*Pol. J. Environ. Stud. Vol. 34, No. 1 (2025), 311-327*
DOI: *10.15244/pjoes/186419* ONLINE PUBLICATION DATE: 2024-07-29

*Original Research*

# Empowering Green Choices: How Laws Influence Ecological Commitment, Environmental Knowledge, and Green Technology Adoption for a Cleaner Tomorrow

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*Received: 28 December 2023*
*Accepted: 23 March 2024*

**Abstract**

The threat of environmental degradation caused by production activities is growing worldwide owing to the unsustainable behavior of firms. Environmental legislation plays a central role in developing firms' conservation-oriented and nature-friendly behavior. Limited literature is available on how environmental legislation affects firms' nature-friendly behavior and adoption of environmentally friendly technologies. This research presents an empirical investigation into the intricate interplay between ecological commitment, environmental knowledge, firms' nature-friendly behavior, and the adoption of environmental technologies within organizations. Moreover, the study examines the moderating role of environmental law between firms' nature-friendly behavior and the adoption of environmental technologies. Data were collected from 401 firms through face-to-face and online surveys during the pandemic in China. The study used Partial least squares structural equation modeling (PLS-SEM) to analyze the collected data. The results show significant associations between ecological commitment ($\beta = 0.421$, $p<0.01$), environmental knowledge ($\beta = 0.301$, $p<0.01$) and firms' nature-friendly behavior. The findings also reveal that a firm's nature-friendly behavior ($\beta = 0.271$, $p<0.01$) positively influences its adoption of environmentally friendly technologies. Similarly, environmental law positively and significantly moderates the relationship between firms' nature-friendly behavior and the adoption of environmental technologies. Therefore, firms should align their values and operations with ecological commitment, fostering a culture of environmental responsibility that permeates all levels of the organization.

**Keywords:** environmentally friendly behavior, environmental laws, green technologies, ecological knowledge, clean production

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## Introduction

In the context of the twenty-first century's global challenges, one of the most pressing issues confronting humanity is the urgent need for environmental sustainability [1]. The unprecedented pace of industrialization, urbanization, and technological advancement has resulted in remarkable economic growth and technological innovation [2, 3], but it has also catalyzed a parallel acceleration in ecological degradation [4]. Climate change, biodiversity loss, air and water pollution, and resource depletion have become ever more palpable threats to the planet and its inhabitants [5, 6]. In response to this ecological crisis, there has been a noticeable increase in the number of individuals advocating for businesses to assume a substantial portion of the burden in addressing environmental damage and guiding society towards a more sustainable trajectory.

The concept of "green entrepreneurship" has risen to prominence as a promising avenue for businesses to contribute positively to environmental preservation while maintaining economic viability [7, 8]. Green entrepreneurship surpasses the conventional pursuit of profit; it represents a commitment to fostering ecological well-being and sustainable development [9]. This statement highlights a significant transformation in the perspective and conduct of businesses, recognizing the necessity of attaining economic success while preserving the essential ecosystem that sustains all living beings.

The interconnection between a firm's ecological commitment, the adoption of environmental technology, and the incorporation of nature-friendly behavior has emerged as a significant area of focus in the field of green entrepreneurship. Firms that choose to pursue green entrepreneurship prioritize the principle of sustainability and environmental responsibility [10] as a basic element of their business identity. They aim to balance their economic goals with ecological stewardship [11] by implementing innovative technologies and practices [12] that lower their impact on the environment and help in the restoration and preservation of the natural ecosystem. Therefore, in view of current environmental issues, it is more important than ever to implement green entrepreneurship [13]. This is a major change in the business environment, as firms are now realizing the importance of balancing their economic growth with ecological concerns [14]. Therefore, the success of this transition is contingent upon the complex interplay between the firm's commitment to ecological sustainability, evidenced by their emphasis on the adoption of sustainable practices [15], by integrating innovative environmental technologies to mitigate their environmental impacts [16], and adoption of behavior that promote the conservation of ecosystem [17]. The symbiotic relationship mentioned highlights the comprehensive transformation of enterprises into environmentally conscious entities. This transformation ultimately leads to the emergence of green entrepreneurship as a powerful means for achieving sustainable development [18].

However, the journey towards green entrepreneurship is far from straightforward. Businesses face a multifaceted landscape rife with challenges, including but not limited to technological barriers, resource constraints, regulatory complexities, and changing societal expectations [19]. Among these challenges, the role of environmental laws has emerged as a pivotal factor that can catalyze the evolution of green entrepreneurship within firms.

The comprehension of the moderating role of regulatory frameworks is crucial in shaping this landscape. The establishment of environmental laws and regulations serves as the fundamental basis for the current framework of environmental governance. These legal instruments are designed to guide and constrain the behavior of firms, prescribing norms and standards that aim to curtail pollution, protect natural resources, and mitigate environmental risks. Yet, their influence on the intricate interplay between ecological commitment, the adoption of environmental technology, and the manifestation of nature-friendly behavior within firms remains a subject of significant academic and practical inquiry.

This study is positioned at the intersection of these critical domains: ecological commitment, environmental knowledge; environmental technology, firms' nature-friendly behavior, and the moderating role of environmental laws. It endeavors to unpack the complex relationships that exist among these elements and contribute to the burgeoning field of green entrepreneurship research. By doing so, it seeks to provide valuable insights into how businesses can successfully navigate the intricate terrain of sustainability, technology, and regulatory compliance in their quest to become environmentally responsible entities.

The possible beneficiaries of this study include policymakers, different firms, and non-governmental organizations working to mitigate the effects of climate change in developing countries. The study would also be helpful in enhancing sustainable consumption and production, reducing greenhouse gas emissions, a prime cause of climate change in the world, and undermining multiple sustainable development goals.

## Literature Review

Academic studies have shown that laws are important to alter the adoption of technology. Arkesteijn and Oerlemans [20] found that different technological modifications, corporate features, and regulations have a significant impact on shaping technology adoption, particularly in SMEs. Weng and Lin [21] testified that corporate performance and environmental laws motivate Brazilian firms to become involved in the adoption and advancement of technologies. Yunus et al.

