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-RESEARCH ARTICLE-

DIGITAL ECONOMY STRUCTURING FOR SUSTAINABLE DEVELOPMENT: THE ROLE OF CSR AND GREEN TECHNOLOGY IN IMPROVING GREEN STOCK: EVIDENCE FROM VIETNAM

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─Abstract─

Amidst contemporary climate change and environmental challenges, sustainability has become a global imperative, requiring substantial commitment from both academics and policymakers. This empirical study examines how corporate social responsibility (CSR) and green technology affect sustainable development, using green stock as a mediating variable and the digital economy as a moderating component. The research investigates these dynamics from an employee-centric perspective, focusing on Vietnam's manufacturing sector to address a contextual research gap. Utilising partial least squares (PLS) methodology, the findings indicate that both CSR initiatives and green technology exert a positive impact on sustainable development. This suggests that CSR-driven activities not only enhance environmental performance but also that green technology optimises firms' manufacturing processes. Additionally, the results demonstrate that green stock mediates the relationship between CSR, green technology, and sustainable development, emphasising the role of programmes such as green stock in fostering inclusive growth among businesses. Furthermore, the moderating effect of the digital economy underscores the importance of digital transformation in enhancing business operational efficiency and driving green technological innovation. The study's identification of both mediation and moderation highlights the synergistic integration of these elements, fostering an enabling environment that supports long-term sustainability.

Keywords: Green Stock, CSR, Green Technology, Sustainable Development, Digital Economy

INTRODUCTION

With the growing awareness of environmental and social issues, business organisations face a critical imperative to pursue sustainable development (SD) in order to succeed in both domestic and international markets. Sustainable development within business contexts involves being socially and environmentally conscious, implementing practices that achieve significant economic objectives while safeguarding environmental health and social well-being (Ruggerio, 2021). Organisations that contribute to sustainable economic development go beyond a profit-centric approach by actively monitoring their social and environmental impacts and providing protection in these areas. In doing so, they cultivate an ecosystem conducive to business success. The importance of sustainable development lies in its relevance to competitive markets, where buyers increasingly demand social and environmental accountability alongside high-quality products and services. Moreover, individuals tend to prioritise organisations that demonstrate a genuine commitment to addressing socio-environmental needs while adhering to regulatory requirements (Ruggerio, 2021).

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

Several factors, such as CSR, green technology, and the digital economy, contribute significantly to enabling business organisations to achieve SD. CSR represents a paradigmatic business framework that encourages organisations to adopt self-regulatory practices, fostering a sense of responsibility towards stakeholders and the environment. Through CSR initiatives, organisations can maintain the quality of resources utilised in their operations, retain skilled and efficient employees, and enhance their public image, thereby ensuring their long-term sustainability (Guo et al., 2020). By adopting green technologies, businesses not only address stakeholders' environmental concerns but also create a resource-efficient and healthier operational environment, ultimately contributing to sustainable development (Guo et al., 2020).

The digital economy, characterised by the integration of digital technologies in economic activities, enhances connections among individuals, businesses, and devices. It facilitates data exchange, improves operational efficiency, and supports eco-friendly resource management. Additionally, the digital economy fosters social and environmental awareness, improves worker productivity, and strengthens sustainable business relationships, thereby enabling firms to achieve higher levels of environmental performance (Guo et al., 2020). The present study examines the concept of SD within the context of Vietnam's manufacturing sector, a critical component of the country's emerging economy. Manufacturing constitutes one of the largest industries in Vietnam, with significant contributions to employment and economic growth. The sector employed 10.3% of the workforce and contributed 20.2% to GDP in 2004. Manufacturing GDP rose 11.3% year between 1994 and 2004 (Nguyen et al., 2021).

