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ESG and Technology Investment: Evidence of Their Synergistic Effect on Corporate Valuation

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ABSTRACT

This study examines the individual and synergistic effects of digital technology application, represented by information technology capital expenditure (Capex IT), and Environmental, Social, and Governance (ESG) performance on corporate valuation, measured using Tobin's Q. The analysis investigates whether technology investment and sustainability performance operate as complementary strategic drivers of firm value. The empirical results indicate that Capex IT exhibits a consistently positive and statistically significant influence on corporate valuation, suggesting that technology-related investments enhance operational efficiency, competitive advantage, and market expectations of future growth. In contrast, ESG performance demonstrates a negative and significant relationship with Tobin's Q across several baseline model specifications, implying that ESG initiatives may not yet be fully priced by the market or may involve short-term costs that outweigh perceived benefits. However, when ESG is decomposed into its environmental, social, and governance components and included simultaneously, the aggregate ESG effect becomes positive and significant, indicating that a more balanced and integrated sustainability structure contributes to value creation. Moreover, the interaction term between Capex IT and ESG Score reveals a positive and significant effect on firm value, providing strong evidence of a synergistic relationship. This finding suggests that digital technology investment enhances the effectiveness, transparency, and market relevance of ESG initiatives. Overall, the results highlight the role of technological capability as a critical enabler that amplifies the value relevance of sustainability performance, offering important implications for managers and investors seeking to integrate digital transformation and ESG strategies to strengthen long-term corporate valuation.

INTRODUCTION

In recent years, corporations have operated in an environment characterized by rapid technological development and rising expectations for responsible and sustainable business practices. Information Technology (IT) investments, particularly capital expenditures on IT (Capex IT), have become an essential strategic lever for firms seeking to improve efficiency, enhance competitiveness, and strengthen their long-term market position. At the same time, Environmental, Social, and Governance (ESG) performance has gained prominence as stakeholders increasingly consider sustainability metrics when assessing corporate value.

These two domains, IT investment and ESG performance, are often examined separately (Qi et al., 2024), yet both are fundamental drivers that can influence a firm's capacity to innovate, manage risks, and create corporate value as reflected in valuation indicators such as Tobin's Q that including market valuation.

The urgency of this study is underscored by heightened investor scrutiny of sustainability practices and the accelerating digital transformation across industries. Corporations increasingly allocate significant resources to IT infrastructure while simultaneously facing pressure to demonstrate ESG responsibility. Understanding whether these two strategic investments complement each other in creating firm value is crucial for managers, investors, and policymakers. This study offers novelty by integrating the inherent proxy of digitalization using Investment on Information and Technology (Capex IT) and ESG performance into a unified analytical framework and empirically testing both their individual effects and their synergistic interaction on corporate valuation, an approach that remains underexplored in prior research.

Accordingly, the objectives of this study are threefold:

(1) to examine the relationship between Capex IT and corporate valuation, with **Hypothesis 1**: The application of digital technology has a significant positive impact on improving corporate valuation.
(2) to assess the effect of ESG performance on corporate valuation, with **Hypothesis 2**: Good ESG performance will significantly improve corporate valuation.
(3) to assess the consistency effect of Capex IT and ESG simultaneously create value, with **Hypothesis 3**: The

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application of digital technology and ESG performance has a significant positive impact on improving corporate valuation.

(4) to analyze the synergistic interaction between Capex IT and ESG performance in influencing corporate valuation **Hypothesis 4**: There is Synergistic effect between the application of digital technology and ESG, which enhances the role of each on corporate valuation.

