

Role of green financing and corporate social responsibility (CSR) in technological innovation and corporate environmental performance: a COVID-19 perspective

Role of green financing and CSR

297

Received 4 March 2021

Revised 23 May 2021

7 July 2021

Accepted 11 July 2021

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Abstract

Purpose – The aim of this study is to estimate the relationship between technological innovation and corporate environmental performance among energy companies working in Egypt.

Design/methodology/approach – The study extended the aim with the intention to assess the role of green financing in enhancing corporate environmental performance. Partial least squares (PLS)-based structural equation modeling (SEM) is applied to estimate the nexus among study variables.

Findings – The results indicated that technological innovation influenced environmental performance and has a positive impact on company performance. The role of green financing for environmental performance is also significant and positive. Moreover, corporate social responsibility (CSR) has insignificant role in environmental performance of the energy companies in the study context.

Research limitations/implications – The study offers a valuable model for general managers of manufacturing organizations and policymakers to manage CSR, environmental strategy and green innovation in examining environmental performance. It can help to assist general managers of large manufacturing organizations to strengthen their internal resources like CSR, environmental strategy and green innovation to enhance environmental performance.

Practical implications – The findings of this article will help the practitioners to design policies regarding sustainable energy systems and green finance in the presence of any natural calamity.

Originality/value – This study primarily complements the existing literature by establishing how green financing and CSR can augment and/or interact between technological innovation and corporate environmental performance under COVID-19 crises, in a developing country.

Keywords COVID-19 crises, Green financing, Technology innovation, Corporate environmental performance, Corporate social responsibility

Paper type Research paper

1. Introduction

External verification of green finance disclosures has been common industry procedure in recent years, and it has seen a major rise in the global arena. The need to communicate to different stakeholders ensuring that environmental and social threats are adequately handled is driving this expansion (Farmaki, 2019), highlighting the value of green finance science. According to previous research, the accuracy of numerous corporate financial accounts has been questioned, and firms are more prone to share manipulated facts about their green



China Finance Review

International

Vol. 12 No. 2, 2022

pp. 297-316

© Emerald Publishing Limited

2044-1398

DOI 10.1108/CFRI-03-2021-0048

financing (Taghizadeh-Hesary and Yoshino, 2019). Furthermore, external assurance of corporate social responsibility (CSR) results help to increase the credibility of the disclosed CSR data (Koseoglu *et al.*, 2021). As a result of the increased need for external assurance of CSR data from businesses, accounting and auditing practitioners have begun to actively participate in CSR reporting through delivering assurance services. External confirmation of CSR reports by multinational companies continues to expand; according to KPMG International, signaling that third-party assurance of CSR reports is becoming more popular (Du and Wu, 2019). Firms seek external verification of their CSR records as a way of stressing their superior contribution to CSR efforts from a signaling viewpoint (Gal and Akisik, 2020). Other reports, on the other hand, contend that businesses seek external assurance for a variety of purposes, including improving internal procedures and processes, increasing reputation and improving CSR efficiency (Hur *et al.*, 2020).

Energy firms are expected to face a wider collection of CSR and sustainable development (SD) initiatives, which take into consideration everything from the atmosphere to labor rights and global sustainability (Franco *et al.*, 2020), as well as interest-free lending. In order to maintain profitability, companies are increasingly accountable to stakeholders, thus taking into consideration sustainability; becoming conscious of societal concerns, complying with international laws and regulations and adopting international approaches including the Sustainable Development Goals, which in turn, allows them to remain profitable (Moyer and Hedden, 2020). Environmental and social effects from industry in environmentally responsive sectors, such as the Global Reporting Initiative (GRI) framework, has seen a significant rise in recent years (Sadiq *et al.*, 2020). Moreover, CSR increases energy creativity (Annan-Diab and Molinari, 2017).

Given that external verification of CSR disclosures and green financing techniques improves corporate environmental performance and technological innovation for various stakeholders (Grover *et al.*, 2019), firms in environmentally sensitive industries (e.g. the oil and gas sector) depend on CSR assurance services and green financing provided by external auditors during the COVID-19 era (Chien *et al.*, 2021a). The aim of this research is to empirically investigate whether the impact of green financing and CSR on technical innovation and corporate environmental efficiency is important, given that empirical research on external CSR assurance and green financing under COVID-19 crises is relatively small and understudied (Shair *et al.*, 2021). Specifically, this research looks into whether companies use CSR directives and green finance options to demonstrate their superior contribution to CSR practices or to leverage stakeholders' expectations of corporate environmental success during the COVID-19 crisis.

Environmental sustainability has become major distress for the business world, and many developing and industrialized countries have been criticized for their roles in environmental degradation that leads to economic, environmental and social challenges (Amankwah-Amoah, 2020). In addition to economic responsibility, successful companies that support environmental community projects can also bring social well-being and greater financial success. Research on small and medium-sized enterprises (energy industries of Egypt) is itself a sub-domain of management and plays an important role across other disciplines (Sarkis and Zhu, 2018). While large companies have undoubtedly expanded their significance and visibility, small businesses are, in fact, the most important type of organization, typically representing more than 95% of private companies (Al-Awadhi *et al.*, 2020). The challenge remains daunting for energy industries of Egypt that want to implement sustainable practices. These companies face a set of challenges to succeeding in a dynamic competitive environment (Asongu *et al.*, 2018). They have to contend with limited human and financial resources and hardly perceive the benefits associated with CSR. The work of El-Aasar and Hanafy (2018) highlights the chance for energy industries of Egypt to seize the opportunities and benefits that can be offered by CSR practices. Still, despite the presence of various

environmental sustainability practices in such businesses, their understanding of CSR requirements is fragmented.