[22] investigated the role of regulations in technology adoption and found supportive evidence in favor of said narrative. Koo and Chung [23] securitized various factors that influence IT adoption; however, the authors ranked external laws and regulations at the top of the list. Chan et al. [24] explored that eco-ratings, symmetric information, and government policies are some of the important strategies that improve green technologies in the construction sector. Darko et al. [25] identified that costs, knowledge, and regulations are the factors that impact eco-technology adoption. Darko et al. [26] studied the Ghanaian economy and found that governmental laws and ethics could promote the adoption of new technologies. In the context of the Malaysian economy, Asadi et al. [27] explained that green IT revaluation is supported by the relevant laws. Wang et al. [28] found that it is not the economic factors alone that contribute to technology adoption but prior knowledge and nations' laws and regulations as well.

Moreover, the countries' laws and regulations have strong implications for eco-commitment as well. Ma [29] explored the need for relevant laws that enhance eco-commitment in developing countries. Henri and Journeault [30] found that environmental commitments are fostered through economic performance and public visibility in the context of Canada. Kesidou and Demirel [31] identified that saving costs, building corporate capabilities, and strict rules can contribute to shaping eco-commitment and corporate innovation. Verschuuren [32] explained that the recent environmental legislation is not enough to enhance environmental efforts. More specific and enforceable regulations are required. Akhtar-Khavari [33] studied that environmental laws supported by mutual cooperation between businesses and government are significant in enhancing environmental efforts. Maior et al. [34] found that ecological commitment is deeply influenced by the laws and regulations that subsequently foster sustainable development. Xu et al. [35] described that eco-legislations are an integral part of promoting environmental commitments.

Environmental laws are not only beneficial for technology adoption but also enhance knowledge. Some of the studies explored this area of research. For example, Kiss and Shelton [36] explored that environmental laws and their proper publications could significantly improve knowledge and, subsequently, their adaptability. Bram [37] found that regulations and laws are important to build knowledge among businesses and individuals. Boyd et al. [38] examined how environmental laws and policies can promote eco-knowledge. The findings provide strong verification in support of said arguments. Natarajan and Khoday [39] found that relevant laws, particularly in the areas of environment and eco-protection, improve information among individuals and businesses. Pavlovych [40] analyzed the impact of legislation on environmental knowledge and found supportive evidence for the mentioned narrative. Lian et al. [41] identified that knowledge regarding the environment and perception of risk are enhanced through laws and regulations. Jester et al. [42] studied the role of eco-protection laws and their enforceability in determining knowledge and adaptability.

## Hypothesis Development

Regardless of the extent to which individuals experience a sense of proximity or affiliation with nature, there exists a mutual dependence between humans and the natural environment, such that the welfare of one can impact the welfare of the other in a bidirectional manner.

The relationship between commitment and ecological behavior has primarily concentrated on the commitment in a unidimensional context, specifically commitment to behavior [43]. The commitment to a partner has significant importance in all relationships and the conceptualization of commitment as a unique construct [44]. Likewise, the firms may regard their environment as an extension of a partner, exhibiting varied degrees of commitments. The theory of interdependence proposed by Kelley [44] and subsequently refined by Rusbult and Arriaga [45] is widely accepted as the foremost conceptual framework of understanding the complexities of interpersonal relationships. This theoretical framework emphasizes the influence of structures of relationships on the motivations and behavior of a person during the course of a relationship. Therefore, the interdependence theory provides an extensive framework for analyzing the relationship between humans and the environment. This interdependency between humans and environment as a whole welfare of one entity can influence the other. Dependence pertains to the degree to which humans rely exclusively on a certain relationship partner, such as the environment, in order to satisfy important requirements.

The significant extension of interdependence theory is represented by the theory of relationship commitment proposed by Rusbult [46]. This theory is widely recognized as the foundational model in the study of human relationship. The fundamental principle of this relationship commitment theory explains that the increased dependency level on the partner will strengthen the sense of commitment toward their partner. Therefore, the high dependency on the partner for the satisfaction of needs can be distinct from the commitment as a subjective interpretation of dependency [47]. Rusbult et al. [48] have described commitment with three interdependent characteristics including, cognitive attachment, the intention to persist, and a commitment to the future. As per our argument, individuals form a personal sense of commitment toward the environment, which is characterized by a deep psychological connection and sustained tendency toward the environment. The relevance of intent to persist in the relationship between humans and the natural environment appears to be limited. The level of an individual's perceived dependence on the natural environment for their personal well-being, such as deriving pleasure from engaging in activities, is directly proportional to their level of commitment towards preserving the environment. This implies that individuals who enjoy spending time in ecological settings are more likely to exhibit a keen interest in ensuring the long-term well-being of natural resources.

Individuals who possess a perception of interdependence with the natural world may exhibit a corresponding transformation of motivation, leading to behaviors that align with the preservation of the environment. In the field of close relationship research, it has been observed that a significant level of perceived commitment towards one's partner is positively associated with pro-relationship behavior, encompassing both cognitive and behavioral aspects. Agnew et al. [49] discovered that in the cognitive domain, couples demonstrated greater cognitive interrelationships, which refers to a shared mental representation of oneself and one's partner when their level of commitment was higher. There is a positive correlation between high commitment and the willingness to make sacrifices for the benefit of one's partner [50]. In summary, individuals who exhibit a commitment towards their intimate relationships will probably undergo a shift in their motivational orientation, leading them to engage in behavior that prioritizes the welfare of their partner (i.e., the environment) or the relationship as a whole. Thus, it is postulated that:

H1: There is a positive relationship between ecological commitment and firms' nature-friendly behavior.

Environmental knowledge pertains to the comprehension and recognition of environmental issues, along with prospective resolutions to these challenges. The widely accepted interpretation of environmental knowledge pertains to empirical data concerning environmental structures, functions, and processes. The manifestation of responsible environmental behavior is a result of a learned process that is not developed in isolation but rather in response to various interacting components. The intellectual strand is a crucial component that encompasses environmental knowledge [51]. This knowledge includes a comprehensive understanding of the ecological principles and processes that are fundamental to comprehending the impact of human activities on ecosystems. Additionally, it involves recognizing the interrelationship between human social structures and the environment and the ecological problems that arise from these complicated relationships. Furthermore, the intellectual strand encompasses strategies of environmental action, which include the ability to recognize and critically assess possibilities for rehabilitation [52]. The intricate and non-linear nature of the interplay between intellectual elements (knowledge) and behavior has been extensively studied by researchers. It has been demonstrated that augmenting someone's environmental knowledge leads to a greater likelihood of exhibiting positive and responsible ecological behavior [52]. Possessing knowledge about the environment is a significant indicator of engaging in environmentally conscious behaviors [51]. Individuals who lack awareness of environmental issues are less likely to exhibit conscious concern or engage in environmentally sustainable behavior [52]. The ability to make informed environmental decisions is hindered by the absence or inaccuracy of information [53]. Thus, it is postulated that:

H2: There is a positive relationship between environmental knowledge and firms' nature-friendly behavior.

