Article

Environmental Outcomes of Green Entrepreneurship Harmonization

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Abstract: Establishing equilibrium between business growth and environmental sustainability is one of the core focuses of green entrepreneurship. However, the scarcity of resources, ecological concerns, business growth, and survival are among the issues that are recognized by entrepreneurs. In the light of the Natural Resource-Based View (NRBV) and Dynamic Capability View, this study aims to examine the effects of Green Innovation Performance (GIP) on Green Entrepreneurship Orientation (GEO) and Sustainability Environmental Performance (SEP). As advocated by NRBV, this study emphasizes the importance of pursuing the three types of distinct yet interrelated environmental strategies and its association impact on GEO. The results indicated that internal green dynamic capabilities, namely, green absorptive capacity, environmental cooperation, and managerial environmental concern to have significant positive effects on GIP, where GIP positively impacted GEO and SEP. Besides, GIP partially mediated the relationship between internal green dynamic capabilities on GEO and SEP. The results also demonstrated that environmental regulations significantly moderated the relationship between GEO and SEP. Furthermore, by linking these three concepts in a single model, this study theoretically pioneering and responding to bridge significant gaps emerged in the NRBV theory. This study provides crucial practical implications for entrepreneurs, policymakers, and academicians. Limitations were also discussed.

Keywords: green entrepreneurship orientation; green innovation performance; sustainable environmental performance; dynamic capability theory; the natural resources-based view

1. Introduction

The significantly increasing impacts of environmental issues in China are due to the rapid economic development of the nation [1,2]. Hence, eco-innovation has become a critical factor for capturing eco-friendly opportunities and ecosystem [3] in order to reduce the natural degradation of resources [4,5]. As such, green innovation is deemed as the primary source for advancing the industry [6], by also considering various environmental aspects [7,8]. Firms are strongly considering to compulsorily apply green innovation practices [9] due to the advanced external pressure from consumers (eco-friendly products), ecology (pollution, quality of groundwater), community (health threats), and the government (governance of revenue) [10,11]. Therefore, the scarcity of resources, increased human needs and preferences, community pressure, and government regulations require firms to achieve a balanced approach between business growth and sustainable development [1,12].

Dynamic capability theory (DCT) advocate that green entrepreneurship orientation (GEO) is the firm's proactive strategies that intend to capture green business opportunities in the light of the entrepreneurial ecosystem [1], whereas green innovation performance viewed as the firm's internal capability that facilitates GEO strategies to influence firms sustainable environmental performance

(SEP) [13]. Understanding the interrelationships embedded within and between these three concepts is quite difficult, and previous studies have overlooked this. The core focus of DCT are internal capabilities that lead to improving the existing procedures, techniques, and processes by reconfiguration and restructuring business engineering [14], while ignoring the external environment of an organization which is the key determinant of achieving GEO and SEP goals. Therefore, the natural resource-based view (NRBV) [15] that originated from the resource-based view (RBV) [16,17] emerged to cover these deficiencies of DCT theory which suggest that firms are able to achieve SEP in the light of entrepreneurial ecosystem when: (1) environmental market failure has been getting significant attention by firms' GEOs, and by (2) improving their relationships with different external environmental partners. However, this study questions that GEO have not been well-addressed in the light of NRBV, and further yet, there is a need to investigate the effects and catalyst role of GEO and their consequences on environmental performance based on this approach. The literature shows fragmented and lack of studies that examining GIP-GEO on SEP in the light of NRBV which motivates us to further conduct and examine these theoretical gaps by empirically testing the interrelationships.

This study thereby fills these theoretical gaps by explaining the process of how each concept complements each other in the light of these two theories. The novelty of this study is that it first introduced these three concepts in a single model and addressed the missing link between and within them, especially where entrepreneurship literature [18,19] and eco-innovation are fragmented [20]. Second, the study explored and empirically tested the impact of the three major factors that are associated with external natural environment, namely, green absorptive capacity, managerial environmental concern, and environmental cooperation on improving the effect of GEO on SEP facilitated by GIP from the DCT and the NRBV lenses.

Studies on green innovation and the numerous relevant concepts have been extensively done within the current literature of management [1,21]. Much attention is given to concepts that involved clean technology, environmental and sustainable innovation, eco-innovation, ecosystem, ethical motivation, and green technology. Nonetheless, the process of GIP and the related driving forces that foster GEO have yet to be highlighted within these studies. This associative course of action is essential to establish environmental governance within the SEP.

In addition, even though entrepreneurship is the term that brings the changes into every single part of firm life [18,22], studies have understood the correlation and the embeddedness meaning of the term at the individual and organizational level [19,23,24]. On the other hand, the GEO primarily focuses on environmental products that match the economic and ecological benefits [25]. The implementation of GEO will aid in combating the extant environmental problems. Therefore, when more firms adopt green practices, entrepreneurs are more encouraged to be oriented towards greening processes and eco-friendly products [26]. Lately, GEO is gaining attention due to its ability to drive superior environmental development [27]. Moreover, from the NRBV point of view, GEO can be seen as a primary source of improving the deployment of internal dynamic capabilities and achieving entrepreneurial ecosystem goals.

GEO focuses on environmental issues via creating green products and services by implementing green innovation concepts [14,28]. Secondly, GEO is also more attentive towards the work environment of employees by ensuring safety and health by controlling hazardous emissions [29]. Finally, it also prioritizes social welfare by protecting consumer safety and health [30]. The more established is the GIP in terms of technical and strategical application, the more GEO goals are achieved, which leads to the sustainability of environmental performance [31]. Hence, organizations that focus on green innovation applications and procedures within relevant environmentally business units would have the advantage of achieving the intended beneficial outcomes. Hence, GIP is vital in achieving superior environmental sustainability and GEO [26]. The relatedness between GIP, GEO, and sustainability performance is thus far not clearly understood due to the different environmental conditions [32] and the fragmentation of entrepreneurship literature [18,19].

Globally, the growing concern among consumers for eco-friendly products has become the strategic focus of GEO which allows them to further their business growth and economic

development [31]. GIP plays a significant role in the achieving GEO goals, thus, bridging the link between GEO and environmental sustainability. However, the literature has shown the distinctive gap between theoretical constructs and practical management [14,33]. Therefore, this paper aims to provide significant implication for academicians, policymakers, and manufacturers.

GIP involves improvement of manufacturing processes towards energy saving, pollution control, reduce degradation of resources, and impede further negative impacts on different environmental aspects [34]. The core motivation of the past literature was to explore the benefits of applying green innovation applications and its effects on ecological and socio-economic benefits [1]. Scholars from the NRBV approach [15,35–37] argued that firms that seek to achieve sustainable competitive advantages in the uncertain business environmental market are required to select, manage, and create ecofriendly strategic resources to fit the external natural environment and exploit ecofriendly opportunities.

Some studies have investigated the effects of GEO on GIP [26,38]. However, the extent of GIP's influence on GEO and environmental sustainability remains unclear, particularly within the petrochemical industry which is considered as the primary driver of environmental issues [39,40]. This paper aims to interpret the type of conditions in which GIP influences GEO and the extent of the increase in SEP through the lens of dynamic capability theory and the NRBV. This perspective is highly ambiguous, and therefore needs to be investigated extensively.

Due to the inconsistent results between GEO and SEP [41], this paper introduced a critical factor intended to test the power of environmental regulations towards environmental sustainability performance. The process and concept underlying GIP are complex due to the varied aspects within the organization and the environment. This results in a lack of underpinning theoretical framework and challenges in accessing data when interpreting the holistic relationship between GIP and environmental issues [42]. From the NRBV lens, we propose that environmental regulation as an external factor that helps firms to facilitate leveraging of green practices to achieve environmental goals.

Understanding the interrelationship between GIP, GEO and SEP in a single model is theoretically and practically important to explore the critical role of particular core capabilities [14]. A good understanding will lead to empowering GIP in order to support green entrepreneurship. GEO here is defined as maintaining environmental performance, thereby balancing economic benefits and ecological sustainability. To date, no known study has addressed these three building blocks in a single model reflecting the core focus of entrepreneurial ecosystem in the length of the NRBV, including global environmental concerns [1,14].