Following the research objective, the framework designed as follows:

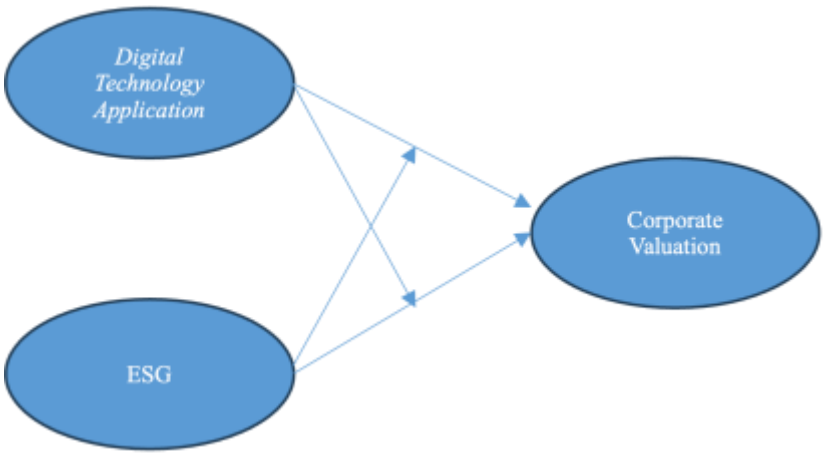


Fig. 1 Research framework

Fig 1 illustrates the research framework of this study, which examines the direct and interactive effects of Digital Technology Application and Environmental, Social, and Governance (ESG) performance on corporate valuation. Digital Technology Application, proxied by technology investment (Capex IT), is posited to have a direct influence on corporate valuation by enhancing operational efficiency, innovation capability, and competitive advantage. ESG performance is also hypothesized to directly affect corporate valuation through mechanisms such as risk management, stakeholder trust, and corporate reputation.

In addition to these direct relationships, the framework highlights a synergistic interaction between Digital Technology Application and ESG performance. The intersecting arrows represent the moderating role of technology investment in strengthening the impact of ESG on corporate valuation. This interaction suggests that firms with stronger digital capabilities are better positioned to implement, monitor, and disclose ESG initiatives effectively, thereby increasing their value relevance in capital markets. Overall, the framework reflects the study's central argument that digital technology investment and ESG performance function not only as independent drivers but also as complementary strategic factors in shaping corporate valuation.

By addressing these objectives and framework developed, this study contributes to a more comprehensive understanding of how technological investment and sustainability initiatives together shape corporate valuation.

LITERATURE REVIEW

Previous studies have emphasized the role of technology and digitalization in boosting operational and financial performance (Siyuan & Kang, 2023), enhancing specialization (Yuan & Pan, 2023), triggering innovation and ensure improvements of business model (Peng & Tao, 2022; Yuan & Pan 2023). Research has similarly shown that strong ESG performance can enhance corporate reputation, spread positive signal to investors (Alsayegh et al., 2020), promote competitiveness, reduce sustainability risk, and positively affect corporate valuation (Chen & Xie, 2022; Lian et al., 2023), although findings remain mixed across industries and regions. Some studies documented a positive association between ESG and corporate valuation, while others found negative effects due to increasing cost that finally will affect negatively to corporate valuation (Cappa et al., 2021; Nareswari et al., 2023).

However, despite the growing body of work on Capex IT corelated to corporate value relationships and ESG corelated to corporate value relationships, relatively few studies have explored the potential interaction and synergy between IT investment and ESG performance in shaping firm value. Qi et al., (2024) confirming that the synergistic effect exists between Digitalization and ESG. Zhou & Liu (2023) find that higher spending on information and communication technology is associated with increased investment in ESG and demonstrates the positive impact of digitalization on sustainability efforts. Another research shows that the digital resources, organizational structure, technology adoption, management practices, and firm competitiveness have a positive effect on ESG performance through the mediating effect of company market performance (Wang & Esperança, 2023).

This gap is particularly important because IT capability can serve as an enabler that strengthens ESG implementation. For example, through improved data management, transparency, and monitoring capabilities, while

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ESG commitment can enhance the strategic impact of IT investment by guiding firms toward more responsible technology deployment. The limited empirical evidence on whether Capex IT and ESG performance simultaneously influence corporate valuation represents a noteworthy shortcoming in existing literature. Furthermore, most prior studies tend to investigate these drivers independently, without examining whether their combined effect may differ from their individual contributions.