Vietnam benefits from its geographical proximity to China and its abundant supply of low-cost labour, positioning the country as a prominent manufacturing hub in Asia, particularly for companies from South Korea and Japan. For example, the Samsung brand produces over 40% of its mobile phones in Vietnam, employing approximately 200,000 workers in Hanoi alone as of 2019. Similarly, LG Electronics has chosen Vietnam for smartphone production to achieve competitive advantages. In recent years, the country has also witnessed rapid growth in its automotive industry, further solidifying its role as a key player in the global manufacturing landscape (Nguyen et al., 2021). Vietnam, as an emerging socio-oriented nation, faces numerous environmental challenges that necessitate the adoption of sustainability principles, particularly within its manufacturing sector, a significant contributor to the country's GDP. Organisations within this industry must prioritise sustainability by balancing financial, environmental, and social objectives. This research makes three key contributions. First, it examines the roles of CSR, a regulatory business concept, and green technology, a sustainable consumption pattern, in achieving SD. In contrast to prior studies, which predominantly focus on either CSR or green technology, this study integrates both perspectives to provide a comprehensive analysis. Second, it introduces

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

the digital economy as a moderator and green stock as a mediator in the relationship between CSR, green technology, and SD, addressing a critical gap in existing research. Third, unlike previous studies, this research focuses specifically on Vietnam's manufacturing sector as the contextual framework, offering valuable insights into the interplay between the digital economy, CSR, green technology, green stock, and SD within the unique dynamics of an emerging economy.

This study is categorised into five distinct parts. The second part provides a comprehensive review of existing literature, serving as the foundation for hypothesis development. The third part details the methodology adopted for the research. The fourth part presents empirical findings derived from the collected data. The fifth part contrasts these findings with existing literature, offering a critical analysis. Finally, the study concludes by discussing its implications and limitations.

LITERATURE REVIEW

Human activities, particularly economic activities undertaken by business organisations, contribute to numerous environmental challenges and impact the social well-being of the communities in which they operate. This dynamic creates a scenario where businesses may achieve short-term success but risk losing the capacity to sustain long-term economic development (Berawi, 2019). CSR, green technology, green stock, and the digital economy are among the factors that can guide organisations towards achieving SD. CSR, as a business management approach, involves firms adopting self-regulatory practices to address societal goals such as community welfare, environmental conservation, and employee well-being. By fulfilling their social responsibilities and meeting societal objectives, organisations secure social and environmental resources for future use while addressing current needs, thereby advancing sustainable development (Berawi, 2019).

Mishra (2021) explored the role of CSR in achieving SD through an exploratory case study involving 40 Indian companies operating in various economic sectors. The study highlighted that environmental degradation remains a pervasive issue in many developing countries, posing risks to future economic performance. Mishra argued that the implementation of CSR reduces firms' involvement in carbon-emitting activities, satisfies stakeholder expectations, and ensures sustainable economic growth. Similarly, Berawi (2019) emphasised that adopting CSR fosters a sense of responsibility among management and employees, driving social and environmentally conscious behaviours. This shift in organisational performance secures natural resources, enhances the quality of human capital, and strengthens social support systems, all of which collectively contribute to the attainment of sustainable development. Hence,

H1: *CSR has a positive relationship with sustainable development.*

The utilisation of green technology in production, processing, transportation, and other infrastructure significantly reduces dependence on carbon-emitting energy sources, harmful chemicals, and waste generation. Additionally, it ensures a healthy working environment for employees, preserves natural economic resources, delivers high-quality products and services to the public, and sustains human capital. These factors collectively contribute to sustainable economic development (D'Amato et al., 2021). Shan et al. (2021) further highlight that green technological innovation within business organisations enhances the adoption of energy-efficient technologies and renewable energy solutions. This innovation reduces carbon emissions, mitigates environmental degradation, and consequently promotes sustainable development. Similarly, Hussain et al. (2022) examined this relationship in the context of high-GDP countries, concluding that when businesses manufacture and implement green technologies, economic expansion is achieved with minimal environmental impact. This approach preserves environmental quality, ensuring that natural and human resources remain viable for long-term use. Under such conditions, sustainable development becomes attainable. Thus,

H2: *Green technology has a positive relationship with sustainable development.*

CSR serves as a business model that outlines the responsibilities of organisations as economic entities while ensuring self-regulation to fulfil their social obligations. Organisations adhering to CSR principles frequently invest in green initiatives, which promote eco-friendly practices within an economy and foster an environment conducive to sustainable growth (Su & Fan, 2022). Lopez et al. (2022) suggest that organisations incorporating CSR prioritise environmental and social practices alongside the achievement of economic objectives. These organisations allocate additional resources to green initiatives such as green data processing, green technology, eco-friendly production methods, waste management, sustainable infrastructure, renewable energy, afforestation, and green infrastructure development. The resulting increase in green stock not only preserves the environment and its associated resources for domestic and economic use but also supports sustainable development for future generations.