Following the logic of the DCT and the NRBV, this study aims to answer the main research question concerning the mechanism to achieve sustainable environmental performance by supporting green innovation practices and entrepreneurial ecosystem. The main research question is followed by sub-questions: (1) Is GIP able to provide a green platform for GEO to foster sustainable environmental performance? (2) To what extent GIP will increase the impact of its environmental and dynamic factors on GEO and SEP? (3) Does GEO have a direct effect on sustainable environmental performance? (4) To what extent will environmental regulation moderate the relationship between GEO and SEP? This research intends to contribute to the eco-innovation and entrepreneurship literature with an evidence-based empirical investigation of the relationship between GIP, GEO, and SEP, as well as the potential moderating effects of environmental regulations, targeting a full sample size of 518 firms operated in petroleum and petrochemical industry in China. This research investigates one of the major sources of environmental problems in China which is the primary cause of air and groundwater pollution, CO_2 emission, ecological and agriculture problems, and community welfare issues.

Based on the findings, GIP plays a significant role in achieving SEP by supporting the entrepreneurs' actions in managing business goals and environmental concerns. Besides that, GIP also effectively and efficiently fosters green activities which in turn supports GEO proactively by capturing and exploiting ecofriendly opportunities to be integrated into the green operation system. This study contributes significantly to firms' decisions making by providing a comprehensive

interpretation of strategically improving GIP practices. Through these informed actions, business goals can be planned by addressing the parameters of societal and environmental concerns to achieve GEO.

This paper consists of a brief overview of the relevant literature, relevant concepts, and hypotheses, accordingly. This is followed by an explanation on the methods. The next sections present the results and discuss the findings and their relevance to academicians, entrepreneurs, and policymakers.

2. Theoretical Background and Hypotheses Development

2.1. Dynamic Capability Theory, the Natural Resource-Based View, and Green Absorptive Capacity

Recently, entrepreneurs are highly concerned by environmental issues due to their significant effects on society, human activities, ecosystem, and natural degradation. As a result, a considerable number of firms have applied new techniques and strategies to foster GI practices in order to deal with the increasing global environmental concerns [14]. Consequently, firms have introduced eco-friendly products and services, green business processes, and methods to avoid further environmental damages and pollution (quality of water ground, air) [34]. These initiatives are recognized as necessary to balance the development of economic needs and the subsequent environmental concerns [9]. On the other hand, a firm's Absorptive Capacity (AC) is its ability to move from the actual knowledge base, management, and operation systems to the newer and developed mechanisms in line with the business and management changes [43]. AC allows the organization to create new knowledge, routines, skills, culture, and know-how which then enables an organization to be more flexible towards environmental conditions and changes [13]. Hence, AC is considered as the main dynamic capability driver of organization-based knowledge. This power of creation, assimilating, transforming, and exploiting new knowledge is the focus of the AC concept [44].

In the light of greening, the purpose of AC is to empower an organization to create new knowledge, leveraging green organizational learning and skills, and upgrading green business processes in the form where competitors unable to understand the process of eco-friendly production systems to fit environmental requirements [45]. Green innovation has been associated with the application of new ideas within environmental practices to create green workplace, techniques, methods and knowledge, which result in the efficient use of resources, reduced pollution, and a cleaner ecosystem [46].

Hence, the AC is crucial in carrying out innovative green activities that emphasize the rational use of resources to achieve environmentally ecofriendly business opportunities. AC played a significant role in fostering innovative outcomes (balance between business needs and environmental concern) in which firms were able to suit the environmental conditions.

Therefore, from the lens of the NRBV and DCT, this study views AC as an organizational capability that seeks to enable GIP toward achieving sustainable environmental performance. AC helps firms to develop their capacities by acquiring, assimilating, and integrating the new external knowledge to support different business operation practices to meet environmental concerns. Considerable studies [13,47] have examined the relationship between AC and GIP. These studies suggested that the extent of support by top management in the intensive acquisition of knowledge and green innovation-based learning would have an impact on the increase in GI practices within different environmentally business units. Hence, an increase in GIP applications would require more support from the management.

However, few studies have linked the relationships within the process of AC that fosters GIP to empower GEO in achieving SEP. The delineation of this path is crucial. As the success of GIP is highly dependable on AC, most firms should be well-informed on the capabilities of AC in transferring actual knowledge, routine, skills and processes, and the extent of the integration with new sources of knowledge that would address the environmental concerns. In order to overcome this critical gap in the literature, this study intends to examine the ability of a firm's AC to capture and acquire relevant

knowledge from external sources toward facilitating GIP (e.g., green workplace, green production techniques, and clean technologies). This will in turn lead to achieving GEO goals.

To conclude, green absorptive capacity act as an intermediary dynamic capability source in understating firms' external natural environment and facilitating GEO to achieve and maintain environmental performance. GAC as dynamic capability support firms to upgrade and leverage green practices which in turn resulted in facilitating GEO initiatives and achieving environmental performance. Thus, from the NRBV and DCT, this study aims to fill this theoretical gap by empirically testing the following hypotheses. Therefore, we hypothesize that:

H1a. AC positively influences GIP.

H1b. GIP mediates the relationship between AC and GEO.

H1c. GIP mediates the relationship between AC and SEP.

2.2. The NRBV and Effects of Managerial Environmental Concern (MEC)

Although the impacts of GI on environmental performance are present, how it occurs remains ambiguous. Hence, the resolution made by the top management in the engagement of GI based on environmental concerns and strategic decisions has more impact than assuming the best practices or specified business policies [44]. Managers who view GIP to be crucial in business growth as well as sustaining and protecting the environment will likely put more effort in terms of attention, time, and support to strengthen the possible impacts of GI within various environmental contexts [12]. However, in the context of the petrochemical industry, worldwide firms are facing strong external regulations to improve environmental performance. Thus, the development of GI products become a critical task for R&D managers and production technicians in order to reduce the degradation of natural resources, waste, air pollution, and groundwater quality [48]. Moreover, the NRBV argues that to achieve and maintain competitive advantages, firms are required to involve in their strategies factors that associated with natural environment due to the increased impact of these environmental restrictions [49].

Thus, GIP is the key advantage of an organization to exploit ecofriendly business opportunities by embedding their external natural environment factors within green practices deployment. These interactions of environmentally natural factors will increase the impact of GEO initiatives to maintain environmental performance. Therefore, this study argues that MEC is an essential player in determining if the firms can continuously pursue GI at a product-process level in order to fulfil the optimum conditions of the environmental system [44], and in understanding and responding to external natural environmental restrictions.

Studies [41,50,51] have found that MEC does have a significantly positive impact on the applied strategies that are concerned with the environmental innovation adoption. However, the existing literature indicates that so far very few studies [41,50] have examined MEC and its relationship with GEO, GIP, and SEP. Therefore, in this study, MEC is assessed as the philosophy of top management on how to strengthen innovation capability towards eco-friendly products to suit environmental requirements. The more that managers are involved in addressing strategies based on environmental concerns, the more that GIP capabilities are increased. Hence, the involvement of GEO is encouraged in greening the corporation in response to environmental problems.

In the context of China, the increased global pressure (the Paris Climate Agreement) on the Chinese authorities is due to their major contribution to the changing climate and immense pollution by their industries [52]. The petrochemical industry is one of the many industrial sectors that face the severity of natural degradation and is continuously exploring alternative measures to achieve environmental sustainability [53].

Hence, empowering green innovation capabilities is a strategic task to be undertaken by managers to successfully green the production and process systems [34]. The commitment of an organization and rigorous managers should be centralized in order to support MEC and to

strategically increase the performance of GI products [41]. Ultimately, strengthened entrepreneurs' behaviors empower GI practices. Following the NRBV lens, MEC seems to be central driver in absorbing environmental activities fluctuation in line with environmental business process changes. The capabilities of GIP, therefore, can be improved when managers embed natural environmental activities within green practices. These mechanisms of connectedness between manager concerns, environmental activities, and green practices enable the GEO proactive strategies in enhancing the entrepreneurial ecosystem.

