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Article

Environmental Management, Green Innovation, and Social–Open Innovation

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Abstract: The present study aims to determine the impact of green innovation (GI) on the overall performance of an organization while keeping the variable of environmental management (EM) as a moderator. We used a dataset consisting of four data years, from 2014 to 2017, of A-share companies listed on the Shanghai Stock Exchange (SSE). The concept of green innovation refers to the use of advancements in technology that enable savings in energy, along with the recycling of waste material. When advanced technology is utilized in the production process, the products are referred to as green products and the whole process of adopting such technologies and product design is referred to as "Corporate Environmental Management". Such innovations improve the overall financial performance of companies as it enables them to improve their social image by reducing their carbon footprint and ensures their long-term sustainability. The main issue is the limited focus and attention given to the topic, from the perspective of companies. This research focuses on the impact of green innovation and the importance of environmental management for the sustainability of companies. Our findings suggest that the relationship between green innovation and the performance of the company is positive and verifies the existence of moderating effects of environmental management on the relationship between green innovation and firm performance. Implications are given to academia and practitioners.

Keywords: green innovation; environmental management; firm performance

JEL Classification: O32; O33

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1. Introduction

Research on green innovation (GI) can mainly be classified into two main parts; the first refers to the financial performance of companies and the latter refers to environmental management (EM) of said companies [1,2]. According to (Berrone, Fosfuri [1], Chen [3]) the relationship between GI and EM is positive. While the main issue regarding the research topic is the relationship between GI and firm performance (FP), which at best remains inconclusive [4]. The main reasons seem to be the mixed results reported by the researchers. For example, [5] reported a positive impact of GI on FP, while [2,6] negates the existence of the positive impact of GI on FP. Keeping in mind the present trends, it seems inevitable that GI will enable all companies to improve their EP and the decision-makers will be able to find ways to increase their overall returns by utilizing it. At the same time, one needs to examine and explore their interrelationships. Rapid growth of industries across the world

has created huge pollution problems and contributed toward waste products that damage the environment, leading to serious issues, such as global warming and climate change.

Hansen, Kharecha [7] refer to a report conducted by The Earth Institute, which blames global warming and climate change on industrial practices that ignore their impact on the environment. Over time, pressure from government legislators and other environmental groups have lead industries to reconsider such policies. Dereli [8] points out that, due to these pressure groups and legislations, industries have no other choice but to consider GI, and to seek ways to achieve or maintain their competitive advantages via environment-friendly practices [9,10]. Sezen and Cankaya [11] earlier suggested that GI is the only option for companies, otherwise they may violate the germane rules regarding environment protection.

GI refers to the use of technological innovations that comprise both hardware and software solutions, which enable production processes to reduce waste and harmful material by enabling them to recycle or reuse them, resulting in a minimum environmental footprint [12–14]. Sharma and Vredenburg [15] stated that, in the future, companies will have no choice but to seek GI to attain a competitive advantage. Burritt, Schaltegger [16] linked it to improvement in production processes and incremental value creation for shareholders. Olik, Coleman [17] also supported this notion. Sorescu and Spanjol [18] came to a similar conclusion and their research was further supported by that of [19], who added that GI reduces the existing risk faced by companies.

Green innovation in future necessary for all companies; moreover, benefits cannot be ignored in the long-term. Academics, such as the authors of [20], point out that some of the main hindrances of companies adopting such technologies relates to the overall costs involved in research and development, finding and developing environmentally friendly materials, training the workforce, obtaining certifications, following new health and safety regulations, and the additional burden of expenses (e.g., depreciation and amortization of new assets). For companies to implement such technologies, all of the above-mentioned costs need to be accurately calculated, the possibility of failure would have to be considered, and management would need to justify these decisions to shareholders, as, in the short-run, their wealth might be adversely affected by such decisions.

The potential academic contributions of this paper are as follows: (1) the current study enriches the environmental management literature by considering green innovation and firm performance framework. Green innovation and environmental management are the basis of companies' sustainable competitive advantages. Although present research on this topic is abundant, there is still a lack of literature on how to develop GI in firms. (2) The present study investigates the relationship between green innovation and firm performance by using environmental management as a moderator variable. There are limited studies on this mechanism; we did not see any study while taking environmental management as a moderator variable. Many researchers still have uncertainties about the impacts of environmental management. Through the study of influential mechanisms, this research offers a conceptual framework that could remedy this academic deficiency, and increase the confidence of environmental management for businesses.