The impact of behavior on actual conduct is well-recognized by psychologists and social scientists [54]. In a previous study, Venkatesh et al. [55] found that the willingness to embrace technology significantly influences the actual adoption of technology. Numerous scholars use intention conduct as a proxy for actual adoption behavior [56]. Environmental technology is now developing a competitive strategy in response to rising environmental restrictions and the pursuit of optimum sustainability results. Moreover, the implementation of Green Innovation Adoption requires organizations to make significant advancements in their processes and goods, which inherently include potential environmental hazards [57]. The larger businesses have a greater readiness to incorporate novel technologies, capabilities, and both external and internal environments. Moreover, these organizations are more inclined to manage possible risks effectively. Accordingly, in alignment with fundamental theory and research frameworks, it is anticipated that firms' nature-friendly behavior will have a significant impact on environmental technology. Therefore, we propose the following hypothesis:

H3: There is a positive relationship between firms' nature-friendly behavior and environmental technology adoption.

The population as a whole may not possess in-depth knowledge of the detrimental impact of their consumption patterns. Even the most basic waste of everyday items, such as fresh produce, can potentially have significant adverse consequences for the environment. According to the expectancy theory, legislative measures offer anticipated incentives or outcomes that have the potential to elicit favorable behavior. The principle of the rule of law holds immense significance in the routine affairs of individuals. The concept of the rule of law exerts a preventive and corrective effect on individuals' behavior, establishing a legal incentive to adhere to ethical standards [58]. The aforementioned legislation holds significant sway in guiding endeavors within the context of ecological consciousness. The researchers highlight that environmental regulations and legislation incentivize farmers to receive financial aid for growth in agriculture. The present investigation examined the environmental-oriented behavior of farmers by considering both internal and external factors, including laws and policies. This approach was taken because individuals' behavior is shaped by a variety of external factors, such as societal norms and legal regulations, along with their own life experiences. In the present study, an assessment was made regarding the moderating impact of laws, with legal cognition being taken into account as an external variable. Our argument posits that the implementation of environmental laws has a positive effect on curbing revolutionary behavior in farmers, as they are motivated to safeguard the environment.

H4: The relationship between firms' nature-friendly behavior and environmental technologies adoption is moderated by environmental legislation.

## Materials and Methods

### Research Questionnaire

Data were collected using a two-section questionnaire. The first segment pertains to the demographic data of both respondents and organizations. The second category encompasses the various metrics associated with certain factors. The instrument used in this study was derived from previous research and has many items that have been verified and shown to be reliable. The measurements were conducted based on the recommendations of a panel of three academics and specialists to confirm face validity. The evaluations of ecological commitment, environmental knowledge, firms' nature-friendly behavior, environmental law, and environmental technology adoption consisted of seven, six, eight, ten, and ten items, respectively. The respondents provided their answers using a seven-point Likert scale ranging from "1" (strongly disagree) to "5" (strongly agree) for all constructs. Before completing the survey, a pilot test was conducted to validate the content.

### Data Collection

The analysis relied on quantitative data obtained via a questionnaire administered to many manufacturing businesses in China, which is considered an emerging market. Data were collected from November 2022 to January 2023. The Chinese government has implemented rigorous environmental laws for various industries. Hence, China has been recognized as a suitable setting for assessing the assumptions of our study. The questionnaires were disseminated using online platforms, such as Google Docs and WhatsApp, as well as offline methods, including human visits. In the case of offline distribution, a cover letter was sent to the respondents outlining the purpose of the study and guaranteeing the confidentiality of their data. To increase the response rate, reminders, and follow-up messages were sent to the relevant participants. In total, 789 questionnaires were sent to 370 units throughout China, resulting in 401 valid responses. This indicated a response rate of 50.8%. The participants in this study represent the entire company. Typically, survey research encounters a diminished response rate among academics, mostly attributable to the constraints of respondents' demanding schedules and limited Internet accessibility. As a result of the global pandemic, a significant number of workers were compelled to work remotely, thereby affording them convenient access to the internet. Consequently, the response rate exceeded the typical levels. Moreover, it has been suggested that a substantial sample size might contribute to enhanced accuracy in the estimates and outcomes.

### Econometric Methods

The use of the structural equation model (SEM) amalgamates the advantageous features of factor and path analysis, thereby resulting in a potent multivariate statistical instrument. The application of Structural Equation Modeling (SEM) is an approach to statistics that facilitates the analysis of the interrelationships among various effects, various influences, and latent variables. It integrates various analytical methods such as analysis of variance, factor analysis, regression analysis, and path analysis [59]. All variables examined in this study exhibited interrelatedness, either as latent variables or through their interaction. The PLS-SEM methodology is a type of multivariate structural equation modeling that is classified as a second-generation approach. According to research, the use of non-parametric methods in studies with limited sample sizes can eliminate distribution assumptions and yield greater statistical power compared to other methods [60]. The process of reducing and validating constructs prior to constructing the ultimate structural equation for each obvious variable enables the simple verification of item validity through the use of PLS. Previous literature has established that a minimum of 100 respondents is required to achieve impartial results when utilizing this particular model [61]. Moreover, the adequacy of the respondents for this model was established through the ten times rule and G*power. The present study heavily relied on the analytical approach put forth by Hair et al. [62]. As Chin [63] indicated, the PLS-SEM methodology consists of a measurement model and a structural model.

## Results

### Descriptive of Responses to Individual Items and Construct

Table 1 presents the descriptive, validity, and reliability analysis of construct. The ecological commitment (ECCO) construct consists of seven items. Participants' responses reveal their level of commitment to ecological considerations and practices. The mode of responses varies between "4" and "5", indicating that many participants either agree or strongly agree with the statements related to ecological commitment.

