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Sustainability Initiatives, Knowledge-Intensive Innovators, and Firms' Performance: An Empirical Examination

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Abstract: This paper examines the role of sustainability as a major driver of innovation, and assesses its affect on firms' performance. This study was based on companies listed in the Forbes list of 100 most innovative companies and BCG's 50 most innovative companies. The innovative sample firms had higher ESG and component scores than the matched control firms, with statistical significance. In terms of distinctiveness of governance, the innovative firms had larger boards, independent board members, higher diversity, and longer board tenure. Innovative firms had superior financial performance in comparison with the matched control firms. A logit regression model was employed to predict whether firms that adopt sustainability initiatives tend also to be innovative companies. Firms with high intensity of investment in social and governance initiatives tended to be innovative. Innovative firms had greater focus on social initiatives related to employee satisfaction, promotion of a healthy and safe workplace, and diversity. However, innovative firms tended to score lower in terms of human rights initiatives. Innovative firms provided superior governance practices for shareholders and effective usage of antitakeover defense mechanisms. Debt-intensive firms tended to be innovative.

Keywords: sustainability; innovative firms; ESG; firm performance

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1. Introduction

At a macro level, knowledge processes in the innovative economy must be propelled in the direction of sustainability in order to gain a competitive advantage. The economic growth rate in an innovation-based economy depends on the products or services that result from knowledge creation. Innovative phenomena such as the emergence of the internet in the early 1990s heralded a new wave of innovative economics. With the advent of a sustainable economy, the focus of companies should shift toward sustainable initiatives such as environmental protection. Hence, it is currently necessary for companies to invest in assets that provide sustainable development. The emergence of sustainability as a major driver of innovation has become a topic of relevant interest among academics, practitioners, and policymakers.

The emergence of sustainability as a major driver of innovation highlights a number of important issues that merit investigation, including potential avenues for sustainable innovation and sustainable product development, as well as factors underlying the differences between firms in their commitment to sustainable innovation.

Recently, there has been growing interest among researchers in the emerging topic of sustainability-oriented innovation (Wagner 2009; Klewitz and Hansen 2013). In this context, the relevant research question relates to whether value can be created through the pursuit of sustainability-oriented innovation activities. The fundamental challenges faced by modern businesses are to develop innovation strategies that respond to the expectations of different stakeholders (Ayuso et al. 2006) and to justify the economic rationale for adoption of sustainable innovative strategic initiatives (Schaltegger and Wagner 2006).

The study by Nidumolu et al. (2009), based on 30 large corporations, showed that sustainability is a critical aspect of organizational and technological innovation that yields both bottom- and top-line returns. Sustainability strategies elicit a positive effect on the implementation of environmental and social innovations, and environmental innovations have a positive effect on all measurements of firms' performance outcomes (Hermundsdottir and Aspelund 2022). Intellectual capital such as green innovation is a critical resource for knowledge-intensive businesses, and is significant in the context of the competitiveness of high-tech industries (Chao and Wei 2021). Scholars and practitioners have examined the business case for sustainability, with a focus on sustainability as a source of value creation (Atz et al. 2019; Busch and Friede 2018).

Innovation is basically centered around the concept of knowledge creation, and can be considered a special case of knowledge management. From a perspective of sustainability, innovation becomes a guiding mechanism with the aim of creating a better society. Innovation can be described as knowledge creation at the level of firms and at the macro level. In an innovative environment, phenomena of sustainability require the adaptation of human and social systems to ever-changing environments. In the context of such characteristics of sustainability, the importance of the creation of new knowledge has become increasingly significant in the modern economy. Usually, innovation is viewed as an engine for propelling economic growth. In the modern era, innovation involves a broader perspective when viewed from the angle of sustainability. In this context, innovation for firms involves adaptation in terms of environmental, social, and governance activity. The dynamic balance between innovation and sustainability can be maintained only if firms innovate to ensure sustainable environmental and social systems. Innovation is characterized by the presence of knowledge of sustainability and the creation of new knowledge.

Sustainability is a key driver of innovation (Adams et al. 2012; Nidumolu et al. 2009). It involves the "quest for sustainable ideal solutions", characterized by innovative approaches to collaboration, cooperation, and integration in developing and deploying the best possible solutions for enhancing people's wellbeing, preserving the natural environment, and ensuring social and economic stability (David 2012, chap. 2, p. 165). Sustainability involves transformation to higher levels of sophistication that allow firms to formulate strategies and policies to achieve success. Sustainable innovation focuses on the economic, social, environmental, and governance perspectives of organization activities, with the aim of achieving a competitive advantage and improving business performance. Eco-innovation involves the development of ideas, products, and processes that reduce environmental or ecological burden. Sustainable innovation involves the "integration of environmental, social, and economic elements into company systems from idea generation through to research and development and commercialization" (Charter and Clark 2007, p. 9). Sustainable innovation applies to products, services, and technologies, as well as new business models.

