EXPLORING THE INTERPLAY BETWEEN DIGITALIZATION, CORPORATE GOVERNANCE, AND SDG REPORTING: A PATHWAY TO SUSTAINABLE DEVELOPMENT

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Abstract: This study explores the role of digitalization in advancing sustainable development and its potential to improve SDG reporting. It investigates how digital technologies, along with other macroeconomic factors such as governance, economic, environmental, and social factors, can enhance the quality and effectiveness of sustainability reporting across different countries. Grounded in stakeholder and resilience theory, the research employs OLS regression along with robustness and heterogeneity tests to ensure the reliability and validity of the findings. The study contributes to the literature by highlighting the interconnections between digitalization, corporate governance, and SDG reporting. It also reveals that corporate governance does moderate the relationship between digitalization and SDG reporting. The findings show that countries with higher adoption of digital technologies tend to demonstrate improved sustainability reporting, along with strong performance in environmental health, ecosystem vitality, and economic progress. However, digitalization proves to be a significant driver of SDG reporting in emerging economies but does not have the same effect in advanced countries. From a practical perspective, the study suggests that governments and organizations should prioritize digitalization strategies and governance frameworks to enhance sustainability reporting and better align with the global development goals set out in the 2030 Agenda.

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Keywords: sustainable development goals (SDG); sustainability reporting; digitalization; corporate governance

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1. Introduction

The increasing focus on sustainability and the pursuit of the Sustainable Development Goals (SDGs) has become a central agenda for policymakers, businesses, and civil society alike. At the heart of this shift lies the recognition of digitalization as a transformative force in driving progress toward sustainability. Digital technologies, including Artificial Intelligence (AI), Big Data, the Internet of Things (IoT), and Information and Communication Technology (ICT), have rapidly reshaped economies, societies, and environments across the globe. These technologies, when strategically integrated, offer significant potential to advance the SDGs by enhancing transparency, optimizing resource use, and improving social well-being (Kostetskyi, 2021; Gouvea et al., 2018). The interplay between digitalization and the SDGs is particularly critical as it empowers organizations to disclose their sustainability practices, monitor progress, and ensure accountability.

However, despite the promising role of digitalization, the relationship between digital technologies and SDG reporting remains underexplored in the academic literature. While some studies have highlighted the importance of digitalization for corporate transparency (Kostetskyi, 2021) and the role of SDG reporting in driving sustainability (Walker et al., 2019), few have examined the combined effects of digital technologies, governance structures, and reporting practices on achieving the SDGs (Del Río Castro et al., 2021). Moreover, while governance is acknowledged as a fundamental driver for shaping organizational behaviors and promoting sustainability (Gerged et al, 2023; Gómez and Garcia, 2020), the nuanced role of digitalization in strengthening or hindering the effectiveness of governance in SDG reporting remains unclear.

Our paper addresses these gaps in the literature by exploring the joint and individual effects of digitalization, governance, and national culture on SDG reporting. We aim to contribute to the growing body of research by examining how these factors when considered together, influence SDG disclosures across different regions and economies. Specifically, our study seeks to answer the following research questions: *(1) What role does digitalization play in enhancing SDG reporting? (2) To what extent does corporate governance moderate the relationship between digitalization and SDG reporting?*

The originality of this study lies in its holistic approach to understanding the interplay between digitalization, governance, and SDG reporting. By integrating insights from stakeholders' theory and resilience theory, this research offers a comprehensive theoretical and empirical framework for analyzing the drivers of sustainability reporting. Previous studies have often focused on these concepts in isolation, but this paper aims to explore their interconnectedness and provide a more nuanced understanding of how digitalization can act as both a facilitator and a moderator in the SDG reporting process.

Our findings provide compelling evidence that digitalization significantly enhances SDG reporting, particularly in emerging economies where digital infrastructure is expanding rapidly. In contrast, the impact of digitalization is less pronounced in advanced economies, where reporting practices are more established, and digitalization has already been integrated into organizational practices. Furthermore, while governance does play a role in shaping SDG reporting, its moderating effects appear to be insignificant compared to the direct influence of digitalization. These results

underline the importance of fostering digital transformation in emerging economies to ensure more comprehensive and transparent sustainability reporting.

This paper makes several contributions to the literature. First, it extends the understanding of how digitalization influences SDG reporting by analyzing the moderating role of governance. Second, it provides empirical evidence on the effectiveness of digitalization in different economic contexts, offering valuable insights for policymakers, businesses, and regulators aiming to enhance sustainability practices. Lastly, the study highlights the importance of integrating digitalization into sustainability reporting frameworks, which can ultimately contribute to more resilient and sustainable societies. The implications of these findings are far-reaching, offering a roadmap for organizations and governments to align their strategies with the 2030 Agenda and accelerate progress toward the SDGs.