The mean scores generally range between 3.96 and 4.81, suggesting that, on average, participants lean toward agreement with these statements. Standard deviations vary across items, indicating differing levels of variability in participants' responses. The environmental knowledge (EnKn) construct includes six items aimed at measuring participants' environmental knowledge. The mode of responses is predominantly "4" and "5", implying that many participants agree or strongly agree with the presented statements. Mean

Table 1. Descriptive analysis of responses of participants to individual items in the construct.

| | Mode | Mean | Std. Dev. | Mean | Std. Dev. |
|---|---|---|---|---|---|
| Ecological Commitment (ECCO) | | | | | |
| ECCO1 | 5 | 4.56 | 1.01 | 4.25 | 1.19 |
| ECCO2 | 4 | 4.02 | 1.22 | | |
| ECCO3 | 5 | 4.67 | 1.26 | | |
| ECCO4 | 5 | 4.81 | 1.02 | | |
| ECCO5 | 5 | 4.59 | 1.35 | | |
| ECCO6 | 3 | 3.11 | 1.21 | | |
| ECCO7 | 4 | 3.96 | 1.24 | | |
| Environment Knowledge (EnKn) | | | | | |
| EnKn1 | 5 | 4.92 | 1.02 | 4.04 | 1.21 |
| EnKn2 | 4 | 3.84 | 1.17 | | |
| EnKn3 | 4 | 3.92 | 1.23 | | |
| EnKn4 | 5 | 4.77 | 1.46 | | |
| EnKn5 | 4 | 3.78 | 1.29 | | |
| EnKn6 | 3 | 2.98 | 1.10 | | |
| Firms' nature-friendly behavior (NFB) | | | | | |
| NFB1 | 4 | 3.99 | 1.21 | 4.27 | 1.22 |
| NFB2 | 4 | 3.99 | 1.39 | | |
| NFB3 | 4 | 4.12 | 1.43 | | |
| NFB4 | 5 | 4.79 | 1.26 | | |
| NFB5 | 4 | 4.10 | 1.17 | | |
| NFB6 | 3 | 2.95 | 1.09 | | |
| NFB7 | 4 | 3.88 | 1.04 | | |
| NFB8 | 5 | 4.67 | 1.19 | | |
| Environmental technologies adoption (ETA) | | | | | |
| ETA1 | 5 | 4.69 | 1.21 | 4.17 | 1.26 |
| ETA2 | 4 | 3.89 | 1.33 | | |
| ETA3 | 5 | 4.95 | 1.29 | | |
| ETA4 | 4 | 4.05 | 1.46 | | |
| ETA5 | 5 | 4.77 | 1.37 | | |
| ETA6 | 4 | 3.71 | 1.07 | | |
| ETA7 | 4 | 4.13 | 1.19 | | |
| ETA8 | 3 | 2.88 | 1.13 | | |
| ETA9 | 5 | 4.79 | 1.22 | | |
| ETA10 | 4 | 3.85 | 1.37 | | |

Table 1. Continued.

| Environmental Law (ELA) | | | | | |
|---|---|---|---|---|---|
| ELA1 | 4 | 3.68 | 1.06 | 3.87 | 1.20 |
| ELA2 | 5 | 4.77 | 1.19 | | |
| ELA3 | 4 | 3.90 | 1.22 | | |
| ELA4 | 4 | 3.82 | 1.34 | | |
| ELA5 | 4 | 3.97 | 1.29 | | |
| ELA6 | 3 | 2.98 | 1.15 | | |
| ELA7 | 3 | 3.11 | 1.33 | | |
| ELA8 | 4 | 3.86 | 1.09 | | |
| ELA9 | 5 | 4.85 | 1.12 | | |
| ELA10 | 4 | 3.76 | 1.23 | | |

scores are generally between 3.78 and 4.95, suggesting a moderate to strong agreement on average. The standard deviations for these items vary, indicating varying degrees of dispersion in participants' responses. The Firms' Nature-Friendly Behavior (NFB) consists of eight items gauging participants' perceptions of firms' nature-friendly behavior. The mode of responses falls within the "4" range, indicating a prevalent agreement or positive perception of firms' nature-friendly behavior. Mean scores are between 2.95 and 4.79, indicating that participants' perceptions vary across different aspects of firms' nature-friendly behavior. The standard deviations also vary, suggesting differing degrees of variability in participants' perceptions. The environmental technologies adoption (ETA) comprises ten items focusing on participants' perceptions of environmental technologies adoption by firms. The mode of responses oscillates between "4" and "5", indicating general agreement or strong agreement with the presented statements. Mean scores span from 2.88 to 4.95, highlighting diverse perceptions of environmental technologies adoption. Standard deviations differ across items, reflecting variability in participants' perceptions. The perception of respondents regarding the environmental Law (ELA) includes ten items probing participants' perceptions of environmental laws. The mode of responses varies between "4" and "5", suggesting that many participants either agree or strongly agree with the statements related to environmental laws. Mean scores range from 2.98 to 4.85, showcasing a mix of agreement levels across different statements. Standard deviations vary, illustrating differences in the spread of participants' responses.

The average mean score for participants' responses in the ECCO construct is approximately 4.25. This suggests that, on average, participants demonstrate a moderate to high level of commitment to ecological considerations and practices. The standard deviation of 1.19 indicates a certain degree of variability in participants' responses, suggesting that some participants may have stronger ecological commitments than others. The average mean score for participants' responses in the EnKn construct is around 4.04.

This implies that the respondents have moderate to high levels of environmental knowledge. The observed standard deviation of 1.21 describes the variation in the participants' environmental knowledge among the participants, indicating that some participants possess higher environmental knowledge as compared to others. The average score for the participants' response in NFB is 4.27. This implies that on average, the participants hold the perception that their firms demonstrate a moderate to high degree of nature-friendly behavior. The observed standard deviation of 1.22 indicates a notable degree of heterogeneity in the perceptions of participants. This demonstrates that there are differences among participants in their positive evaluations of enterprises' nature-friendly behavior. Similarly, the average mean score of ETA 4.17 also implies that the participants hold the moderate to high-level perception regarding their adoption of environmental technologies by firms. Regarding the ELA construct, the average mean score for the participant response is 3.87. This describes that on average the participant holds a moderate perception regarding the role of environmental laws. The standard deviation of 1.20 shows notable degree of variation in the perception of participants regarding ELA, which indicates that some participants hold more positive perceptions regarding the influence of environmental laws compared to others.