METHOD

This study employs a quantitative research design using panel data to examine the individual and synergistic effects of Information Technology Capital Expenditure (Capex IT) and Environmental, Social, and Governance (ESG) performance on corporate valuation. The population consists of publicly listed companies, while the sample is selected using purposive sampling based on data availability for Capex IT, ESG scores that provided by Bloomberg, and financial indicators required to cal1culate Tobin's Q. The final dataset is structured as an unbalanced panel covering multiple firms and years, allowing the analysis to capture both cross-sectional variation and temporal dynamics.

Capex IT on this study is measured by its proportion of Capex IT against company's Total Asset. This measurement is refering Quantitative Statistical Method of Zou et al, (2024) that explain that there are several alternative methods for measuring a company's digital transformation, including the Questionnaire Scale Method, Quantitative Statistical Method, and Text Analysis Method. In line with one of these methods, this study uses the Quantitative Statistical Method, which is an approach used to measure digitization by analyzing relevant historical data that reflects the company's digital transformation process. This approach is relevant with some researchers who use the proportion of intangible assets related to the digital economy, including Qi (2020) and Cheng et al. (2022). In addition, He and Wang (2023) use the proportion of investment projects in digital hardware and software from the details of fixed assets and intangible assets.

Corporate valuation is measured using Tobin's Q, a widely adopted market-based indicator reflecting investors' expectations of future performance. Tobin's Q ratio on Bloomberg formulated by:

$$Tobin's\ Q = \frac{Market\ Cap + Total\ Liability + Preff.\ Equity + Min\ Interest}{Total\ Asset} \quad \text{..... (1)}$$

This formula is an alternative modification of from the basic formula of original version Tobin's Q because replacement cost of assets data is rarely available.

ESG performance is measured using an aggregated ESG Score and, in extended models, the three ESG pillars (Environmental, Social, and Governance) that provided by Bloomberg Terminal. To test the synergistic relationship, an interaction term between Capex IT and ESG Score is constructed, enabling assessment of whether IT investment strengthens the value relevance of sustainability performance.

The empirical estimation relies on the OLS multiple linier regression model that assuming fixed effect on year. Classical assumption diagnostics including linearity, multicollinearity, heteroskedasticity, and autocorrelation tests are conducted to ensure the robustness of the model. Additional robustness checks are performed by decomposing ESG into its three subdimensions and observing whether the results remain consistent under alternative specifications. Data/Model transformation was necessary to ensure fulfilment of the above assumptions, so the empirical model in this study is as follows:

$$LnTobin'sQ_{i,t} = \Psi + \tau CapexIT_{i,t} + \sigma_t + \in_{i,t} \quad \text{..... (2)}$$

$$LnTobin'sQ_{i,t} = v + \vartheta LnESGScore_{i,t} + \sigma_t + \in_{i,t} \quad \text{..... (3)}$$

$$LnTobin'sQ_{i,t} = \theta + \tau CapexIT_{i,t} + \vartheta LnESGScore_{i,t} + \sigma_t + \in_{i,t} \quad \text{..... (4)}$$

$$LnTobin'sQ_{i,t} = \Omega + \tau CapexIT_{i,t} + \vartheta LnESGScore_{i,t} + \phi(CapexIT_{i,t} * LnESGScore_{i,t}) + \sigma_t + \in_{i,t} \quad \text{..... (5)}$$

Whereas:

i,t	:	Denote firm and year subscript
LnTobinsQi,t	:	Represents the firm i's corporate performance in year t
CapexITi,t	:	Represents the degree of digital technology application of firm i in year t.
ESGi,t	:	Represents the ESG score of company i in year t.
σ	:	Denote year-fixed effects
ϵ	:	Error term

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Models (2) and (3) are to test the effects of digital technology application and ESG performance on corporate valuation, respectively. Model (4) is to introduce digital technology applications and ESG performance simultaneously to analyze the impact on corporate valuation. Model (5) is to introduce the interaction term between digital technology application and ESG performance based on model (4). We focus on the coefficients of CapexIT in the model (2), ESGScore in the model (3), the coefficients of CapexIT and ESGScore in the model (4), and the coefficients of CapexIT*ESG in the model (5).