The debate about renewable technologies, fossil-based fuels and their environmental impact fascinates environmental economists all over the world (Mohsin *et al.*, 2021). Trade transparency, sustainable growth, technological innovation, environmental performance, green finance and CSR are only a few of the recent terms that have emerged as a result of renewable energy trends (Nawaz *et al.*, 2021). Economic growth and wealth, as well as trade openness and energy use, provide an exciting area for scientific study. Energy use is a critical component of a country's economic growth, and demand has risen steadily in recent decades (Li *et al.*, 2021). Policymakers all over the planet are working to develop long-term strategies for technical advancement and environmental performance management (Chien *et al.*, 2021b). While green financing is seen as a significant driver for industries that are less creative and pollute the environment, it is also seen as a significant driver for industries that are less innovative and pollute the environment. Most business and economic analysts support this viewpoint, which supports creativity. Before implementing a green company, it is critical to examine the factors that influence its success. Green financing is one of the most important indices of green sustainability (Yoshino *et al.*, 2019). The composition of green finance, according to the literature, has a direct impact on technical advancement and corporate environmental efficiency.

The remainder of the paper is set out as follows. Section 2 offers a related review of the literature. The data and methods are presented in Section 3. The empirical results, discussion and robustness of results are summarized in Section 4. Section 5 explains the conclusion and policy implications.

2. Literature review

2.1 Corporate social responsibility (CSR) and corporate performance

Researchers such as van Huis and Oonincx (2017) and Pulido-Fernández *et al.* (2019) opined that leaders have often considered sustainability as an investment opportunity that yields the promised results. For example, researchers have highlighted how organizations could attract stakeholders through CSR investments to build loyalty and to achieve better financial performance. However, researchers have found contradictory results under different contexts for the relationship between a firm's sustainability investments and its financial results. Some other nonfinancial benefits of sustainability initiatives include new skilled labor, additional marketing opportunities via greener competition, brand repositioning, a stronger brand image and the attainment of social and ecological labels. Some studies even confirmed the ability of CSR to improve organizational performance (Chang *et al.*, 2018; Hou *et al.*, 2019). Besides, the researchers emphasized that large companies do not have the privilege of corporate social responsibility, and their focus has begun to shift to energy industries of Egypt (Yongming and Yini, 2017). Still, people have no idea about the impact of CSR on energy industries of Egypt. People are increasingly getting aware that small and medium-sized enterprises are the backbone of the economy. However, many studies on CSR are based upon a series of unsupported expectations about the behavior of energy industries of Egypt. The practice, tools and benefits of CSR can be scaled down to suit the Energy industries of Egypt.

The relationship between innovation and environmental sustainability has been extensively researched in the literature. Thus, innovation is conceptualized by the addition of products, processes and managerial activities involved in product or service provision. Severo *et al.* (2019) found a relationship between innovation and environmental sustainability practices and recommended that companies should comply with the principles of CSR to their manufacturing practices by the use of new technology that is friendly to the environment.

The goal of CSR is to combine economic prosperity, social equity and environmental preservation. Many initiatives have emerged to frame companies in their commitment to the sustainable development in their disclosure activities (Hou *et al.*, 2019).

Energy industries of Egypt are indebted to innovate considerably by developing strategies friendly to their environment and clients. In practice, energy industries of Egypt are supposed to develop products/services and processes that are geared toward SD. Previous studies on innovations have focused mainly on the environmental features known as *eco-innovations* leaving out other facets of SD practices (Dalcomuni, 2018). The energy industries of Egypt eco-innovations includes a wide spread of activities including, eco-efficiency, cleaner production and eco-design. This kind of innovations boost better production, application of uninterrupted improvement processes, promote stakeholders' satisfaction and encourage the development of training models and linkages. Also, innovations inspire productive partnerships with several stakeholders, thus letting energy industries of Egypt access resources useful in SD practices. These collaborations with stakeholders in SD practices allow energy industries of Egypt to harness substantial human resources that lack internally (Ovbiagbonhia *et al.*, 2019). Thus, SD practices generate economic, social and environmental value that builds a competitive edge for energy industries of Egypt by improving their performance. According to a study conducted, technological innovation is necessary to bring firm growth through CSR practices. This is why this paper assumes that:

H1. Technology innovation has a positive effect on the implementation of sustainable practices by energy industries of Egypt.

Currently, green finance has been considered as the foremost solution for the environmental issues globally, and it also captures the attention of recent studies and regulators. Green finance also provides assistance to the corporations regarding investment in the environmental issues and to reduce the carbon emission for improving environmental conditions in the country. A study conducted by Sachs *et al.* (2019) and investigated the green finance impact on the sustainable development goals and found that the green finance has a positive role on the environmental solutions and also helpful to attained the sustainable development goals. In addition, a study by Taghizadeh-Hesary and Yoshino (2020) investigated the role of green finance and renewable energy on the sustainable development goals and concluded that the high investment in renewable energy and green finance could increase the environmental performance and also strengthen the nations to attain the sustainable development goals. Moreover, Zhang *et al.* (2021) conducted the study on the public spending impact on green economic growth with mediating role of green finance. They investigated that green finance could improve the public spending role on the green economic growth and also improve the environmental condition of the country.

In addition, according to the Jha and Bakhshi (2019), who conducted their study on the role of green finance in sustainable development in India and indicated that the effective investment in green finance such as investment on renewable energy could improve the environmental condition and reduce the carbon emission that move the economy toward sustainable development. Moreover, Liu *et al.* (2020) conducted the study to examine the role of green finance on the development of green economy and sustainable development in China. They revealed that the effective investment and use of green finance could play a positive role on the green economy and also attained the sustainable development. Thus, based on the above literature, it is concluded that the effective investment and usage of green finance could improve the green economy and also attained the high environmental performance and sustainable development goals.

