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The Link between Sustainable Innovation and Industrial Performance: The Case of the United States

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Abstract: Notwithstanding the impact of sustainable innovation on environmental management, its bearing on industrial performance remains hypothetical. Our study seeks to empirically investigate the link between sustainable innovation and industry performance in the United States by employing the generalized method of moments on a nine-year panel spanning from 2014 to 2022. The sample consists of 94 U.S industries, which covers about 7300 companies. The results show that sustainable innovation is not significantly related to industrial performance in the United States. However, it has a moderating effect on industrial output. The Arellano–Bond test, AR (2), confirms the robustness of our findings given the endogeneity assumption and model specifications, and the Hansen test confirms the validity of the instruments. This study expands our knowledge of the link between sustainable innovation and industry performance. A study of this kind is relevant in current times as the United States seeks to attain Sustainable Development Goal 9 by 2030. Further, it provides theoretical guidance on successful environmental management practices to enhance social welfare and maximize output.

Keywords: sustainable innovation; industrial performance; environmental management; social welfare

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1. Introduction

Sustainable innovation is crucial when corporate entities seek to recover fully from the ravages of a global pandemic such as COVID-19 [1,2]. It signifies the delivery of social, environmental, and economic value through innovation in industrial activities [3]. It also ensures the commercialization of innovative ideas to resolve an environmental or social issue to enhance social welfare [4,5]. The practice of innovation in a sustainable manner is geared towards safeguarding the socioeconomic environment at a time when companies are bent on increasing output consistently [6]. Previous studies have demonstrated that companies can enjoy higher profits when they increase their innovative preferences [7,8], enabling them to be socially accountable. Corporate entities tend to be more responsible in their societies when they enjoy higher financial outputs [9]. However, these high outputs come at a cost to social welfare. Carbon emission rises in this case [10], and acts as a negative externality to social welfare. Thus, in the quest for industries to obtain higher financial standing, production is continually heightened, resulting in social welfare loss [11], hence the need for sustainable innovation. The purpose of this study is to establish the link between sustainable innovation practices and the performance of United States industries (Appendix A). The context is critical, with the United States being the most developed nation in the world, thereby having a higher tendency to emit pollutants. Also, a study of this kind, with a focus on the United States, is necessary as the world seeks to achieve Sustainable Development Goal 9 (build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation) by 2030, with the United States being a very active member in the Sustainable Development Goals (SDGs) agenda.

The focus of innovation was hitherto solely centered on its ability to foster higher growth quantitatively [12]. However, its direction has now shifted to ensuring higher output with quality, i.e., being concerned about sustainable production processes and the consequences of applying technology in the management of the environment [13,14]. Sustainable innovation implies developing and implementing new ideas, services, technology, or business plans with positive environmental and socioeconomic impacts. On the other hand, industrial performance signifies the effectiveness and efficiency of industrial processes and is reflected in the level of output or productivity. The increasing production pattern and the phenomenal pace of industrialization lend credence to the need for a study focusing on sustainable innovation and how that impacts industrial productivity. This is to aid in bridging the gap between continuous production and the imperativeness of environmental management [15]. Sustainable Development Goal 9 (build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation) emphasizes the need for innovation in industrial activities towards reducing social costs and maximizing benefits. Sustainable innovation is therefore believed to be the panacea to gaining social and environmental value [16]. Research has shown that it fosters higher demand for industrial products because consumers are now drifting toward sustainable products [11]. This enables companies to increase value and enhance their competitive power [13].

There is much concern about environmental destruction and its impact on human health in the United States. Hence, forceful action is taken on climate change and environmental degradation [17]. Captured in the nation's policy decision is a concerted effort to minimize environmental pollution. Also, the Sustainable Development Goals (SDGs), meant to be achieved by 2030, offer a set of critical economic and environmental dimensions regarding environmental management and its sustainability [18]. These dimensions apply to all nations irrespective of their income levels since it is a continuum of progress that no country has fully attained, and the United States is no exception. The SDGs offer a shared framework to improve the coherence of U.S. priorities and interventions on the environment [19]. Research has indicated that the general economy offers significant opportunities when managing the environment efficiently [20]. It is worth noting that the U.S. was not on track to achieve its SDGs even before the pandemic [17]. However, there is a targeted effort to deal with this concern by applying technological innovation.

In as much as the Sustainable Development Goals are set to be achieved by 2030, there seem to be managerial challenges that impede its attainment. First, there is the issue of acceptability by the whole government body. Thus, goals must be welcomed by all branches of government to ensure effective implementation. Also, there is the problem of engagement of all sectors of society. Successful implementation of the SDGs requires a joint effort of governments, the business community, the general citizens, and society at large. Furthermore, acceptance by financial institutions is critical. The role of financial institutions in the mobilization of resources is fundamental; hence, their cooperation is needed to attain the SDGs. Finally, the issue of accountability by stakeholders is paramount to generating the necessary support for the implementation of the SDGs. All stakeholders must be held accountable for their role in attaining the SDGs.

This study is conducted on 94 United States industries, covering about 7300 companies. The generalized method of moments (GMM) is employed in the empirical analysis. The GMM is a dynamic estimator that minimizes possible endogeneity. Our research has both empirical and theoretical contributions to the existing knowledge in the literature. Theoretically, a more nuanced understanding of the link between sustainable innovation and industrial performance is provided. Also, the scholarly discourse on sustainable innovation and industrial performance is enhanced by our study [21–24]. It also provides empirical reasoning to practitioners on enhancing sustainable innovation practices to maximize social welfare.

This paper is structured as follows: The first part introduces the topic, including the subject of analysis and this study's objectives. The next section reviews the literature related to this study. The subsequent section captures the methodology and data used for this study. The next section presents this study's results and discusses the findings and implications for theory and practice. The final stage captures this study's limitations and recommendations for future research.

2. Review of the Literature

Previous works have not been definitive regarding the interplay between sustainable innovation and performance. Past related studies are examined to investigate the interplay and factors that can cause industries (Appendix A) to practice innovation with a focus on sustainability.

2.1. Sustainable Innovation and Environmental Management

Corporate entities practice environmental management with the intent of aiding in the maximization of revenue. Wyckhuys et al. [25] highlighted that innovation focusing on sustainability can foster environmental changes, which happens when economic development necessitates scientific innovation. This implies that increased growth demands careful attention to the environment since it leads to increased carbon emissions [26]. Mendoza et al. [27] concluded that sustainable innovation ensures an improved renewable energy sector and can significantly augment socioeconomic benefits, promote resource security, and enhance environmental performance. This is consistent with the findings of Wu et al. [28], where it is noted that the practice of sustainable innovation reduces the emission of carbon significantly.