The triple bottom-line concept of sustainable organization leads to sustainable development by simultaneously delivering economic, social, and environmental benefits (Hart and Milstein 2003). Developing competencies that foster innovation for sustainable development lays the foundation for competitiveness. Corporate sustainability and ESG have become prerequisites for achieving superior business performance (Chang and Kuo 2008; Dyllick and Hockerts 2002; Linnenluecke and Griffiths 2013).

We propose a three-pillared model for to assess the connections between sustainability, innovation, and value creation. In this paper, we explore the relationship between sustainability initiatives of knowledge-based innovators and the performance of firms, and assess the impact of sustainability pillars on environmental social factors, governance initiatives, and firm performance in the most innovative companies.

To the best of our knowledge, no studies have examined the impact of the sustainability initiatives of the most innovative companies in comparison with matched control firms. The focus of this paper is on the sustainability of innovative firms. There is a need for a deeper approach to identify the impact of the performance of innovative companies on the different pillars of ESG.

The main objective of the present study was to verify the relationship linking innovation, sustainability initiatives, and value creation for firms. The results suggest that sustainability-oriented innovative firms have higher market valuation and superior financial performance. Sustainability initiatives by innovative firms improve economic performance. This study contributes to the literature on sustainability and innovation by extending the understanding of its impact on the financial performance of firms.

2. Literature Review

The triple bottom line of sustainability stresses the fact that the long-term success and profitability of firms depend on the three dimensions of sustainability, namely, economic, environmental, and social aspects (Bansal 2002; Dyllick and Hockerts 2002).

Pujari (2006) analyzed the link between eco-innovation and market performance. Wagner (2009) examined the relationship between sustainability-oriented innovation and sustainability performance. Research studies have examined the relationship between sustainable innovation and organizational performance (Kobayashi et al. 2011; Lopez-Valeiras et al. 2015; Sanchez-Medina et al. 2011).

One of the major determinants affecting the performance of firms is the ability to develop and implement innovations (Kauffeldt et al. 2012; Hashi and Stojčić 2013). Corporate sustainability involves multidimensional aspects including regulatory compliance, sustainability-oriented innovation, and strategic levels of sustainability activities (Amini and Bienstock 2014). Sustainability-oriented innovation practices are positively related to overall organizational performance (Matjaz et al. 2016).

The study by Ramanathan et al. (2017) examined the relationship linking environmental regulations, innovation of firms, and private benefits of sustainability, using case studies of UK and Chinese firms. The study found that firms that adopted a more dynamic approach in terms of response to environmental regulations and a proactive approach to managing environmental performance were able to reap the private benefits of sustainability. The study by Joo et al. (2018) suggested that firms' environmental and technological innovation capabilities enhanced their environmental and export performance, and that government intervention enabled firms to improve their environmental and technological innovation capabilities.

The study by Colin (2020) examined the determinants of sustainable orientation of diverse green entrants, and the impact of these on green innovation performance. The study by Ramanathan et al. (2018) analyzed the impact of the flexibility of regulations on the relationship between firms' innovation capabilities and their financial performance. The researchers applied the DEA technique to capture the flexibility of environmental regulations, and the results suggested that innovation capabilities significantly influenced the financial performance of firms in the context of flexible environmental regulations.

Green research and sustainable development have a positive relationship with financial performance and contribute to carbon reductions (Lee and Min 2015). The adoption of eco-innovative steps such as improved recycling of products led to reductions in firms' productivity (Doran and Ryan 2016). Innovation and performance are strongly influenced by the country where the firm is located (Bong Choi and Williams 2013).

There has been a radical shift in the attitudes of modern firms with respect to the idea of doing business, not only for financial gain but also to contribute to society (Tsai and Liao 2017). In the context of firms adopting ecologically proactive strategies, modern research has focused on the association between environmentally sustainable business practices and firms' performance (Golici and Smith 2013). Several studies have examined the relationship between eco-innovative practices and the performance of firms, with conflicting results (Przychodzen et al. 2018; Reyes-Santiago et al. 2019; Bitencourt et al. 2020). Global pro-environmental awareness has compelled firms to engage in eco-innovation such as green business practices and to restructure their business activities (Esty and Winston 2009; Przychodzen and Przychodzen 2013). Sustainable eco-innovative practices have been found to lead to operational and financial gains for companies (Burki et al. 2018; Huang and Li 2017). Addressing environmental concerns in the design of existing products or in the development of new eco-friendly products can boost customer demand and positively impact financial and market performance (Lee and Min 2015). Sustainability practices such as green innovation improve economic performance (Tang et al. 2018; Marra et al. 2020). Sustainability-oriented innovation practices improve both economic and noneconomic performance (Matjaz et al. 2016).