According to Cepec *et al.* (2017), the study of the characteristics of the firm is a necessary step to understand the phenomenon of corporate ownership of SD. Organizational

contingencies shape companies' responses to SD concerns as companies are required to address the negative impacts they may have to prevent such a situation from happening again in the future. According to this approach, the very nature of the business is to dictate the behaviors that are expected in SD. These contingency factors include business strategy, the owner's decision-making style, innovation and financial performance (Malagueño *et al.*, 2018). At the level of the entrepreneur's attributes, the study uses interpersonal behavior. This theory of interpersonal behavior postulates that the decision to behave sustainably stems from intention, habit and facilitating factors (Liao, 2018). It also considers social factors such as norms, roles, self-image, affect and perceived consequences. This is why we assumed that: (see Figure 1).

- H2. Economic factors have a positive effect on the implementation of sustainable practices by energy industries of Egypt
- H3. Social factors have a positive effect on the application of sustainable practices by energy industries of Egypt.
- H4. Environmental factors have a positive effect on the implementation of sustainable practices by energy industries of Egypt.
- H5. Financial factors have a positive effect on the implementation of sustainable practices by energy industries of Egypt.

3. Methods and design

3.1 Data collection

The research participants for this study are the managers of energy sector enterprises in different cities of Egypt. The researcher selected these areas because of the following reasons: first, the major economic activity in these counties is textile, fruits, horticulture, vegetables, agriculture and gems. In the development of any country in terms of industrial development,

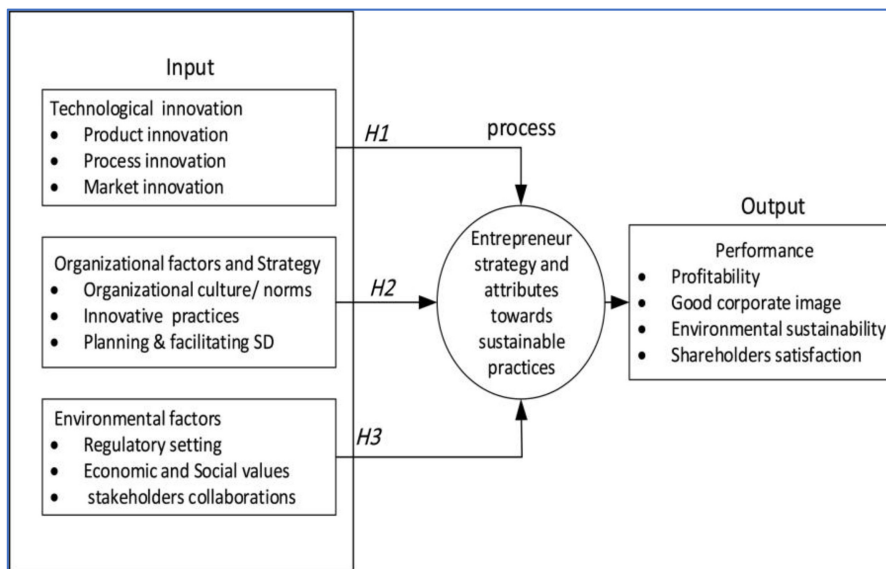


Figure 1. Conceptual model

the energy sector importance cannot be overstated. Among all enterprises in Egypt, the energy sector accounts for 90% approximately. These companies employ approximately 80% of the non-agricultural labor force, and the energy sector accounts for approximately 40% of the annual GDP. Though, different large companies in the formal sector, small and medium enterprises are forced by economic and further resources. This inherent feature of energy industries of Egypt makes it necessary to have a mechanism that enables them to obtain support in different functions of the business (including technology upgrades, marketing, financial and human resources training and development) (Ho *et al.*, 2018). European Bank for Reconstruction and Development provides necessary services to help Energy industries of Egypt overcome weaknesses due to their nature. It is an autonomous organization which contributes to the growth and development of Egyptian energy industries of Egypt through the following methods:

- (1) Establish a favorable regulatory environment
- (2) Industrial cluster development
- (3) Provide business development services for small and medium-sized enterprises in all business management fields.

It also follows a clear mandate and a logical path to achieve quantifiable and verifiable goals and conducts a comprehensive analysis of international trends, national policies and other macroeconomic factors affecting Egypt's small and medium-sized enterprises, to gradually create a good business environment for major customers: Egypt energy industries of Egypt. At the same time, we also interact with small and medium-sized enterprises engaged in the fields of agriculture, fishery, textiles, handloom weaving, transportation, leather, carpets and light industry. This interaction takes place at the individual and collective levels to provide energy industries of Egypt with proactive financial, technical, management and marketing services.

3.2 Sample characteristics

The data in Table 1 show that among the 175 respondents, 125 respondents are male, accounting for 71.43% of the total sample, and the age group with the largest number of respondents is 31–35 years old, accounting for 39.43–20% of respondents over 41 years old. In our sample, the majority of respondents (38.86%) have a bachelor's degree, while a master's degree accounts for 37.14%, and the rest are holders of diplomas in different fields. Most employees of small and medium enterprises have three to four years of work experience.

3.3 Measurement scale and common method bias

The questionnaire of technological innovation was adopted by the Souitaris (2002), where researchers tested technological innovation with company specific competencies in Greece context. Later on, many other researchers considered this questionnaire with innovation patterns (Zhang *et al.*, 2019), director's effectiveness (Hakovirta *et al.*, 2020), socioeconomic paradigms (Rupčić, 2020) and CEO dominance (Prugsamatz, 2021). We used five-point Likert type scale to measure corporate environmental performance. After that, the scale of environmental performance was used by many studies, from which, Delmas and Blass (2010) and Tam *et al.* (2006) are prominent. All the items of input, process and output dimensions were not subjected to pilot testing because the item loading and inter-item reliability shown significant outcomes, and these items loaded on main constructs significantly.