Environmental management policies are mostly formulated when the cost to social welfare is very material. These policies aim to mitigate the impact of increased production and industrialization on the environment. Wu et al. [28] found suggestive evidence that enterprises in China strategize to mitigate pollution, while those in the United States are much more concerned about the impact of negative externalities on human health, even though they both exhibit less concern for environmental protection during the early stages of project implementation. Innovation in ensuring environmental sustainability is useful for tracking climate change conditions [20]. Innovation, when practiced sustainably, contributes significantly towards having a safe environment. This position is reinforced by Jiang et al. [29], where it is established that highly intensive innovative practices diminish the impact of carbon emissions on society.

Sustainable environmental management ensures alternative ways of production and industrialization that minimize the risks to social welfare. A study by [30] showed that innovation sustainability in production ensures viable alternative energy sources with less environmental impact. The practice of sustainable innovation has a spillover effect when industries exert mass effort to ensure a sustainable environment [31]. This spillover would significantly impact social welfare when accepted by several large companies. This argument is supported by previous study findings [32], where it was ascertained that sustainable innovation enhances companies' attempts to protect the environment. The study further demonstrates the influence of sustainable innovation on societal life expectancy, indicating that ensuring a sustainable environment would significantly impact social lives.

Being environmentally responsible has become crucial due to rapid industrialization in the global economy and the ravaging effects of the global pandemic, which has caused companies to raise output astronomically. Protection and preservation of the environment are now imperative for maximizing social welfare [33]. Environmental responsibility is now a general concern for both individuals and industries. It is the sense of responsibility that is geared towards intentional management of the environment. Research has shown that environmental consciousness significantly impacts environmental management by reducing disruptive innovation [23]. However, its practice becomes more complex when the benefits derived by industries from degrading the environment are substantial [34].

2.2. Sustainable Innovation and Industrial Performance

Innovation is indisputably a significant phenomenon in implementing new ideas or policies. It can add value to existing products or policies to meet market and societal demands [13]. Its concept can be viewed from many perspectives but is geared towards ensuring product or service delivery quality. Innovation can focus on products [35,36], adding value to an existing one. It can be directed toward marketing [37], focusing on product design and packaging. It can also be viewed from the angle of sustainability, which may be categorized into eco [38,39], green [40], or environmental [41]. Sustainable innovation ensures product and production quality and minimizes potential negative environmental impact [31].

Extant knowledge is divided on the link between sustainable innovation and industrial performance. The few past studies state varied positions. For instance, whereas Ref. [11] posited that sustainable innovation enhances industrial productivity through increased patronage of produced products, Refs. [21,22] argued that it increases operational costs, thereby outweighing the benefits. Pekovic and Bouziri [42] found consistent evidence for the later findings. It is worth noting that other researchers have also drawn varied conclusions in their attempt to establish the existing link. Rahman [40] concluded that sustainable innovation has an impact on industrial financial constraints, which affects both current and future performance. On the other hand, Rammer et al. [12] demonstrated that innovation with sustainability improves industrial productivity, and that it outweighs the long-term costs. This is consistent with previous studies [43,44]. After assessing the interplay between green innovation and industrial output, Sun et al. [45] found that eco-innovation plays a significant role in the performance of industries. These varied positions suggest that there is more to be understood about how industrial sustainable innovation practices interact with performance. The inconclusiveness of previous findings serves as motivation for this current study. Thus, this paper aims to ascertain the existing link between sustainable innovation and performance from the perspective of United States industries.

Sustainable innovation is implemented to ensure environmental management while maximizing industrial performance [46]. Research has long established that innovation has what it takes to cause changes in the operations of a business entity [47], and these changes are expected to be reflected in its financials. Zhang et al. [26] posit that industries can sustain their performance if they ensure sustainability in innovation. In as much as companies are interested in protecting the environment by reducing pollution [1,41], they do so to increase industrial benefits [8]. They can invest greater resources into ensuring environmental sustainability if they earn higher revenue [16,48]. This implies that the real motivation for industries seeking to ensure environmental value is to enhance production capacity [49].

Also, sustainable innovation can ensure environmental management through the reduction in the emission of carbon [50,51]. However, the cost of practicing sustainable innovation is sometimes burdensome for firms [21] and can result in lower financial output. A study by [52] showed that sustainable innovation is influenced by resource availability and enterprise capabilities. This is consistent with previous studies [53,54], where it is concluded that entities with many resource capabilities tend to prefer innovation more to ensure environmental sustainability. Zhang et al. [55] argued that large firms tend to be exploitative in their quest to improve productivity. This supports earlier findings [56], where it is suggested that higher organizational profits usually interfere with social welfare.

A critical examination of the past literature shows a gap in knowledge regarding the link between sustainable innovation and industrial performance in the United States. This study, therefore, adopts both explanatory and empirical approaches to analyze this nexus. To bridge the identified gap in the literature, this study responds to the following research questions: what is the link between sustainable innovation and industrial performance? What factors motivate industries to develop an interest in sustainable innovation [43,57]? To respond to these research concerns empirically, an analysis of the innovation and performance relationship is performed on industries in the United States. In our study, we argue that there is no direct link between the performance of U.S. industries and sustainable innovation practices in the country. Thus, U.S. industries experience higher performances at the expense of the environment. We further postulate that those who enjoy consistently higher financial performances would have greater concerns for environmental management and its sustainability. Thus, industries that continuously acquire higher growth rates in earnings can show higher preferences for environmental management and tend to be socially responsible. A study that seeks to analyze the interplay between sustainable innovation and industrial performance with a focus on United States industries is quite distinct and has not been attempted to the best of our knowledge.

3. Materials and Methods

This research aims to analyze the interplay between sustainable innovation and industrial performance from the perspective of United States industries. Industrial returns on invested capital and equity returns are used to measure performance. Also, research and development inputs, specifically technological investments, are used to measure sustainable innovation. The U.S. has the opportunity to create the conditions for a robust economy while growing in the context of sustainability. Sustainable innovation is best recognized as part of the SDGs, specifically SDG 9. The practice of innovation with sustainability is a major component of the United States' sustainability strategy. This is where innovative ideas from employees and the private sector are harnessed and directed to solving industrial problems concerning environmental management. For instance, the development of a global smart metering network for utilities, the implementation of the air-quality program, and telematics (a program focusing on vehicles). These are all geared toward enhancing operational efficiency while maximizing social welfare [58].