Lanoie, Patry [21] argued that, in the above scenario management, environmental concerns and depletion of natural resources are of major concern for almost every government around the world, and with the passing of ever-tightening environmental regulations, they do not have any other choice. Nowadays almost all countries need to consider the environmental impact of their industrial activities. Countries, such as China, have long ignored the environment in the past; according to the Environmental Performance Index, which ranked 180 countries for environmental performance, China ranked 177th in the world [22]. Liang, Zhang [23] states that if regulators continue to ignore the environment, then, in the future, natural resources will become so depleted that economic growth will not be sustainable. As a result, the Chinese government has started to introduce environmental regulations and legal reforms, but these are still lagging behind those of developed countries, since developing countries, including China, have not achieved the level of

social welfare compared to developed nations. They have no other choice but to continue industrialization; they also need to protect the general environment by incorporating legal reforms [24].

The Investor Responsibility Research Center (1992) defines environmental management as efforts to reduce the adverse impact of industrial activities on the environment, from production to product lifecycle. This includes a business reducing its adverse impact on the environment as compared to industry peers. Though it is a novel idea, many managers have always thought of it as an additional burden, as it might reduce the profitability of a company [25]. One such example put forward by Bragdon and Marlin [26] concerns air pollution, as many governments have imposed additional taxes on companies that cause air pollution, so the cost comes back to companies. Meanwhile, Allen [27] disagrees with this notion and points out that companies that have focused on environmental performance were able to reduce the cost of production, as they were able to recycle a lot of their waste material. Schmidheiny and Timberlake [28] also support this notion.

Our main research objectives are to find the relation between green innovation and firm performance, and to check whether environmental management moderates the relationship between the two. To achieve these objectives, we developed further research questions: (1) is there any association between green innovation and firm performance? (2) Does environmental management moderate the green innovation and firm performance?

The research comprises of six sections: the first section consists of a basic introduction; the second section contains a detailed literature review and research hypotheses; the third section presents the research methodology; the fourth section consists of statistical analysis and results; the fifth section consists discussion of results and the final section presents the conclusion and recommendations.

2. Literature Review and Research Hypotheses

Ferreira [29] points out that other studies seemed to have generally passed the area of environmental management in general. Therefore, there is limited literature available on the environmental management topic and one is unable to come to a definite conclusion regarding the impact of EM and GI on the financial and overall performance of the company. This presents the gap, which we aim to contribute to by assessing the impact of GI on the performance of companies. Furthermore, we aim to assess the moderating role of EM on the existence of this relationship. Our target population consists of A-share listed companies on the Shanghai Stock Exchange (SSE), to address the earlier held notions.

2.1. Green Innovation and Firm Performance

When it comes to measuring the performance of any firm, the focus is generally placed on the company's financial performance, but this does not provide the complete picture, as the literature performance has two facets. The first is the financial performance, the second relates to environmental performance [1,6,30]. GI cannot fully be attributed to the improvement of the environmental performance of any company, mainly because there are many externalities involved [1]. The adoption of GI and the improvement in environmental performance are not guarantees of sound financial performance [30]. The attention to GI by stakeholders, such as managers and shareholders, mainly depends upon the level of their investment in such innovative technologies [31]. The performance in this regard can be best-measured using a cost–benefit analysis. Stefan and Paul [32] suggest that companies can cut their overall costs by introducing innovations such as GI.

Pollution means waste of resources. Where these resources (including material and energy) are underutilized [33,34], by reducing such waste, companies can manage their cost of production. This leads to a reduction in pollution as well as incentives for companies in terms of cost reduction. Wolf [35] presents the practical example of "3M"corporation, as it was able to save over $1 billion by cutting down on pollution (by recycling in 2005 alone). In the past, many companies, such as "Ecover" (Belgium-based manufacturer) also

adopted environment-friendly practices, such as recycling and waste reduction, to improve their financial performance [36].