An empirical study targeting managers (production, R&D, and marketing of Chinese firms) [41] investigated the moderating effects of MEC between GI and firm performance. The authors reported that MEC negatively moderated the relationship between GI product and firm performance. This critical evidence indicated that firms are still reluctant to invest more in GI products due to the increased operating costs and reduced revenues. Leaders in these firms are encouraged to be committed to improving ecosystem performance through strategic plans that conform to the objectives of environmental sustainability. While the relevance of the MEC within the strategic plans of managers can improve GIP, the reluctance of managers to invest in GI that result in suitable environmental conditions is the critical issue. Efforts must be invested towards strategizing and interpreting these conditions in achieving economic and sustainable objectives into procedures that will alleviate the further deterioration of resources.

From the NRBV lens, the negative role of MEC in strengthening the impact of green innovation product on firm performance [41] might due to the failure to embed natural environmentally activities within the production system strategies as a determinant of ecofriendly product or managers' lack of environmental awareness. Therefore, this study argued that managers need to be aware and apply their strategies based on environmental activities to foster the capabilities of green innovation performance in understanding and capturing eco-business opportunities. Exploring green business opportunities that are captured by GEO is dependent upon the firm's capability to leverage and exploit green innovation practices which in turn create competitive advantages and maintain environmental performance. MEC therefore, takes strategic place in the interpreting and applying green practices in the light of environmental responsibilities to foster entrepreneurs' capabilities and environmental performance. By applying these two lenses, the study also argued that the firm performance capabilities of green practices might increase the impact of MEC on both GEO and environmental performance. Thus, we hypothesized:

H2a. Managerial environmental concern positively influences GIP.

H2b. GIP mediates the relationship between managerial environmental concern and GEO.

H2c. GIP mediates the relationship between managerial environmental concern and SEP.

2.3. Environmental Cooperation (EC) and the NRBV

During uncertain environments, maintaining superior environmental performance is highly influenced by the extent of strategies initiatives that involves environmental responsibilities. The NRBV emphasizes those environmentally activities that must be incorporated into green strategies and practices [49]. Collaboration and establishing relationships with external parties are recognized to be more valuable and meaningful to acquire and sharing knowledge and technologies [54]. An empirical study by Higgins and Yarahmadi [55] revealed that collaboration with external partners facilitated the introduction of environmental innovations within the production systems. Hence, organizational collaborations encourage the progress of corporate green strategy by implementing green technologies that result in green processes and products. Supporting GI capabilities to green the corporation products and processes will ultimately lead to the improvement of sustainable development performance [56].

In the manufacturing industry, cooperation between different internal and external stakeholders is the key to successfully deploying green supply chain management. Suppliers that provide eco-

friendly raw materials can assist a factory in successfully achieving GIP [33], besides catering to the environmental preferences and choices of eco-friendly products by customers. A previous study on Korean electronics firms has examined the effects of integrating environmental cooperation into financial and non-financial performances [57].

Another study by Perotti and Zorzini [58] addressed the effects of environmental cooperation and green supply chain initiatives on adopting green supply chain practices to improve the firm's performance. Meanwhile, Diabat and Khodaverdi [59] investigated the differences in performance that is measured through the impact of integrating suppliers, customers, and green supply chain practices.

Past studies focused on the link between green supply chain literature and environmental cooperation on firm performance [54,55,58,59] by applying several theoretical bases in explaining environmentally activities while neglecting the NRBV lens. In addition, the literature poorly provides theoretical and empirical results on the impact of environmental cooperation on GIP, GEO, and SEP. Hence, this study addresses this emerging critical gap of understanding of the relationship based on environmental concerns between the relevant mechanisms and the collaborations that can foster GIP and GEO to meet environmental responsibilities [15,60]. Hence, this study bridges this theoretical gap and extending entrepreneurship and eco-system literature in explaining the phenomenon from the NRBV lens [15,61].

In an environment where resources and opportunities are scarce, firms are required to establish relationships with universities or research laboratories to foster innovation and capabilities-based collaborations. This measure in turn leads to creating new production systems and techniques [62] to support production efficiencies, enhance GIP [63] ,and reduce environmental pollution which refers to improving SEP [64]. Hence, firms that achieve GI through innovation cooperation are empowering green business growth [65]. Thus, supporting GIP through innovation cooperation based on environmental concerns will result in balanced green business growth, customer satisfaction, and ESP [65]. However, fewer studies have attempted to examine the underlying mechanism of environmental cooperation as a determinant of GIP.

Based on a recent empirical study [64] in advanced manufacturing technologies, GI (products and processes) is significantly influenced by internal environmental cooperation. Whereas, Albort-Morant [43] stated that strong interrelationships with stakeholders could strengthen GIP through the assimilation and transfer of new knowledge into production and managerial systems.

Accordingly, since cooperation based environmental innovation is falls within the core focus of the NRBV and following this perspective, this study argues that to enhance green innovation practices, environmental performance, and achieve competitive advantages, firms must create links and interorganizational collaborations in the light of existing environmental problems which ultimately help to maintain and foster GEO goals and a sustainable eco-system.

Applying the NRBV lens, this study aims to analyze the collaborative process based on environmental innovation to enhance GIP and GEO towards achieving SEP. This research, therefore, bridges the gap that emerged in entrepreneurship and eco-innovation literature by linking and empirically testing the direct impact of EC on GIP, and the indirect impact on both GEO and SEP through the existing mediating effect of GIP. Wee hypothesized that:

H3a. Environmental cooperation positively influences GIP.

H3b. GIP mediates the relationship between environmental cooperation and GEO.

H3c. GIP mediates the relationship between environmental cooperation and SEP.

2.4. The NRBV, Green Innovation, and Environmental Entrepreneurship

Environmental degradation is becoming a global concern for all stakeholders, policymakers, and the public [66]. Consequently, development based on green economic growth is necessary for this new era of industrial revolution 4.0. Hence, GI is the key driver of balancing environmental

degradation and economic development [67]. GI is a collective practice seeking to save resources through increased production efficiencies and impeding further environmental pollution [56] by applying advanced clean technologies and production systems [48] to facilitate green business growth. Due to the scarcity of resources and environmental regulations [46], organizations are required to integrate environmental concerns into their GI practices. Therefore, exploring entrepreneurial business opportunities through greening their processes and products has become a critical driver to deal with the increased customer and market environmental awareness [60]. Thus, firms that drive business growth through the deployment of GI strategies are able to effectively respond to environmental regulations and to achieve superior SEP [68].

Previous studies have determined several factors that influence GI such as big data, green human resource management, coordination and dynamic capabilities, green supply chain management, smart manufacturing solutions [69], environmental regulation, and green shared vision [14]. Besides identifying the factors to maintain the performance of green innovation, an organization must manage and strategize business plans, especially when resources in a highly demanding. Studies that have addressed the outcomes, mechanisms, and solutions in this field are scarce [33].

Besides that, other studies [6] explored the role of knowledge accumulation, collective learning, and GEO as an antecedent of GI. The failures of entrepreneurs in gaining entrepreneurial ecofriendly opportunities due to the poor green practices deployment which has led to significant environmental concerns [31]. Based on the concepts discussed, investigations on this critical gap will allow us to understand entrepreneurs' behavior towards greening their corporations comprehensively. Nevertheless, GEO is only deemed successful when GI practices are integrated into the overall business strategy [70]. Most firms have, therefore, been encouraged to examine numerous opportunities in integrating GI within the expected goals of green strategy. Besides, since the core focus of GEO is to yield economic and ecological benefits, fostering GI practices is the most suitable for achieving this particular central goal of GEO [1]. Consistent with this point of view, GEO reflects the proactive strategy of an organization to sense, determine, and exploit market opportunities to generate business growth and ecological sustainability through the deployment of GIP [31]. Therefore, this study aims to examine the interrelationship between GIP and GEO in the context of the petrochemical industry in China.

GIP acts as the core driver to improve the eco-system which remains as the main concern of entrepreneurs. From the NRBV and DCT lens, this study seeks to analyze the critical contribution of GIP to achieving GEO goals. Dynamic capability literature failed to provide a comprehensive examination concerning the impacts of GIP on GEO to improve environmental performance which led to generate several inconclusive results and debates. Therefore, this research desires to bridge this gap by combining both lens and linking all three concepts into a single model to empirically test the hypotheses. The NRBV emphasizes on the issue of environmentally concerns and the sustainable competitive advantages (SCA) which this overlooked in the body of dynamic capability view [15,49], thus combining both lenses would open new door and research stream.