Table 1 highlights some of the important studies related to sustainable strategy and the performance of firms.

Table 1. Relevant studies on innovative sustainable strategy and firms' performance[1].

Study	Domain Focus	Implications
Lin et al. (2013)	Green product innovation	Green product innovation has a positive influence on firms' performance.
Chen et al. (2015)	Green service innovation	Results suggest that green absorptive capacity has positive effects on green dynamic capacities, green service innovation, and firms' performance.
Song et al. (2017)	Green supply chain innovation	Green supply chain innovation has a positive impact on operational and financial performance.
Rennings and Rammer (2011)	Regulatory driven environmental innovation	Innovations induced by regulations on recycling and waste management contribute to higher profit margins.
Lee and Min (2015)	Green R&D investment	Green R&D investment leads to improved financial performance of firms.

3. Data and Methodology

Details of the most innovative companies were collected from the Forbes *World's Most Innovative Companies 2019* and BCG's *50 Most Innovative Companies 2019*. BCG's list is based on BCG's 13th annual global innovation survey, and highlights the rising importance of AI and platforms that support innovation. For example, McDonald's at number 21 uses an AI algorithm to serve digital menus that continuously change in response to factors including time of day, day of the week, restaurant traffic, and weather. NTTDOCOMO developed a vertically integrated ecosystem based on partnerships and acquisitions, providing valuable services and experiences to users of feature phones. BCG's list of most innovative companies has been published annually since 2005[2] according to surveys of thousands of innovation leaders.

Forbes prepares their list according to the ranking of companies by their innovation premium, which is the difference between their market capitalization and the net present value of cash flows from existing businesses. This methodology is based on a proprietary algorithm from Credit Suisse, HOLT. To be included in the list, firms must have 6 years of published financial data and be among the world's 500 largest publicly traded companies in terms of market capitalization. Forbes includes only those companies that invest in innovation, and firms with no investment in R&D are excluded from the analysis.[3]

The ESG data for the most innovative companies were taken from the ESG Thomson Reuters database. The financial data for the companies were collected from Thomson Reuters. The ESG data cover about 4800 companies with scores awarded according to the respective pillars of environmental, social, and governance and their major components.

Table 2 gives the major components of the ESG pillars.

Table 2. Environmental, social, and governance pillars and major components.

Pillar	Major Component
Environmental (EPS)	Resource use, emissions, innovation
Governance (GPS)	Management, shareholders, CSR strategy
Social (SPS)	Workforce, human rights, community, product responsibility

Source: ESG Data | Refinitiv.

Table 3 shows the highlights of the category scores of each ESG pillar.

Table 3. Category scores.

ESG resource use score (RS)	The resource use score highlights a firm's performance and its capacity to reduce the use of materials, energy, or water and to find more eco-efficient solutions by improving supply-chain management.
ESG emissions score (ES)	The emission reduction score reflects a firm's commitment to and effectiveness in reducing environmental emissions in its production and operational processes.
ESG innovation score (IS)	The innovation score reflects a company's capacity to reduce environmental costs and to create new market opportunities through new environmental technologies and processes or eco-designed products.
ESG workforce score (WS)	The work score measures a company's effectiveness in terms of job satisfaction, ensuring a healthy and safe workplace, maintaining diversity and equal opportunities, and providing development opportunities for its workforce.
ESG human rights score (HS)	The human rights score measures a company's effectiveness in respecting fundamental human rights conventions.
ESG community score (CS)	The community score measures a company's commitment to good citizenship, protecting public health, and respecting business ethics.
ESG product responsibility score (PS)	The product responsibility score reflects a company's capacity to produce quality goods and services integrating customers' health and safety, integrity, and data privacy.
ESG management score (MS)	The management score measures a company's commitment to and effectiveness in following best practice in terms of corporate governance principles.
ESG shareholder score (SS)	The shareholder score measures a firm's effectiveness in the equal treatment of shareholders and the use of antitakeover devices.
ESG CSR strategy (CS)	The CSR strategy score reflects a company's communication practices integrating economic (financial), social, and environmental dimensions into its day-to-day decision-making processes.