Another incentive for companies relates to savings in potential fines and cost of future legal actions, which they might incur due to the ever-increasing focus on environmental pollution by governments and non profit organization

Non-profit organizations (NGOs) [30]. GI can also be viewed as a potential competitive edge (which every company seems to look for), as, in the future, it will not be considered a trend, but will become a necessity [37]. Stefan and Paul [32] add that such innovations also improve the corporate social profiles of companies and, in the future, may attract environmentally conscious customers and investors. Research conducted by Wolf [35] also backs this notion. Many large business corporations, including Walmart, IBM, and The Body Shop, have a policy of evaluating the environmental performance of their suppliers [38]. Businesses that have adopted GI as a pre-emptive measure are more likely to attract large clients, such as those mentioned above, resulting in the growth of their market shares. This has also been the case in China, as, after 2005, the government issued strict environmental policies, and has been actively encouraging GI and EM practices [39,40]. Pollution reduction requires the adoption of technological innovations that ensures a reduction in waste, from the start of the process to the end. This includes technology that enables the efficient utilization of raw material and recycling—technology that can recycle or reduce greenhouse gases along with using environmentally friendly sources of energy, such as hydroenergy or solar energy [40]. Many studies have proven that companies adopting environment-friendly practices cannot only improve profitability by cost cutting, but can also increase their revenues by increasing their corporate social image, and avail tax incentives provided by different governments around the world. This also provides them with the opportunity to become leaders in the field of GI and achieve a competitive advantage in the long-term. Another incentive that firms can exploit relates to the shortening of the lifecycles of their products, meaning that they can produce more innovative products at a lower cost [41]. Hart and Ahuja [42] have advocated in favor of adopting environmentally friendly practices, as it enables companies to fully utilize their resources, and it leads to economic and financial sustainability in the future (for the reasons mentioned above). Their study is further supported by [43,44].

Aragón-Correa [45] stated that GI is one of the most important channels for companies to enhance their customer base and contribute to environmental development; such firms are generally considered as market leaders when it comes to innovation and improvement in technology. These innovations provide them with flexibility, in terms of production processes, and helps to recruit new customers and investors. These companies achieve more social acceptability due to their environmentally friendly activities [46,47]. It can be argued that green innovative firms can reduce their production and marketing costs as well as improve their internal processes, as they are considered more legitimate, not only in the eyes of customers and society, but also by employees. They are flag-bearers of environmentally friendly practices, and the public generally views them as putting the environment ahead of monetary gains. Based on the literature, more companies invest in green innovation, the more they will get benefit financially.

Hypothesis 1 (H1). *There is a positive relationship between the level of green process innovation and financial performance at the firm level.*

2.2. Moderating Role of Environmental Management on Green Innovation and Firm Performance

When it comes to regulations imposed by governments related to EM, many academics, such as [34], consider them as a hindrance, as they are hard to follow and their implementation is costly for a business. Moreover, they are mostly ineffective, as most companies find ways to bypass them entirely. Since these regulations are not universal and vary from country-to-country, large corporations can shift their production processes to developing countries that have light regulations. Even if they opt to not shift their

production-based operations to such countries, their compliance costs would still be very high [34]. Christainsen and Haveman [48] deem them to be detrimental to the overall profitability of companies, while the authors of [49] noted that such costs may limit the growth potential and opportunities for many companies. Similar views are held by Alesón (2007), he adds that modifications in the production process are costly for companies, and it might take significant time for companies to recover such massive costs. Engau and Hoffmann [50] also support this argument, and point out that, due to these reasons, environmental regulations have been subject to adjustment, depending on the economic environment.

Hoffman [51] draws attention to the confusion caused by such regulations among the decision-makers of companies, which hinders their ability to come up with a clear policy regarding the implementation of environmental regulations. Keeping such issues in mind, it is hard to account for the actual impact of environmental regulations on the financial performance of companies [34,52].

Due to these issues, many researchers and policymakers have argued in favor of mild interventions rather than enforcement of harsh regulations; they argue that such interventions would lead companies to adopt and integrate environmentally friendly policies at their own pace, which would prove more effective and practical in the long run [46].