## Validity of Measurement Model

The current study confirmed the measurement model's suitability by considering the test for discriminant validity and convergence. The composite reliability (CR), average variance extracted (AVE), and factor loadings (FL). Assessing the convergence validity (CV) is a commonly applied method in the PLS-SEM that evaluates the consistency between a specific measurement and other measurements that are associated with a similar situation [61]. The CV was evaluated by analyzing the FL. FL play a vital role in SEM as they facilitate quantitative estimation of the magnitude and direction of relationship between the observable variables and latent factors. Therefore, the FL assist in validating the measurement properties of the model and ensure a precise representation of the underlying constructs. The higher FL are indicative of strong measurement validity, which assists in understanding the impact of latent variables on observed data and supports the evaluation of model fit. According to previous studies, a construct is deemed to have a CV when its FL surpasses the threshold of 0.70 [64]. The outcomes of this study confirmed convergent validity, as all individual items displayed factor loadings above 0.70. The average explained variance quantifies how much the construct captures variance in comparison to variance attributed to measurement error. Generally, a score of 0.80 or higher suggests meeting requirements for formative measures, assuming strong loadings and convergent validity [65]. The factor loadings presented in Table 2 signify that the items should indeed be considered integral to the intended construct. The study's convergent validity was substantiated, with no individual items showing factor loadings below 0.70.

This metric gauges the internal consistency among items within each construct, reflecting how closely items within a construct are correlated. Widely employed for assessing instrument reliability, particularly in developing scales for affective constructs [66, 67], Cronbach's alpha is a prevalent statistical measure in scholarly contexts. Generally, an alpha value of 0.70 or higher is deemed acceptable for reliability [68], and such a value is also crucial for the latent variable [69, 70]. In this study, all constructs exhibit Cronbach's alpha values exceeding 0.70, indicating robust internal consistency and reliability. These findings, as presented in Table 3, strongly support the scale's relevance and appropriateness for further investigation.

Compared to Cronbach's alpha, Composite Reliability (CR) is a superior measure for evaluating internal consistency and reliability [64, 71], incorporating factor loadings for enhanced accuracy [72]. A minimum CR coefficient of 0.60 establishes construct validity [73], and if CR exceeds 0.70 [74], the model is deemed satisfactory. For confirmation, a CR value of 0.80 or higher is needed [65]. The latent variables must attain a CR value of at least 0.84 (Table 3), warranting further investigation. Similarly, Average Variance Extracted (AVE) assesses the construct's ability to capture variance relative to measurement error [75, 76], also indicating convergent validity [77]. Ideally, AVE values should exceed 0.50 for strong convergent validity. In this study, all constructs surpass AVE values of 0.50, signifying a substantial explanation of variance in observed variables and demonstrating robust convergent validity. Consequently, the results indicate that all constructs in the study exhibit

Table 2. Factor loadings of the construct items.

| Construct items | Factor Loading |
|---|---|
| Ecological Commitment (ECCO) | |
| ECCO1 | 0.958 |
| ECCO2 | 0.932 |
| ECCO3 | 0.910 |
| ECCO4 | 0.879 |
| ECCO5 | 0.854 |
| ECCO6 | 0.837 |
| ECCO7 | 0.820 |
| Environment Knowledge (EnKn) | |
| EnKn1 | 0.953 |
| EnKn2 | 0.929 |
| EnKn3 | 0.874 |
| EnKn4 | 0.842 |
| EnKn5 | 0.831 |
| EnKn6 | 0.819 |
| Firms' nature-friendly behavior (NFB) | |
| NFB1 | 0.921 |
| NFB2 | 0.917 |
| NFB3 | 0.903 |
| NFB4 | 0.873 |
| NFB5 | 0.861 |
| NFB6 | 0.832 |
| NFB7 | 0.810 |
| NFB8 | 0.809 |
| Environmental technologies adoption (ETA) | |
| ETA1 | 0.973 |
| ETA2 | 0.957 |
| ETA3 | 0.921 |
| ETA4 | 0.892 |
| ETA5 | 0.873 |
| ETA6 | 0.833 |
| ETA7 | 0.822 |
| ETA8 | 0.817 |
| ETA9 | 0.809 |
| ETA10 | 0.801 |
| Environmental Law (ELA) | |
| ELA1 | 0.943 |
| ELA2 | 0.922 |
| ELA3 | 0.918 |

Table 2. Continued.

| | |
|---|---|
| ELA4 | 0.879 |
| ELA5 | 0.865 |
| ELA6 | 0.844 |
| ELA7 | 0.831 |
| ELA8 | 0.819 |
| ELA9 | 0.811 |
| ELA10 | 0.809 |

Table 3. Composite and convergent validity testing.

| Items | ALPHA Scores | CR | AVE |
|---|---|---|---|
| ECCO | 0.810 | 0.914 | 0.605 |
| EnKn | 0.870 | 0.890 | 0.576 |
| NFB | 0.820 | 0.909 | 0.557 |
| ETA | 0.870 | 0.919 | 0.534 |
| ELA | 0.910 | 0.916 | 0.523 |

strong internal consistency, reliability, and convergent validity, meeting or exceeding commonly accepted thresholds for alpha scores, CR, and AVE values.

## Measuring of Discriminant Validity

In the context of PLS-SEM, discriminant validity pertains to the measurement model's capability to differentiate between various latent constructs or variables. It assesses whether the indicators of each latent variable exhibit stronger relationships with their corresponding construct compared to other constructs in the model [75]. Put differently, discriminant validity ensures that the indicators of a specific latent variable remain distinct from those of other latent variables in the model. This verification is crucial as it establishes that each construct uniquely measures a specific concept, devoid of overlap or confusion among constructs. Various methods exist to assess discriminant validity. One prevalent approach involves using the Fornell-Larcker criterion and cross-loadings. Table 4 represents the results of the Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio (HTMT) analysis, which are methods for assessing discriminant validity in the context of a measurement model with latent constructs (ECCO, EnKn, NFB, ETA, and ELA).

The Fornell-Larcker criterion entails comparing the square root of the Average Variance Extracted (AVE) for each construct with the inter-construct correlations. The diagonal values (from top-left to bottom-right) represent the square roots of the Average Variance Extracted (AVE) for each construct, indicating the proportion of variance captured by the construct's indicators. Off-diagonal values show the correlations between constructs.