This study examines 79 public listed company in Jakarta Stock Exchange/IDX (that reflecting 64% of IDX market capitalization) in 6 years (2019-2024) ith 367 data observations. Overall, this methodological approach provides a rigorous empirical examination of how Capex IT, ESG performance, and their interaction influence corporate valuation. The combination of panel-data techniques and interaction modeling strengthens the internal validity of the findings and allows for a deeper understanding of the complementary roles of technology investment and sustainability initiatives in driving more valuable company.

RESULT

Descriptive Statistics

The descriptive statistics provide an overview of the distributional characteristics of the main variables used in this study: Capex IT, ESG Score, and Tobin's Q. To improve interpretability, Capex IT was scaled by multiplying its original ratio values by 1,000, as the raw numbers were extremely small (below 1). After scaling, the descriptive results show that Capex IT has a mean of 4.46, a median of 1.13, and a standard deviation of 12.98, with a wide range of 166.73. The distribution is highly right-skewed (skewness = 7.79) with exceptionally high kurtosis (78.05), indicating extreme non-normality. This pattern suggests that most firms allocate very minimal IT capital expenditure relative to total assets, while only a few firms invest heavily in IT, creating substantial outliers. These characteristics imply that IT capital investments are not yet a common practice across the sample firms and tend to be concentrated among a small group of technologically intensive companies.

Table 1. Descriptive Statistic

Variable	Capex_IT (*1000)	ESGScore	TobinsQ
Count	367	367	367
Mean	4,46	3,02	2,09
Median	1,13	2,94	1,12
Std Dev	12,98	1,01	3,74
Min	0,01	1,07	0,42
Max	166,73	5,02	35,63
Skew	7,79	0,45	5,77
Kurtosis	78,05	-0,25	38,82

The ESG Score exhibits a considerably more balanced distribution, with a mean of 3.02, a median of 2.94, and a moderate range of 5.02 (from 1.07 to 6.09). The skewness of 0.45 and kurtosis of –0.25 indicate that ESG data are approximately normally distributed. Most companies fall within the ESG range of 2 to 4, with a few achieving values above 6. This suggests a relatively stable and consistent level of sustainability performance across firms, with limited extreme deviations. Unlike Capex IT, ESG practices appear more standardized and widely adopted.

Tobin's Q presents a markedly different pattern. The variable has a mean of 2.09, a median of 1.12, and a very wide range of 35.21 (0.42–35.63). The distribution is heavily right-skewed (skewness = 5.77) with high kurtosis (36.82), indicating the presence of significant outliers. The large gap between the mean (2.09) and median (1.12) suggests that while most firms exhibit relatively modest market valuations, a small subset of firms commands exceptionally high valuations, pulling the mean upward. This distributional profile is common in capital markets, where a few high-growth or high-performing firms dominate market capitalization.

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The analysis of the regression results

Table 2. Regression Result

Independent Variable		LnTobins_Q			
		(2)	(3)	(4)	(5)
Capex_IT	Coeff	0,023***		0,023***	-0,004
	Error	0,003		0,003	0,012
LnESG_Score	Coeff		−0,257*	−0,284**	−0,364***
	Error		0,133	0,131	0,141
Capex_IT : LnESG_Score	Coeff				0,026**
	Error				0,012
Constant	Coeff	0,203**	0,560***	0,459***	0,550***
	Error	0,087	0,152	0,155	0,164
R-squared		0,200	0,022	0,221	0,228
F-Statistic		15,037***	1,378	14,520***	13,230***
N (Observations)		367	367	367	367
***p<0,1; **p<0,05; ***p<0,01**					

Across the baseline regressions, Capex IT consistently demonstrates a positive and statistically significant effect on Tobin's Q, indicating that firms investing in IT infrastructure tend to achieve higher market valuation. This finding supports the notion that digital capability enhances operational efficiency, innovation capacity, and future growth expectations.