Most academics have supported the mild intervention argument, based upon the following points: (1) stringent environmental regulations, to most, halt innovative processes, as the legal requirement is based upon the simple principle of "one fits all". This hinders innovation as all companies implement similar processes to comply with the law. Thus, many companies lose their innovative edge, which might have differentiated them from their competitors. (2) Loss of flexibility in the production process, due to the lack of strict legal requirements, which mostly leads to loss of financial flexibility. As mentioned earlier, these forced innovations require firms to suddenly shift their production processes, which require heavy capital expenditures and additional costs related to the training of employees as held by [53]. On the contrary, such regulations cause more harm than good in many cases as they adversely affect the financial stability of the companies. Another aspect of such regulations, pointed out by [54], relates to legally forcing companies to divert their human and financial resources to environmental activities, which can increase the nonproductive costs for companies, hindering their profitability. A similar opinion is held by [55]. Christainsen and Haveman [48], while following suit, add other nonproductive costs related to environmental audits, litigations, and waste management, to the list. (3) The rise of uncertainty regarding future economic sustainability within companies. One such example relates to the introduction of new laws regarding renewable energy. These regulations caused many financial issues with green innovative electrical firms. This leads to a huge deviation in their financial results [56,57]. Based upon these points, we propose the following hypothesis:

Hypothesis 2 (H2). *Environmental management moderates the relationship between green innovation and firm performance.*

3. Methods

3.1. Data

For this research paper, we examined the data of A-share listed companies of the SSE (China), spanning the period from 2014 to 2017. Our proposed examination includes all companies, except financial companies and those whose data were missing. This meant that our sample was reduced to 3557 companies. To eliminate the impact of extreme values, continuous variables were adjusted for 1% for both at the top and the bottom. We adopted the environmental index created by China's Financial Ecological Environment report. We further utilized the "Wind database" in conjunction with China stock market and accounting research "CSMAR" for financial indicators and corporate governance indicators.

3.2. Measurement of Variables

3.2.1. Dependent Variable

We utilized Tobin's Q ratio to analyze the performance of the companies; by following Sial, Zheng [58], we calculated with the following formula (total assets market capitalization–book value of equity–deferred tax liability)/total assets.

3.2.2. Independent Variable

Although there are many methods for evaluating GI, for this research, we utilized measures proposed by [33,59]. This measure is commonly known as "INNO" (ratio R&D to operating income).

3.2.3. Moderator Variable

To evaluate the variable of EM, we used eco-efficiency as proposed by Schaltegger, Bennett [60], and calculated as:

$$\text{eco-efficiency} = \text{value of product/environmental influence}$$

3.2.4. Control Variables

By following previous studies (Abdullah, Mohamad [61], Khan and Vieito [62], Chen, Kao [63]), other variables, such as firm size, firm age, debt equity (D/E) ratio, and Top1 are considered control variables, as they have a great impact on the financial performance of the companies and can hinder the results.

3.2.5. Models

To assess whether environmental management moderates the relationship between green innovation and firm performance, by following previous studies (Sial, Zheng [58]) the regression model was established.

$$FP_{it} = \beta_0 + \beta_1 INNO_{it} + \beta_2 F.Size_{it} + \beta_3 F.Age_{it} + \beta_4 D/R_{it} + \beta_5 Top1_{it} + \beta_6 YearDum_{it} + \beta_7 Industry\ Dum_{it} + \in_{it(1)}$$

$$FP_{it} = \beta_0 + \beta_1 INNO_{it} + \beta_2 EM*INNO_{it} + \beta_3 F.Size_{it} + \beta_4 F.Age_{it} + \beta_5 D/R_{it} + \beta_6 Top1_{it} + \beta_7 YearDum_{it} + \beta_8 Industry\ Dum_{it} + \in_{it(1)}$$

Firm performance is measured by Tobin's Q (which in turn is calculated by a formula proposed by [64]); INNO (it is a commonly held view that a higher value of INNO means that the firm has achieved a higher level of innovation and vice versa); EM (we calculate EM by using this formula eco-efficiency = value of product/environmental influence); F.Size (calculated by taking the natural log of all assets held by firm); F.Age (age of firm from listing date of firm); D/E Ratio (calculated by dividing the total debt or liabilities of the firm by total equity of firm) TOP1(refers to the shareholding ratio of the largest shareholder to the total shareholding of the company).