Next, using these two theories, we aim to address the relationship between GIP, GEO, and SEP to better understand the critical interrelationship path among these variables to overcome the concerns of environmental responsibilities [15,60]. In addition, Gast and Gundolf [26] argued that in order to yield green value-added, fostering GIP (clean technologies, advanced production systems, air emission hazards, etc.) is the key strategic solution for entrepreneurs to generate value-added based on environmental responsibilities. Key factors that foster GIP practices that influence the GEO in achieving and maintaining environmental performance are determined. Thus, we hypothesized that:

H4: GIP has a positive effect on GEO.

2.5. The NRBV, Green Innovation, and Environmental Performance

According to NRBV, environmental activities are an important driver of green competitive advantage especially within the increased environmental concerns [36,49]. The increase in demands

from customers and the global market at large have led to the rapid deterioration of natural resources. Hazardous gas emissions, compromised groundwater quality, decrease in marine wealth and abundance of chemical waste were some of the effects of industrialization in response to increasing the global economy, which resulted in the emergence of unexpected ecological and socio-economic concerns [61]. Suggestions had been made to apply green practices as a strategic solution in managing these environmental concerns. Through the green practices, advanced clean technologies and production systems would be used [43]. Employees would also be encouraged to acquire a green mindset within the technical parameters of work and training [71] and green engineering [39] that would lead to an overall enhanced corporate environmental strategy [1]. Besides, sustained and improved green innovation encouraged technical advancements (cleaner production systems) and green entrepreneurship, which would be supportive of environmental performance [72]. Therefore, to foster GIP and improve SEP [56], activities that could threaten the environmental had to first be identified before exploring and investing in cleaner production systems within the green practices as solutions [73].

Although past research provided evidence on factors that influenced green innovation (products-processes), aspects that improve the performance of green innovation were still limited. Moreover, specific reasons related to the core focus of GIP had continuously been overlooked, which led to ambiguity in reported ecopreneurship achievements. These aspects would be crucial for entrepreneurs to determine essential green capabilities that can be applied within core activities to avoid environmental issues. These processes would ultimately support clean production systems and improve environmental performance. Using the NRBV theory, this study is a pioneering one that intends to address the impact of green innovation on environmental activities from this lens. Hence, we hypothesized:

H5: Green innovation performance has a positive effect on sustainable environmental performance.

2.6. Green Entrepreneurship Orientation and Environmental Performance

Green entrepreneurship practices had been critical strategies to improve economic benefits, empower social welfare, and prevent environmental degradation in addressing the scarcity of resources and increased constraints of environmental concerns [1]. Also known as green entrepreneurship, this system rationalized the use of limited resources to increase productivity efficiently besides fostering environmental performance [74]. Hence, these practices exploited opportunities in business advancement and increasing market value [1]. The natural resource-based view suggests that to maintain and ensure the survival of businesses especially within the increased of several environmental concerns, firms should take into consideration external environmental aspects in the heart of their strategies and practices [15,36].

As a result, from this lens we can understand the concerns of ecopreneurship in obtaining ecofriendly business opportunities in the light of environmental responsibilities. Green chemistry and green engineering are viewed as key solutions to reduce environmental degradation [39]. The safety and health of workers safety can also be improved by applying green chemistry, which would hamper harmful emissions and toxicology that can cause ecological degradation [75]. Green entrepreneurs who made efforts to maintain the environment would create value-added green technologies and green engineering through the innovation of manufacturing processes [76] as well as meeting the ISO 14000 requirements to comply with human and environmental concerns.

Based on the DCT, GEO yielded alternative paths and systems in developing new products and processes through renewable configuration and developing new value-added green capabilities. Meanwhile, the NRBV provides a comprehensive view on how to capture ecofriendly business opportunities when entrepreneurs imperatively respond to environmental responsibilities. Thus, combining these two lenses, this study extends the body of knowledge of entrepreneurship and dynamic capabilities literature in understanding the phenomenon under investigation. Thus, this study hypothesized:

H6. GEO had a positive effect on SEP.

2.7. Moderating Effect of Environmental Regulation (ER) and the NRBV

Environmental regulation (ER) has been the driving force of green innovation [77], which empowered GEO in protecting the environment, economy, and community [78]. The core focus of GEO was to create eco-friendly products and services that were beneficial both economically and ecologically, through the implementation of green innovation processes as solutions to environmental problems [60]. Nonetheless, these benefits could only be achieved when entrepreneurs received support from external stockholders [34,38]. Past studies found environmental regulation supported and influenced GEO by enabling GIP through financial incentive support [79], innovative policy, facilities and tax discount [38], R&D grant and patents protection [31], clean production system [80], and green workplace environment [81]. These factors would strengthen the green practices which led to sustain environmental performance.

Government innovation policy was supportive of firms to encourage R&D expenditure investment in clean production systems and technologies by introducing green industry funds and green subsidies [82]. This support resulted in high GIP, which had observed minimal environmental degradation while maintaining environmental sustainability [29]. Therefore, the extent of GIP being applied technically and strategically would result in the achievement of GEO that enabled the sustainability of environmental performance. Nonetheless, studies asserted that environmental regulation and green technological innovation were dependent on the learning capabilities and environmental practices of individuals and organizations, which would result in differences in GI practices and performances [83].

Firms that complied to the environmental regulation would improve the environment by reducing CO_2 emission [84], improving efficiency in production systems [85], and increasing eco-friendly products [86]. These steps not only led to an increase in productivity within the available resources [87], but natural degradation could be eliminated, which encouraged environmental performance [88,89]. The NRBV scholars asserted that the relationships between firms and their external environment responsibilities must be close, hence, ER can be seen as a catalyst source of improving GEO and environmental performance.

Also, past studies that examined the effects of ER on GIP and indirectly on GEO had yet to address the impact of ER on SEP. Hence, the current investigation in exploring this critical transitive relationship between ER, GEO, and SEP in the presence of GIP could be crucial in expanding the body of knowledge in green entrepreneurship and dynamic capability literature. By applying both lenses, this study assumed that the more significant the emphasis of environmental regulation on GIP, the more robust GEO would be in mediating between economic and ecological benefits in achieving high environmental performance sustainability. This study hypothesized:

H7. Environmental regulation moderated the relationship between green entrepreneurship orientation and sustainable environmental performance.

Following the above discussion, Figure 1 proposes the theoretical model that developed based on prior empirical studies and aimed to fill the emerged gaps that exist in the literature by examining the interrelationships between GIP, GEO, and sustainable environmental performance in the light of entrepreneurship theory and dynamic capability view.
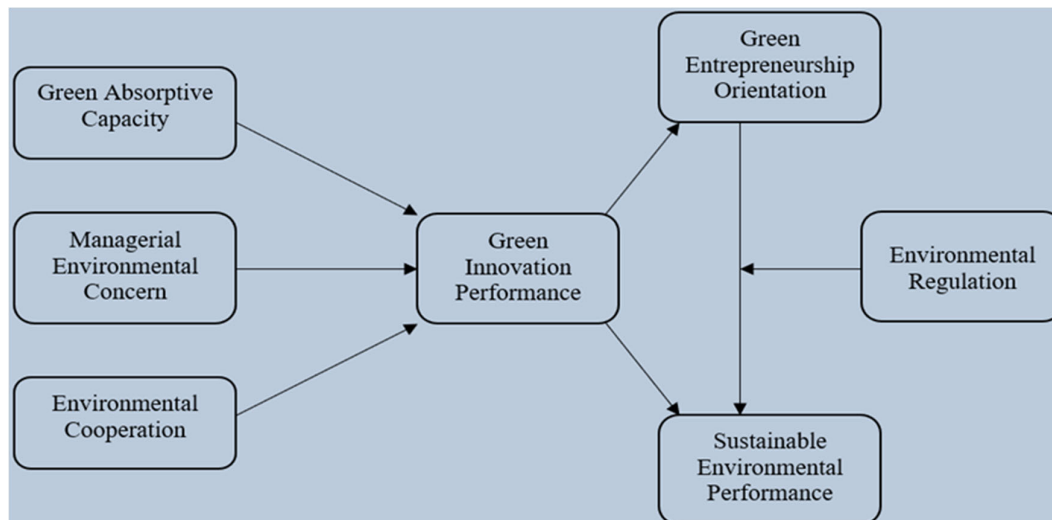
Figure 1. Theoretical Framework.