The paper is structured as follows: Section 2 outlines the theoretical background and hypotheses, Section 3 covers the methodology, including data collection and model specification, Section 4 presents the empirical results, and Section 5 concludes with key insights, limitations, and suggestions for future research.

1. Literature review and hypotheses development

Sustainable development and SDG reporting

Sustainable development emphasizes the interconnectedness of economic prosperity, environmental stewardship, and social equity, recognizing that progress in these areas must be balanced to ensure long-term well-being for current and future generations (Del Rio Castro et al., 2021). This concept underpins the Sustainable Development Goals (SDGs), a global framework aimed at addressing pressing issues such as poverty, inequality, and environmental degradation through key pillars like planet, people, peace, prosperity, and partnerships (Dalby et al., 2019). The SDGs encourage businesses to integrate sustainability into their strategies, fostering innovative solutions that benefit stakeholders and society (Garcia-Meca and Martinez-Ferrero, 2021; Gunawan et al., 2021).

As a response to stakeholders' growing interest in non-financial performance, sustainability reporting has evolved to go beyond traditional financial metrics. This shift reflects an increasing demand for transparency on environmental, social, and governance (ESG) impacts (Adams and Abhayawansa, 2021)). Over time, sustainability reporting has expanded, driven by regulatory developments like the EU's Directive 2014/95/EU, which mandated non-financial disclosures for large companies, marking a significant move toward mandatory reporting (Dumay et al., 2019). The recent Corporate Sustainability Reporting Directive (2021) further emphasizes digital integration, allowing for automated reporting and reinforcing the role of digital technology as a critical tool for sustainable development (La Torre et al., 2018).

In this context, digitalization is increasingly recognized as a driver for achieving SDGs and enhancing the transparency, accessibility, and accuracy of sustainability reports. By supporting innovative approaches to longstanding challenges, digital technologies contribute to creating sustainable business environments, allowing countries to pursue improved living standards while supporting business success aligned with the SDGs (Farinha et al., 2018).

Digitalization and SDG reporting – insights from stakeholders and resilience theories

Digitalization plays an increasingly vital role in achieving the Sustainable Development Goals (SDGs) by transforming how organizations approach sustainability reporting. The stakeholder theory provides a foundation for understanding how digital advancements can influence sustainability practices. This theory emphasizes the importance of transparent disclosure to meet stakeholders' growing demand for non-financial information, amplifying their voices and accountability expectations (Barnett et al., 2020). Alongside stakeholder theory, resilience theory also underscores the role of digitalization in enhancing corporate adaptability. Digital tools can help companies build resilience in response to unforeseen crises like financial downturns or the COVID-19 pandemic, making sustainable practices an integral component of long-term organizational stability (Gillespie-Marthaler et al., 2019).

The integration of digital technologies such as AI, IoT, and big data accelerates sustainable reporting, enabling more accessible and data-driven disclosures that support the SDGs (Filho et al., 2023; Del Rio Castro et al., 2021). By enhancing transparency, digitalization fosters an environment where stakeholders, particularly investors, can drive economic, social, and environmental goals. For emerging economies, digitalization presents an opportunity to bridge gaps in sustainable governance and empower stakeholders to champion SDG-related initiatives (Lichtenthaler, 2021). Prioritizing digital advancement in policy-making can thus lead to more robust national and organizational frameworks for sustainable growth.

Moreover, digital technologies contribute to sustainable development by enabling a circular economy, promoting resource efficiency, and supporting evidence-based decision-making (Del Rio Castro et al., 2021). The impact of digitalization on economic growth and sustainability has been widely recognized as a catalyst for achieving the SDGs. By streamlining information-sharing and enabling enhanced environmental, social, and governance (ESG) evaluations, digitalization helps organizations measure and improve their sustainability performance, further aligning with global goals (Kiron and Unruh, 2018).

The convergence of digitalization and sustainability represents a transformative path forward, allowing organizations to better meet societal demands and adapt to environmental challenges (Del Rio Castro et al., 2021). This interplay creates opportunities for governments and businesses to embrace greener economic models, positioning digitalization as a critical driver for the SDGs and offering a promising route for sustained global growth and resilience (Mondejar et al., 2021).