A study by Lopez et al. (2022) investigated the correlation of CSR, green stock, green accounting, and sustainable development in significantly polluting sectors in Bangladesh. The study employed data from 212 firms registered on the Dhaka Stock Exchange between 2010 and 2019. The study concluded that the adoption of CSR redirects organisational management's focus towards green initiatives, motivating investments in green stock. The enhanced value of green stock provides both social and environmental benefits while ensuring the sustainability of economic development. Therefore,

H3: *Green stock is a significant mediator between CSR and sustainable development.*

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

Companies that develop, install, or implement green technologies like renewable energy, waste management, recycling, sustainable transportation, and energy efficiency receive more financing and investment when organisations adopt such policies. This growth in green stock contributes to environmental preservation, stabilises weather cycles, and sustains the productivity of natural resources. Consequently, firms benefit from improved environmental performance and achieve sustainable development (Ali et al., 2021). Madaleno et al. (2022) also examine the relationship between these variables, asserting that the adoption of green technologies enhances the use of renewable energy and facilitates access to green finance. Organisations with significant green stock contribute to environmental conservation and demonstrate progress towards sustainable development. The study further emphasises that when green technology investment and utilisation are embedded in business policies, the value of green stock increases, thereby encouraging further green investment. This cycle ensures the attainment of sustainable development. Thus,

H4: *Green stock is a significant mediator between green technology and sustainable development.*

In the digital economy, economic activities arise from the growing interconnectedness between individuals, organisations, devices, data acquisition, processing, and transfer, as well as the execution of operations through digital technologies. This integration of business organisations within digital economic networks raises awareness of social responsibilities, market demands, and innovative business strategies. Consequently, it enhances the capacity and motivation for organisations to adopt CSR strategies (Melnyk et al., 2019). Chen (2023) suggests that the digital economy creates pathways for accessing eco-friendly energy sources, sustainable materials, and green technologies. The use of clean energy, environmentally responsible materials, and energy-efficient technologies supports organisations in implementing CSR practices and reducing carbon emissions. In turn, this enables businesses to foster sustainability in economic development. Chen (2023) conducted a study to explore the relationship between the digital economy, CSR, and sustainable development, using a sample of Chinese enterprises registered between 2011 and 2020. The findings indicate that the digital economy simplifies the implementation of CSR practices, and by adhering to CSR principles, organisations can achieve sustainable development. Thus,

H5: *Digital economy is a significant moderator between CSR and sustainable development.*

The digital economy refers to the growing online connectivity and transactions across various entities and sectors, facilitated by the use of multiple technologies. This increased connectivity among business organisations provides valuable information about emerging environmental issues and fosters a closer connection with nature. As a

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

result, firms gain knowledge of green technologies and adopt these innovations to reduce the environmental impact of their operations. This improvement in environmental performance contributes to sustainable development (Savchenko & Borodina, 2020). Luo et al. (2023) investigate the relationship between the digital economy, green innovation, green technology, and sustainable development. The study utilised panel data from 278 Chinese cities over the period 2011–2019. The authors argue that, within the digital economy, business organisations are increasingly embracing technological innovation, facilitated by the easy availability and installation of various technologies. Further, Luo et al. (2023) examine the interplay between the digital economy, green technology, and sustainable development using data from European Union countries. Therefore,

H6: *Digital economy is a significant moderator between green technology and sustainable development.*

RESEARCH METHODS

This study investigates the correlation among CSR, green technology, green stock, the digital economy, and sustainable development within the Vietnamese manufacturing sector (Figure 1). A quantitative methodology is utilised to evaluate these correlations from the employees' perspective. The variables are quantified using items sourced from existing literature: CSR is assessed with four items from Shahzad et al. (2020), green technology with seven items from (Song et al., 2020), green stock with three items from (Osman et al., 2019), the digital economy with four items from (Jun et al., 2022), and sustainable development with four items from (Gericke et al., 2019). Purposive sampling is employed to select respondents, as the study aims to gather data from employees who work in environmentally conscious roles. A total of 544 surveys were distributed, yielding 357 valid responses. Additionally, the study utilises Smart-PLS, a method known for delivering optimal results, even with complex models or large datasets (Hair Jr et al., 2020).