Source: Thomson Reuters Eikon ESG scores, May 2018.

The current study compared the unique distinctive characteristics of sample and control firms. For each sample innovative firm, a control firm was matched on the basis of revenue in 2020. A list of sample and control firms is provided in Appendix A. The first step was to perform univariate analysis; the distinctive characteristics of the sample and control firms were analyzed using the t test of differences. The t-test statistics were computed to test the null hypothesis that mean values for the sample and control firms were equal, under the assumption of unequal variance.

The logit regression model was applied to predict whether firms that adopt sustainability initiatives tend to be innovative companies. Different regression models were established to examine the extent to which sustainability-intensive firms tend to become innovative companies.

Table 4 presents analysis of the differences in mean values of ESG variables and performance variables between the innovative sample firms and the control firms matched by revenue size that were not on the lists of most innovative companies prepared by BCG and Forbes. The sample innovative firms had significantly higher ESG and component scores than the matched control firms. The average combined ESG scores and the pillar scores for environmental, social, and governance aspect were higher for the sample firms than the control firms, with statistical significance. The average component score for each pillar score was higher for sample innovative firms in comparison with sample firms, and these results were also statistically significant.

Table 4. ESG and financial characteristics of sample and control firms.

Variable	Sample	Control	*t* Test for Difference in Means
ESG combined score	58.12	54.56	1.45 *
Social pillar score	75.69	66.02	3.78 ***
Governance pillar score	64.84	57.4	2.5 ***
Environmental pillar score	70.09	57.79	3.5 ***
Resource use score	80.99	66.91	4.2 ***
Emissions score	77.08	63.65	3.7 ***
Environmental innovation score	51.09	40.13	2.63 ***
Workforce score	81.96	66.98	4.92 ***
Human rights score	68.39	59.55	2.37 ***
Community score	80.88	73.49	2.31 **
Product responsibility score	72.08	62.68	2.68 ***
Management score	65.87	60.75	1.38 *
Shareholders score	58.47	47.8	2.7 ***
CSR strategy score	59.26	48.8	1.32 *
DIR diversity score	38.92	34.27	2.23 **
Number of board meetings	8.62	9.49	−1.6 *
Board size	11.62	10.96	1.76 **
Independent board members, %	71.46	65.68	1.81 **
Board gender diversity, %	26.68	25.29	0.8
Average board tenure	8.25	7.37	1.95 **
CEOBM	0.85	0.9	−0.98
Financial Characteristics			
Log EV	11.26	10.89	3.10 ***
Asset turnover	0.62	0.72	−1.93 **
Debt equity ratio	2.89	0.77	1.71 *
Earnings per share	16.06	42.62	−1.1
Price-to-earnings ratio	45.11	50.15	−0.63
Enterprise value to sales	5.33	4.6	1.1
ROA, %	8.42	5.8	3.007 ***
ROE, %	28.83	15.15	1.97 **
EBITDA margin, %	21.38	16.78	1.94 **

***, **, * Statistical significance at 1%, 5%, and 10%.

The average number of board meetings for innovative firms was lower than that of control firms, with statistical significance. The average board size was larger for innovative firms compared with the control firms. The presence of independent board members in innovative firms was higher in comparison with control firms. The average score for director diversity and the average length of board tenure were comparatively higher for the most innovative firms. In terms of financial characteristics, the sample firms had higher ratios of debt equity and profitability. Hence, the financial performance of the sample innovative firms was superior compared with the control firms. The asset turnover ratios of control firms were higher than those of sample firms, with statistical significance. The profitability measures of ROA, ROE, and EBITDA margin were higher for innovative firms compared with the matched control firms, with statistical significance. The size of samle firms proxied by enterprise value was larger than that of control firms, with statistical significance.

Descriptive statistics of financial variables of sample firms is given in Table 5. and control firms in Table 6.

Table 5. Descriptive statistics of financial variables—sample firms.

Variable	Mean	Median	SD	Max	Min
Log EV	11.26	11.12	0.80	13.70	9.97
Asset turnover	0.62	0.54	0.33	2.29	0.12
Debt equity ratio	2.89	0.40	12.50	126.06	0.00
Earnings per share	16.062	4.02	49.68	342.17	−1.96
Price-to-earnings ratio	45.12	32.57	41.46	315.38	7.87
Enterprise value to sales	5.34	4.23	4.80	31.67	0.26
ROA, %	8.00	7.32	6.13	24.11	−16.74
ROE, %	22.42	16.43	20.73	106.20	−39.99
EBITDA margin, %	21.39	22.57	17.84	52.46	−94.99

Table 6. Descriptive statistics of financial variables—control firms.

