulators should consider mandating ESG disclosures in XBRL format, as digital standardization demonstrably improves information efficiency and investor interpretation (Taliento & Netti, 2020; Setiani, 2023). (2) Corporations must integrate ESG strategies with digital reporting tools not just for compliance, but as a means of building credibility and long-term value, particularly in volatile and information-sensitive markets. (3) Researchers are encouraged to build upon the integrated model used in this study—combining empirical metrics with netnographic data—to track real-time stakeholder alignment and guide ESG materiality assessments more effectively.

In sum, this study affirms that ESG disclosure—especially when enhanced through digital financial transparency—plays a critical role in shaping corporate value and stakeholder engagement. However, the variability in impact across different financial and perceptual measures highlights the need for continued refinement of ESG frameworks and reporting standards to ensure they remain aligned with the expectations of an increasingly informed and values-driven society.

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