3.1. Data and Sample

This study employs an empirical approach to examine the nexus between sustainable innovation and performance. Secondary data are used for the analysis, and the generalized method of moments is employed as an econometric technique. Data for the analysis consist of 94 United States industries, comprising about 7300 U.S. companies. The data are constructed into a nine-year, strongly balanced panel from 2014 to 2022 for the empirical analysis. The study sample fairly represents all the industrial sectors in the United States, with a judgmental sampling technique adopted [9]. This technique allows the researcher to determine the sample used for the study based on the study's objective. Data for this study are obtained from [59], drawn from Bloomberg, Morningstar, Capital I.Q., and Compustat. This database contains the most current data on U.S. industries as of 5 January 2023. These data are used to construct the panel for the analysis (Table 1).

Table 1. Studied variables and measurements.

Variable	Symbol/Proxy	Measurement
Return on Invested Capital	ROIC	Is estimated by dividing the after-tax operating income by the book value of invested capital. Thus, ROIC = EBIT (1 − t)/(BV of Debt + BV of Equity-Cash) [55].
Enterprise Profitability	ROE	This is a measure of profitability. Estimated by dividing the net income by the book value of equity [1].
Operating Margin	OPM	Is estimated by dividing operating income by total revenues [60].
Earnings Growth Rate	EGR	Is estimated by (EPS (today)/EPS(5 years ago))^(1/5) − 1.
Sustainable Innovation	SUSIN	Research expense of firms [26,61,62]. Transformed using logarithm.

Table 1. *Cont.*

Variable	Symbol/Proxy	Measurement
Enterprise Value	Value	(Market value of debt + market value of equity)/Invested Capital.
Enterprise Risk	Leverage (lev)	Is estimated by the ratio of total debt to equity [63].
Effective Tax Rate	Tax	Is Estimated by taxes paid by the company's taxable income as reported to stakeholders.
Capital Expenditure	CAPEX	Is estimated by capital expenditure/sales [64]. Log transformed.
Insider holdings	Insider	Is estimated by the number of shares held by insiders such as directors.
Institutional holding	InstHold	Number of company shares held by Funds as a percentage of total stock outstanding.

Source: Authors (2023).

3.1.1. Main Variables

Dependent Variables:

Return on Invested Capital:

This determines the profit an industry earns from the capital it receives from its shareholders. A higher return on capital invested signifies a good-performing industry. It captures all sources of funds received in the operation of a business and ensures operational efficiency [55]. This is, therefore, used as a measure of industrial productivity.

Return on Equity. The return on equity of U.S. industries is also used as an indicator for measuring financial output [9]. This is an acceptable measure of firm profitability and financial performance [1].

Independent Variable:

Sustainable Innovation. This study empirically examines how the practice of sustainable innovation in U.S. industries enhances financial performance. The measurement of sustainable innovation helps identify the expected environmental and social benefits derived from the operations of industries and their ability to gain competitive power through sustainable innovation practices. Its measure traditionally has four approaches [65], i.e., (i) input measures, such as the use of industrial R&D expense; (ii) intermediate output measures, such as the number of patents and scientific publications; (iii) direct output measures, such as the number of innovations and sales of new products; and (iv) indirect impact measures, such as observed changes in efficiency and level of productivity. Innovation-capability-oriented measures focusing on input are employed as a proxy for measuring sustainable innovation [29,66]. Specifically, corporate R&D investment expense is employed as a measure of innovation input [67,68]. This is because R&D expense captures the direct amount of resources industries have toward research and development, reflecting technological innovativeness. Industries that allocate many resources to research, specifically in areas such as renewable technologies and clean energy, are more likely to practice sustainable innovation in their operations. It is opined that innovation performance has two basic dimensions: efficiency and efficacy. Innovation efficacy is the degree of success of an innovative idea, while efficiency is the effort applied to achieving that success. Therefore, innovation efficiency focuses on input performance, while efficacy measures are related to innovation output. Our research focuses on ascertaining the technological commitment of U.S. industries toward ensuring environmental management through the practice of innovation with sustainability and its influence on industrial productivity.

3.1.2. Controls

Other variables that may have the ability to foster industrial productivity are captured in our model. These are as follows:

Operating margin (OPM). Industries with higher operating margins tend to invest in sustainable innovation and can attract higher output. OPM describes an industry's operational efficiency. Therefore, it is captured in the model as an explanatory variable.

Earnings growth rate (EGR). The growth rate in industrial earnings determines the ability to receive funding for future investments. Higher rates signify better performance. We include this variable in our model as the control variable.

Industrial value (Value). Industries with a higher value are more likely to develop a preference for sustainable innovation and can attract increased productivity. Therefore, this variable is included in our model.

Leverage (lev). Industries with lower debt profiles are generally considered to have lesser risks, enabling them to attract higher investments that would significantly impact productivity. Leverage is included in our model as a control variable.

Effective tax rate (Tax). High taxes are disincentives to industrial productivity. Companies that have higher tax burdens tend to experience lower output. Therefore, this can be a policy tool to reduce negative externalities and ensure improved social welfare. It is included in our model as an explanatory variable.

Capital expenditure (CAPEX). High capital expenditure is expected to be reflected in industrial output. Industries with high environmental management tolerance are more likely to dedicate higher funds toward sustainability. We capture this variable as explanatory in our model.

Insider holdings (Insider). Holdings by insiders such as directors and managers would have an impact on industrial investment decisions. These decisions would affect performance in the long run. It is, therefore, included in our model as a control variable.

Institutional holdings (Institutional). The holding status of industrial assets by institutions such as mutual funds and banks has a bearing on industry performance since many investors pay attention to where larger investors invest their funds. This is added as a control variable in the model.

3.2. Empirical Strategy

Following [15], we employ a two-step generalized method of moments (GMM) to investigate the link between sustainable innovation and the performance of industries in the United States. This approach is employed because the GMM is a dynamic estimator that reduces possible endogeneity and the absence of relevant variables in the model [69]. We adopt the WC-robust estimator to reduce possible downward bias [70]. Sustainable innovation is regressed on measures of industrial output (measured by two proxies: return on invested capital, ROIC, and return on equity, ROE) to ascertain the link between these two variables. The regression model is estimated as follows:

$$y_{it} = \mathrm{a}y_{it-1} + \sigma X_{it} + \beta Z_{it} + \pi Industry_s + \chi year_t + \lambda Region_t + \varepsilon_{it} \quad (1)$$

where y_{it-1} is the lag of the dependent variables (ROIC and ROE); X_{it} is the independent variable (sustainable innovation); Z_{it} represents the control variables in the model. Also, $Industry_s$, $Region_t$, and $year_t$ denote industry-specific, location-specific, and time-specific dummies, respectively. There is 'i' indexed and time 't' industries. σ, β, π, χ, and λ are known as parameters, and ε_{it} represents the random error term.