Hypothesis development

In the aftermath of the COVID-19 pandemic, digitalization has become a critical factor in reshaping the way businesses, governments, and societies function, with digital technologies playing a central role in transforming operations and decision-making processes (Delgosha et al., 2021). Digital tools have the potential to drive greater efficiency, transparency, and value in reporting practices, enhancing both the quality and accessibility of information (Rozario and Thomas, 2019). In particular,

digitalization offers significant prospects for improving the harmonization of SDG reporting,

with the potential to revolutionize the way organizations measure and disclose their sustainability impacts.

Traditional reporting methods, particularly in the era of Big Data, are increasingly viewed as outdated (La Torre et al., 2018). With the power of digital technologies, companies and organizations are now able to generate and process data in ways that were previously unimaginable, enabling them to present more comprehensive and real-time insights into their economic, social, and environmental performance. For effective SDG reporting, however, it is essential to balance technological advancements with the need for stakeholders to easily interpret and understand the information being communicated (Smith, 2020). Digitalization, when properly leveraged, provides an opportunity for organizations to meet these demands while improving the quality of their sustainability disclosures.

The SDGs, which address global challenges such as poverty, inequality, and environmental sustainability, are a framework for sustainable development that transcends national boundaries. While achieving these goals may be more challenging for some countries and organizations, digitalization is increasingly seen as a tool that can bridge gaps by facilitating more effective and transparent reporting (Costanza et al., 2016; Fukuda-Parr and McNeill, 2019). Digital tools enable organizations to make meaningful progress toward the SDGs by improving business practices, fostering social inclusion, and supporting sustainable economic growth.

Digital technologies have already demonstrated their ability to advance the SDGs by addressing key challenges in areas such as education, health, clean energy, and economic growth (Mondejar et al., 2021). By improving data collection, enabling greater transparency, and providing new insights, digitalization plays an essential role in driving sustainability efforts. As such, we hypothesize that:

H$_1$: Digitalisation positively influences SDG reporting

Corporate governance plays a pivotal role in shaping sustainable development, as it serves as both a driving force for progress and a crucial element to integrate into development strategies. The relationship between governance and sustainable development is bidirectional, with effective governance structures enabling countries to address sustainability challenges more effectively, while sustainability itself requires strong governance frameworks to ensure its success. The level of governance within a country can significantly impact its economic and social development, and this, in turn, influences the quality and extent of sustainability reporting, including SDG disclosures (Stefanescu, 2021).

Governance structures are essential in shaping the environment in which sustainability reporting occurs. In countries with robust governance systems, there are fewer external pressures to drive change, as the internal regulatory and enforcement mechanisms are strong. These systems ensure compliance with sustainability standards and encourage organizations to adopt responsible practices (Gómez and Garcia, 2020). Conversely, in countries with weaker governance frameworks, characterized by poor transparency or high levels of corruption, the adoption and enforcement of sustainability reporting standards are often inconsistent, leading to national differences in the harmonization of SDG reporting (Stefanescu, 2021).

Governance structures also impact corporate social responsibility (CSR) practices and the overall transparency of organizations. In countries with strong political

stability, accountability, and transparent legal systems, businesses are more likely to adopt responsible behaviors and disclose relevant non-financial information (Cahan et al., 2016). This is because a stable governance environment allows organizations to operate securely and engage in environmentally friendly initiatives, which align with global sustainability goals (Jamali et al., 2020). In contrast, nations with weak governance systems, characterized by corruption and ineffective legal structures, often face challenges in fostering responsible corporate behavior and transparency (Pinheiro et al., 2022).

Considering the influence of governance on organizational behavior and sustainability, we hypothesize that corporate governance may strengthen, weaken, or reverse the impact of digital transformations on SDG reporting, as follows:

H_2: Corporate governance moderates the relationship between digitalisation and SDG reporting

2. Methodology

Sample and data collection

This study includes 105 countries from the latest global ranking by the World Economic Forum (WEF, 2020). To analyze systematic effects from multiple perspectives, the sample was divided into advanced and emerging economies groups and further categorized by regions: Africa, Asia-Pacific, Europe, and the Americas. Among the countries studied, 42% were advanced economies, with nearly half showing trends of development advancement, and income distribution ranging between 30% and 70%, encompassing lower-middle to high-income groups. Detailed sample characteristics are present in Table 1.