The participants responded to the survey questionnaire without having the interference of the researcher or any other factors, which may bring the problem of common method variance (Podsakoff *et al.*, 2003). Second, we used a composite scale of career competency of Tehseen *et al.* (2017); however, future studies should use a multidimensional scale of career

Classification	Frequency	Percentage
<i>Gender</i>		
Male	125	71.43
Female	50	28.57
Total	175	100.00
<i>Age (years)</i>		
25–30	26	14.86
31–35	69	39.43
36–40	45	25.71
Above 41	35	20.00
Total	175	100.00
<i>Work experience(years)</i>		
0–1	8	4.57
1–2	25	14.29
3–4	68	38.86
5–6	74	42.29
Total	175	100.00
<i>Education level</i>		
Masters	65	37.14
Bachelors	68	38.86
Diploma	42	24.00
Total	175	100.00
<i>Registration</i>		
Groups	70	40.00
Limited company	22	12.57
Partnership	53	30.29
Sole proprietorship	30	17.14
Total	175	100.00
<i>Number of employees (Firm size)</i>		
1–10	62	35.43
11–15	78	44.57
16–20	35	20.00
Total	175	100.00
<i>Firm types</i>		
Local	146	83.43
Foreign	29	16.57
Total	175	100.00

Table 1.
The Sample information

competency to better understand and comprehend the contribution of individual factors toward the development of corporate environmental performance through green financing, CSR and technological innovation amid COVID-19. Hence, by this, using the suggested guidance of Podsakoff *et al.* (2003), the problem of common method bias is rectified.

3.4 Data analysis technique

We determined the input and output responses of a particular technology to investigate the topic and fill the important gaps in the literature by assessing variations in environmental innovation technology, studying corporate environmental performance with the role of green financing under COVID-19 crises. Therefore, partial least squares structural equation modeling (PLS-SEM) was used to test the hypotheses. PLS-reputation SEM's among current

mathematical methods of study is due to its robustness (Hair *et al.*, 2017). Despite its flaws, PLS is still regarded as a good tool for estimating path coefficients in structural models. To model latent structures, PLS cleverly manages limited sampling sizes and nonnormality of results (Hair *et al.*, 2017). PLS-SEM is the most suitable methodology for this analysis since it requires the estimation of dependent variables (Hair *et al.*, 2010).

PLS-SEM is also a widely recommended method owing to the prevalence of gradual character (career resilience as a mediator between career competency and career success) in this research (Hair *et al.*, 2017). The critical to calculating sample size for PLS-SEM is ten times the largest numbers of observed in the model. The initial measurements model was studied for internal accuracy and validity and durability and then underwent final model testing with SmartPLS 3.6, the Structural PLS.

4. Results and discussion

4.1 Empirical results and interpretation

To regulate the reliability and validity of the variables, the current study used Cronbach's alpha (α). The value of Cronbach's alpha ranges from 0 to 1. This means the value closer to 1 indicates that the internal reliability of the selected items is higher on the measurement scale. It is recommended to use an alpha value greater than 0.70. The results of the study show that in all the research variable structures, α is greater than 0.7, which indicates sufficient consistency. This research work tested the convergent validity and found that a load of all 53 research items was higher than 0.7, consequently sustaining the well-known research scale. The overall reliability (CR) is also higher than 0.7, which is considered an acceptable benchmark. Also, the extracted average variance (AVE) is acceptable for every variable construction because it exceeds 0.50. While all the dimensions of research items show appropriate internal reliability with a value higher than 0.70 of Cronbach's alpha, as shown in Table 2. The result is within the recommended maximum value. It is found that all scales have convergence and effective discrimination, which makes us full of confidence in pursuing hierarchical regression models.

In the evaluation of the dimensions of sustainable practices (see Table 3), the first dimension on the sustainable economic practices, which is the average score of the extent of implementation of sustainable economic practices, is insignificant ($\beta = 0.109$, $t = 2.523$, $p = 0.012$). This dimension provides energy industries of Egypt with the greatest flexibility to improve their sustainability performance. Since the economic dimension of SD is the least visible in energy industries of Egypt, we believe that energy industries of Egypt are committed to SD for reasons other than those that are business-related. The second dimension on the sustainable social practices, which is the average score for the extent of implementation of sustainable social practices, is significant ($\beta = 0.012$, $t = 1.834$, $p < 0.000$). These results demonstrate that the social dimension the one that is most strongly represented in energy industries of Egypt and confirms the discovery of the importance of these practices in the eyes of SME owners. These results corroborate the findings of Chege and Wang (2020) on the importance of ethical considerations by the owners of energy industries of Egypt. Sustainable social practices enable owner-managers to operationalize ethics within their company, establish social dialogue and strengthen and secure links with key stakeholders in their organization.

For the third dimension of sustainable environmental practices, the result was significant ($\beta = 0.036$, $t = 0.875$, $p < 0.000$). The results reinforce the idea that this dimension is a key component of SD in energy industries of Egypt. The extent of implementation of environmental practices by energy industries of Egypt is consistent with the results of Ge and Liu (2015), who found that nearly half of the sustainable practices that are implemented by energy industries of Egypt are intended to reduce the pressure of production

Variables	Factor loads	AVE	CR	α
<i>Technology innovation</i>		0.731	0.881	0.876
Our company introduced new lines of products	0.881			
Our company invested in R&D to produce quality products	0.927			
Our company used new technology in the production process	0.912			
Our company used new methods/procedures in production and service delivery	0.798			
Our company has marketed new products	0.797			
Our company market share has increased due to the new branding of our products	0.816			
<i>Economic dimension</i>		0.53	0.797	0.838
Our company primarily hires local employees	0.844			
Our company encourages employees on sustainable practices	0.848			
Our company sets aside funds for sustainable practices	0.677			
Our company donates to the community	0.872			
Our company buys from local suppliers	0.622			
<i>Social dimension</i>		0.719	0.888	0.913
Our company minimizes the risk of accidents at work	0.833			
Our company invests in the ongoing training of its employees	0.678			
Our company provides equal treatment for all employees	0.894			
Our company ensures respect for human rights by its business partners	0.856			
Our company respects the right of association of its employees	0.883			
Our company considers the impacts of its activities on local communities	0.716			
Our company considers the health and safety impacts of its products	0.883			
<i>Environmental dimension</i>		0.612	0.886	0.883
Our company minimizes its consumption of resources (raw materials, water and energy)	0.828			
Our company protects biodiversity and protected areas	0.819			
Our company minimizes its emissions into the air (greenhouse gases and other substances)	0.814			
Our company minimizes its releases into the water	0.803			
Our company minimizes residual materials	0.754			
Our company minimizes the environmental impact of its products	0.766			
<i>Financial dimension</i>		0.601	0.857	0.843
Profitability	0.893			
Corporate image	0.867			
Environmental sustainability	0.857			
Shareholders satisfaction	0.842			