As part of further analysis, two diagnostic tests are performed to assess the validity of the specified model [10,26]. Specifically, the Arellano–Bond AR (2) test is employed to evaluate the validity of the strong endogeneity assumption, and the Hansen test is performed to examine the validity of the instruments.

4. Results and Discussion

4.1. Summary Statistics

Table 2 presents the summary statistics of the study variables. The statistics report a mean value of 0.154 for returns made on capital investments, indicating that U.S. industries receive about 15% return on invested capital on average. It also shows a mean value of

0.141 for industrial return on equity and a standard deviation of 0.162. This signifies about a 14% average return on equity to industries, suggesting good profitability. The statistics also report a mean value of 5.421 for sustainable innovation, with about 3.482 dispersion from its mean. It is observed that the sample companies have reasonable operating margins and earnings growth rates, 11.4% and 11%, respectively. It further shows a good value-generating ability for the companies, a moderate insider holding (about 13.5%), a reasonable tax burden on industrial income (10%), a good leverage ability on industrial finances, a good preference for capital spending, and a reasonable amount of institutional holdings.

Table 2. Summary statistics of the studied variables.

Variable	Mean	SD	Min	25th %	50th %	75th %	Max
ROIC	0.154	0.123	−0.052	0.074	0.138	0.201	0.644
ROE	0.141	0.162	−0.335	0.067	0.129	0.201	0.741
SUSIN	5.421	3.482	−0.467	2.521	6.239	8.094	11.240
OPM	0.114	0.082	−0.086	0.064	0.103	0.163	0.366
EGR	0.110	0.138	−0.273	0.040	0.104	0.172	0.568
Value	5.410	33.654	0.752	1.847	3.031	4.572	29.943
Insider	0.135	0.066	0.003	0.093	0.130	0.178	0.303
Leverage	4.109	1.833	1.249	2.843	3.760	4.952	9.779
Tax	0.102	0.064	0.005	0.054	0.094	0.143	0.270
CAPEX	8.309	1.550	3.135	7.470	8.525	9.280	11.382
InstHold	0.519	0.146	0.189	0.410	0.521	0.628	0.817

Source: Stata output (2023).

4.2. Correlation Analysis

Table 3 reports the correlation between the variables. The correlation analysis establishes a significant relationship between the industrial return on invested capital and the return on equity. The results further indicate that the operating margin significantly correlates with the return on invested capital and equity. It also shows a significant bearing between operating margin and sustainable innovation. It is also observed that the earnings growth rate significantly correlates with output. We also find that enterprise value and capital spending significantly correlate with capital returns and returns on equity. The analysis further shows that the income tax rate paid by industries in the U.S. significantly correlates with their equity returns.

Table 3. Correlation Matrix of the studied variables.

Variables	ROIC	ROE	SUSIN	OPM	Earnings	Value	Insider	Lev	Tax	CAPEX	Institution
ROIC	1.000										
ROE	0.387	1.000									
SUSIN	0.242	0.015	1.000								
OPM	0.449	0.282	0.083	1.000							
EGR	0.113	0.272	−0.006	0.175	1.000						
Value	0.328	0.194	0.032	0.142	−0.006	1.000					
Insider	0.133	−0.057	0.149	−0.045	−0.033	0.057	1.000				
Lev	0.185	−0.137	0.169	0.123	−0.102	0.016	0.457	1.000			
Tax	−0.048	0.188	−0.295	−0.177	0.060	0.008	−0.262	−0.494	1.000		
CAPEX	−0.059	0.096	0.371	0.051	0.045	−0.012	−0.183	−0.097	0.012	1.000	
InstHold	−0.059	0.211	−0.213	−0.106	0.123	−0.024	−0.573	−0.584	0.531	0.024	1.000

4.3. Regression Analysis

This study employs the generalized method of moments (GMM) technique as an econometric technique to empirically examine the link between performance and the desire for sustainable innovation practices. This technique is employed due to its robustness. Table 4 reports the estimation results for the impact of sustainable innovation on enterprise output. Model 1 captures the interaction on invested capital returns, i.e., assessing the impact of sustainable innovation on industrial capital investment returns. Model 2 also considers the return on industrial equity as a performance measure.

Table 4. Regression results of sustainable innovation on industrial performance.

Variable	Dependent Variables	
	Return on Invested Capital	**Return on Equity**
$ROIC_{t-1}$	0.397 *** (0.080)	
ROE_{t-1}		0.247 (0.200)
SUSIN	0.057 (0.066)	−0.065 (0.067)
OPM	0.552 *** (0.099)	0.291 ** (0.123)
Tax	−0.183 *** (0.057)	0.097 (0.103)
EGR	0.046 *** (0.016)	0.140 *** (0.032)
Insider	0.097 * (0.056)	0.159 (0.105)
Value	0.236 *** (0.065)	0.225 ** (0.104)
Leverage	0.121 (0.102)	0.086 (0.191)
CAPEX	−0.748 *** (0.246)	−0.144 (0.320)
InstHold	0.151 (0.194)	0.228 (0.254)
AR (1) *p*-value	0.000	0.070
AR (2) *p*-value	0.207	0.443
Hansen J test	5.61	6.38
p-value	0.346	0.271
Instruments	16	16
No. of groups	80	77

Significance levels: *** $p < 0.01$; ** $p < 0.05$; and * $p < 0.10$; standard errors are presented in parentheses.

The results from Model 1 (β = 0.057; $p > 0.1$) show inadequate evidence regarding the link between sustainable innovation and industrial performance in the United States. Thus, a statistically insignificant link exists between sustainable innovation and the performance of U.S. industries, suggesting that higher industrial performances in the U.S. could not be attributed to the practice of sustainable innovation. This is consistent with earlier findings [17,18], where it is ascertained that sustainable innovation practices are still a major concern in the United States business environment in the quest to maximize output. The early studies assert that entities enjoy higher output even without considering sustainable innovation in their operations. Findings in Model 2 (β = −0.065; $p > 0.1$) also suggest negligible evidence of a relationship between sustainable innovation and the performance of United States industries. The results cannot confirm with a reasonable level of confidence that sustainable innovation has any significant impact on the performance of industries in the United States. This supports the findings of a previous study [20].

However, the results establish a significant link between industrial output and most control variables. The results show that the operating margin has a statistically significant and positive relationship with output (β = 0.552, $p < 0.01$ and β = 0.291, $p < 0.01$ in Models 1 and 2, respectively), signifying that industrial performance rises when there is an increase in operating margin. This supports the findings of previous studies [7,9]. It is further observed in Model 1 that the income tax rate directly affects industrial productivity (β = −0.183; $p < 0.01$). This suggests that environmental regulatory bodies can use tax policies to curb environmental costs to society and maximize social welfare. Suggestive evidence on the link between earnings growth rate and industrial performance (β = 0.046, $p < 0.01$ and β = 0.140, $p < 0.01$ in Models 1 and 2, respectively) is provided by our study, suggesting an increase in performance when there are higher earnings. There is a statistically significant and direct relationship between what is earned annually and the general performance of industries. An industry's value is also significantly associated with its capital and equity returns (β = 236, $p < 0.01$ in Model 1 and β = 0.225, $p < 0.01$ in Model 2). This implies that higher-value investors would attract greater financial and capital returns. Capital expenditures are shown to have a significantly negative relationship, statistically, on invested capital and returns on equity.