Variable description

To explore the connections between *digitalization* and *SDG reporting,* the proposed model includes the following variables:

Dependent variable - SDG Reporting

Sustainable development aims to enhance present and future generations' well-being by promoting equality, inclusion, and sustainability, addressing interconnected global economic, social, and environmental challenges. The SDG Index, developed by Sachs et al. (2022), provides a multidimensional perspective on these challenges, measuring countries' progress through various indicators that reflect each SDG's achievement percentages. Despite critiques regarding qualitative data limitations, the SDG Index remains a widely used benchmark for assessing national performance on SDG reporting (Del-Aguila-Arcentales et al., 2022).

Table 1. Sample characteristics

Region[1)	%	Income group[1)	%	Development status[2)	%	Development trend[2)	%
Europe	50	Low	0	Emerging	42	Receding	5
Asia	25	Lower middle	6	Advanced	58	Slowly receding	23
America	15	Upper middle	24			Stable	18
Africa	10	High	70			Slowly advancing	29
						Advancing	25

[1) *World Bank (2022)*
https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html
[2) *World Economic Forum (2020)*
https://www.weforum.org/reports/the-inclusive-development-index-2020

Independent variable – Digitalization

Digitalization plays a crucial role in encouraging organizations to align with the Sustainable Development Goals (SDGs) and to report their progress, supporting greater transparency and accountability in sustainability efforts (Rosati and Faria, 2019). The widespread adoption of digital technologies and IT innovations has facilitated more effective communication and improved information-sharing, enhancing reporting practices (Hilali et al., 2019). In this context, we draw upon the Digital Adoption Index (DAI) developed by the World Bank (2016) to reflect the transformative impact of recent technological advances that have spurred the development of innovative business models, reinforcing companies' commitment to sustainability (Piscielli et al., 2018). Subsequently, for the *robustness analysis,* we relied on the Digital Competitiveness Index (DCI) recently developed by IMD World Digital Competitiveness (2021), as it has recently gained increased attention as a catalyst for effective digital transformation that can provide a competitive advantage in both business environments and national economies (Stankovic et al., 2021).

Control variables

To analyze harmonized sustainability reporting under digitalization, we identified five macroeconomic factors and selected control variables based on their relevance to each type of influence.

Governance: Governance plays a critical role in enhancing reporting and ensuring harmonization, as highlighted by international accounting standards. In this study, governance quality is measured using the average of the six *Worldwide Governance Indicators (WGI)* (World Bank, 2020). Following Pinheiro et al. (2022), the behavior of companies reflects the governance environment of the country in which they operate, with stronger enforcement mechanisms - such as regulatory quality and the rule of law - being essential for effective reporting. As sustainability reporting, particularly on the SDGs, is often linked to corporate reputation and legitimacy (Cahan et al., 2016), we expect a positive impact of governance quality on SDG reporting.

Economic development: Economic development is crucial for sustainable growth, industrialization, and innovation, but also linked to the well-being of

individuals, addressing issues like poverty reduction, food security, and health. To measure it, this study uses the *Inclusive Development Index (IDI)* developed by the World Economic Forum (2020), which is well-suited for assessing countries' economic progress, particularly regarding sustainability and its associated goals (Gupta and Vegelin, 2016). We expect a positive influence of the economic development pillar of sustainability on the reporting of SDG progress, as countries with stronger economic sustainability are likely to report more effectively on their achievements.

Social development: Human development, focuses not just on economic growth but on people's capabilities and well-being, making it a powerful tool for evaluating a country's overall progress (Rosati and Faria, 2019; Xiao et al., 2018). This study uses the *Human Development Index (HDI)* established by the United Nations (2019), which has become the official index for governments to measure progress toward the SDGs. We expect a positive influence of the social sustainability pillar on reporting.

Environmental performance: It provides a clear picture of how effectively countries address environmental challenges and meet their sustainability targets. This study uses the *Environmental Performance Index (EPI)* developed by the Yale Center for Environmental Law and Policy (Wolf et al., 2022). The EPI is commonly employed as a national scale to measure countries' ability to set and achieve policy goals related to environmental health and ecosystem vitality (Rosati and Faria, 2019; Xiao et al., 2018). We expect a positive influence, as sustainability reporting serves as an incentive to promote environmental initiatives and reflect countries' progress and achievements in environmental performance.

Model specification

This study examines the impact of digitalization (DAI) on SDG reporting and its interaction with corporate governance (WGI).