4. Results and Analysis

4.1. Descriptive Statistics

The summary of descriptive statistics is provided in Table 1. As indicated in Table 1, the average INNO stands at 0.0398, which is indicative of a low level of innovation in the sample companies. This indicates that the Chinese government needs to provide incentives to companies that undertake green innovation. The mean value of ER, considered an explanatory variable in the present research, stands at 0.1976, with a standard deviation of 0.0398.

Table 1. Descriptive Statistics.

Variable	Obs	Mean	Std. Dev
Tobin's Q	8000	0.0671	0.0651
INNO	8000	0.0398	0.0634
ER	8000	0.1976	0.3861
F.Size	8000	22.0567	1.9146
F.Age	8000	11.3885	3.8434
D/E Ratio	8000	0.4189	0.1861
TOP1	8000	32.3678	12.1143

Note: Tobin's Q (which in turn is calculated by a formula proposed by [64]); INNO (it is a commonly held view that a higher value of INNO means that the firm has achieved a higher level of innovation and vice versa); EM (we calculate EM by using this formula eco-efficiency = value of product/environmental influence); F.Size (calculated by taking the natural log of all assets held by firm); F.Age (age of firm from listing date of firm); D/E Ratio (calculated by dividing the total debt or liabilities of the firm by total equity of firm) TOP1 (refers to the shareholding ratio of the largest shareholder to the total shareholding of the company).

In terms of control variables, the average firm size is 22. The average value of the age of the firm is 11 years. The average value of D/E ratio is 41 percent; it means most of the firm promotes their business with leverage, and the average shareholding ratio of the largest shareholder (Top1) is 32.36%.

4.2. Correlation Test

The summary results of the correlation test for the variables are presented in Table 2. The results indicate the presence of a strong positive relationship between INNO (variable for measuring GI) and Tobin's Q at a 99% confidence interval. This provides strong support in favor of our first research hypothesis (H1). At the same time, we concluded a positive correlation between EM and Tobin's Q at a 99% confidence interval. There is a positive correlation between firm size and firm performance. Similarly, results indicate a significant negative relationship between Top1 with firm performance. This indicates that, as the shareholding pattern becomes more dilute, the firm performance also seems to reduce. We found similar results as far as the D/E ratio was concerned; it also had a strong negative relationship with firm performance. We did not find any issues relating to multicollinearity, as correlation was lower than the threshold. To summarize, we can safely state that our results are indicative of the fact that green innovation (INNO) has an impact on firm performance.

Table 2. Correlation Matrix.

	1	2	3	4	5	6	7	VIF
1-Tobin's Q	1.0000							
2-INNO	0.0394 **	1.0000						1.03
3-EM	0.4011 ***	0.1614 ***	1.0000					1.20
4-F.Size	0.1721	0.2712 ***	0.5422 **	1.0000				1.98
5-F.Age	0.5190	0.1068 ***	0.0904 **	0.4289 **	1.0000			1.05
6-D/E	−0.0603 ***	0.0768 ***	−0.4386 **	0.0146 **	0.0711 **	1.0000		1.21
7-TOP1	−0.0756 ***	0.1380 ***	−0.3107 **	−0.4158 **	−0.3613	0.0941 **	1.0000	1.28

Note: represents $p < 0.01$ ***, $p < 0.05$ **, Tobin's Q (which in turn is calculated by a formula proposed by [64]); INNO (it is a commonly held view that a higher value of INNO means that the firm has achieved a higher level of innovation and vice versa); EM (we calculate EM by using this formula eco-efficiency = value of product/environmental influence); F.Size (calculated by taking the natural log of all assets held by firm); F.Age (age of firm from listing date of firm); D/E Ratio (calculated by dividing the total debt or liabilities of the firm by total equity of firm) TOP1 (refers to the shareholding ratio of the largest shareholder to the total shareholding of the company).