Table 2. Factor loadings, average variance extracted (AVE), composite reliabilities (CRs) and Cronbach's alpha (α)

activities on the environment. A link can be made to (Ge and Liu, 2015) in that the awareness of environmental threats generates an altruistic opening and enables more search opportunities related to SD. Furthermore, the facilitators for the implementation of sustainable practices by energy industries of Egypt such as changes in organizational culture ($\beta = -0.004, t = -0.596, p > 0.001$) and support from governmental authorities ($\beta = 0.018, t = 0.534, p > 0.001$) that can facilitate their implementation showed insignificant results, which explains the need for collaboration in SD practices.

Also, the interaction between family characteristic factors and CSR reports (significantly 10% ($0.053 < 0.10$)) reflects that family companies that have a CSR report (6.36) are more likely than those without the report A stronger orientation toward corporate social responsibility. (6.08). Similarly, compared with nonfamily businesses that have no family business report (6.31) or no family business (5.76), they prefer CSR. These variances can be

Coefficients	<i>B</i>	Std. Error	Beta	<i>t</i>	Sig
Constant	0.30	0.09		3.20	0.00
<i>Dimensions of sustainable practices</i>					
Sustainable economic practices	0.10	0.04	0.11	2.52	0.01
Sustainable social practices	0.01	0.00	0.01	1.83	0.00
Sustainable environmental practices	0.04	0.04	0.04	0.88	0.00
Sustainable performance	-0.35	0.04	-0.32	-9.878	0.38
<i>Sustainable practices</i>					
Local employment	-0.17	0.04	-0.16	-4.590	0.00
Donations to the community	0.52	0.04	0.47	14.37	0.00
Use of local materials	0.06	0.03	0.04	1.88	0.06
Environment conservation	-0.01	0.04	0.00	-0.11	0.00
Use of residual materials	0.18	0.04	0.14	5.05	0.00
Releases into the water	0.56	0.03	0.46	17.07	0.00
Product innovation impacts	0.01	0.04	0.01	0.27	0.79
Resource consumption	-0.01	0.03	-0.01	-0.17	0.87
Greenhouse emission to air	0.19	0.04	0.18	5.27	0.00
Protection of biodiversity	-0.23	0.03	-0.18	-7.530	0.00
<i>Regression statistics</i>					
<i>R</i>	0.99				
<i>R</i> ²	0.99				
Adjusted <i>R</i> ²	0.98				
Std. Error	0.14				
Observation	175.00				
<i>ANOVA statistics</i>					
	SS	df	MS	<i>F</i>	Sig
Regression	639.22	27.00	23.68	1154.28	0.00
Residual	10.05	490.00	0.02		
Total	649.27	517.00			

Table 3.
Stepwise regression
results of CSR and
SME financial
performance

seen further evidently in Table 3, where it can be perceived as they are family businesses, they have some understanding of CSR, especially when they have a CSR report. Though, for nonfamily companies, whether there is a CSR report is a determinant that is worth paying attention to in terms of CSR.

This table shows the sustainable practices that energy industries of Egypt have implemented. The results show that the most important sustainable environmental practice is for energy industries of Egypt to reduce their residual substances ($\beta = 0.136$, $t = 5.054$, $p < 0.001$), which is comparable to the results obtained previously. Many small and medium-sized enterprises reduce residual materials through recycling activities and believe that this approach is a simple and understandable synonym for cost reduction. Companies seeking to minimize the costs associated with implementing sustainable practices and companies seeking opportunities use recycling and owner-managers, who fully incorporate SD into their organizations to implement a zero-waste policy. The impact of the reduction on the release of water ($\beta = 0.460$, $t = 17.069$, $p < 0.001$) and air ($\beta = 0.181$, $t = 5.273$, $p < 0.001$) was significantly higher than the release obtained by these methods. These results are encouraging, small and medium enterprises have implemented this practice. The reduced consumption of raw materials, water and energy resources was also evaluated ($\beta = -0.007$, $t = -0.171$, $p > 0.001$). The results of consumption reduction practices are consistent with those obtained (Ge and Liu, 2015). Generally, owner-managers who understand the

company's energy consumption are more likely to monitor energy consumption and take steps to minimize it.

Inadequate monetary resources ($\beta = 0.233, t = 4.691, p < 0.001$) is a major concern of energy industries of Egypt. The scarcity of resources is regularly mentioned and is found in the studies. Our results confirm the inevitability of this issue for energy industries of Egypt. Energy industries of Egypt also find it difficult to fully understand the meaning and expectations of SD as the clarity of SD guidelines is presented as the second barrier to sustainable practices ($\beta = 0.049, t = -1.400, p > 0.001$). These results are similar to those obtained by [Chen et al. \(2018\)](#) and demonstrate that energy industries of Egypt remain vague in explaining their representation of CSR. The language that is used when it comes to CSR may be inaccessible and even alienating for energy industries of Egypt and may be more complicated for SME owners than it. Difficulties in understanding SD are followed by lack of time ($\beta = -0.241, t = -5.296, p < 0.001$), which is another factor that is common in the literature. It is clear that the limited resources of energy industries of Egypt influence their implementation of sustainable practices, and they do not all have the same levels of time and energy.