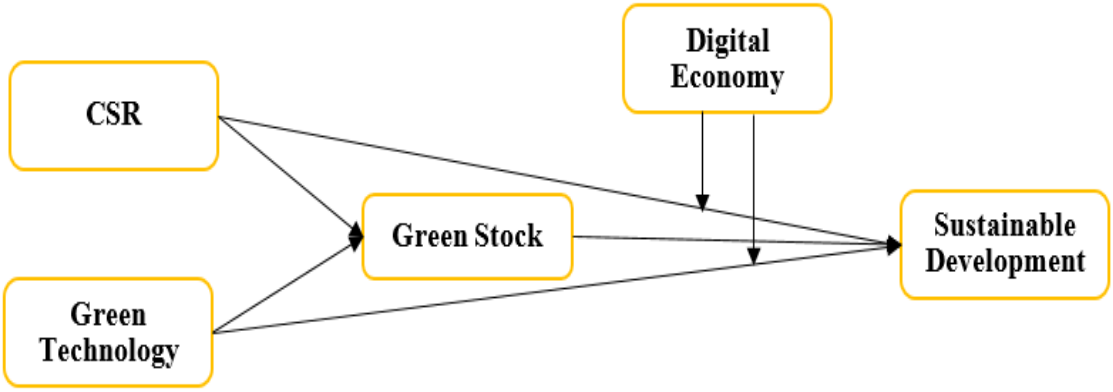

Figure 1: Research Model

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

RESEARCH FINDINGS

Convergent validity is assessed using composite reliability (CR), Cronbach's Alpha, and Average Variance Extracted. Table 1 shows all values match the threshold requirements, proving convergent validity. Moreover, Table 1 indicates that all factor loadings are more than 0.5, indicating substantial item association.

Table 1: Convergent Validity

Constructs	Items	Loadings	Alpha	CR	AVE
CSR	CSR1	0.839	0.892	0.925	0.756
	CSR2	0.903			
	CSR3	0.880			
	CSR4	0.855			
Digital Economy	DE1	0.902	0.818	0.882	0.654
	DE2	0.800			
	DE3	0.664			
	DE4	0.850			
Green Stock	GS1	0.858	0.833	0.900	0.749
	GS2	0.875			
	GS3	0.864			
Green Technology	GT1	0.765	0.886	0.911	0.594
	GT2	0.802			
	GT3	0.720			
	GT4	0.820			
	GT5	0.731			
	GT6	0.773			
	GT7	0.779			
Sustainable Development	SD1	0.773	0.794	0.866	0.618
	SD2	0.796			
	SD3	0.792			
	SD4	0.782			

These findings support the model's convergence. Discriminant validity is assessed using the HTMT ratio. Table 2 shows that all values are below 0.90, supporting discriminant validity and low correlation across variables.

Table 2: Discriminant Validity

	CSR	DE	GS	GT	SD
CSR					
DE	0.532				
GS	0.612	0.540			
GT	0.641	0.629	0.530		
SD	0.751	0.826	0.721	0.751	

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

The study's findings indicate that both corporate social responsibility and green technologies positively influence sustainable development (Table 3). Moreover, the findings demonstrate that green stock serves as a crucial mediator between CSR, green technology, and sustainable development. The study demonstrates that the digital economy substantially influences the interaction between corporate social responsibility, green technology, and sustainable development in the industrial sector (Figure 2).

Table 3: Path Analysis

Relationships	Beta	Standard Deviation	T Statistics	P Values
CSR -> GS	0.393	0.056	6.975	0.000
CSR -> SD	0.231	0.044	5.210	0.000
DE -> SD	0.376	0.043	8.842	0.000
GS -> SD	0.181	0.041	4.402	0.000
GT -> GS	0.232	0.057	4.075	0.000
GT -> SD	0.216	0.052	4.130	0.000
DE x GT -> SD	0.117	0.049	2.387	0.017
DE x CSR -> SD	0.105	0.042	2.498	0.013
CSR -> GS -> SD	0.071	0.018	3.928	0.000
GT -> GS -> SD	0.042	0.015	2.879	0.004