Variable	Mean	Median	SD	Max	Min
Log EV	10.89	10.74	0.98	14.64	8.43
Asset turnover	0.72	0.65	0.45	3.30	0.13
Debt equity ratio	0.78	0.52	0.73	3.93	0.00
Earnings per share	19.29	4.20	50.99	335.77	−2.81
Price-to-earnings ratio	50.16	34.06	66.90	507.33	3.80
Enterprise value to sales	4.60	3.18	5.14	34.57	0.04
ROA, %	5.47	5.46	7.55	29.80	−23.05
ROE, %	13.66	13.48	34.60	151.15	−188.44
EBITDA margin, %	16.8	17.2	17.4	49.6	−97.4

Logit Regression Results

Statistical techniques including linear probability functions, logit analysis, probit analysis, and discriminant analysis were applied to assess the likelihood of sustainable firms being innovative firms. For the logit analysis, the samples of innovative and matched firms of similar size (in terms of assets) that did not feature in the BCG and Forbes lists of innovative firms in the sample period were used for estimation of the likelihood of innovation.

The logistic probability model was employed to examine the likelihood that a given firm that had adopted sustainability initiatives would be an innovation-intensive firm. The regression model was specified as follows:

$$p(i, t) = 1/(1 + e - bx(i, t), \tag{1}$$

where p(i, t) is the probability that firm i is an innovative firm that adopts sustainability initiatives during the sample period t, x(i, t) is a vector of measured attributes for firm i at time t, and b is the unknown parameter vector.

To test for multicollinearity, Pearson's correlation test was conducted for all financial variables. The enterprise value (EV) was correlated to earnings per share (EPSHARE) with a value of 0.516. The other correlated variables were ROE and ROA (0.586), as well as EBITDA margin and ROA (0.66).

Model Results.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Variables	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff
ESGC	−0.005	−0.004				
SPS	**0.475** **	0.01		0.013		
GPS	−0.05	**0.031** **		0.012		
EPS	0.071	0.012		0.009		
RS	−0.003		0.035		0.01	0.008
ES	−0.033		−0.016		−0.003	−0.007
IS	−0.02		0.002		0.002	0.005
WS	−0.057		**0.042** *		**0.042** **	**0.051** **
HS	**−0.151** **		**−0.027** *		−0.013	0.005
CS	**−0.106** *		0.005		0.016	0.012
PRS	**−0.129** **		0		−0.007	−0.01
MS	0.061		**0.019** *		0.008	0.016
SS	0.033		**0.021** **		**0.015** *	0.014
DIRDS	0.012	0.023	0.005		−0.003	0
NBM	**−0.205** **	**0.176** **	**0.134** *		**0.129** **	**0.179** **
BS	−0.029	−0.037	−0.012		0.001	0.039
IBM	0.021	**0.025** *	0.018		0.006	0.006
BGD	−0.017	−0.008	−0.002		−0.008	−0.029
ABT	**0.228** **	0.09	0.194		**0.198** **	0.14
CEOBM	−1.61	−1.32	−0.838		−0.889	−0.737
EV	**2.077** **	**1.71** ***	**1.94** ***	**0.448** **	**0.725** *	
ATR	−1.169	**−1.9** **	−1.03	**−1.18** **		−0.979
DER	**0.88** **	**0.52** **	**0.707** **	**0.272** *	**0.451** **	**0.481** **
EPSHARE	**0.014** *	**0.014** *	**0.014** **			−0.002
PER	0.002	0.001		−0.001		0.003
EVS	0.032	−0.006	−0.05		0.028	0.015
ROA	−0.04	−0.067			−0.069	
ROE	−0.041		−0.012	0.004		

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
EBITDAMP	−0.052	−19.25	−0.018	0.001		−0.009
Constant	−26.97	−19.25	−26.89	−6.51	−12.28	−5.29
Cox and Snell R-Square	0.424	0.324	0.429	0.162	0.302	0.324
Nagelkerke R-Square	0.572	0.437	0.572	0.217	0.407	0.437

*, **, *** Statistical significance at 1%, 5%, and 10%. Bold signifies statistically significant results.