4.3. Regression Analysis

Table 3 contains the summarized results of regression analysis among three main variables represented by GI and INNO, the financial performance represented by return on equity ROE, and EM presented by eco-efficiency. Model 1 illustrates the existence of a positive and significant correlation amongst INNO and Tobin's Q at a 99% confidence

interval, at the firm level, the coefficient of INNO is 1.564 with a significance value of 0.006. The value is <0.01, so it can be concluded that GI significantly influences the performance of the sample company, which supports our first hypothesis.

Table 3. Regression Results.

Variables	Model 1 (Tobin's Q)		Model 2 (Tobin's Q)	
	Coefficient	***p*-Value**	**Coefficient**	***p*-Value**
INNO	1.4651	0.006	1.3156	0.005
EM	0.0311	0.050	0.01291	0.051
EM*INNO	–	–	2.107	0.001
F.Size	0.0556	0.786	0.0645	0.687
F.Age	0.1420	0.142	0.0152	0.241
D/R	−0.0962	0.007	−0.0737	0.009
TOP1	−0.3906	0.002	−0.3543	0.005
Industry Dummies	YES		YES	
Year Dummies	YES		YES	
Adjusted R^2	21.39%		23.25%	
Probability (F-Statistic)	0.000		0.000	

Note: INNO (it is a commonly held view that a higher value of INNO means that the firm has achieved a higher level of innovation and vice versa); EM (we calculate EM by using this formula eco-efficiency = value of product/environmental influence); F.Size (calculated by taking the natural log of all assets held by firm); F.Age (age of firm from listing date of firm); D/E Ratio (calculated by dividing the total debt or liabilities of the firm by total equity of firm) TOP1 (refers to the shareholding ratio of the largest shareholder to the total shareholding of the company).

The values of Model 2 validate our second hypothesis (H2), as these values indicate that EM considerably moderates the relationship between EM*INNO and Tobin. The coefficient of EM*INNO is 2.107 with a *p*-value is 0.001, which was statistically significant at a 99% confidence interval.

Along with these results, we also found that the control variable indicative of a shareholding pattern represented by (Top1) was negatively correlated with Tobin's Q; this relationship was also significant at a 99% confidence interval. This indicates that the dispersion of ownership is detrimental to the financial performance of the firm. We found a similar relationship between D/E and Tobin's Q at the same confidence interval. This also verifies the earlier claims of academics that an increase in debt significantly reduces the profitability of the companies.

Our results support that our first hypothesis is in line with the stakeholder theory proposed by Freeman, Harrison [65]. The results support the notion that the main objective of the firm is, not only to increase the wealth of shareholders by value creation, but to cater to all stakeholders by creating value for them as well. The performance of the companies was measured based on the financial aspect as well as the social performance indicated by eco-efficiency. These results are in line with those held earlier by [66].

Our results also correspond with the "theory of competitive advantage" [67] that firms are always seeking a competitive advantage over their peers and GI represents such an advantage [68]. As per this theory, the advantages ensure the survival of companies in the long-term as it ensures their economic and financial sustainability in the future. Durif, Boivin [69] add that environmentally friendly products, commonly known as "green products", are durable and also have a very low carbon footprint on the environment, as they ensure the optimum use of natural resources. Using GI, companies can expand their product ranges due to the short product lifecycles, as well as attract new environmentally-conscious customers and investors. This usually results in increased profitability and an increase in the financial flexibility of the company. Thus, the use of GI not only ensures the long-term survival of companies but also ensures the optimum use of natural resources, which helps to protect the environment, creating a win-win situation for all stakeholders.

4.4. Robustness: Alternative Measure of Firm Performance

We replaced Tobin's Q with return on assets ROA, which is measured by net profit divided by total assets. The findings of alternative measures of firm performance are reported in Table 4, and the results are similar to our main findings in Table 3.

Table 4. Robustness: alternative measure of firm performance.