We further observe that the conducted Hansen test fails to reject the validity of the instruments specified, and the AR (2) test does not reject the null position of no second-order autocorrelation in the models. Moreover, the number of instruments reported in Models 1 and 2 are less than the sampled groups analyzed, supporting the criteria of [71]. Therefore, results obtained from the empirical analysis are generally robust.

The analysis is extended to examine the moderating role of sustainable innovation on performance. This analysis is intended to examine the impact of the moderating effect of sustainable innovation on the performance of industries in the United States. The results are presented in Table 5. Model 1 captures the interactive effect of industrial return on invested capital (ROIC), while Model 2 considers the moderating role of equity return. The analysis shows a statistically significant and negative impact regarding the link between sustainable innovation and industrial output in Models 3 and 4. This suggests that those who pay much attention to environmental sustainability incur higher operational costs that negatively affect their overall performance. This finding is consistent with that ascertained by previous research [21]. The analysis demonstrates that the interaction between sustainable innovation and operating margin (SUSIN × OPM) is directly related to its returns on invested capital and equity (performance measures). This suggests that industries that enjoy higher operating margins are capable of experiencing higher productivity if they invest in sustainable innovation. This assertion is supported by findings of previous studies [50,51].

Table 5. Estimation results for moderating effect of sustainable innovation.

Variable	**Dependent Variables**	
	Return on Invested Capital	**Return on Equity**
$ROIC_{t-1}$	0.397 *** (0.080)	
ROE_{t-1}		0.247 (0.200)
SUSIN	−0.582 (0.318)	−1.147 (0.630)
SUSIN × OPM	0.552 *** (0.099)	0.291 ** (0.123)
SUSIN × Tax	−0.183 *** (0.057)	0.097 (0.103)
SUSIN × Earnings	0.046 *** (0.016)	0.140 *** (0.032)
SUSIN × Insider	0.097 * (0.056)	0.159 (0.105)
SUSIN × Value	0.236 *** (0.065)	0.225 ** (0.104)
SUSIN × Leverage	0.121 (0.102)	0.086 (0.191)
SUSIN × CAPEX	−0.748 *** (0.246)	−0.144 (0.320)
SUSIN × InstHold	0.151 (0.194)	0.228 (0.254)
AR (1) *p*-value	0.000	0.070
AR (2) *p*-value	0.207	0.443
Hansen J test	5.61	6.38
p-value	0.346	0.271
Instruments	16	16
No. of groups	80	77

Significance levels: *** $p < 0.01$; ** $p < 0.05$; and * $p < 0.10$; standard errors are presented in parentheses.

It is further ascertained that the interaction between industrial earnings and environmental management practice through the focus on sustainable innovation has a statistically significant bearing on output. Also, the analysis indicates a positive and significant coefficient for the interaction between income tax and the quest for sustainable innovation, as captured in Model 3. A notable finding is that the coefficient of the interaction between capital expenditure and sustainable innovation is significant and negative, signifying that the direction of capital spending by industries in the U.S. reduces the expected positive impact of sustainable innovation on productivity. It is also observed that the earnings made by firms positively moderate the link between sustainable innovation and output.

Moreover, the Hansen test fails to reject the validity of the instruments in all the specifications. The AR (2) test supports the null hypothesis that there is no second-order autocorrelation in the models, suggesting that residuals in the model do not correlate with each other in the two periods prior. Thus, errors at time t are not influenced by those in time t − 2. In addition, the number of sampled industries is greater than the number of instruments. This is consistent with the empirical position of Roodman [71]; hence, the results are generally robust.

5. Discussion and Conclusions

Our study examines the link between the practice of sustainable innovation in the United States and the impact on industrial performance. The context makes our study quite distinct from others, with the United States being the most developed country in the world, with a higher propensity to emit pollutants. Also, a study of this kind with a focus on the United States is necessary as far as the attainment of Sustainable Development Goal 9 is concerned. Two financial proxies are employed as indicators for determining performance, specifically, returns on invested capital and returns on equity. The generalized method of moments is employed in the empirical analysis due to its robustness. Our study underscores that the link between sustainable innovation practices and industrial output has not been properly explored. Thus, the subject of study lacks adequate literature on global challenges regarding environmental management. Our research, therefore, provides empirical evidence of this effect. This study's findings suggest that sustainable innovation has no significant bearing on the productivity of industries in the United States. This implies that sustainable innovation practices in the U.S. are currently not associated with performance, suggesting that companies in the U.S. do not necessarily need that for higher output. This confirms the earlier position of [17], where it is observed that the U.S. is still lagging in attaining SDG 9, which is geared towards ensuring environmental sustainability in production through the use of sustainable technologies. Industrial output keeps rising in the United States despite the inadequate attention to sustainable innovation practices. This may be attributed to the cost involved [8] and the highly industrialized nature of the U.S. economy, making strict adherence to environmental sustainability practices difficult.

Policymakers are encouraged to enhance education on sustainable innovation for industries to adhere to it effectively. Policies that can minimize carbon emissions, such as the introduction of pollution taxes, are also encouraged to be implemented to ensure environmental sustainability.

This study further explores the moderating role of sustainable innovation on industrial productivity. The results show that sustainable innovation is significantly related to industrial returns on invested capital and equity, as captured in the moderating analysis. This study's contribution to theory and practice is based on the above discussions.

5.1. Theoretical Implications

Extant knowledge has not critically explored the nexus between sustainable innovation and performance. Our study theoretically provides adequate knowledge of the scholarly discourse regarding sustainable innovation and industrial output [17,18], contributing to bridging the gap in the literature. This study provides a theoretical underpinning for corporate innovation activities emphasizing environmental sustainability. Theoretically, it provides information on how factors such as tax policies by regulatory bodies can minimize environmental destruction caused by corporate entities.

Our research expands the theoretical boundary of the interaction between industrial performance and environmental management through the practice of sustainable innovation. It also adds to the literature on corporate social responsibility in the context of environmental management and sustainability. It further expands the theoretical framework regarding the moderating role of sustainable innovation on industrial output, which previous studies have not examined to the best of our knowledge.