Altogether, six logit regression models were used for analysis. In the first model, all ESG, specific governance, and financial performance variables were included in the regression model. In the second model, the ESG pillar scores, specific governance, and selected performance variables were used for analysis. In model 3, the ESG sub-pillar scores, governance, and performance variables were included for analysis. In model 4, the pillar scores and performance variables were included in order to analyze the sustainability and performance of innovative firms. Models 5 and 6 included sub-pillar scores and selected performance variables to account for any multicollinearity problems. The Cox and Snell R-square value ranged from 0.162 to 0.429 in the different models, while the Nagelkerke R-square value ranged from 0.217 to 0.572 in the six logistic regression models. The Nagelkerke R-square is a version of the Cox and Snell R-square that adjusts the scale of the statistic to cover the full range from 0 to 1.

The results for models 1 and 2 suggest that the ESG variables of SPS and GPS were positively related to the dependent logit variable, with statistical significance (coeff = 0.475 at the 5% level and coeff = 0.031 at the 5% level of significance). Firms with high intensity of investment in social and governance initiatives tended to be innovative. In other words, those that committed resources to governance and social aspects of their operations were the more innovative firms. The results of models 3, 5, and 6 suggest that the social sub-pillar score (WS) was positively related to the dependent logit variable of innovation, with statistical significance. It can be interpreted that firms that focused on employee satisfaction, diversity, and promotion of a healthy and safe workplace tended to be innovative. In models 1 and 3, the sub-pillar variable HR representing the social pillar had a negative relationship with the innovation variable, with statistical significance. In model 1, the coefficient was −0.15 which was significant at the 5% level, whereas in model 2 the coefficient was −0.27 with statistical significance at 10%. Innovative firms scored lower in terms of human rights initiatives.

In model 1, the social sub-pillar variables of community (CS) and product responsibility (PR) were negatively related to the dependent logit variable (for CS, coeff = −0.106; for PRS, coeff = −0.129), with statistical significance.

In model 3, the governance component of te management score was positively related to innovative firm characteristics (coeff = 0.019), with statistical significance at 10%. Similarly, the results of models 3 and 5 suggest that the governance component of shareholder strategy initiatives had a direct positive relationship with the innovation variable (coeff = 0.021 at 5% level of significance; coeff = 0.015 at 10% level of significance). These results suggest that innovative firms are characterized by the adoption of best-practice corporate governance principles. Innovative firms demonstrated increased effectiveness in the equal treatment of shareholders and the use of antitakeover devices. Results from all models indicated that innovative firms tended to have fewer board meetings. The governance variable of IBM was statistically significant at the 10% level (coeff = 0.025). Independent members tended to be more frequently present in innovative firms. The results of models 1 and 5 suggest that the average tenure of board members was higher for innovative firms (coeff = 0.228 and coeff = 0.198), with statistical significance at 5%.

The results of all models suggest that innovative firms had higher market valuation. The results of models 2 and 4 suggest that innovative firms had lower efficiency of asset turnover. Innovative firms were debt-intensive. Results of all models indicated that innovative firms had higher debt equity ratios. Innovative firms demonstrated superior financial performance in terms of higher earnings per share, according to the results of the first three models.

4. Discussion

The results suggest that sustainability initiatives are a critical factor affecting the economic performance of innovative knowledge-intensive firms. Innovative firms that are sustainability-oriented tend to invest in social and governance initiatives. Innovative firms place more focus on employee satisfaction, provision of a congenial work environment, and diversity, and tend to adopt better corporate governance practices. Innovative sustainability-oriented firms have higher market valuation and superior financial performance. Sustainability initiatives by innovative firms improve economic performance (Matjaz et al. 2016; Tang et al. 2018; Marra et al. 2020).

5. Conclusions

This study examined the role of sustainability as a major driver of innovation in firms by analyzing the major sustainability characteristics of innovative firms. The research examined the impact of pillars of sustainability including environmental, social, and governance initiatives on the performance of the most innovative companies. The study focused on the most innovative companies listed in Forbes *World's Most Innovative Companies 2019* and BCG's *50 Most Innovative Companies 2019.*

For each sample innovative firm, a control firm was matched on the basis of revenue in the previous year. The distinctive characteristics of the sample and control firms were analyzed using the *t* test of differences. The sample firms had higher average combined ESG scores and pillar scores for environmental, social, and governance aspects compared with the control firms, with statistical significance. In terms of governance characteristics, the sample innovative firms had larger board size, more independent board members, higher diversity, and longer board tenure. The profitability measures of ROA, ROE, and EBITDA margin were higher for innovative firms compared with matched control firms, with statistical significance.