3. Methodology

3.1. Scope and Reasons for Choosing the Petrochemical Industry

This study employed a quantitative deductive survey on petroleum and petrochemical firms in China. This investigation was carried out based on the different policies, procedures, funds, and regulations by the authorities that supported green economy development, which reflected the environmental concerns and a need to protect the ecosystems [1]. The petroleum and petrochemical firms caused significant environmental impacts (ecological and socio-economic). This study assumed that by empowering GIP, the firm's entrepreneurial orientation could be influenced, and the performance of GI practices in ensuring environmental performance would lead to economic benefits as ecological concerns were addressed.

The extent of GI practices in increasing performance and as a response to the public concerns through actions by entrepreneurs remained unclear. Several communities in China suffered from compromised groundwater quality, air pollution, and hazardous CO_2 emissions due to industrialization of petrochemical firms [40]. The high global death rate due to these environmental hazards had accounted for nearly one million people, which costs billions of yuan yearly [1]. Since the impact of environmental concerns became more apparent at socio-economic, and environment level, with ambiguous empowerment of GI practices, several actions had to be taken by petrochemical entrepreneurs. Multiple past studies examined the effects of actions taken by entrepreneurs towards GIP, though investigations on the influence of GIP on GEO in responding to governmental and societal regulation toward ensuring environmental performance were lacking.

3.2. Sampling and Targeted Respondents

The focus of this study was on GIP, GEO, and SEP in the context of petroleum and petrochemical industry. From the list of 11,140 firms registered in State Administration for Industry and Commerce of the People's Republic of China, and adhering to the formula by Krejcie and Morgan [90], the sample size of this study was 370 firms. Respondents (managers of the production, the R&D, the environmental protection as well as the marketing units, and CEO) were selected to provide data to address the objectives and demonstrate the different relationships in this study. An email with a cover letter attached was sent to the selected firms that explained the importance of participation in this study and that all data would be of utmost confidentiality. A dual-language (English and Chinese) questionnaire was then distributed to the sample and was then followed up by calls. As suggested by Wolf et al. [91], actions were made to avoid any missing survey along with low-response rate, thus this study added 40% of surveys to the total simple size.

Hence, through self and postal distribution, this study distributed 518 questionnaires across all provinces in China, and successfully had collected 226 usable surveys. Thus, the response rate of this study was 43.6%. Data were collected through a 7-point Likert scale that ranged from 1 (strongly disagree) to 7 (strongly agree). To ensure the items in the questionnaire used for this study were adequate, clear, and easy to be understood, an in-depth process of content validity was conducted. Two experts from the research department at the School of Management, University of Guizhou in the validation, which was then followed by an interview with four experts in petrochemical firms in Guangdong province, China. The interview further validated the questionnaire by distinguishing each construct of items to reflect each variable of this study. The output from the academics and experts were carefully incorporated into the final draft of the survey. A pilot study was carried out on 16 companies, which were selected at random through personally contacting the managers. The results obtained showed that internal consistency and composite reliability of all variables ranged from 0.836 to 0.928, with a high-reliability coefficient. The items in the survey were then adjusted accordingly and the final version that had been established was then translated into the Chinese language.

As tabulated in Table 1, respondents in this study were well-educated, experienced and underwent several training programs in managerial and interpersonal skills provided by the respective firms. The majority of the firms had engaged in the petrochemical industry for many years, which was one of the major sources of economy in China.

Table 1. Background of the respondents and firms.

Respondents Profile	Frequency	Percentage (%)
Education		
Degree	106	46.9%
Master	72	31.8%
PhD	22	9.7%
Others	26	11.6%
Years of experience		
1 to 5 years	34	15%
5 to 10 years	118	52.2%
More than 10 years	74	32.8%
Firms age		
1–5 years	18	7.9%
6–10 years	54	23.9%
More than 10 years	154	68.2%
Ownership structure		
Private firms	131	57.9%
Collective and state-owned firms	67	29.7%
Foreign firms	28	12.4%
Position		
Production manager	33	14.6%
Executive director	41	18.2%
Engineers	25	11%
Director of the environment	32	14.2%
Marketing managers	22	9.7%
R&D directors	18	7.9%
CEO	44	19.5%
Others	11	4.9%
Number of employees		
50 to 100	54	23.9%
100 to 250	63	27.9%
251 to 500	77	34%
More than 500	32	14.2%

3.3. Measurement of Variables

The measurement used in assessing the variables for this study was adapted from past studies to suit the context of petrochemical industry in China and fit the objectives of the study. Hence, items from Pacheco et al. [13] were used to measure green absorptive capacity. Items on managerial environmental concerns were adopted from studies by Xue and Boadu [44] and Eiadat and Kelly [92]. Environmental cooperation was assessed by adapting items from Younis and Sundarakani [57] and Vachon and Klassen [93] while items on green innovation performance were adapted from Pacheco et al. [13] and Chen and Lai [94]. Green entrepreneurship orientation adapted items from a study done by Jiang and Chai [1]. Items on environmental regulation were adapted from He and Huang [95]. Finally, items that assessed sustainable environmental performance were adapted from Jiang and Chai [1] and El-Kassar and Singh [12].

4. Data Analysis

This study the applied Partial Least Square (PLS) technique using SmartPLS 3.0 software [96] to predict and assess the measurement model (convergent and discriminant model) and structural model. Both models in this study were complex (mediation and moderation effect), which suited PLS-SEM that allowed predictive purposes [97] of endogenous factors to be maximized while maintaining more items for each factor. The sample size of this research was adequate to be analyzed using PLS-SEM though the distribution of sample data was not normal [98].

This study assessed the validity and reliability of the measurement tool while examining the structural model using the significance of path coefficient and the effect size of endogenous factors on exogenous factors, before calculating the determination value (R^2). Finally, the blindfolding procedure was applied to examine the relevance of the research models (Q^2) (Hair et al., 2014).

Independent samples *t*-test was applied to avoid any possibility of non-response bias (the differences between former and latter respondents that might share same characteristics). The Levene's test for equality of variance was found to be higher than 0.05 for all constructs, which suggested that this study was free from non-response bias, and the requirement of significance level had been fulfilled [99]. Nonetheless, measurement errors should be identified to ensure the validity of the overall relationships in the model. This procedure was carried out through common method variance (CMV) by applying full collinearity test. The estimated observed values of variance inflation factors (VIFs) generated for all research model must be lower than 3.3 [100]. The results showed that the model was free of CMV.

4.1. Validity and Reliability of the Measurement Model

The measurement model consisted of convergent and discriminant validity. PLS 3.0 was used to assess convergent validity by testing the outer loading, factor loading, composite reliability, and average variance extracted (AVE) of the indicators. As shown in Table 2, indicators loading was higher than 0.707 and included only the remaining significant items for each variable [101]. The composite reliability for all constructs was higher than 0.7 [98], while AVE values were also higher than 0.5 ([102].

Table 2. Measurement model results.