Variables	Model 1 (ROA)		Model 2 (ROA)	
	Coef	*p*-Value	Coef	*p*-Value
INNO	1.3762	0.045	1.7211	0.053
EM	0.0112	0.030	0.0325	0.050
EM*INNO	–	–	1.5686	0.005
F.Size	0.0432	0.586	0.0434	0.634
F.Age	0.1345	0.224	0.0154	0.243
D/R	−0.0753	0.076	−0.0645	0.008
TOP1	−0.4302	0.004	−0.3647	0.004
Industry Dummies	YES		YES	
Year Dummies	YES		YES	
Adjusted R^2	20.87%		21.36%	
Prob (F-Statistic)	0.000		0.000	

Note: INNO (it is a commonly held view that a higher value of INNO means that the firm has achieved a higher level of innovation and vice versa); EM (we calculate EM by using this formula eco-efficiency = value of product/environmental influence); F. Size (calculated by taking the natural log of all assets held by firm); F. Age (age of firm from listing date of firm); D/E Ratio (calculated by dividing the total debt or liabilities of the firm by total equity of firm) TOP1 (refers to the shareholding ratio of the largest shareholder to the total shareholding of the company).

4.5. Interpretation of Results

The results of the present study support the study conducted by Amores-Salvadó, Martin-de Castro [70], as they held that GI helps the value creation process for companies. A study by Ar [71] also concluded that GI provides a competitive advantage to companies adopting these practices. This was also supported by Küçükoğlu and Pınar [72], and now our study further validates their findings. Rosenbusch, Rauch [73] noted that innovation is key to value creation for companies, regardless of age; our study also supports their findings. All innovation does not necessarily guarantee the financial success of a company, as there is always the risk of failure associated with innovation. However, in terms of green innovation, one can safely assume that such innovation would likely add value to a company by streamlining the process in an environmentally friendly way, increasing the customer base, profitability, market share, and the social profile of the company. Our study negates the findings of [11], who contended that GI has no impact on the financial performance of a company. The author stated that companies following GI mostly lack innovativeness, and as most companies in the industry are forced by regulators to adopt such technological innovation, the comparative advantage and the value creation aspect are lost in such cases.

GI is considered a positive innovation that enables companies to achieve their long-term goals, such as value creation, for shareholders and stakeholders, to promote a better environment. One of the major problems relating to GI is the large sum of capital expenditure in the form of financial resources and human resources. These companies have to incur and maintain R&D facilities to implement such innovations. At the same time, management needs a comprehensive plan to implement such changes in a way that not only reduces the environmental impact, but also produces reliable high-quality products. Green innovation also reduces the demand for energy as it mostly relies on alternative sources of energy, such as solar and wind power, which are free and renewable, as compared to sources such as fossil fuel and nuclear energy, which extract heavy tools on the environment for each unit produced. Environmental management practices indicate the general mindset of management, as this applies that management holds the environment in high regard. EM is indicative of a positive frame of mind towards the environment and, in such cases,

companies are more likely to adopt and develop GI processes. Amores-Salvadó, Martin-de Castro [70] state that GI is not a process, but is part of a wider environment-friendly philosophy.

5. Discussion: Environmental Management and Social–Open Innovation as a Green Innovation

Social and open innovations have emerged as a bridge between society and technology. They are the basic requirements of a capitalistic system that market openness, social–open innovation, as well as closed innovation, steered in tandem with each other. Traditional scholars—on the subject of social innovation—tend to argue against the use of general entrepreneurial methods used by social sector organizations, such as NGOs and charities, as traditional companies always aim to maximize their profits. Social sector organizations tend to solve social issues by charitable contributions made by society [67]. The most successful models used in social sector organizations are modified models of commercial organizations; these mainly include profit sharing between the staff and the organizers, compensating the participating members, staff, and suppliers above the expected market rate, providing subsidies to the specific community or members to achieve their stated objectives in the long-term. Such organizations also have their sets of challenges just like commercial organizations. These challenges include conflicts of interest that might arise as a result of some actions of the organization's participants, which might result in neutralizing the social benefits. The main motivation behind the creation of such organizations relates to the fact that certain social needs are left unattended by commercial organizations.

The present article institutes "social–open innovation," since social innovation comes into play when innovative social sector organizations come into contact with society. The participative approach, which calls for active participation of the public in social sector organizations, such as public sector organizations managed by government and NPOs, results in more innovation. This also results in better implementation of innovation, but also increases the knowledge base.