Table 2. Variables description

Variable	Abbrev.	Description (scale)
SDG score[1]	SDG	Total progress towards achieving all 17 SDGs (ranges from 0 to 100)
Digital Adoption Index[2]	DAI	Countries' digital adoption across three dimensions of the economy: people, government, and business (ranges from 0 to 1)
Digital Competitiveness Index[3]	DCI	Capacity and readiness to adopt and explore digital technologies for economic and social transformation (ranges from 0 to 100)
Worldwide Governance Indicators[4]	WGI	Quality of governance across countries and over time (ranges from -2.5 to 2.5)
Inclusive Development Index[5]	IDI	Level of growth and development growth (based on a 1-7 scale: 1=worst and 7=best)
Human Development Index[6]	HDI	Level of social development (ranges from 0 to 1)
Environmental Performance Index[7]	EPI	Level of environmental health and ecosystem vitality (ranges from 0 to 100)

Variable	Abbrev.	Description (scale)

[1] SDG Index and Dashboard https://dashboards.sdgindex.org/chapters/part-2-the-sdg-index-and-dashboards

[2] World Bank https://www.worldbank.org/en/publication/wdr2016/Digital-Adoption-Index

[3] IMD World Digital Competitiveness https://www.imd.org/centers/wcc/world-competitiveness-center/

[4] Worldwide Governance Indicators https://www.worldbank.org/en/publication/worldwide-governance-indicators

[5] World Economic Forum https://www.weforum.org/publications/the-global-competitiveness-report-2020/

[6] United Nations https://hdr.undp.org/content/human-development-report-2019

[7] Yale Center for Environmental Law and Policy https://epi.yale.edu

The baseline model (Model 1) for testing *hypothesis H_1*, which analyzes the role of digitalization (DCI) on the SDG Index, is set as follows:

$$SDG_i = \beta_0 + \beta_1 DAI_i + \beta_2 X_i + \varepsilon_i$$

where i represents the country; β_0 is the intercept; the term X_i represents control variables (economic, social, environmental, and governance factors); while ε_i signifies an error term.

To test hypothesis H_2, we expand the model to include an interaction term for digitalization and governance *(DAI*WGI)*:

$$SDG_i = \beta_0 + \beta_1 DAI_i + \beta_1 WGI_i + \beta_2 (DAI*WGI)_i + \beta_3 X_i + \varepsilon_i$$

Detailed definitions and data sources of the variables are presented in Table 2.

3. Results

This section presents the study's findings, starting with descriptive statistics and multicollinearity results. We then provide hypothesis testing outcomes using OLS regression for both baseline and moderating models, followed by an analysis of heterogeneity across country sub-samples. Finally, we confirm the robustness of our results through additional analyses using alternative variables.

Descriptive statistics

The descriptive analysis shows an average SDG score of 69.86, with a high of 85.9 in an advanced economy and a low of 40.9 in an emerging one. Table 3 details statistics for independent variables, distinguishing between developed (28% of sample) and emerging economies (72%). Emerging countries have an average SDG score of 65.92, while advanced countries average 79.71. Digitalization measures, DAI and DDCI, are also lower in emerging economies (0.05 and 46.48) than in advanced ones (0.76 and 77.89), mirroring trends seen across all control variables due to varying development levels.

Table 3. Descriptive statistics

	SDG	DAI	DCI	WGI	IDI	EPI	HDI
Emerging economies							
N	75	75	48	75	72	75	75
Mean	65.92	.05	46.48	-0.31	3.73	41.82	0.68
Std. Dev	8.64	0.15	10.43	0.54	0.57	10.15	0.12
Variance	74.67	0.12	108.85	0.30	0.33	103.20	0.01
Advanced economies							
N	30	30	29	30	29	30	30
Mean	79.71	0.76	77.89	1.27	5.11	73.44	0.92
Std. Dev	3.46	0.07	9.61	0.40	0.62	5.88	0.02
Variance	11.97	0.01	92.42	0.16	0.38	34.66	0.01

Given the relatively high correlations between several variables (see Table 2), we calculated the Variance Inflation Factor (VIF) and checked it against correlation tolerance (1/VIF). Variables with a tolerance below 0.1 and/or a VIF above 9 indicated a high degree of collinearity between them. The tests showed critical values for HDI (0.089/11.14), pointing to multicollinearity issues that could lead to unstable estimates, consistent with prior research, which has already shown that digitalization and digital innovations influence human development and/or GDP per capita (Stremousova and Buchinskaia, 2019), both with a notable main and interactive effect on sustainability outcomes (Gouvea et al., 2018).