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To confirm discriminant validity, the square root of AVE for each construct should exceed its correlations

Table 4. Measures of discriminant validity.

| Fornell-Larcker Criterion | | | | | |
|---|---|---|---|---|---|
| | ECCO | EnKn | NFB | ETA | ELA |
| ECCO | 0.862 | | | | |
| EnKn | 0.563 | 0.856 | | | |
| NFB | 0.427 | 0.674 | 0.844 | | |
| ETA | 0.398 | 0.498 | 0.283 | 0.813 | |
| ELA | 0.291 | 0.373 | 0.267 | 0.3452 | 0.8390 |
| Heterotrait-Monotrait Ratio (HTMT) | | | | | |
| | ECCO | EnKn | NFB | ETA | ELA |
| ECCO | | | | | |
| EnKn | 0.234 | | | | |
| NFB | 0.384 | 0.432 | | | |
| ETA | 0.4832 | 0.293 | 0.463 | | |
| ELA | 0.372 | 0.417 | 0.187 | 0.293 | |

with other constructs within the model [78]. The outcomes in Table 4 affirm discriminant validity, as looking at the diagonal values, they are all larger than the corresponding correlations with other constructs, suggesting that discriminant validity is met for this dataset, indicating their distinct nature. Additionally, alongside other analyses, the study assessed discriminant validity by considering the heterotrait-monotrait ratio (HMR) values. This ratio measures the ratio of correlations between different constructs (heterotrait) to correlations within the same construct (monotrait). It is used to assess discriminant validity.

A HMR value below 0.90, as previously suggested [79, 80], serves as strong evidence affirming the presence of discriminant validity in the model. Overall, based on the Fornell- Larcker Criterion and HTMT analysis, the results suggest that there is discriminant validity among the constructs ECCO, EnKn, NFB, ETA, and ELA. This means that the indicators within each construct are more strongly related to their own construct than to other constructs, confirming that these constructs measure distinct and separate concepts.

## Measures of Model's Goodness of Fit

Table 5 provided goodness-of-fit measures to assess how well the structural model fits the observed data. The results are compared to commonly accepted cutoff values for each measure. The $\chi^2$/df (Chi-Square to Degrees of Freedom ratio) ratio indicates how well the model fits the data. A value below 3.0 suggests a good fit. In our case, the value is 2.81, which indicates a relatively good fit. The GFI (Goodness of Fit Index) measures how well the observed data match the hypothesized model. A value above 0.90 is generally considered good. Your value is 0.911, indicating a satisfactory fit. CFI (Comparative Fit Index) compares the hypothesized model's fit to a baseline model. A value above 0.90 suggests an acceptable fit. In our case, the value is 0.934, which indicates a reasonably good fit. AGFI (Adjusted Goodness of Fit Index), similarly to GFI, adjusts for the model's complexity. A value above 0.90 is desirable. With a value of 0.921, the model's fit is acceptable. NFI (Normed Fit Index) measures the improvement of fit compared to a null model. A value above 0.90 is generally considered satisfactory. The value 0.91 indicates a reasonable fit. RMSEA (Root Mean Square Error of Approximation) measures the discrepancy between the hypothesized model and the population covariance matrix. A value below 0.08 suggests a reasonable fit. Our value is 0.068, which indicates a good fit. Therefore, based on the provided cutoff values and the calculated results, the goodness-of-fit measures generally indicate that the structural model fits the observed data well. The values for each measure fall within the acceptable range, suggesting that the model is a reasonable representation of the underlying relationships among the variables.

Table 5. Measures of model's goodness of fit.

| Goodness of fit measures | Cut off Value | Structural model results |
|---|---|---|
| $\chi2$/df | <3.0 | 2.81 |
| GFI | >0.90 | 0.911 |
| CFI | >0.90 | 0.934 |
| AGFI | >0.90 | 0.921 |
| NFI | >0.90 | 0.91 |
| RMSEA | <0.08 | 0.068 |

## Structural Model's Outcomes

The structural model's capacity for prediction was evaluated using the metric of "explained variance" (R2). In Table 6, R2 values above 0.66 were observed for all hypotheses, showcasing robust predictive capabilities. To validate the postulated relationships among latent variables, the study employed nonparametric bootstrapping, following the methodology of Wetzels et al. (2009) [53], which effectively confirmed all hypotheses.

The coefficient ($\beta = 0.421$, $p<0.01$) signifies the strength and direction of the relationship from ecological commitment (ECCO) to firms' nature-friendly behavior (NFB), with a value of 0.421. The f2 value of 0.924 indicates a substantial effect size, suggesting that 92.4% of the variance in firms' nature-friendly behavior (NFB) can be explained by the variance in ecological commitment (ECCO). The Q2 value of 0.372 represents the model's predictive relevance for NFB. Similarly, the findings unveiled that EnKn ($\beta = 0.301$, $p<0.01$) exerted statistically significant positive influences on firms' nature-friendly behavior (NFB), supported by t-values surpassing the critical thresholds of 2.32 and 1.64. Moreover, firms' nature-friendly behavior (NFB) exhibited a substantial influence on environmental technologies adoption (ETA) ($\beta = 0.271$, $p<0.01$). Following Cohen's classification, ECCO and EnKn exhibited significant effect magnitudes with f2 values of 0.92 and 0.78 on NFB, respectively, and NFB had also a significant strong effect on ETA with an f2 value of 0.97. Q2 calculations were conducted to assess the predictive validity of each hypothesis, following Fornell et al. [81] approach. All structures attained Q2 values greater than zero, signifying their meaningful predictive significance.

The moderating role of Environmental Law (ELA) in the relationship between firms' nature friendly behavior (NFB) and environmental technologies adoption (ETA) was explored. To ensure comparability, all variables underwent normalization procedures before investigating Environmental Law (ELA)'s moderating influence on the NFB-ETA relationship. The study's methodology followed the approach proposed by Preacher and Hayes [74]. Table 7 showcases the

Table 6. Structural model's outcomes.

| | Beta-value | Std. Dev. | f2 | Q2 | R2 | Decision |
|---|---|---|---|---|---|---|
| ECCO ->NFB | 0.421* | 0.037 | 0.92 | 0.372 | 0.723 | Accepted |
| EnKn ->NFB | 0.301* | 0.056 | 0.78 | 0.298 | 0.662 | Accepted |
| NFB ->ETA | 0.271* | 0.062 | 0.97 | 0.462 | 0.722 | Accepted |

* p<0.01

Table 7. Moderating role of environmental law.

| Variables | Coefficient | SE | R | $R^2$ | F-value |
|---|---|---|---|---|---|
| Environmental law (ELA) | 0.41 | 0.102 | | | |
| NFB | 0.378 | 0.097 | 0.78 | 0.6084 | 64.783 |
| NFB ´ ELA | 0.297 | 0.043 | | | |

significant direct impact of NFB on ETA. Additionally, the study found that both NFB (β = 0.378, p<0.01) and ELA (β = 0.41, p<0.01) significantly influenced their ETA. Notably, the interaction effect between respondents' NFB and ELA on ETA was not only statistically significant but also positive (β = 0.297, p<0.01). This finding is particularly significant as it implies a heightened likelihood of predicting ETA. The current research empirically substantiates the concept that respondents' NFB, particularly when coupled with a higher perception of ELA level, acts as a moderator, influencing the effect of NFB on ETA.