Conversely, ESG performance exhibits predominantly negative or insignificant coefficients in the initial model specifications. This trend suggests that, in the observed context, ESG implementation may impose short-term costs or may not yet be fully recognized by investors as a driver of value.

Most notably, the interaction term between Capex IT and ESG Score is positive and statistically significant, providing strong evidence of a synergistic effect. This means that IT investment enhances the value relevance of ESG performance. Firms with stronger IT capabilities may implement ESG programs more efficiently, improve sustainability reporting, ensure higher data accuracy, and increase transparency mechanisms that reduce information asymmetry and strengthen investor confidence.

DISCUSSION

The application of digital technology and corporate valuation

The results of this study indicate that IT Capex has a significant positive effect on Tobin's Q. This shows that the greater a company's investment in IT development, the higher its market value relative to its assets. This supports the results of previous studies, including Qi et al., (2024), Siyuan &Kang (2023), Peng & Tiao (2022), and Wu & Lu (2023). Furthermore, based on Equation (5) when there is interaction with ESG, IT Capex itself becomes negative and insignificant, indicating a moderating effect.

Table 3. Level of Technology Investment

Level	Ratio Capex IT per Total Asset	Ratio Capex IT per Total Capex
Avg. Proportion	0,403%	27,896%
Min	0,004%	0,212%
Max	8,164%	100%

For some companies that have a large proportion of investment in IT, such as technology company and digital bank, it is likely that IT Capex is positioned as a valuable, rare, difficult to imitate, and difficult to replace Strategic Resource driving competitive advantage. Companies whose core business is closely related to technology must maintain their competitiveness in the industry by continuing to maintain Capex that also focuses on supporting their business in technology. IT Capex allocation can vary across several business lines/projects or be focused on a single allocation, such as in companies whose main business focus is on providing data centers, where IT Capex allocation is focused on the expansion of new data center development. In addition, in companies in the banking sector, a significant large portion of the total Capex allocation for IT is used for the development of digital banking. However, the allocation of IT Capex for cybersecurity is also very significant due to the importance of ensuring the security of banking services. If there are problems in this area, the financial and reputational consequences will be enormous. IT investment in these banking companies is an example of IT being positioned not only as an investment asset but also as a dynamic capability that reflects the company's ability to adapt quickly to market changes. Thus, the more a company is willing to invest or allocate more of its investment to IT development, the more agile the company can be in responding to market changes. This also strengthens the role of technology in supporting operational efficiency, innovation and new business models, and transparency (reporting).

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Based on the explanation of the two perspectives in positioning IT Capex, namely as a Strategic Resource and Dynamic Capabilities, it is reasonable that IT Capex has a significant influence on creating value for company. The Resource-Based View (RBV) theory states that long-term competitive advantage arises from resources and capabilities that are valuable, rare, inimitable, and non-substitutable (VRIN). Intangible assets such as IT capabilities, digital know-how, and data analytics are strategic resources that can increase productivity and company value. The finding that IT Capex has a significant positive effect on Tobin's Q is consistent with RBV. IT investment builds organizational capabilities (data, digital processes, analytics, integration) that are difficult for competitors to imitate, thereby increasing future profit expectations and market valuation (reflected in Tobin's Q). In relation to this theory, CapexIT can be explained as more than just an expense, when accompanied by organizational and knowledge changes (training, processes, integration), it becomes a source of competitive advantage that increases valuation. Furthermore, the consistent positive influence of IT Capex in both equations (2) and (4) demonstrates the dominant role of IT Capex, even though other variables, such as ESG, have a negative impact, thereby compensating for this and continuing to create value for the company at the same time.