Constructs	Item	Loadings > 0.707	CA > 0.7	CR > 0.7	AVE > 0.5
Environmental Cooperation	EC 1	0.76	0.93	0.94	0.67
	EC 2	0.79			
	EC 3	0.84			
	EC 4	0.89			
	EC 5	0.71			
	EC 6	0.87			
	EC 7	0.86			
	EC 8	0.80			

Green Absorptive Capacity	GAC 1	-			
	GAC 2	-			
	GAC 3	-			
	GAC 4	0.75			
	GAC 5	0.82	0.92	0.94	0.70
	GAC 6	0.91			
	GAC 7	0.74			
	GAC 8	0.90			
	GAC 9	0.87			
	GAC 10	0.82			
Managerial Environment Concern	MEC 1	0.84			
	MEC 2	0.81	0.87	0.90	0.70
	MEC 3	0.84			
	MEC 4	0.85			
Green Innovation Performance	GIP 1	-			
	GIP 2	0.84			
	GIP 3	0.85			
	GIP 4	0.86			
	GIP 5	0.88	0.94	0.95	0.67
	GIP 6	0.88			
	GIP 7	0.83			
	GIP 8	0.75			
	GIP 9	0.75			
	GIP 10	0.71			
Green Entrepreneurial Orientation	GEO 1	0.82			
	GEO 2	0.80			
	GEO 3	0.78	0.85	0.89	0.63
	GEO 4	0.81			
	GEO 5	0.75			
Sustainable Environmental Performance	SEP 1	0.84			
	SEP 2	0.85			
	SEP 3	0.84	0.89	0.92	0.65
	SEP 4	0.78			
	SEP 5	0.81			
	SEP 6	0.71			
Environmental Regulations	ER 1	0.73			
	ER 2	-			
	ER 3	0.76			
	ER 4	0.73			
	ER 5	0.71	0.90	0.91	0.54
	ER 6	0.72			
	ER 7	0.71			
	ER 8	0.81			
	ER 9	0.76			

Discriminant validity was required to test the Fornell–Larcker criterion, which compared the correlation between constructs with the square root of AVE of a specific variable. As shown in Table 3, the values that were in bold were higher than the values within the respective row and column, indicating that the measures used in this study were discriminant. The cross loading criterion was assessed, and the results revealed that the outer loading exceeded cross-loading for all constructs and remained valid.

Table 3. Fornell–Larcker Criterion and Heterotrait–Monotrait Ratio (HTMT).

Variables	EC	ER	ESP	GAC	GEO	GIP	MEC
EC	**0.812**						
ER	0.601 (0.69)	**0.734**					
ESP	0.732 (0.71)	0.701 (0.64)	**0.827**				
GAC	0.781 (0.63)	0.694 (0.76)	0.767 (0.78)	**0.801**			
GEO	0.704 (0.78)	0.518 (0.53)	0.684 (0.72)	0.609 (0.73)	**0.795**		
GIP	0.667 (0.70)	0.578 (0.56)	0.604 (0.54)	0.637 (0.67)	0.712 (0.62)	**0.832**	
MEC	0.423 (0.42)	0.596 (0.61)	0.367 (0.47)	0.434 (0.48)	0.39 (0.45)	0.323 (0.34)	**0.841**

One of the crucial tests in the evaluation model was the Heterotrait–Monotrait (HTMT) ratio [96] which was used when the study was unable to detect the lack of discriminant validity through the Fornell–Larcker criterion and cross-loading. Therefore, this study applied an HTMT ratio test to ensure that the model was well-examined. The values presented in the parentheses of Table 3 was less than 0.80, whereby the value in fulfilling the criterion of HTMT was at least 0.85 [103]. Hence, the discriminant validity was achieved in this study, with the HTMT inference showing a confidence interval of values less than 1.0 for all variables [96] that confirmed the discriminant validity further.

4.2. Structural Model

Results for the structural model are presented in Figure 2 and Table 4. Using the PLS analysis technique, the hypothesized path was tested and showed a positive and significant relationship between GAC and GIP ($B = 0.090$, $t = 2.00$, $p < 0.001$). Hence, H1a was supported. Managerial environmental concern path was positive and statistically significant on GIP ($B = 0.317$, $t = 7.09$, $p < 0.001$), which indicated that H2a was supported. Environmental cooperation had a positive and significant effect on GIP ($B = 0.372$, $t = 8.04$, $p < 0.001$), suggesting that H3a was supported.
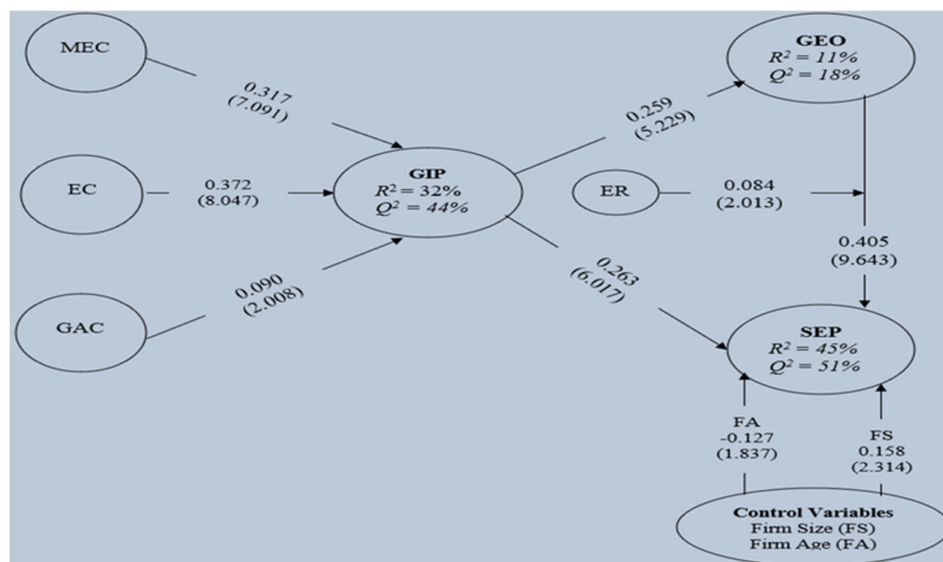

Figure 2. Results of Structural Model with Moderator Effect. GAC: Green absorptive capacity, EC: Environmental cooperation, MEC: Managerial environmental concern, GIP: Green innovation

performance, GEO, Green entrepreneurship orientation, SEP: Sustainable environmental performance. ER: Environmental regulation.

Table 4. Results of the structural model analysis.

Hypotheses	Relationships	Beta	T-Value	*p*-Value	f^2	Decision
H1a	GAC -> GIP	0.090	2.00	0.00 ***	0.118	Supported
H2a	MEC -> GIP	0.317	7.09	0.00 ***	0.087	Supported
H3a	EC -> GIP	0.372	8.04	0.00 ***	0.236	Supported
H4	GIP -> GEO	0.259	5.22	0.00 ***	0.102	Supported
H5	GIP -> SEP	0.263	6.01	0.00 ***	0.115	Supported
H6	GEO -> SEP	0.405	9.64	0.00 ***	0.258	Supported

Note: *** Significant at 0.001 (1 tailed).

Moreover, the results based on Figure 2 and Table 4 also showed that GIP significantly and positively influence GEO (*B* = 0.259, *t* = 5.22, *p* < 0.001*)* and SEP *(B* = 0.263, *t* = 6.01, *p* < 0.001) respectively. These results indicated that H4 and H5 were supported. GEO showed a significant and positive effect on SEP (*B* = 0.405, *t* = 9.64, *p* < 0.001), which suggested that H6 was supported.

The study also assessed control variables. The findings (Figure 2) indicates that the size of factories possess a positive impact *B* = 0.158, and statistically significant *t* = 2.36 indicating that the more firms mobilizing intellectual capital, the more acquiring experiences and skills towards leveraging green practices, whereas years of operation was negatively *B* = − 0.127 associated with firm environmental performance but was statistically significant *t* = 1.83 asserting that some factories still struggle to apply green practices, which resulted in huge environmental degradation.

4.3. Effect Size of the Model

By testing the effect size of the constructs on a particular dependent variable, the extent of these factors being connected and affected GIP simultaneously can be determined to demonstrate the strength of the model [101]. As depicted in Table 4, the effect size of GAC, MEC, EC were 0.11, 0.08, and 0.23 suggesting that the effect of GAC and MEC on GIP was small and EC on GIP were moderates. Whereas the effect size of GIP and ER on GEO was small, respectively. The effect size of GIP and ER on SPE was also small. Lastly, the effect size of GEO on SPE was moderate [104]. Moreover, all these constructs contributed and explained the high-value variance of R-square (32%) on green innovation performance, GEO (11%), and SEP (45%), which indicated the reliable relationships between the dependent variables.