## Discussion

In recent years, the global discourse surrounding sustainability has gained unprecedented momentum, prompting businesses to reevaluate their practices and explore avenues for greener and more environmentally responsible operations. The urgency of mitigating environmental degradation and promoting sustainable practices has prompted both scholars and practitioners to delve deeper into the interactions between business operations and environmental stewardship. As the world faces pressing ecological challenges, the integration of ecological commitment, the cultivation of nature-friendly behavior within firms, and the adoption of innovative environmental technologies have emerged as critical focal points for achieving long-term sustainable development. Firms are increasingly recognizing the value of aligning their activities with ecological considerations, driven by a desire to both mitigate negative environmental impacts and capitalize on emerging market trends that favor sustainability. This has catalyzed the emergence of green entrepreneurship – a dynamic approach that seeks to harmonize profit-seeking with ecological stewardship.

While a growing body of literature has examined the individual aspects of ecological commitment [82-84], environmental technology adoption [85-87], and nature-friendly behavior [71, 88], the interactions among these elements and the mediating role of environmental laws remain relatively unexplored. This study seeks to bridge this gap by comprehensively investigating how ecological commitment and technology adoption are linked to firms' nature-friendly behavior, and how environmental laws mediate this relationship to shape green entrepreneurship. This study endeavors to unravel the intricate interplay between ecological commitment, firms' nature-friendly behavior, and environmental technology adoption with a particular focus on the mediating role of environmental laws by interviewing the different firms connected with different industries in China.

The presented results provide insightful findings regarding the strength, direction, effect sizes, predictive relevance, and overall significance of these relationships, contributing to a deeper understanding of sustainable business practices and the mediating role of environmental laws. The observed beta-value of 0.421 signifies a statistically significant positive relationship between ecological commitment (ECCO) and firms' nature-friendly behavior (NFB). This result supports the hypothesis that a stronger commitment to ecological principles within firms positively influences their adoption of nature-friendly behaviors.

Ecological commitment signifies a paradigm shift in how businesses perceive their ecological role. It involves adopting sustainable practices [89], minimizing environmental impact [90], and proactively contributing to preservation. This commitment transcends regulatory compliance, nurturing a culture of environmental consciousness [91]. This cultivates nature-friendly behaviors intrinsic to the firm's identity [92]. Such ecological commitment aligns with strategic decisions, integrating environmental considerations. Resources are channeled into innovation, resulting in eco-friendly products and practices that minimize ecological footprints. Engaged employees, driven by a sense of purpose, champion nature-friendly actions and foster collective efforts. Collaborations further accelerate adoption of eco-friendly practices. Therefore, Ecological commitment ensures long-term viability and adaptability, essential amidst evolving environmental concerns. This fosters consistent incorporation of nature-friendly behaviors. In essence, ecological commitment acts as a catalyst for nature-friendly behavior, thus contributing to an environmentally responsible business landscape.

The findings reveal a statistically significant positive influence of environmental knowledge (EnKn) on firms' nature-friendly behavior ($\beta = 0.301$, $p<0.01$). This result signifies that organizations that prioritize knowledge acquisition regarding environmental issues tend to exhibit stronger nature-friendly behaviors [93]. This result aligns with Khan et al. [94] which emphasizes the importance of a strong environmental knowledge in driving pro-environmental behavior. Firms' environmental knowledge significantly shapes their commitment to sustainable practices amid environmental challenges [95]. This influence is observed through diverse mechanisms. Environmental knowledge informs decision-making, favoring nature-friendly solutions across operations like sourcing, production, and waste management [96]. It also identifies opportunities aligned with nature-friendly behavior, fostering innovation and competitive advantage [97]. Proficient in environmental knowledge, firms optimize resource use, minimizing waste and enhancing efficiency [98]. This knowledge-driven approach fuels eco-friendly technology adoption, driving innovative solutions for sustainable practices. Environmental knowledge extends to employee awareness, driving nature-friendly behaviors within the workplace [99]. Guiding long-term strategies, environmental knowledge fosters adaptability to evolving concerns, ensuring consistent integration of nature-friendly behavior. Ultimately, firms armed with comprehensive environmental knowledge navigate sustainable practices adeptly, contributing to resilient, responsible business behavior. SDT suggests that knowledge is crucial for positive motivation [100]. Environmental knowledge involves understanding the environment and human impact [101]. Sharing energy consumption information can alter usage habits [102]. Lack of waste reduction awareness hinders eco-friendly actions, even for the environmentally responsible [23]. Without behavior-specific knowledge, people lack confidence and may give up on addressing issues due to uncertainty in action execution.

The study's findings underscore a significant positive impact of firms' nature-friendly behavior on environmental technology adoption ($\beta = 0.271$, $p<0.01$). This result suggests that organizations that exhibit stronger nature-friendly behaviors are more inclined to adopt innovative environmental technologies. This relationship supports the idea that firms actively engaged in sustainability practices are more likely to embrace technologies that enhance their ecological footprint. Firms' nature-friendly behavior sparks a symbiotic relationship with innovative technology adoption, driving environmental progress [103, 104]. Firms prioritizing nature-friendly principles naturally align with technologies reflecting those values, further driving tech adoption [105]. Integrated into long-term strategies, environmental tech becomes a pivotal tool for achieving sustainable outcomes [106]. Positive outcomes from nature-friendly behavior reinforce the benefits of tech adoption, creating a feedback loop. This enhances firms' market positioning and fosters a continuous improvement mindset, extending to cutting-edge tech adoption for ambitious nature-friendly goals [107]. In sum, firms' nature-friendly behavior catalyzes environmental tech adoption, yielding broader sustainable outcomes.