ESG and Corporate Valuation

The results of this study indicate that ESG has a significant negative effect on Tobin's Q. This shows that the higher a company's ESG implementation score, the more it can reduce/lower the company's market value relative to its assets. These results prove that hypothesis 2 is rejected, namely that ESG has a significant effect on company value, but the effect is negative, which is inconsistent with the results of research by Qi et al., in 2024 and Rahat & Nguyen in 2024, that found a positive relationship between ESG and company value in developing countries. The study by Rahat and Nguyen found that a company's Tobin's Q is influenced by its past ESG score. Therefore, in addition to testing the hypothesis, this study examines the possibility of different results when using ESG-1 data (lag 1 year prior) in Indonesia. This experiment resulted in a lower significance of influence and a relationship direction that remained negative. The results of the experiment using ESG Lag 1 are as follows:

Table 4
Regression Result ESG Lag 1

Independent Variable		LnTobins_Q			
		(2)	(3)	(4)	(5)
Capex_IT	Coeff	0,028***		0,028***	0,006
	Error	0,005		0,005	0,016
LnESG_Score	Coeff		−0,213*	−0,248**	-0,315**
	Error		0,127	0,123	0,136
Capex_IT : LnESG_Score	Coeff				0,021
	Error				0016
Constant	Coeff	0,296**	0,634***	0,519***	0,588***
	Error	0,122	0,185	0,189	0,198
R-squared		0,200	0,210	0,021	0,227
F-Statistic		15,037***	14,993***	1,190	0,571***
N (Observations)		367	288	288	288
***p<0,1; **p<0,05; ***p<0,01**					

From the results of our experiments above using LnESG_Score Lag 1, as shown in Table 4 it can be observed that ESG continues to have a negative effect on Tobin's Q. R-squared, particularly in model (3), is slightly lower than when using ESG for the same year, thus not explaining the variability of Tobin's Q any better. In the regression results, ESG Score has a significant negative coefficient on Tobin's Q. Thus, investors/markets assess that a high ESG Score can suppress company value, at least in the short term (6-year research period). This result is in line with previous study which states that corporate investment in CSR will have a negative impact on the company's financial performance due to the reallocation of company funds to other stakeholders instead of being distributed back to shareholders through dividends. Previous research in Italy, which focused on 54 public companies, also found a negative relationship between ESG scores and company financial performance. Similar results were also found in a study by Duque-Grisales and Aguilera Caracuel (2021) on 104 companies in Latin America and a study by Garcia and Orsato (2020), which further found a negative relationship, especially in developing countries. In addition, previous study analyzed market reactions to CSR news and found that the market punished negative ESG news more strongly than it rewarded positive ESG news. This also indicates that the market does not yet fully appreciate ESG, especially in emerging markets such as Indonesia, where investors are still more focused on financial profitability than sustainability aspects. Furthermore, there is the issue of greenwashing, where some investors are skeptical of ESG scores, as they can be considered a formality without any real contribution to profitability.

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ESG (both current year and ESG Lag -1) that is consistently negative in all models can be explained by several mechanisms/perspectives, namely the link between ESG and investment cost effect, the existence of disclosure & market perception, and the possibility of delay in benefits realization or lag effects. The Investment Cost Effect explains that ESG implementation often requires initial expenditures (clean technology investments, audits, reporting, etc.) that increase operational costs or capex in the short term. Markets that respond quickly may assess these costs as more prominent than the benefits that will emerge later, causing a decline in Tobin's Q in the current period. The literature review found a heterogeneous relationship between ESG and company value in the research results. Most studies linking ESG to Corporate Valuation and Financial Performance in Postiglione et al., (2024) show that some studies indicate negative/insignificant short-term effects (Brandon, 2021) but positive long-term effects.