4.4. Testing Mediation Effect

The mediation effect of GIP between EC, GAC, and MEC on GEO and SEP was tested by applying the Preacher and Hayes [105,106] approach. The bootstrapping procedure was used to test the indirect effect, as suggested in the literature. Result showed that the indirect effect (GAC -> GIP -> GEO) had B value of 0.028 and t value of 2.23, respectively. As recommended by Hair et al. [107], the variance accounted for (VAF) was calculated to determine the indirect effect size in relation to the total effect. Thus, the VAF = direct effect/total effect had a value of 0.028/0.090 = 0.311, which indicated that 31.1% of GAC effect on GEO was explained via the existence of mediation effect of GIP. Since the VAF was greater than 20% but less than 80%, GIP partially mediated this relationship, whereby H1b was supported. The results in Tables 5 and 6 show that the indirect effect of (GAC -> GIP-> SEP) had a *B* = 0.029, t = 2.30, respectively. Hence, the VAF = 0.029/0.090 = 0.322 indicated that 32.2% of GAC effect on SEP was explained by the mediation effect of GIP, suggesting that this relationship was partially mediated. Thus, H1c was supported (see Tables 5 and 6).

Table 5. Indirect effects in the mediation model.

Hypotheses	Relationship	Beta	SE	T-Value	*p*-Value	Decision
H1b	GAC -> GIP -> GEO	0.028	0.013	2.236	0.00 ***	Supported
H1c	GAC -> GIP -> SEP	0.029	0.012	2.308	0.00 ***	Supported
H2b	MEC -> GIP -> GEO	0.066	0.020	3.375	0.00 ***	Supported
H2c	MEC -> GIP -> SEP	0.067	0.018	3.731	0.00 ***	Supported
H3b	EC -> GIP -> GEO	0.107	0.025	4.315	0.00 ***	Supported
H3c	EC -> GIP -> SEP	0.109	0.020	5.396	0.00 ***	Supported

Note: *** Significant at 0.001 (1 tailed).

Table 6. Variance Accounted for (VAF) of the Mediator Variable for Green Entrepreneurship Orientation (GEO) and Sustainability Environmental Performance (SEP).

Independent Variable	Mediator Variable	Dependent Variable	Indirect Effect	Total Effect	VAF (%)
GAC	GIP	GEO	0.028	0.090	31.1
GAC	GIP	SEP	0.029	0.090	32.2
MEC	GIP	GEO	0.066	0.317	20.8
MEC	GIP	SEP	0.067	0.317	21.1
EC	GIP	GEO	0.107	0.372	28.7
EC	GIP	SEP	0.109	0.372	29.3

Note: GAC, green absorptive capacity; MEC, managerial environmental concern; EC, environmental cooperation; GIP, green innovation performance; GEO, green entrepreneurship orientation; SEP, sustainable environmental performance.

Based on the results from Tables 5 and 6 that followed the same method of calculation, this study found that the VAF for H2b and H2c to be 20.8% and 21.1%, respectively. These results suggested that GIP partially mediated the relationship between MEC, GEO, and SEP, and supported both H2b and H2c. Lastly, the results of the mediation effect of GIP between environmental cooperation and GEO was (B = 0.107, t = 4.31, *p* < 0.001). The VAF value was 0.107/0.372 = 0.287, indicating that 28.7% of EC affecting GEO was explained by the mediation effect of GIP. Hence, this relationship was partially mediated, supporting H3b. The mediation effect of GIP on the relationship between EC and SEP was significant (B = 0.109, t = 5.39, *p* < 0.001). The VAF had a value of 0.109/0.372 = 0.293, which showed that 29.3% of EC effect on sustainable environmental performance occurred with the existence of mediation effect of GIP, supporting H3c (see Tables 5 and 6).

4.5. Testing the Moderation Effect

This study used the product indicator approach [108] and applied the PLS technique to assess and determine the strength of the moderation effect of environmental regulation (ER) towards the relationship between GEO and SEP. Figure 3 showed the results for the strength of ER towards the relationship between GEO and SEP.
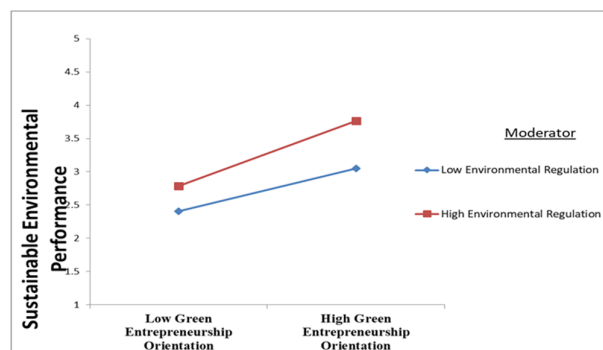
Figure 3. Moderation effect.

Results from Table 7 indicated that environmental regulation positively and significantly moderates the relationship between GEO and SEP (B = 0.08, t = 2.05, p < 0.001). Thus, H7 was supported.

Table 7. Results of moderation effect of environmental regulation.

H	Relationship	Beta	T-Value 2 Tailed	p-Value	f^2	Decision
H7	ER*GEO -> SEP	0.084	2.013	0.00	0.137	Supported

Note: t-value >1.96.

Figure 3 showed that the presence of the moderator variable, ER, affected the intensity of the positive relationship between GEO and SEP (0.405; t = 9.31), as depicted in Figure 3. This result suggested that higher environmental regulation (supported by funds, R&D investment, tax preferences, and clean technologies) would have a greater effect on green entrepreneurship and sustainability environmental performance (ecological and socio-economic aspects).

In this study, the strongest interrelationships among the constructs of the structural model were determined by the predictive relevance *(Q^2)*. Using the blindfolding procedures [109], predictive relevance test was applied through PLS path modelling to detect Q^2 value for GIP, GEO, and SEP. Values greater than zero would predict that the model was relevant. The nearer of the Q^2 value was to 1 would indicate the greater relevance of the model, which would reflect the power of the model [98]. As presented in Table 8, the values of predictive relevance of GIP, GEO, and SEP were 0.44, 0.18, and 0.51 respectively. As shown from these Q^2 values (Table 8), when GIP was more relevant which also suggested more power, the influence on GEO was greater and further affected SEP. This relationship between the three crucial variables (GIP, GEO, and SEP), as explained through the structural model, addressed the pertinent issues related to environmental sustainability.

Table 8. Results of variance explained by constructs and predictive relevance of the research model.

Construct	Variance Explained R²	Predictive Relevance Q^2
Green innovation performance (GIP)	0.32	0.44
Green entrepreneurship orientation (GEO)	0.11	0.18
Sustainable environmental performance (SEP)	0.45	0.51

5. Discussion

DCT lens viewed GEO as a dynamic capability that fosters firms to achieve environmental and organizational performance in a highly uncertain environment, whereas GIP seen as a dynamic practice that reconfigure the business process to absorb ecofriendly business opportunities. Also, from the NRBV lens, GEO can be seen as an entrepreneur responsiveness or alertness to external environmental responsibilities while keep searching for opportunities, whilst GIP is an imperative task of an organization responding to external environmental activities. Advancing this perspective, we examined the role of GIP in assisting firms to maintain environmental performance through empowering GEO.

This study contributes to developing the theory about entrepreneurship and eco-innovation by extending the body of knowledge of dynamic capability view by incorporating the NRBV lens to overcome the deficiencies observed in past studies. Overall, it is essential to understand the interrelationships between GIP, GEO, and SEP as a holistic model. GEO can only grow when firms involved in green practices. This helps to update and keep continuously maintain environmental performance.

The reason behind improving the performance of GI practices capabilities is mainly because it can foster and support the actions taken by entrepreneurs toward greening the overall business strategy, which in turn, meet their business goals from the lens of the growing societal and ecological concerns. The primary contribution of this study is the exploration of three integral research streams in the area of entrepreneurship using a single model, in which the interrelationships between green innovation performance, green entrepreneurship orientation, and sustainable environmental performance were assessed. The study outcomes seemed to support the argument and the hypothesized paths pertaining to the critical role of GIP on both GEO and SEP, in which the effects of the proposed factors of green absorptive capacity, managerial environmental concern, and EC on green entrepreneurship and environmental performance were vivid in the presence of GIP as the mediator. While most prior studies [14,73,110] examined the effect of GEO on GIP, they neglected external environmental responsibilities. As such, this study extends previous research work by theoretically and empirically investigating this critical path to support the decisions made by entrepreneurs in light of external environmental responsibilities. This is because GEO is highly determined by the extent to which GIP capabilities is increased or otherwise [14].