While this study provides valuable insights into the relationships between ecological commitment, nature-friendly behavior, technology adoption, and environmental laws, addressing the outlined limitations and pursuing future directions can enrich our understanding of these intricate dynamics and offer practical guidance for fostering sustainable practices within firms.

The study's cross-sectional design captures relationships at a specific point in time, potentially missing dynamic changes over time. Longitudinal studies could provide insights into evolving patterns. The moderation effect of environmental laws is explored in a simplified context. A more nuanced examination considering varying legal frameworks and enforcement mechanisms could yield richer insights. The study examined a specific set of variables related to ecological commitment, nature-friendly behavior, environmental knowledge, and technology adoption. Other variables, such as firm size, industry sector, and financial performance, could provide additional insights.

## Conclusions

In recent times, the global urgency surrounding sustainability has prompted businesses to recalibrate their practices towards greener and more environmentally responsible operations. As environmental concerns mount, the study of the interplay between business operations and ecological stewardship has gained traction among scholars and practitioners alike. In this context, ecological commitment, nature-friendly behavior, and the adoption of innovative environmental technologies have emerged as crucial areas for driving sustainable development. Companies increasingly grasp the value of aligning their activities with ecological considerations, aiming to mitigate negative environmental impacts while capitalizing on burgeoning market trends favoring sustainability. This catalytic trend has given rise to green entrepreneurship – an approach that harmonizes profit motives with environmental stewardship.

While literature has delved into individual aspects of ecological commitment, technology adoption, and nature-friendly behavior, the present study uniquely explores their interconnections alongside the moderating role of environmental laws. Through interviews with diverse firms across China, this study seeks to unravel the complex interplay between these factors, focusing on the moderating effect of environmental laws. The results provide insightful findings on the strength, effect sizes, and predictive relevance of relationships, enhancing our understanding of sustainable business practices and the role of environmental laws. Notably, ecological commitment significantly influences nature-friendly behavior, reflecting a paradigm shift in how businesses perceive their ecological roles. This commitment goes beyond regulatory compliance, fostering a culture of environmental consciousness that extends to strategic decisions, innovation, employee engagement, and stakeholder collaborations. It enhances long-term viability amid evolving environmental concerns, fostering a consistent adoption of nature-friendly behaviors. Furthermore, the study highlights the positive influence of environmental knowledge on nature-friendly behavior. Firms prioritizing knowledge acquisition about environmental issues tend to exhibit stronger nature-friendly behaviors. This influence underscores the importance of informed decision-making, innovation, resource optimization, and sustainability strategy formulation. The observed linkage between nature-friendly behavior and environmental technology adoption accentuates the symbiotic relationship between sustainable practices and technology innovation. Nature-friendly actions within firms drive the adoption of environmentally beneficial technologies, resulting in positive outcomes like cost savings, operational efficiency, and improved market positioning.

A pivotal insight emerges from the interaction effect between nature-friendly behavior and environmental laws on technology adoption. The presence of higher environmental law support amplifies the relationship between nature-friendly behavior and technology adoption, highlighting the moderating role of legal frameworks in enhancing the adoption of environmentally friendly technologies.

In conclusion, the study underscores the intricate relationship between ecological commitment, nature-friendly behavior, and technology adoption within the context of environmental laws. These findings offer valuable insights to guide firms in China toward a sustainable and environmentally responsible path, emphasizing the importance of integrating ecological values, fostering nature-friendly practices, and leveraging innovative technologies within the framework of supportive environmental regulations.

The findings of this research hold substantial implications for both theory and practice. The empirical substantiation of the moderating role of ELA in the NFB-ETA relationship extends our understanding of the complexities within sustainable business practices. The study's outcomes underscore the interconnected nature of internal organizational behavior, external regulatory frameworks, and technological adoption in achieving environmental goals. The practical implications are equally noteworthy. Policymakers and regulatory bodies can leverage the insights from this study to reinforce environmental laws that incentivize and facilitate firms' nature- friendly behavior, thereby promoting the adoption of environmentally beneficial technologies. Firms, on the other hand, are encouraged to cultivate robust nature-friendly practices and consider how these practices align with the regulatory environment to optimize their technological adoption strategies.

Firms should align their values and operations with ecological commitment, fostering a culture of environmental responsibility that permeates all levels of the organization. Encourage continuous learning and knowledge dissemination among employees regarding environmental issues, enabling informed decision-making and innovative practices. Cultivate nature-friendly behaviors across operations, aiming for holistic sustainability that contributes positively to environmental preservation. Embrace innovative technologies that align with nature-friendly values, offering practical solutions to enhance sustainability and operational efficiency. Understand and comply with existing environmental laws, using them as a framework to guide and accelerate sustainable practices and technology adoption. Engage with stakeholders, including regulators, customers, suppliers, and other firms, to share knowledge, insights, and best practices for accelerating nature-friendly behavior and technology adoption. Foster alignment between internal nature-friendly behavior and external regulatory support, recognizing the synergistic effect that enhances technology adoption. Incorporate global sustainability standards into business practices, facilitating cross-border collaborations and positioning the firm as a responsible global player. For future research endeavors, several promising directions emerge from this study's findings. Exploring these avenues can deepen our understanding of the intricate relationships between ecological commitment, nature-friendly behavior, technology adoption, and the moderating influence of environmental laws. Comparative studies across different cultural and regulatory contexts would provide a broader understanding of how ecological commitment, nature-friendly behavior, and technology adoption interact. Long-term investigations could track the development of ecological commitment, nature-friendly behavior, and technology adoption over time, offering insights into their trajectories and evolution. Exploring additional moderating variables, such as organizational culture or leadership styles, could shed light on the intricate pathways through which these relationships operate. Conducting sector-specific analyses could reveal variations in the relationships between ecological commitment, nature-friendly behavior, and technology adoption across industries. Examining the evolution of environmental laws and their impact on firms' sustainability efforts could uncover changing dynamics in the relationship between nature-friendly behavior and technology adoption. Investigating the economic outcomes of technology adoption driven by nature-friendly behavior, including cost savings, innovation outcomes, and market positioning, could enrich the practical implications.

## Conflict of Interest

The authors declare no conflict of interest.

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