Regarding the nature of the family, compared with nonfamily businesses (6.07), family businesses (6.68) have formulated additional strategies associated to employee exercise, with a significant rate of 5% ($0.015 < 0.05$). Besides, if we detail the average values shown in [Table 4](#), it is worth mentioning that family businesses pay extra attention to employee training, whether it is a micro-business (6.74), a small business (6.53) or a medium-sized business (6.78) because all the results are identical. Nevertheless, of this, for nonfamily companies, micro-enterprises (6.23) have a greater propensity to train employees. This may be because, in micro-enterprises, fewer employees must perform many different tasks. Therefore, these companies pay more attention to employee training due to the need to have versatile employees in different areas of the company.

Also, in the presence of 5% ($0.049 < 0.05$), the collaboration between the department, the size of the company and the CSR report, the difference is significant. In this case, researchers pointed to point out that medium-sized tertiary industry companies with CSR reports (7.51) are much anxious about employee training. From other side, considering the CSR dependent variables ([Table 5](#)), another analysis of variance was carried out, in which the family variable (family and nonfamily business), level of education (university and nonuniversity) and family variables have independent variables. Gender (man vs woman).

The results show that the significant levels are 1% ($0.008 < 0.01$) and 5% ($0.043 < 0.05$), indicating that family businesses are supplementary informally responsible (6.25) than nonfamily businesses (5.88). This is also affected by the educational level because managers with a college degree (6.24) are more inclined to CSR than colleagues without a college degree (5.96). On the contrary, facts about men or women have no impact on CSR. However, when using dependent employee training variables for analysis, no significant differences were found. While [Table 4](#) shows the hypothesis development.

Relationship	Hypothesis	Mean	Standard Deviation	Path coefficient	T	p
TCSR and SP	H1	0.447	0.041	0.368	4.621	0.004**
SCSR and SP	H2	0.528	0.069	0.420	4.818	0.001***
FF and SP	H3	0.347	0.114	0.239	2.622	0.272
ECSR and SP	H4	0.479	0.061	0.370	4.102	0.006**
FF and SP	H5	0.378	0.119	0.272	2.562	0.242

Note(s): *** $p < 0.001$; ** $p < 0.01$; TCSR = Technological CSR, SCSR = Social-CSR; FF = Financial-CSR performance; ECSR = Environmental-CSR

Table 4. SEM and hypothesis testing results

Table 5 indicates the practice of structural state demonstration. The SEM is applied to determine the auxiliary connection among the dormant development and measure factors because the finish of this examination that conjectures the choice of EMS organizations in their IMS has more important CSR implementation than EMS nonadopters. As the two interaction terms are input into the model at the same time, the interaction between CSR and proximity is not important except for one of them. In contrast, the interaction between saliency and CSR remains significant. Particularly, the salience of stakeholders has a significant interaction with employees' respective CSR actions customers ($b = 0.341, p < 0.05$); ($b = 0.388, p < 0.05$); environment ($b = 0.392, p < 0.05$) and supplier ($b = 0.316, p < 0.05$), proximity has a significant interaction with the community ($b = 0.338, p < 0.05$). In any case, the two interactions will not happen at the same time.

According to the survey results, the small and medium-sized enterprises that are usually deeply rooted in the community and have close relationships with the local area, immediacy may be an extra important indicator of how their CSR affects community behavior and its environmental performance. Any of the study's instances include a CSR/sustainability article that has been released (corresponding to 50.36% of all cases). Most of the CSR reporting cases (71.06%) follow the green finance formatting standards while preparing CSR reports, and 67 cases had their CSR reports independently checked (corresponding to 42.92%).

The addition of the organizational variables to the control variables marks the first explanation of the phenomenon by which energy industries of Egypt implement sustainable practices since the adjusted R^2 becomes positive (adjusted $R^2 = 0.071, p < 0.001$). The significant variation in the F statistic shows that the addition of organizational variables contributes significantly to the explanation of the variance in the implementation of sustainable practices by energy industries of Egypt. Considering organizational variables, only marginally improves our understanding of the phenomenon of sustainable practices, as the adjusted R^2 rises to 0.112 ($p < 0.001$). The nonsignificant variation of the F statistic between the second and third models shows that the predictive power of the model does not improve with the addition of the block of organizational variables. In the fourth model, all of the variables indicate a strong linear correlation between the values of the independent variables and those estimated by the model, with a correlation coefficient of $R = 0.601$ ($p < 0.001$).

4.2 Robustness analysis

The introduction of individual variables significantly increases the adjusted R^2 to 0.361 ($p < 0.001$) see (Table 6). Since the variation of the F statistic between the third and the fourth model is highly significant, our hierarchical regressions reveal the extent of the contribution of the interpersonal behavior theory to the explanation of the variance of the sustainable practices by energy industries of Egypt. They are also more motivated to implement such

Variables	F1	F2
Sustainable technological practices	0.76	0.64
Sustainable economic practices	0.85	0.69
Sustainable social practices	0.81	0.78
Sustainable environmental practices	0.86	0.69
Sustainable performance	0.87	0.78
χ^2	298.70	101.70
Cronbach alpha value	0.74	0.72
Eigenvalues	3.71	1.61
Level of significance (p -value)	0.00	0.00

Table 5.
The results of
exploratory factor
analysis

practices when they perceive the benefits of implementing these practices. However, it is also possible that environmental practices are the most resource-intensive and that owner-managers who feel that their companies need to prioritize the implementation of sustainable practices do not have the required capital to move forward with setting up these practices in the business.

The results demonstrate that financial performance is a necessary condition for the ability of energy industries of Egypt to move forward with the implementation of sustainable environmental practices. The average free float percentage is 73.83%, with a standard deviation of 27.69%. In addition, the natural logarithm of the total assets fluctuates between 14.15 and 26.74, and the leverage has a mean value of 52.93%.