The significantly positive impact of green absorptive capacity on firm's GIP signifies that these firms do understand that fostering GIP and reducing environmental problems are enabled by integrating new knowledge into green practices, which then leads to restructuring business engineering, production system techniques, workplace environment [111], and eventually, environmental concerns [13]. This study revealed that GAC had a significantly positive effect on both GEO and SEP, especially when GIP served as a mediator. This implies that successful green entrepreneurs need to absorb and explore new opportunities that suit the increasing external environmental concerns [13,112]. The GIP, which reflects a combination of GAC [111] and GEO [113], is integral to achieve the noble objective that advances industry and economy without influencing ecological systems [13,72]. This study found that GIP was highly impacted by the success and flexibility of the top management absorbing, assimilating, and applying the newly explored knowledge (data) across firms hierarchy translated into green factory (e.g., practices, procedures, routines, tasks, and culture) [44,114]. The DCT upholds GAC as a major driver of business growth in the highly fluctuated environment [111], while views GIP as the key source of reconfiguration existence systems to match new business opportunities [1] the integration of GAC, GIP, and GEO helps an organization to meet environmental concerns [113], and address the scarcity of resources in line with advancing ecological and economic development [115]. As such, this study appears to be the first empirical study that has successfully linked GAC, GEO, and SEP in a single model mediated by GIP in understanding how complement each other.

The study outcomes revealed that managerial environmental concern exemplified a significantly positive impact on GIP; denoting that the top management displayed strong awareness about environmental responsibilities [44]. This resulted in supporting entrepreneur's decision-making toward investing more in clean technologies, advanced production system, and workplace improvement that can lead to high environmental performance. This study extends the past empirical research work [41,116,117] by putting forward the evidence that the interaction between MEC and GIP can substantially influence and improve GEO, along with SEP. The MEC practices and their implications [41,44,117] increased the responsibilities taken toward internal and external environment, hence enhancing GI practices at all level. The MEC exerted a positive and direct effect on GIP [44], while indirect impact on GEO and SEP through the mediation effect of GIP. This means fostering GIP capabilities can increase GEO that ultimately improves environmental performance.

It was discovered that EC exhibited a significantly positive effect on GIP, whereas a significantly positive and indirect impact on both GEO and SEP through the mediation effect of GIP. This implies that EC is a strategic source to establish relationships with external partners, such as private and public laboratories, external consultants, and inter-organizational relationships, to yield innovative cooperation based on environmental concern, which in turn, significantly influence firms overall green practices [55]. The finding is significant for management practices since this evidence clearly demonstrates the importance of collaboration based on common benefits that weigh in socio-

economic and ecological benefits as a primary concern [54]. In order to successfully foster GIP, these firms are required to establish innovation collaboration based on environmental responsibilities [64], which is the central pillar of environmental cooperation of an organization and its external parties. Collaboration with government (regulations and tax preferences), private and public laboratories (R&D), inter-organizational collaboration (suppliers of green raw materials, clean technologies, eco-friendly products preferences, and production systems) appears to be the driving force of GIP and GEO, which can lead to enhance environmental performance [54,55].

This study had investigated the moderating role of environmental regulation on the link between GEO and SEP. The findings support the moderation hypothesis, indicating that the more the government and other stakeholders support green business initiatives, the greater entrepreneurs will be oriented toward greening their factories [2,82]. More environmental regulation that supports GEO by improving the environmental activities of GI practices [118], and greater GEO empowerment can result in a high green mindset among entrepreneurs [72] to strike a balance between business growth survivability and environmental performance sustainability [119]. From the NRBV theory, this empirical study supports the practices that must be undertaken by entrepreneurs in light of environmental concerns prior to engaging in any investment, particularly if it is based on the scarcity of environmental resources [120]. As illustrated in Figure 3, increase in environmental regulation enhances environmental performance through GEO and their responsibility to external environment.

6. The Implication for Research, Practice, and Limitation

The DCT acknowledges green absorptive capacity as the key driver of GIP and GEO to empower a firm's capability to transform green knowledge into the existing ones [1,14], so as to respond with environmental restriction through the development of green practices to address environmental concerns [41]. The GAC is commonly fostered in a firm's abilities to understand and adopt cutting-edge environmental changes through green practices, besides incorporating the existing ones into newly absorbed green practices [111]. These will result in high eco-friendly products, environmental sustainability, and green business growth [121]. This study found that GAC, directly and indirectly, influenced GIP, GEO, and SEP; signifying that entrepreneurs' proactive actions are empowered by the effect of GAC that can successfully absorb new opportunities, flexible responsiveness with external environmental changes and restrictions, and understand customer environmental awareness [113]. Hence, enabling manufacturers to support internal green capabilities to achieve superior environmental performance.

While DCT advocates that GEO is a proactive compulsory action taken in the highly fluctuating environment to strike a balance between restrictions and opportunities [5,14], the entrepreneurs take significant responsibility to environmental activities [1,120,122], thus demanding them to maintain environmental resources while continuously conducting their businesses. Consequently, this study applied the two theories to explain the issues of greening mindset (entrepreneurs) [123], and greening factories (practices) toward sustainable environmental performance [26], which eventually led to the understanding of the potential of pursuing businesses in highly scarcity resources and dynamic environment.

This study has extended the DCT by demonstrating strong evidence about environmental activities to support green practices, in order to protect firms moving from stable to high dynamic environment (greening restrictions) without any increased cost, lost opportunities, market changes or customer preferences, hence maintaining environmental performance [13]. Additionally, this study has established one of the pioneer theoretical models to examine and understand the interrelationships among eco innovation, green entrepreneurship, and environmental performance in a single model in the light of natural external environment and dynamic capability view which have been overlooked by past researchers. As such, the study outcomes support the arguments held by DCT and extend the body of entrepreneurship literature by elaborating the critical effect of natural environmental activities. Entrepreneurs seeking to explore market opportunities need to consider environmental responsibilities [36,49,124], as argued by the NRBV theory.

Given the crucial role of green absorptive capacity, environmental cooperation, and regulation, as well as managerial environmental concern on GIP, GEO, and SEP it is crucial to comprehensively explore the implications of findings reported in this study. Managers should explore the market opportunities and exploit the existing internal capabilities through green absorptive capability, in which the latter offers firms the ability to do so by reconfiguring, developing, and applying new capabilities that accompany the explored opportunities, which in turn, update firms with cutting-edge changes. The results tend to prove that inter-organizational collaboration based on sharing the newest environmental innovation practices can foster GIP capabilities, thus successfully empowering entrepreneur's action to explore and extend market opportunities, and then, gain competitive advantages. The findings of this study suggest that managers possess high environmental awareness that is highly associated with the successful GIP capabilities, as they can update their overall business strategy by responding to environmental restrictions, thus ensuring the business advancement in accordance with environmental sustainability. It was also found that governmental cooperation and regulations significantly associated with achieving super environmental performance through sponsoring R&D activities, clean technologies, advanced production systems techniques, tax and funds facilities resulted in continuously greening entrepreneurs' mindset action, responding to customer's environmental awareness with eco-friendly products, and setting up a green workplace environment that enhances awareness among employees.

This study has several limitations that can be improved in future studies. First, this study focused on an industry that generates ecological problems. There would be other industries with a considerable effect on environmental sustainability that may be explored using other methods. Second, this study was carried within the parameters of petrochemical firms in China. The findings of this study might not be applied in an international context due to the differences and consequences of environmental impact as well as firms' green orientation culture thus, it is suggested to test and extend this research model within other industries and contexts. Third, this research had applied the cross-sectional survey to investigate the outlined hypotheses, whereby the truth of the phenomenon may not be well-observed. A longitudinal survey is suggested to observe the developmental progress of GIP, GEO, and SEP across time, whereby critical effects between these three essential variables of ecological and socio-economic sustainability can be further examined.

Future research should acknowledge individual, organizational, and institutional roles on GIP, GEO, and SEP, whereby the development in the capabilities of GIP and the relationships across all these three levels toward environmental sustainability can be intensively explored. Besides, as no study has investigated the relationship between green workplace environment on GIP and GEO within the knowledge of this research, future investigations may want to assess this critical link toward the success of green practices among employees. Moreover, studies that apply this model in other contexts and economy settings may potentially discover unique factors linked with GI practices, environmental sustainability, and green entrepreneurship.

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