Reverse Causality of ESG and Corporate Valuation

The negative coefficient for LnESG (both current year and lag −1) can be explained by the mechanism/perspective above, but there is also the possibility of reverse causality between CSR/ESG and financial performance. Therefore, a reverse causality test was conducted to determine whether the negative relationship between ESG and Tobins_Q could be caused by reverse causality. The reverse causality test was conducted using the Simple Panel Dynamic Causality Test (Granger-Like Test). The reverse causality test used the Simple Panel Dynamic Causality Test rather than the Dumitrescu–Hurlin Panel Granger Causality Test because the number of observation periods (T = 5) did not meet the minimum requirement for performing the Dumitrescu–Hurlin Panel Granger Causality Test (which requires T ≥ 9).

$$LnTobin'sQ_{i,t} = v + \vartheta LnESGScore_{i,t-1} + \sigma_t + \in_{i,t} \quad \text{..... (6)}$$

$$LnESGScore_{i,t} = v + \vartheta LnTobin'sQ_{i,t-1} + \sigma_t + \in_{i,t} \quad \text{..... (7)}$$

Table 5. Reverse Causality of ESG and Corporate Valuation

Equation Model	Purpose	Result	Direction	Conclusion
(6)	Testing whether last year's ESG affects this year's company value	-0,213*	Negatif	Last year's ESG lowered the current year's company value with a significant effect at the 10% level.
(7)	Testing whether last year's company value affects this year's ESG decisions	-0,083*	Negatif	Last year's company value lowered the current year's ESG score with a significant effect at the 10% level.
Conclusion of Reverse Causality Test				• A bidirectional causality relationship has been proven. • A negative feedback loop between ESG and company value has been proven.

Based on the results of the dynamic relationship test between variables, it was found that both ESG (t-1) on Tobin's Q (t) and Tobin's Q (t-1) on ESG at t were significant at a 10% confidence level ($p < 0.1$) with a negative coefficient direction. This finding indicates a negative bidirectional causality, or negative feedback loop, between ESG performance and company value.

In this context, an increase in ESG performance in the previous period was responded to negatively by the market through a decline in company value. Conversely, a decline in company value in the previous period encouraged companies to increase ESG activities to restore their reputation. This negative feedback cycle indicates that in the short term, the Indonesian capital market does not yet appreciate ESG activities as a factor of value creation and even considers ESG investments as a cost effect rather than a value effect. These results are in line with the Resource-Based View theory and the literature on the short-term cost effect of ESG, which emphasize that the benefits of ESG only emerge in the long term after the supporting organizational transformation and digitalization processes have taken place.

Decomposing ESG Score (Robustness Test)

Decomposing the ESG Score into three separate variables, namely Environment (Env), Social (Soc), and Governance (Gov), aims to re-estimate separate models for the Env, Soc, and Gov components and determine the possible dominant partial influence of one or more of these factors on the ESG Score's effect on Tobins_Q. In addition, decomposing the ESG Score into partial factors can simultaneously test the robustness of equation (4.2) model to see whether the effect remains after controlling for individual components. The equation model in this robustness test is as

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follows:

$$LnTobin'sQ_{i,t} = v + \vartheta LnESGScore_{i,t} + \sigma_t + \in_{i,t} \quad (3)$$

$$LnTobin'sQ_{i,t} = v + \lambda LnEnv_{i,t} + \xi LnSoc_{i,t} + \varepsilon LnGov_{i,t} + \sigma_{t-1} + \in_{i,t} \quad (8)$$

$$LnTobin'sQ_{i,t} = v + \vartheta LnESGScore_{i,t} + \lambda LnEnv_{i,t} + \xi LnSoc_{i,t} + \varepsilon LnGov_{i,t} + \sigma_{t-1} + \in_{i,t} \quad (9)$$

Table 6. Robustness Test –Decomposing ESG Individual Factors

Independent Variable		LnTobins_Q		
		(3)	(8)	(9)
LnESG_	Coeff	-0,220*		0,733**
Score	Error	0,131		0,358
LnEnv	Coeff		0,055	-0,060
	Error		0,040	0,048
LnSoc	Coeff		-0,302***	-0,527***
	Error		0,078	0,161
LnGov	Coeff		-0,150	-0,463*
	Error		0,248	0,273
Constant	Coeff	0,587***	0,848**	0,829**
	Error	0,161	0,354	0,374
R-squared		0,014	0,107	0,133
F-Statistic		0,741	4,649***	0,614***
N (Observations)		319	319	319
***p<0,1; **p<0,05; ***p<0,01**				

Model (3), as explained earlier, produces a decrease in Company Value due to an increase in ESG Score. In economic terms, this negative relationship means that an improvement in ESG performance is followed by a decline in company value. These results are consistent with previous tests using 367 observations.