5.2. Practical Contributions

Practically, our study demonstrates how regulators could enhance environmental sustainability by introducing pollution control tax policies. Effluent tax is a disincentive to continuous emission of carbon; hence, its introduction would enhance environmental management. Our study provides useful information to companies on how to incorporate sustainable innovation in their operational activities to ensure environmental management. It further provides policymakers with enough knowledge to encourage firms to embrace sustainable innovation. Thus, firms are encouraged to reduce the emission of carbon in the practice of sustainable innovation to reduce the tax burden. Furthermore, it is observed that sustainable innovation moderates the relationship between industrial operating margin and performance. Our research provides insight into how companies in the United States perceive sustainable innovation in their business operations. This echoes the need for government to strengthen policies to ensure sustainable innovation practices.

The analysis provides a more intuitive knowledge of how industries regard sustainable innovation in the United States. This can provide insight into improving sustainable innovation practices as antecedents for environmental management. This study presents the need for regulatory bodies in the United States to pay more attention to sustainable innovation practices to enhance social welfare.

5.3. Limitations and Future Research

Our study has some identified limitations that can aid future studies. To begin with, data used for our research are fully centered on United States industries; hence, research scholars should be mindful when generalizing the results for industries in other countries since the influencing factors may not be the same. This requires similar studies in other regions or economies to generalize this study's findings to different contexts. Also, future studies are admonished to extend the range of the panel and size of the data for the analysis to capture other relevant variables that could foster industrial performance but are not covered by ours. Our study also identifies limitations to the metrics. Our study analyzes the link between sustainable innovation and industrial performance. However, limitations on data make the measurement of sustainable innovation relatively generic and do not consider the heterogeneous effect of different innovation types. Future studies are encouraged to consider other metrics in determining sustainable innovation. Notwithstanding the moderating role of sustainable innovation in the link between industrial productivity and operating outcome, other factors of external nature regarding government policy directions and shocks on macroeconomic variables may also moderate the said relationship. Studies in the future should, therefore, control factors regarding shocks in the economy and the effects of policies from the government.

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Appendix A

Industries

Advertising
Aerospace/Defense
Air Transport
Apparel
Auto and Truck
Auto Parts

Bank (Money Center)
Banks (Regional)
Beverage (Alcoholic)
Beverage (Soft)
Broadcasting
Brokerage and Investment Banking
Building Materials
Business and Consumer Services
Cable TV
Chemical (Basic)
Chemical (Diversified)
Chemical (Specialty)
Coal and Related Energy
Computer Services
Computers/Peripherals
Construction Supplies
Diversified
Drugs (Biotechnology)
Drugs (Pharmaceutical)
Education
Electrical Equipment
Electronics (Consumer and Office)
Electronics (General)
Engineering/Construction
Entertainment
Environmental and Waste Services
Farming/Agriculture
Financial Svcs. (Nonbank and Insurance)
Food Processing
Food Wholesalers
Furn/Home Furnishings
Green and Renewable Energy
Healthcare Products
Healthcare Support Services
Healthcare Information and Technology
Homebuilding
Hospitals/Healthcare Facilities
Hotel/Gaming
Household Products
Information Services
Insurance (General)
Insurance (Life)

Insurance (Prop/Cas.)
Investments and Asset Management
Machinery
Metals and Mining
Office Equipment and Services
Oil/Gas (Integrated)
Oil/Gas (Production and Exploration)
Oil/Gas Distribution
Oilfield Svcs/Equip.
Packaging and Containers
Paper/Forest Products
Power
Precious Metals
Publishing and Newspapers
R.E.I.T.
Real Estate (Development)
Real Estate (General/Diversified)
Real Estate (Operations and Services)
Recreation
Reinsurance
Restaurant/Dining
Retail (Automotive)
Retail (Building Supply)
Retail (Distributors)
Retail (General)
Retail (Grocery and Food)
Retail (Online)
Retail (Special Lines)
Rubber and Tires
Semiconductor
Semiconductor Equip
Shipbuilding and Marine
Shoe
Software (Entertainment)
Software (Internet)
Software (System and Application)
Steel
Telecom (Wireless)
Telecom. Equipment
Telecom. Services
Tobacco
Transportation

Transportation (Railroads)
Trucking
Unclassified
Utility (General)
Utility (Water)