Hypothesis test results

This sub-section tests our hypotheses using a simple OLS regression model, with a summary of results in Table 4. The baseline model (Model 1) assesses the impact of digitalization (DAI) on SDG reporting (Hypothesis H1), while the moderating model (Model 2) explores the interaction effect between digitalization and country governance on the same SDG score (Hypothesis H2). Table 3 follows a hierarchical estimation procedure: Model (0) includes only control variables, Models (1a) and (2a) focus on the independent variables and their moderation effect, respectively, and Models (1b) and (2b) present results for all variables combined.

Model (1a) shows that digitalization positively influences SDG outcomes across countries. The coefficients are statistically significant, and this positive impact remains robust when controlling for various country-specific factors in Model (1b). Therefore, digitalization plays an important role in advancing SDG progress, demonstrating a strong, meaningful relationship between DAI and the SDG score.

Table 4. Estimated results from the regression analysis

Variables	Baseline model			Moderating model	
	Model (0)	Model (1a)	Model (1b)	Model (2a)	Model (2b)
IDI	3.781***		2.535**		3.249**
	(0.849)		(13.002)		(4.448)
EPI	0.262***		0.219***		0.104**
	(0.047)		(0.060)		(0.875)
WGI	2.072***		-1.605*	1.575***	-2.037
	(0.898)		(1.002)	(0.918)	(0.776)
DAI		26.055***	27.376***	31.258***	25.564**
		(4.567)	(4.677)	(4.516)	(3.625)
DAI*WGI					-0.029
					(0.058)
Constant	34.503	42.295***	32.633	45.740	62.788
	(2.163)	(2.625)	(3.549)	(2.625)	(7.914)
Observations	105	105	105	105	105
R-squared	0.759***	0.813***	0.833***	0.830***	0.851***

Significance *10%; **5% and ***1%. p-values reported in brackets.

These findings support *hypothesis H_1*, demonstrating that technological advancements foster innovative business models that strengthen companies' commitment to sustainability (Piscielli et al., 2018). Digital transformations balance economic, social, and environmental factors, contributing to sustainable growth and alignment with the SDGs. Examples like AI in agriculture, smart water management, and blockchain technology to fight corruption (Goralski and Tan, 2020; Palomares et al., 2021) show how digital technologies drive SDG progress. Our results confirm that countries embracing digital technologies also improve their reporting practices, reflecting the broader trend of increased reporting in the digital age. Technologies like Big Data and XBRL have standardized taxonomies, enhancing corporate social responsibility and sustainable strategies (Seele, 2016). Digitalization supports organizational resilience, ensuring sustainability even in uncertainty, and improves stakeholder engagement and management policies (Miceli, 2021). Overall, our results validate that digitalization significantly influences sustainability reporting, enriching prior evidence and confirming our hypothesis that digitalization positively impacts sustainability reporting across macroeconomic determinants.

The control variable results also provide valuable insights. Better environmental health, ecosystem vitality, and higher economic progress were found to increase the likelihood of SDG reporting. These findings align with prior studies, confirming that environmental and economic sustainability are key drivers of sustainability reporting (Faccia et al., 2021). Countries facing greater environmental challenges (e.g., pollution, global warming) are under more pressure to act sustainably and are more inclined to report on SDGs (Rosati and Faria, 2019). Similarly, economically advanced countries, with more resources and public pressure, are more likely to report on sustainability (Ali et al., 2017). These results support stakeholder-oriented approaches that promote

transparent reporting on financial, social, environmental, and governance matters (Barnett et al., 2020). Developed economies, with greater resilience and access to new technologies, can enhance long-term value creation and sustainable development by supporting digitalization investments for broader social, economic, and environmental benefits.

Model (1b) tests the impact of digitalization (DAI) and corporate governance (WGI) on SDG reporting, exploring how their interaction moderates this relationship. As outlined in *hypothesis H_2*, we expect that corporate governance could either strengthen, weaken, or reverse the relationship between digitalization and SDG outcomes. To test this, we ran a modified regression model (Model 2) that included an interaction term (DAI*WGI), using the same estimation procedure as the baseline model.

The results show a negative moderation effect based on the sign of the interaction term. However, this effect is not statistically significant, suggesting that, contrary to our expectations, the interaction between digitalization and governance does not meaningfully influence SDG progress. As a result, we reject *hypothesis H_2*.

It is not surprising that governance enforcement mechanisms are insufficient to drive sustainability reporting, as these practices remain voluntary and digitalization presents ongoing challenges for many governance systems. For instance, while EU Member States were expected to lead SDG implementation and improve public governance, their Digital Government capacity was inadequate (Janowski, 2016). Given digitalization's key role in sustainable development, governments must invest more in aligning it with SDG objectives, as delayed adoption of digital technologies could worsen inequalities and impede sustainable development.