The logit regression model was applied to predict whether firms that adopt sustainability initiatives tend to be innovative companies. Altogether, six logit regression models were used for analysis. Innovative firms tended to have higher investments in social and governance initiatives, and tended to invest more in social initiatives related to employee satisfaction and the promotion of a healthy and safe workplace. Innovative firms scored lower in terms of human rights initiatives.

Innovative firms were characterized by their adoption of best-practice corporate governance principles. Innovative firms were more effective in terms of the equal treatment of shareholders and the use of antitakeover devices. Innovative firms tended to have more representation of independent board members, longer tenure for board members, and fewer board meetings.

6. Implications

This research contributes to the theoretical literature by focusing on the link between sustainability-oriented innovation and the performance of firms. The study provides useful insights in terms of managerial implications, and has implications for practitioners and policymakers and their understanding of how the adoption of sustainability strategies and innovations can impact firms' performance. Policymakers require this knowledge to devise effective policies in order to achieve sustainability. Firms will be able to improve their financial performance through the adoption of sustainability-oriented innovative practices. Management should create an organizational climate that encourages sustainability-based innovative practices throughout the organization to support the success of the firm. It is critical for innovative firms to managing ESG to ensure suitable performance-related outcomes.

7. Limitations and Future Research Directions

This study focused on sustainability, innovation, and financial performance. Future studies can encompass noneconomic perspectives and qualitative research, and can clinically analyze the impact of sustainability initiatives on different typologies of innovation according to different contextual factors. Future studies can explore the impact of sustainability on the performance of R&D-intensive firms.

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Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The author declare no conflict of interest.

Appendix A

Table A1. List of sample and control firms.

SL	Sample Firms	Control Firms
1	Salesforce.Com Inc.	HubSpot Inc.
2	Amazon.com Inc.	Rakuten Group Inc.
3	Intuitive Surgical Inc.	Fanuc Corp
4	Tencent Holdings Ltd.	NetEase Inc.
5	Apple Inc.	Samsung Electronics Co Ltd.
6	Hindustan Unilever Ltd.	ITC Ltd.
7	Alphabet Inc.	Rackspace Technology Inc.
8	Bharat Heavy Electricals Ltd.	Isgec Heavy Engineering Ltd.
9	Reckitt Benckiser Group PLC	McBride PLC
10	Nidec Corp	Dana Inc.
11	Terumo Corp	Grifols SA
12	Infosys Ltd.	Cognizant Technology Solutions Corp
13	Pernod Ricard SA	Carlsberg A/S
14	Keyence Corp	Nikon Corp
15	Starbucks Corp	Dunkin' Brands Group Inc.
16	Nintendo Co Ltd.	Ubisoft Entertainment SA
17	Activision Blizzard Inc.	Bandai Namco Holdings Inc.
18	Beiersdorf AG	Shiseido Co Ltd.
19	Procter & Gamble Co	Revlon Inc.
20	EssilorLuxottica SA	Hoya Corp
21	L'Oreal SA	Coty Inc.
22	Schlumberger NV	Baker Hughes Co
23	Ecolab Inc.	Clorox Co
24	Alstom SA	Thales SA
25	General Mills Inc.	Ingredion Inc.

Table A1. *Cont.*

SL	Sample Firms	Control Firms
26	CSL Ltd.	Baxter International Inc.
27	Colgate-Palmolive Co	Church & Dwight Co Inc.
28	NetApp Inc.	Pure Storage Inc.
29	Danone SA	Ingredion Inc.
30	Citrix Systems Inc.	Okta Inc.
31	Rockwell Automation Inc.	Dassault Systemes SE
32	Kone Oyj	Otis Worldwide Corp
33	China Oilfield Services Ltd.	Transocean Ltd.
34	Juniper Networks Inc.	Arista Networks Inc.
35	Estee Lauder Companies Inc.	Amorepacific Corp
36	Fanuc Corp	Omron Corp
37	Hershey Co	Yamazaki Baking Co Ltd.
38	Paccar Inc.	AGCO Corp
39	SMC Corp	Roper Technologies Inc.
40	PepsiCo Inc.	Keurig Dr Pepper Inc.
42	Secom Co Ltd.	Community Health Systems Inc.
43	Anheuser Busch Inbev SA	Vivint Smart Home Inc.
44	Adobe Inc.	Heineken NV
45	Agilent Technologies Inc.	Dropbox Inc.
46	HTC Corp	Keysight Technologies Inc.
47	Kellogg Co	BlackBerry Ltd.
48	Sandvik AB	Grupo Bimbo SAB de CV
49	ASML Holding NV	Gerdau SA
50	Air Products and Chemicals Inc.	Applied Materials Inc.
51	Qualcomm Inc.	Nippon Sanso Holdings Corp
52	Compagnie Financiere Richemont SA	Texas Instruments Inc.
53	SAP SE	Hermes International SCA
54	Emerson Electric Co	VMware Inc.
55	Campbell Soup Co	Roper Technologies Inc.
56	Kao Corp	Post Holdings Inc.
57	Atlas Copco AB	Natura & Co Holding SA
58	Danaher Corp	Trane Technologies PLC
59	Corning Inc.	Avantor Inc.
60	Daikin Industries Ltd.	Smiths Group PLC
61	Thermo Fisher Scientific Inc.	Mitsubishi Corp
62	Sany Heavy Industry Co Ltd.	Waters Corp
63	Johnson Controls International PLC	Sumitomo Corp
64	Zoomlion Heavy Industry Science and Technology Co Ltd.	Watsco Inc.
65	Rolls-Royce Holdings PLC	Guangxi Liugong Machinery Co Ltd.
66	Oracle Corp	Safran SA