Table 6 presents the results of the hierarchical regression in which all of the interaction variables are simultaneously entered in the model according to the step-by-step method. The data satisfactorily fit the model with a coefficient of determination $R = 0.755$ ($p < 0.001$). The inclusion of the interaction variables explains a significantly larger part of the execution of CSR practices as the adjusted R^2 increases to 0.485 ($p < 0.001$). The F statistic is significant for the

Variables	Sustainable practices	Economic practices	Social practices	Environmental practices
<i>Control variable</i>				
Size	1.757	-0.232	0.787	1.19
Age	0.032	-0.028	0.021	0.0321
<i>Technology innovation</i>				
Product innovation	7.784***	0.196	4.818**	3.880**
Process innovation	2.313	0.502	1.718*	0.103
Market innovation	0	0.001	0.012	-0.001
<i>Organization values</i>				
Strategy	-1.251	-0.456	-0.032	-0.792
Decision-making	5.453**	-2.559**	3.567**	3.410**
Innovativeness	0.014	0.112*	0.154*	0.021
Performance	0.088**	-0.005	0.024	0.061**
<i>Entrepreneur attributes</i>				
Facilitator	-0.533	0.419	0.524	-0.385
Habit/attitudes	-0.077	-0.019	-0.021	0.016
Affection	4.498**	1.414**	2.227**	1.728*
Norms	1.141	0.317	-1.477**	0.653**
Roles	1.710**	0.495*	1.027**	1.066**
Image	0.886	0.192	0.064	-1.206**
Consequence	0.413	-0.179	0.588	0.021
Affection × Strategy	-10.126**	-0.833	-5.757**	-3.305**
Norms × Decision-making	8.629**	2.487	3.759**	3.323**
Image × Innovation	9.345***	1.479	7.213***	4.833***
Consequence × Performance	-11.213***	-1.439	-6.436***	-2.237*
Consequence × Decision-making	-11.780***	0.787	-6.440**	-8.907***
Intercept	63.023***	12.753***	31.547***	7.343*
R	0.766	0.511	0.682	0.815
R^2	0.61	0.261	0.465	0.614
Adjusted R^2	0.485	0.123	0.355	0.523
F	6.369***	1.687**	4.219**	6.043**

Note(s): *** $p < 0.001$, ** $p < 0.05$, * $p < 0.01$

Table 6. Estimating outputs of control variable

economic dimension. It is highly significant for the implementation of sustainable practices, including social and environmental practices, which confirms the explanatory power of the combined effect of interactions on the application of CSR practices by energy industries of Egypt.

For these findings, the results can be reported to be: a 1% improvement in success on CSR skills and a 1.24% change in the chances of disclosing certain skills (i.e. the probability of publishing a CSR report versus the probability of not publishing it). In addition, an increase in CSR performance adds 0.08 and 0.10 in the odds ratio, respectively, while assurance of an external CSR contributes to that of a 0.1% increase in the odds ratio. Finally, a one-unit improvement in GRI system acceptance results in an 11.11 unit change in CSR report assurance odds ratio. As a consequence of these odds ratio estimates, it is clear that better CSR success leads to a significant increase in the likelihood of CSR filing, GRI system acceptance and external assurance. They also demonstrate the significant impact of GRI system acceptance on external CSR report authentication. As a consequence, H1a, H2, H3 and H4 are all agreed theories, whereas H1b is dismissed. As a result, according to signaling theory, companies with better CSR results are more likely to post a CSR study (H1a). Furthermore, CSR reporters with better CSR results are more prone to use the GRI system (H2) and have their CSR stories independently checked (H3). Furthermore, GRI system adopters are more inclined than nonadopters to certify their CSR files externally.

4.3 Discussion on findings

The results of the study did not cover other potential impacts that may promote corporate social responsibility actions and financial performance. To eliminate the problems that may generate potential bias estimates and may lead to endogeneity, least squares regression analysis is applied, and the Hausman test is used. Also, we used an instrumental approach to discover whether our outcomes are prejudiced due to endogeneity. Raw data (i.e. financial performance beyond the indirect impact of corporate social responsibility can isolate problematic differences. Variables previously used, for example, executive compensation, ownership intensity, transparency or company visibility, not applicable to small and medium-sized companies. The company and other variables (such as company size, company age, etc.) do not meet the above conditions. Recently, we checked the financial performance of CSR; similarly, we found that the importance of participating in CSR rewards for the benefit of energy industries managers and companies is highly related to their corporate social responsibility activities but does not affect their financial performance.

This is similar to our overall research on the relationship between CSR and financial performance because five independent instrumental variables for each dimension of corporate social responsibility cannot be obtained. We use Sargan's statistics to test whether our tools are exogenous. It turns out ($p = 1$) that we cannot reject the null hypothesis that the tool is exogenous. In the first stage, we use instrumental variables (interest in participating in CSR rewards) as an independent variable to regress CSR. The results show that our instrumental variables have an optimistic and momentous impact on CSR ($p < 0.05$), thereby increasing our confidence in using existing tools. In the second stage, we use "interest in CSR rewards" to return the economic performance residuals attained from the first stage. The results showed no substantial impact on economic performance, indicating that we have no endogenous problems, and our ordinary least squares (OLS) regression is very reliable. Services are tapping a top on the part of exchange in services to control national economies must be a main component of countries' methodologies for recuperation from COVID-19.

Our results show that during the economic downturn, stakeholders' significant positive influences have affected the relationship between financial performance and CSR. Therefore, small and medium-sized enterprises interested in improving financial performance through CSR approaches should emphasize their activities on the stakeholders. The small and medium-

size enterprises should work hard to find ways to choose the ones that are most important to them easily. As a theoretical base, the practice of stakeholder theory is useful for studying whether small and medium-sized enterprises benefit equally from similar CSR actions. Scholars believe that CSR is implemented by the pressure and requirements of different stakeholders. However, it is difficult for a company to meet the needs of all stakeholders.