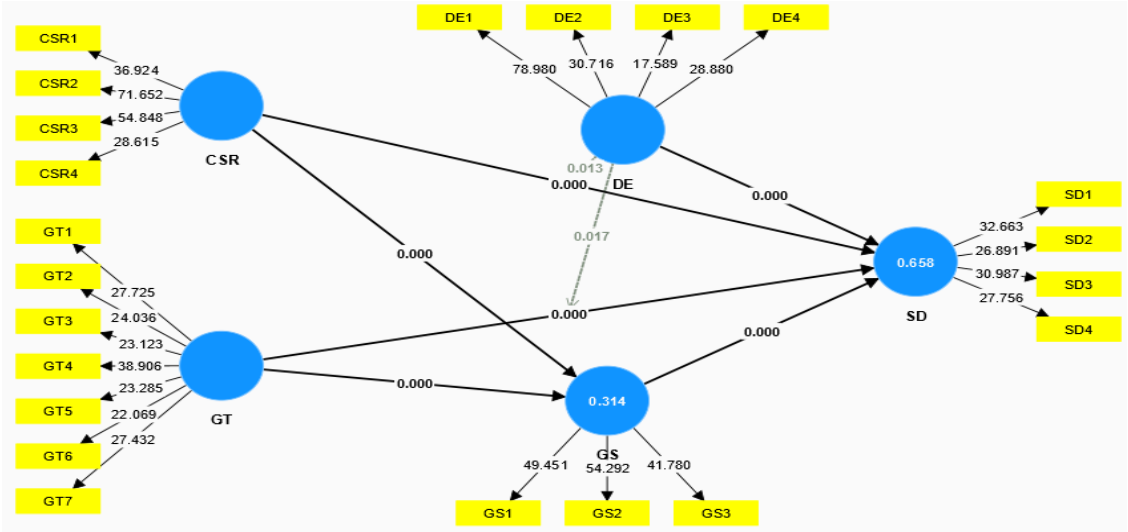

Figure 2: Structural Assessment Model

DISCUSSION

The findings of the present study suggest a positive association between CSR and SD. This conclusion is consistent with the work of Abad-Segura et al. (2019), who argue

that firms that implement CSR strategies are able to balance economic, environmental, and social objectives in their business operations. These results further align with those of Grover et al. (2019), who suggest that the adoption of CSR initiatives by individual firms helps to secure various resources and opportunities that ultimately drive SD. Additionally, the study reveals a positive relationship between green technology and SD. This finding is corroborated by Abad-Segura et al. (2019), who highlight that the integration of green technologies into business operations leads to eco-friendly changes that mitigate the environmental impact of industrial and transportation activities. Such environmental preservation is a key factor in achieving SD. In accordance with Tien et al. (2020), the study further affirms that the utilisation of green technologies not only addresses environmental concerns but also enhances the quality of products and services provided to the public, thus contributing to the assurance of SD.

The results of the study further suggest that green stock plays a significant mediating role. The findings indicate that when organisations embrace their CSR responsibilities, there is a notable increase in investment in green initiatives. This growth in green stock fosters environmentally-friendly economic practices, thereby enhancing the quality of sustainable production. Consequently, green stock acts as a vital link between CSR and SD, as supported by (Tien et al., 2020). The findings suggest that when organisations adopt green technologies in their daily operations, the value of green stock rises as a result of the increased manufacturing and installation of such technologies. This, in turn, leads to enhanced environmental performance, guiding firms towards achieving SD. These results align with the work of Wang et al. (2022), who contend that the growing utilisation of green technology contributes to the expansion of green stock, ultimately supporting the advancement of SD. These results are consistent with the work of Song et al. (2022), which highlights that the adoption of the digital economy enhances environmental and social awareness among individuals, thereby motivating organisations to adopt CSR practices.

The incorporation of CSR guidelines and the application of digital technologies facilitate organisations in attaining sustainable development. These findings correspond with Castro and Lopes (2022), who contend that the prominence of the digital economy enhances the significance of CSR in promoting SD. Furthermore, the study indicates that the digital economy serves as a crucial moderator between green technology and SD. These findings are supported by Yang et al. (2022), who suggest that the shift towards a digital economy encourages the adoption of green technologies, thus promoting SD. Similarly, Sudoh (2005) asserts that as the digital economy expands, the use of green technologies increases, contributing positively to the achievement of SD.