Table A1. *Cont.*

SL	Sample Firms	Control Firms
67	Fresenius SE & Co KGaA	CGI Inc.
68	Legrand SA	Community Health Systems Inc.
69	Schindler Holding AG	Hubbell Inc.
70	Kraft Heinz Co	Thyssenkrupp AG
71	Henkel AG & Co KgaA	Mondelez International Inc.
72	Intuit Inc.	Sika AG
73	Microsoft Corp	PayPal Holdings Inc.
74	Automatic Data Processing Inc.	Proofpoint Inc.
75	L'Air Liquide Societe Anonyme pour l'Etude et l'Exploitation des Procedes Georges Claude SA	Workday Inc.
76	Boston Scientific Corp	Linde PLC
77	Tenaris SA	Olympus Corp
78	Abb Ltd.	Vallourec SA
79	Toshiba Corp	Honeywell International Inc.
80	Stryker Corp	Asustek Computer Inc.
81	BAE Systems PLC	Smith & Nephew PLC
82	Halliburton Co	Lockheed Martin Corp
83	Conagra Brands Inc.	Devon Energy Corp
84	International Business Machines Corp	Suntory Beverage & Food Ltd.
85	Sony Group Corp	Accenture PLC
86	Pfizer Inc.	Panasonic Corp
87	Siemens AG	Teva Pharmaceutical Industries Ltd.
88	Facebook Inc.	Continental AG
89	Alibaba Group Holding Ltd.	Twitter Inc.
90	Dell Technologies Inc.	JD.Com Inc.
91	Cisco Systems Inc.	Acer Inc.
92	Target Corp	Arista Networks Inc.
93	Hewlett Packard Enterprise Co	Qurate Retail Inc.
94	Johnson & Johnson	Seiko Epson Corp
95	Toyota Motor Corp	GlaxoSmithKline PLC
96	Walmart Inc.	Volkswagen AG
97	Nike Inc.	Costco Wholesale Corp
98	Lenovo Group Ltd.	Puma SE
99	Coca-Cola Co	Fujitsu Ltd.
100	Abbott Laboratories	National Beverage Corp
101	Bosch Ltd.	Medtronic PLC
102	Fast Retailing Co Ltd.	Parker-Hannifin Corp
103	Adidas AG	H & M Hennes & Mauritz AB
104	Merck & Co Inc.	Fila Holdings Corp
105	Novartis AG	Bristol-Myers Squibb Co

Table A1. *Cont.*

SL	Sample Firms	Control Firms
106	eBay Inc.	Amgen Inc.
107	Industria de Diseno Textil SA	ETSY Inc.
108	Moderna Inc.	LPP SA
109	Koninklijke Philips NV	Sarepta Therapeutics Inc.
110	Walt Disney Co	Osram Licht AG
111	Comcast Corp	ViacomCBS Inc.
112	General Electric Co	Charter Communications Inc.
113	Roche Holding AG	Boeing Co
114	AstraZeneca PLC	Eli Lilly and Co
115	Bayer AG	Becton Dickinson and Co

Notes

1. Fabian Stei, Niklas Bayrle, Leo Brecht, Innovation and Firm Performance: A bibliometric study, The ISPIM Innovation Conference, June 2019.
2. The most innovative companies 2019, The rise of AI, Platforms and ecosystems, BCG Report 2019.
3. https://www.forbes.com/sites/innovatorsdna/2018/05/29/how-we-rank-the-most-innovative-companies-2018/#2e1660181e3c; (accessed on 2 December 2021).

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