Green finance and environmental performance are extensively explored in the literature. We will achieve low carbon emissions and conserve natural resources by embracing a green economy (Nawaz *et al.*, 2021). Environmental protection and job creation, according to some reports, will aid green growth in ensuring economic prosperity. Aliyu *et al.* (2018) used the energy input-output measure to investigate the future course of Canada's green economy in the face of multiple events. Building on this research gap as well as, in the wake of ongoing discussion regarding the positive impacts of energy companies of Egypt mega companies on causing CO₂ emissions and its contribution to further harm the environmental situation of region, the present study aims to contribute in the environmental performance and green finance literature by investigating its consequences. We have focused on investigating the impact of accelerated economic growth on environment with specific context of Egypt. This offers a deeper insight for the future execution of Egyptian energy industries in an eco-friendly manner. As opposed to the subjective judgments of possible disparaging impacts of economic activities emerging markets region including Egypt, we have offered rigorous findings based on empirical evidence (Abdou and Atya, 2013).

The research has two theoretical contributions. First, we employ the hypothetical standpoint of shareholder concept to search the impact of explicit CSR actions on the economic performance of energy industries of Egypt. In this process, we considered which energy industries of Egypt should prioritize shareholders during the economic crisis. Despite reaching conclusions, managers should still reach a conceptual consensus and actively address stakeholder claims. "There is almost no determination of which stakeholders' interests should be paid attention to", and there has been little progress since then. Therefore, we responded to the call for investigating the personal impact of stakeholders on the implementation of green financing techniques and CSR policies by energy industries of Egypt to work for corporate environmental performance enhancement. Through empirical testing and the further development of stakeholder saliency models, we expanded the existing stakeholder theoretical research.

Understanding the dynamics of the relationship between green financing, CSR, technological innovation and green environmental performance are predominantly significant for managers, who are looking for understanding of how corporate opportunities can generate business opportunities through the value created by their CSR. Although researchers pointed out that companies not only need to consider the concept of value, but also need to consider the concept of value, but for most small and medium-sized enterprises, it is difficult to go beyond the daily business economics and institutional factors to hinder their development. Consider CSR. Moreover, although many small and medium-sized enterprises decide to fulfill their corporate social responsibilities according to strategic standards, the selections of specific actions are usually arbitrarily determined based on random reasons. This study shows that managers of energy industries of Egypt should pay more attention to specific implementation measures, especially when resources are limited. Our proposed framework shows that strong, legitimate and close stakeholder actions need to be prioritized, and strong propositions must be made.

5. Conclusion and policy implication

This article aims to bridge the gap between technological innovation and SME performance in a literature review when energy industries of Egypt implement environmental

sustainability practices. In today's increasingly competitive business environment to achieve global sustainable development, the technological innovation and sustainable management practices of energy industries of Egypt have become crucial. Under technological innovation, the research attempts to examine the connection between product, process and marketing innovation and the CSR practices of small and medium-sized enterprises. Regarding organizational factors, this research is based on the contingency theory and studies the links between strategy, decision-making style, innovation, financial performance and the implementation of sustainable practices. Finally, for environmental factors, research focuses on the regulatory environment, stakeholder collaboration and financial support.

This research tested a model that considered the unique characteristics of small and medium-sized enterprises and recognized that the operating methods of small and medium-sized enterprises have different characteristics, processes and functions from those of large-scale small and medium-sized enterprises –large enterprise. The study recognizes that due to the inherent differences between small and medium-size enterprises, CSR is a different issue compared to large enterprises. The stakeholder model is usually used to study each and every level enterprise without understanding the characteristics of energy industries of Egypt. Compared with energy industries of Egypt, the prominent position of stakeholders is particularly important for energy industries of Egypt because energy industries of Egypt have a tendency to participate more in particular communities. Generally, energy industries of Egypt have less power; they reduce the pressure on stakeholders and have higher direct and personal legitimacy to direct stakeholders. Therefore, a close relationship with energy industries of Egypt may be important, especially because the company is small and the lack of anonymous personnel in most subdivisions resources that there is nowise to hide. If a mistake is made or suspicious measures are taken, it is easy to determine who is responsible, and the responsibility can usually be traced back to the owner-manager.

The study presents following practical and theoretical implications:

- (1) Chief managers, industry professionals and lawmakers may take note of the findings of our report. Our research platform seeks to provide guidance to major industrial companies on the impact of green finance, corporate social responsibility, sustainability policy and green innovation on environmental performance execution.
- (2) Nowadays, general managers and politicians are focused on environmental efficiency; in the meanwhile, they will use the study context of environmental performance in developing markets to mitigate waste, noise, air pollutants, conserve water, electricity and nonrenewable capital, all of which contribute to improved environmental sustainability. The findings show that green financing and CSR have little clear impact on environmental efficiency in the period of COVID-19 crises, but that this relationship has begun to shift as a result of environmental policy and green innovation. As a result, general managers of major production companies cannot overlook green financing under COVID-19 pandemic when evaluating environmental efficiency as many studies have shown that green financing increases corporate environmental performance dramatically. In order to assess environmental efficiency, general managers and politicians must focus on green financing, environmental planning and green innovation.
- (3) Over time, as the Egypt continues to transition to a renewable energy resource economy, there will be a continual need to assess both the benefits and costs of increases in net generation being supplied by Wind and Solar Photovoltaics (WPV). As economically viable commercial storage technologies are relatively rare, energy

storage technology options should also continue to be explored for achieving emissions reductions targets using WPV. Furthermore, without a sustainable supply of battery storage capacity, back-up generation (e.g. natural gas) will continue to be necessary for supporting the US electrical grid and meeting power demand. For this, green financing option is very essential that Egypt must follow.

- (4) The study presents the novel connection of green financing with technological innovation and corporate environmental performance. This is prime theoretical contribution of this research. Second, our research also studied the role of CSR between technological innovation and corporate environmental performance. This is second theoretical contribution from the context of Egypt.

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