Vol: 17 **No:** 01 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 1-15) **Doi:** 10.34109/ijefs. 202517101

STUDY IMPLICATIONS

This article holds significant relevance for countries such as Vietnam, where economic growth is occurring but there is a need for sustainability in the pace of development. The study offers valuable guidance for policymakers on how to achieve SD. It suggests that business organisations must adhere to the principles of CSR in their operations to contribute to the nation's SD. The study further advocates for the promotion of green technologies within business organisations as a means to attain SD. The research also recommends that businesses incorporate CSR into their policies, which would foster the growth of green stock and drive the country towards SD. It highlights the importance of integrating and utilising green technologies in regular operations, which would increase the value of green stock and support sustainable economic development. The study suggests that both authorities and businesses should encourage the expansion of the digital economy, as this would facilitate the implementation of CSR practices and promote SD.

CONCLUSION

This study aimed to examine the influence of CSR and green technology on sustainable development, as well as to evaluate the mediating and moderating effects of green stock and the digital economy in the interaction among CSR, green technology, and sustainable development. A quantitative research methodology was employed to gather primary data via questionnaires distributed to corporate groups in Vietnam. The study's findings revealed a positive correlation between CSR and green technology with SD. Specifically, when organisations implement CSR, they secure natural resources for future use, enhance human resource efficiency, improve their business image, and increase the quality of production, all contributing to the sustainability of economic development. The results also indicated that the adoption of green technologies allows organisations to implement environmentally-friendly practices, addressing the environmental and social concerns of stakeholders. This, in turn, assures the attainment of sustainable economic development.

LIMITATIONS AND FUTURE DIRECTIONS

The study possesses specific limitations that necessitate consideration from other researchers. Primarily, although it emphasises the significance of the digital economy, corporate social responsibility, and green technology in sustainable development, it neglects to examine other relevant variables such as green finance, green human resources, energy efficiency, and sharing efficiency, all of which are essential for ascertaining sustainable economic development. Subsequent research should integrate these elements to yield a more thorough comprehension of SD. The data gathered for this study were solely from Vietnam, a developing nation characterised by distinct

environmental and economic conditions. Future research should expand the analytical environment to encompass both emerging and established nations, facilitating a more generalisable and comparative examination of the interrelations among the digital economy, corporate social responsibility, green technology, green stocks, and SD.

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Table 1: Measurement Scale of the Variables

Items	Statements	Sources
Corporate Social Responsibilities		
CSR1	"Our firm participates to the activities which aim to protect and improve the quality of the natural environment."	(Shahzad et al., 2020)
CSR2	"Our firm makes investment to create a better life for the future generations."	
CSR3	"Our firm implements special programs to minimize its negative impact on the natural environment."	
CSR4	"Our firm targets a sustainable growth which considers to the future generations."	
Green Technology		
GT1	"The firm chooses the materials of the product that produce the least amount of pollution."	(Song et al., 2020)
GT2	"The firm chooses the materials of the product that consume the least amount of energy and resources."	
GT3	"The firm uses the smallest amount of materials to create the product."	
GT4	"The firm circumspectly deliberates whether the product is easy to recycle, reuse, and decompose."	
GT5	"The manufacturing process effectively reduces the emissions of hazardous substances or waste."	
GT6	"The manufacturing process recycles waste and emissions to allow them to be treated André-used."	
GT7	"The manufacturing process reduces the consumption of water, electricity, coal, or oil."	
Green Stock		
GS1	"I feel choosing green investment is a wise idea."	(Osman et al., 2019)
GS2	"I feel that green investment performance is generally reliable."	
GS3	"I feel that green investment claims are generally trustworthy."	
Digital Economy		
DE1	"Our platform easily accesses data from our partners' IT systems."	(Jun et al., 2022)
DE2	"Our platform provides seamless connection between our partners' IT systems and our IT systems."	
DE3	"Our platform has the capability to exchange real-time information with our partners."	
DE4	"Our platform easily aggregates relevant information from our partners' data bases."	
Sustainable Development		
SD1	"I think that using more natural resources than we need does not threaten the health and well-being of people in the future."	(Gericke et al., 2019)
SD2	"I think that we need stricter laws and regulations to protect the environment."	
SD3	"I think that it is important to take measures against problems which have to do with climate change."	
SD4	"I think it is OK that each one of us uses as much water as we want."	