Model (8) shows that the social value in ESG has a significant influence in explaining Tobins_Q. This means that the social pillar is the most dominant factor in ESG and the most "expensive" in investment. This result indicates that short-term social responsibility costs suppress profitability and have not been translated into an increase in company value. These results are in line with the findings of previous study and found that social investments often do not immediately increase company value because the reputation effect is long-term. In addition, Drempetic et al. (2020) also found in their research that in emerging markets, the social pillar often has a negative effect because investors doubt its effectiveness on economic performance.

Model (9) is a robustness test model that aims to determine whether the total ESG score remains significant after controlling for its individual components. The test results show that the total ESG score remains significant and has a positive direction of influence. Thus, the total ESG is positive for company value, but the social and governance components reduce company value. Based on the robustness model estimation results in Table 6, the direction of the ESGScore coefficient, which changed from negative in the simple model to positive and significant in the combined model, does not indicate instability but rather indicates a suppressor effect between the total ESG score and its components (Env, Soc, Gov). This reinforces the validity of the main finding that ESG has a significant relationship with company value, but its effects can be explained as having two characteristics: (1) as a cost that has a short-term impact, and (2) is perceived negatively on company value, specifically in the Social and Governance components, and as a reputation that has an impact and is perceived positively to increase company value in the aggregate ESG.

Thus, these results can be said to be statistically and theoretically robust, as the direction of the relationship can still be logically explained within the framework of signaling theory and the resource-based view. Substantively, these findings show that when social and governance activities are controlled, the net effect of ESG on company value becomes positive. This result is consistent with the view that the market values aggregate sustainability reputation more than the implementation costs of individual pillars (Broadstock et al., 2021).

Synergistic Effect between Technology and ESG

The results of this study indicate a synergistic relationship between Digital Technology Application and ESG in increasing Corporate Valuation. The simultaneous influence of both factors is confirmed to be significant in model (4) and confirms the existence of a moderating effect in model (5). The results of this study are in line with the research by Qi et al, 2024 in China, which also found a positive synergistic effect of both factors in increasing company value. The

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significant positive interaction coefficient in model (4.4) shows that even though ESG has a direct negative effect on Tobin's Q, the existence of IT investment can change the effect of ESG to be more influential in increasing company value. IT capex can strengthen the effectiveness of ESG implementation in cases such as digital emission monitoring, governance transparency systems, green supply chain platforms, and other environmental impact management through digital technology. Furthermore, positive synergy means that ESG is not only a burden but can also be a value driver if supported by technology. Thus, these findings confirm that the relationship between ESG and market performance (Tobin's Q) does not stand alone but depends on synergy with digital transformation. The synergistic relationship could be explained in some condition such as technology as enabler of ESG, both relation in investor perception and the relationship of both as company's strategic policy.

CONCLUSION

This study demonstrates that Information Technology capital expenditure (Capex IT) and Environmental, Social, and Governance (ESG) performance contribute differently to firm value, with IT investment consistently exerting a positive (Hypothesis 1 is accepted) and significant effect on Tobin's Q, while ESG performance shows predominantly weak or negative associations unless evaluated in a more integrated form (Hypothesis 2 and 3 are rejected). The findings further reveal a strong synergistic effect, as the interaction between Capex IT and ESG Score positively influences firm value (Hypothesis 4 is accepted), indicating that digital capability enhances the effectiveness and market perception of sustainability initiatives. These results highlight the complementary roles of technology and sustainability in shaping corporate valuation, suggesting that firms that strategically integrate IT investments with well-structured ESG practices are better positioned to create long-term value. Overall, the study underscores the importance of adopting a combined technological–sustainability orientation as a pathway toward improving competitiveness and strengthening investor confidence.

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