Rosenbusch, Rauch [73] relates this concept to the addition of another dimension to a knowledge-based economy, which adds to existing knowledge and further expands the borders of Schumpeter's economics. We plan to expand the concept of open innovation into an economic model, in which we conceive that open innovation can be achieved from the combination of the market or society in general, as well as technology. This innovative trend is of economic and social development, and is in line with the basic idea presented by Schumpeter. The application of the innovative combination of technology and entrepreneurship will enable the development of an "open innovation model." The economic cycle represents the cyclic flow of economic resources with society, similar to blood flow within a living body, and the cyclic nature of open innovation also serves a similar purpose within the economy.

Environmental issues can also be tackled using social innovation. Many environment-based drivers have already instigated social innovations, including problems, such as pollution caused by waste, motor vehicles, and other environmental issues, which have led to a decline in "bio-diversity", and a decline in natural ecosystems, such as reduction of wetlands and other ecosystems. All of these environmental drivers have great social consequences as well as negative repercussions for human health, as ecological resource depletion has also led to problems, such as an increase in food insecurity, flooding, and soil depletion. These issues are interlinked and both cannot be ignored. Some of the environmental and social innovations in this regard include the formation of organic farms, the formation of farmers' markets, an increase in ride-sharing via different apps, and an increase in renewable energy resources [17].

The subject area of open innovation is vast and ever-growing; it encompasses the triple bottom line approach of social, environmental, and economic sustainability as its cornerstone, as the industry, government, and society in general share the responsibility of economic and social development. At the same time, issues related to the creation of knowledge, engagement of users, providing support for policy implementation, and the

reciprocal economy, lead to sustainability actively. The basic requirements of innovation require the formation of long-lasting alliances between various stakeholders as the main motivator for open innovation at both macro and micro levels.

6. Conclusions and Policy Implications

The results of the present study support the "stakeholder theory", as they indicate a significant positive impact of GI, on Tobin's Q, at a firm level. Our study validated the earlier findings of [70,71]. They all advocated the positive impact of GI on the value creation aspect of the company, by increasing the efficiency of the processes, along with an increase in the customer and investor base for environmentally friendly green companies.

The second part of our research indicates that environmental management plays a considerable moderating role between the GI and Tobin's Q (financial performance). Effective EM practices provide the basic framework for the implementation and success of GI. This is because decision-makers have a much clearer vision, as all of the potential actual costs related to the implementation of such innovations are accounted for, so the decision-making process becomes more precise and effective. These findings support the eco-efficiency theory, which holds that companies that adopt environmentally friendly practices can achieve better levels of corporate performance, as held by [67,74], for reasons mentioned earlier in this section.

When it comes to companies under private ownership, our findings indicate that these firms are better off considering all of the stakeholders rather than just focusing on the wealth creation of shareholders. Society rewards such firms by endorsing their products and services, which ultimately improves their financial and corporate performance, resulting in wealth creation for shareholders, more efficiently, via value creation. Thus, the management of companies needs to broaden their horizons from just fulfilling their legal obligation to adopting environmentally friendly practices as a matter of corporate policy.

Our study has important implications for regulators and governments to promote firm performance; employing environmental innovation measures and regulation plays a key role in green process innovation [5,13,17]. The government can encourage companies to use dirt-free technology, taxes, abatement subsidies, green public purchases, etc. [36]. We also endorse earlier findings by [37,75,76]. Our results indicate that governments need to attach incentives for companies that adopt GI and actively peruse environmentally friendly practices. This can be achieved by providing tax incentives for lowering carbon omission and reducing customs duties and tariffs on environmentally friendly equipment [32]. Regarding China, the environment is the next big issue for this rapidly developing country. Even though the government has implemented a comprehensive environmental policy, the government needs to incentivize environmental policies by providing incentives for companies that follow environmental standards, to encourage other companies to adopt GI, and make it a necessary part of their corporate strategy.

This study provides a useful understanding of issues related to the adoption of GI, and its overall positive impact on the performance of companies, from the Chinese perspective. The major limitation of this research, which can be considered by future researchers, are the choice of variables, as future researchers can add certain variables to further endorse or refute the findings of the present research. Moreover, the present research is based on data of Chinese companies; in the future, researchers can increase the dataset by including companies from other countries, and conduct cross-sectional research with similar variables [77,78].

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