References

1. Qu, Y.; Cheung, A. Organization capital and green innovation: Evidence from China. *Corp. Soc. Responsib. Environ. Manag.* **2023**, *30*, 3043–3062. [CrossRef]
2. Lim, Y.; Morris, D. Business optimism and the innovation-profitability nexus: Introducing the COVID-19 adaptable capacity framework. *Res. Policy* **2023**, *52*, 104623. [CrossRef]
3. UNEP. United Nations Environmental Programme Annual Report (Online), UNEP Annual Report 2022. Available online: https://www.unep.org/annualreport/2022/ (accessed on 9 January 2024).
4. Sulova, S. A conceptual framework for the technological advancement of e-commerce applications. *Businesses* **2023**, *3*, 220–230. [CrossRef]
5. Feldman, M.; Johnson, E.; Bellefleur, R.; Dowden, S.; Talukder, E. Evaluating the tail of the distribution: The economic contributions of frequently awarded government R&D recipients. *Res. Policy* **2022**, *51*, 104539.
6. Lopez-Gamero, M.; Molina-Azorin, J.; Pareira-Moliner, J.; Pertusa-Ortega, E. Agility, innovation, environmental management and competitiveness in the hotel industry. *Corp. Soc. Responsib. Environ. Manag.* **2022**, *30*, 548–562. [CrossRef]
7. Xu, X.; Isaac, A.; Hao, L.; Wang, D. Investor sentiment, innovation investment, and cash dividend. *Int. J. Econ. Financ.* **2019**, *11*, 1–13. [CrossRef]
8. Wang, C.; Qureshi, I.; Guo, F.; Zhang, Q. Corporate Social Responsibility and disruptive innovation: The moderating effects of environmental turbulence. *J. Bus. Res.* **2022**, *139*, 1435–1450. [CrossRef]
9. Saeed, M.; Mudliar, M.; Kamari, M. Corporate Social Responsibility and financial performance nexus: Empirical evidence from Ghana. *Corp. Soc. Responsib. Environ. Manag.* **2023**, *30*, 2799–2815. [CrossRef]
10. Alam, M.; Atif, M.; Chien-Chi, C.; Soytas, U. Does corporate R&D investment affect firm environmental performance? Evidence from G-6 countries. *Energy Econ.* **2019**, *78*, 401–411.
11. Lee, J.-Y.; Nayil, D.; Chen, C. Multinational enterprises, sustainability and innovation. *Sustainability* **2023**, *15*, 2524. [CrossRef]
12. Rammer, C.; Fernandez, P.; Czarnitzki, D. Artificial intelligence and industrial innovation: Evidence from German firm level-data. *Res. Policy* **2022**, *51*, 104555. [CrossRef]
13. Lopes, J.; Gomes, S.; Pacheco, R.; Monteiro, E.; Santos, C. Drivers of Sustainable Innovation Strategies for Increased Competition among Companies. *Sustainability* **2022**, *14*, 5471. [CrossRef]
14. Zapata-Cantu, L.; Gonzalez, F. Challenges for innovation and sustainable development in Latin America: The Significance of institutions and human capital. *Sustainability* **2021**, *13*, 4077. [CrossRef]
15. Zhang, P.; Li, P.; Yang, S.H.S. Inventory financing under risk-adjusted-return-on-capital criterion. *Nav. Res. Logist.* **2022**, *69*, 92–109. [CrossRef]
16. Hojnik, J.; Prokop, V.; Stejskal, J. R&D as a bridge to sustainable development? Case Czech Republic and Slovenia. *Corp. Soc. Responsib. Environ. Manag.* **2021**, *29*, 146–160.
17. Pipa, F.; Rasmussen, K.; Pendrak, K. The state of the sustainable development goals in the United States. *Int. J. Oper. Res. Manag. Soc. Sci. Educ.* **2022**, *8*, 145–149. [CrossRef]
18. Brown, K.; Pipa, F.; Rasmussen, K.; Bouchet, M. *Growing American Leadership on the Sustainable Development Goals*; Brooking: Washington, DC, USA, 2021.
19. Pipa, F.; Brown, K. *Leveraging the Biden-Harris Climate Agenda and the Sustainable Development Goals*; Brooking: Washington, DC, USA, 2021.
20. Baum, M.; Low, S.; Sovacool, K. Between the Sun and us: Expert perceptionson on the innovation, policy and deep uncertainties of space-based solar geoengineering. *Renew. Sustain. Energy Rev.* **2022**, *158*, 112179. [CrossRef]
21. Aibar-Guzman, C.; Somohano-Rodriguez, F. Do consumers value environmental innovation in products? *Adm. Sci.* **2021**, *11*, 33. [CrossRef]
22. Ogiemwonyi, O. Factors influencing generation Y green behavior on green products in Nigeria: An application of theory of planned behavior. *Environ. Sustain. Indic* **2022**, *13*, 100164.
23. Wang, S.; Ahmad, F.; Li, Y.; Abid, N.; Chandio, A.; Rehman, A. The impact of industrial subsidies and enterprise innovation on enterprise performance: Evidence from listed Chinese manufacturing companies. *Sustainability* **2022**, *14*, 4520. [CrossRef]
24. Du, S.; Bstieler, L.; Yalcinkaya, G. Sustainability-focused innovation in the business-to-business context: Antecedents and managerial implications. *J. Bus. Res.* **2022**, *138*, 117–179. [CrossRef]
25. Wyckhuys, G.; Zou, Y.; Wanger, C.; Zhou, W.; Yubak, D.; Lu, Y. Agro-ecology science relates to economic development but not global pesticide pollution. *Environ. Manag.* **2022**, *307*, 114529. [CrossRef] [PubMed]

26. Jakku, E.; Fleming, A.; Espig, M.; Fielke, S.; Finlay-Smits, S.C.; Turner, J.A. Disruption disrupted? reflecting on the relationship between responsible and digital agriculture research and development at multiple levels in Australia and Aotearoa New Zealand. *Agric. Syst.* **2023**, *204*, 103555. [CrossRef]
27. Mendoza, F.; Gallego-Schmid, A.; Valenturf, P.; Jensen, P.; Ibarra, D. Circular economy business models and technology management strategies in the wind industry: Sustainability potential, industrial challenges and opportunities. *Renew. Sustain. Energy Rev.* **2022**, *163*. [CrossRef]
28. Wu, L.; Ye, K.; Hastak, M. A comparison study on environmental policies for expressway construction projects between China and the US: A tiered analysis approach. *J. Environ. Manag.* **2022**, *1*, 305. [CrossRef] [PubMed]
29. Jiang, H.; Liu, C. Economic policy uncertainty, CEO characteristics, and firm R&D expenditure: A Bayesian analysis. *Appl. Econ.* **2020**, *52*, 3709–3731.
30. Murillo-Alvarado, P.; Russel, E. Optimization approach for bioethanol production from agro-industrial waste. *Front. Energy Res.* **2022**, *10*, 975133. [CrossRef]
31. Liu, X.; Dai, H.; Cheng, P. Drivers of integrated environmental innovation and impact on company competitiveness: Evidence from 18 Chinese firms. *Int. J. Technol. Glob.* **2011**, *5*, 255. [CrossRef]
32. Achi, A.; Adeola, O.; Achi, F.C. CSR and green process innovation as antecedents of micro, small, and medium enterprise performance: Moderating role of perceived environmental volatility. *J. Bus. Res.* **2022**, *139*, 771–781. [CrossRef]
33. Dîrt, U.C.; Prundeanu, O. Narcissism and pro-environmental behaviors: The mediating role of self-monitoring, environmental control and attitudes. *Sustainability* **2023**, *15*, 1571. [CrossRef]
34. Massaro, L.; Calvimontes, J.; Ferreira, L.; de Theije, M. Balancing economic development and environmental responsibility: Perceptions from communities of garimpeiros in the Brazillian Amazon. *Resour. Policy* **2022**, *79*, 103063. [CrossRef]
35. Shi, J.; Sadowski, B.; Li, S.; Namaler, O. Joint effects of ownership and competition on the relationship between innovation and productivity: Application of the CDM model to the Chinese manufacturing sector. *Manag. Organ. Rev.* **2020**, *16*, 769–789. [CrossRef]
36. Guo, H.; Wang, C.; Su, Z.; Wang, D. Technology push or market pull? Strategic orientation in business model design and digital start-up performance. *J. Prod. Innov. Manag.* **2020**, *37*, 352–372. [CrossRef]
37. Dwivedi, A.; Pawsey, N. Examining the drivers of marketing innovation in SMEs. *J. Bus. Res.* **2023**, *155*, 113409. [CrossRef]
38. Puertas, R.; Marti, L. Eco-innovation and determinants of GHG emissions in OECD countries. *J. Clean. Prod.* **2021**, *319*, 128739. [CrossRef]
39. Huang, Y.; Ahmad, M.; Ali, S.; Kirikkaleli, D. Does eco-innovation promote cleaner energy? Analyzing the role of energy price and human capital. *Energy* **2022**, *239*, 122268. [CrossRef]
40. Meng, L. The virtuous circle between green product innovation and performance: The role of financial constraint and corporate brand. *J. Bus. Res.* **2023**, *154*, 113296.
41. Lingyan, M.; Zhao, Z.; Malik, H.; Razzaq, A.; An, H.; Hassan, M. Asymmetric impact of fiscal decentralization and environmental innovation on carbon emissions: Evidence from highly decentralized countries. *Energy Environ.* **2022**, *33*, 752–782. [CrossRef]
42. Pekovic, S.; Bouziri, A. Overcoming obstacles to innovation: Can environmental management practices help? *Knowl. Manag. Res. Pract.* **2023**, *21*, 345–360. [CrossRef]
43. Kneipp, J.; Gomes, C.; Bichueti, R.; Frizzo, K.; Perlin, A. Sustainable innovation practices and their relationship with the performance of industrial companies. *Emerald* **2019**, *25*, 94–119. [CrossRef]
44. Boons, F.; Montalvo, C.; Quist, J.; Wanger, M. Sustainable innovation, business models and economic and economic performance: An overview. *J. CLeaner Prod.* **2013**, *45*, 1–8. [CrossRef]
45. Sun, H.; Frank, K.; Shi, Y. Green innovation and industrial ecosystem reconstruction in achieving environmental sustainability. *Environ. Econ. Manag.* **2023**, *10*, 1–4.
46. Liao, Z.; Ping, L.; Shuchun, L. A meta-analysis of environmental innovation and firm performance. *J. Environ. Plan. Manag.* **2021**, *64*, 2047–2065. [CrossRef]
47. Schumpeter, J. *Theory of Economic Development*; Harvard University Press: Cambridge, MA, USA, 1934.
48. Molina-Castillo, F.J.; Meroño-Cerdán, A.L.; Lopez-Nicolas, C.; Fernandez-Espinar, L. Innovation and Technology in hospitality sector: Outcome and performance. *Businesses* **2023**, *3*, 198–219. [CrossRef]
49. Sarfraz, M.; Ivascu, L.; Abdullah, I.; Ozkurt, I.; Tarig, J. Exploring a pathway to sustainable performance in manufacturing firms: The interplay between innovation capabilities, green process, product innovations and digital leadership. *Sustainability* **2022**, *14*, 5945. [CrossRef]
50. Vaisman, D.; Podshivalova, V.; Alola, A. Examining the interaction of sustainable innovation activity and the life cycle of small high-tech enterprises. *Bus. Strategy Environ.* **2021**, *31*, 1018–1029. [CrossRef]
51. Liguo, X.; Ahmad, M.; Khattak, I. Impact of innovation in marine energy generation, distribution or transmission related technologies on carbon dioxide emissions in the United States. *Renew. Sustain. Energy Rev.* **2022**, *159*, 112225. [CrossRef]
52. Tripathy, S. A comparative assessment of performance, cumbersion and emisions of a gasoline port and direct injection camless engine. *Environ. Prog. Sustain. Energy* **2023**, *42*, e13946. [CrossRef]
53. Aurelie, H.; Aurelie, K.; Fanny, M. The effect of sustainable product innovation on the consumer-luxury brand relationship: The role of past identity salience. *J. Bus. Res.* **2021**, *139*, 1513–1524.
54. Rybalka, M.; Mark, M.S. Innovation pattern heterogeneity and crisis resilence. *Businesses* **2023**, *3*, 323–346. [CrossRef]