Robustness analysis

To explore the robustness of our results, we conducted the same analysis (see Table 5) using an alternative measure of digitalization, namely the Digital Competitiveness Index (DCI), developed by IMD World Digital Competitiveness (2021). This index assesses a country's ability to adopt and leverage digital technologies across various sectors, driving successful transformations in government, business models, and society. We choose due to its increasing recognition as a key driver of digital transformation, offering a competitive advantage in both business environments and national economies (Stankovic et al., 2021).

Our estimations strongly support the main analysis according to the variance explanation power. The independent variable (DCI) remains statistically significant, showing a positive influence, though with a lower significance (p-values < 0.05), while the interaction term confirms that corporate governance does not have any moderation effect on between digitalization and SDG reporting.

In conclusion, the robustness analysis confirms the initial findings, with only minor changes in the significance of the variables. Digital competitiveness emerges as a key driver for achieving the SDGs, promoting cultural and multidimensional changes across businesses and societies (Del Rio Castro et al., 2021). Furthermore, digitalization not only enhances sustainability reporting practices but also accelerates the achievement of specific SDGs through innovative technologies (Kunkel and Tyfield, 2021).

**Table 5. Estimated results from the regression analysis
with alternative variable**

Variables		Baseline model			Moderating model	
	Model (0)	Model (1a)	Model (1b)	Model (2a)	Model (2b)
IDI	3.936***		3.894***		2.241**
	(1.249)		(1.263)		(1.131)
WGI	0.391***		0.526	2.408*	-0.797
	(0.529)		(1.542)	(1.717)	(1.347)
DCI		0.231*** (0.056)	0.209**	0.248***	0.310**
			(0.850)	(0.081)	(0.061)
DCI*WGI					0.079
					(0.077)
Constant	42.462	48.219	43.735	57.491	41.688
	(3.129)	(1.551)	(4.882)	(4.253)	(4.206)
Observations	105	105	105	105	105
R-squared	0.724***	0.782***	0.721***	0.631***	0.795***

*Significance *10%; **5% and ***1%. p-Values reported in brackets.*

Heterogeneity analysis

A potential critique of our analysis is the varying impact of digitalization on SDG reporting across different country characteristics. To address this, we explored the heterogeneity of digitalization's effect by analyzing two sub-samples: emerging vs. advanced economies, based on the Inclusive Development Index (IDI), and by region (Africa, Asia-Pacific, Europe, and America) following The World Bank's classification. We re-estimated the baseline model for each group to better understand how economic development and regional context influence the relationship between digitalization and SDG reporting.

The heterogeneity analysis results by countries' development status (Table 6) reveal that digitalization significantly impacts SDG reporting in emerging economies (Model A), with DAI showing a positive effect ($p<0.01$) and strong predictive power (79.4%). In contrast, advanced economies (Model B) show no significant results, suggesting that digitalization does not enhance sustainability reporting in these countries.

In advanced economies, strong legal frameworks and public pressure already drive sustainability practices and reporting, reducing the need for digitalization to play a key role. However, emerging economies face weaker governance and regulatory challenges. Despite this, companies have used digital technologies—like blockchain, mobile apps, and AI—to promote corporate social responsibility and address SDG targets, particularly in areas like education, poverty reduction, and infrastructure (Forcadell and Aracil, 2019; Mhlanga, 2021). These technologies have helped bridge policy gaps, supporting sustainable development in regions with limited resilience. Overall, digitalization is a crucial driver of sustainability in emerging economies, where it compensates for institutional and regulatory weaknesses, enabling progress toward SDG goals.

Table 6. Regression results for the heterogeneity analysis by development status

	Model A			Model B	
Variables	*Advanced*	*Emerging*	**Variables**	*Advanced*	*Emerging*
DAI	20.926***	5.743	DCI	0.317***	-0.133
	(6.282)	(7.798)		(0.109)	(0.088)
IDI	4.836***	-0.697	IDI	6.524***	1.401
	(1.257)	(1.593)		(1.621)	(1.299)
EPI	0.272***	0.143			
	(0.083)	(0.134)			
WGI	-0.525	2.405	WGI	-0.209	4.429*
	(1.179)	(2.335)		(1.707)	2.220
Observations	*35*	*75*		*35*	*75*
R-squared	0.096***	0.794***		0.292***	0.666***

*Significance *10%; **5% and ***1%. p-Values reported in brackets.*

The regional analysis (Table 7) confirms the heterogeneity in digitalization's impact based on development levels. In developing countries, such as those in Africa (e.g., Egypt, Ghana, Kenya), digital policies aimed at boosting productivity, job creation, and sustainable transformation have advanced SDG attainment (ElMassah and Mohieldin, 2020). Similarly, digitalization has supported SDG progress in Nigeria, driven by stakeholder commitment and e-governance (Ufua et al., 2021).