55. Zhang, Z.; Zhu, H.Z.Z.; Zou, K. How does innovation matter for sustainable performance? Evidence from small and medium-sized enterprises. *J. Bus. Res.* **2022**, *153*, 251–265. [CrossRef]
56. Knott, M. Persistent heterogeneity and sustainable innovation. *Strateg. Manag. J.* **2003**, *24*, 687–705. [CrossRef]
57. Medeiros, J.; Garlet, T.; Ribeiro, J.; Cortimiglia, M. Success factors for environmentally sustainable product innovation: An updated review. *J. Clean. Prod.* **2022**, *345*, 131039. [CrossRef]
58. Castro, M.; Lechthaler, F. The contribution of bio-economic assessments to better informed land-use decision making: An overview. *Ecol. Eng.* **2022**, *174*, 106449. [CrossRef]
59. Damodaran, A. Damodaran Database. Available online: https://pages.stern.nyu.edu/~adamodar/ (accessed on 1 July 2023).
60. Magbool, S.; Zameer, M. Corporate social responsibility and financial performance: An empirical analysis of Indian banks. *Future Bus. J.* **2018**, *4*, 84–93. [CrossRef]
61. Gunarathne, N. Sustainable innovation measurement: Approaches and Challenges: Palgrave studies in sustainable business in association with future earth. *Innov. Sustain.* **2019**, *2019*, 233–251.
62. Zhu, C.; Adubofour, I.; Nkrumah, N.K.E. Innovation and Organizational Performance: A perspective among Chinese enterprises. *Front. Psychol.* **2022**, *13*, 927617. [CrossRef] [PubMed]
63. Gololo, I. Corporate social responsibility and financial performance of some selected banks in Nigeria: An empirical analysis. *Millenium Univ. J.* **2016**, *1*, 77–89.
64. Wahba, H. How do institutional shareholders manipulate corporate environmental strategy to protect their equity value? A study of the adoption of ISO 14001 by Egyptian firms. *Bus. Strategy Environ.* **2010**, *19*, 495–511. [CrossRef]
65. Arundel, A.; Kemp, R. *Measuring Eco-Innovation*; UM-MERIT Research Memorandum: Maastricht, The Netherlands, 2009.
66. Calik, E.; Bardudeen, F. A measurement scale to evaluate sustainable innovation performance in manufacturing organizations. *Procedia CIRP* **2016**, *40*, 449–454. [CrossRef]
67. Alegre, J.; Lapiedra, R.; Chiva, R. A measurement scale for product innovation performace. *Eur. J. Innov. Manag.* **2006**, *9*, 333–346. [CrossRef]
68. Piperopoulos, P.; Wu, J.; Wang, C. Outward FDI, location choices and innovation performance of emerging market enterprises. *Res. Policy* **2018**, *47*, 232–240. [CrossRef]
69. Nunes, P.; Serrasqueiro, Z.; Leitao, J. Is there a linear relationship between R&D intensity and growth? Empirical evidence of non-high-tech vs high-tech SMEs. *Res. Policy* **2012**, *41*, 36–53.
70. Windmeijer, F. A finite sample correction for the variance correction of linear efficient two-step GMM estimators. *J. Econom.* **2005**, *126*, 25–51. [CrossRef]
71. Roodman, D. How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata J.* **2009**, *9*, 86–136. [CrossRef]