Table 7. Regression results for the heterogeneity analysis by region

Variables	*Model C (Africa)*	*Model D (Asia-Pacific)*	*Model E (Europe)*	*Model F (America)*
DAI	25.898**	4.650	4.614	-9.594
	(11.864)	(6.796)	(8.114)	(19.825)
IDI	5.338**	2.004	-0.593	3.469
	(2.429)	(2.144)	(1.039)	(3.999)
EPI	0.422**	0.272**	0.147*	-0.385*
	(0.178)	(0.103)	(0.078)	(0.174)
WGI	2.022	-1.029	2.261	0.202
	(1.969)	(1.804)	(1.519)	(2.103)
Observations	24	24	35	17
R-squared	729***	632***	.618***	.850***

*Significance *10%; **5% and ***1%. p-Values reported in brackets.*

In Asia, rapid digital growth, particularly in China and ASEAN countries, has modernized business processes, with government policies promoting the digital economy (Chen et al., 2022). However, digitalization has become less crucial for transparency and sustainability reporting in these regions. In Europe, North America,

and Japan, the knowledge economy and the COVID-19 pandemic have accelerated digital transformation, driving both economic growth and sustainability. Overall, digitalization is a key growth driver for developing nations, fostering sustainable development.

4. Conclusion

In today's world, characterized by rapid changes and uncertainties, sustainability reporting has emerged as a vital tool for aligning business activities with the real needs of stakeholders and enhancing system resilience. Digitalization, by enabling unprecedented interconnectivity among business processes, organizations, societies, and stakeholders, provides the backbone for present and future development. This study explores the complex relationship between digitalization and sustainability reporting, offering a holistic approach to understanding how various macroeconomic factors - governance, economics, environmental concerns, and social dynamics - impact sustainability reporting practices across countries. We propose that digitalization functions as a central, overarching factor influencing these practices, providing the catalyst for systemic change in sustainability efforts globally.

Our findings offer several important contributions to the literature. First, we highlight the significant role that digitalization plays in enhancing SDG reporting, confirming the hypothesis that countries with higher digital adoption also demonstrate improved reporting practices. These countries not only report better on sustainability but also exhibit strong environmental health, ecosystem vitality, and sound economic performance. These findings align with previous studies suggesting that digitalization is a fundamental driver of societal transformation and economic growth. We also show that digital technologies are vital for accelerating progress, particularly in emerging economies, where digital adoption is a key enabler of sustainable development.

However, the study also revealed that governance did not play a substantial role in enhancing SDG reporting, which reflects the current voluntary nature of sustainability practices in many countries. This finding points to the need for a re-evaluation by both businesses and governments, who should consider accelerating efforts to align with the SDGs. Moreover, while sustainability has often been linked with resilience, our research demonstrates that digitalization provides the flexibility to navigate change and promote growth, ensuring the capacity to meet future sustainability challenges. These results underscore the transformative power of digitalization, particularly in emerging economies, and emphasize the need for global efforts to leverage digital tools for sustainable development.

Despite the promising findings, this study has some limitations that should be addressed in future research. Our sample, comprising 105 countries categorized as advanced or emerging, is limited by its scope, and future studies could expand the sample to include more nations or focus on specific regions, such as the EU, OECD, or Asia-Pacific. Furthermore, while our analysis controls for several macroeconomic factors, the impact of omitted variables remains a possible avenue for further exploration. Testing our model on different datasets or conducting region-specific studies could yield valuable insights into the nuances of digitalization's impact on sustainability reporting.

The implications of our findings are both theoretical and practical. From a theoretical perspective, we contribute to the ongoing debate on the interplay between

digitalization, governance, and sustainability reporting. Our study provides a clearer understanding of the role digital technologies play in advancing SDG reporting, offering a foundation for future research in this area. Practically, our findings offer valuable guidance to policymakers, businesses, and regulatory bodies. Governments and organizations should consider developing more robust frameworks to support the harmonization of sustainability reporting practices, encouraging global alignment with the 2030 Agenda. Digitalization and governance frameworks must be strategically integrated to ensure that businesses can align their reporting with the SDGs and contribute meaningfully to sustainable development.

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