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The impact of fintech-based eco-friendly incentives in improving sustainable environmental performance: A mediating-moderating model

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A B S T R A C T

China is the largest emitter of greenhouse gases globally, responsible for a substantial portion of the world's total carbon dioxide emissions. Many researchers investigated this issue; however, the literature is silent on how FinTech-based incentives can improve environmental performance. The research aims to shed light on the complex relationships among FinTech incentives, green consumer behavior, environmental consciousness, and environmental performance. Data was collected from 380 respondents representing diverse roles in the manufacturing industry. We used Smart-PLS and SPSS to test our hypothesis. The results confirm a positive relationship between FinTech incentives and green consumer behavior. However, consumer demographics and environmental awareness do not significantly moderate this relationship. The mediation analysis reveals that green consumer behavior mediates the relationship between FinTech incentives and environmental performance, while environmental consciousness mediates the relationship between FinTech incentives and green consumer behavior. Additionally, green consumer behavior mediates the relationship between environmental consciousness and environmental performance. The study's findings suggest that FinTech incentives effectively encourage eco-friendly choices, positively influencing environmental performance. This research contributes valuable insights for policymakers and businesses seeking to design effective environmental strategies and promote sustainability in the manufacturing industry. By leveraging FinTech incentives to encourage eco-friendly choices and foster environmental consciousness, businesses can contribute to a more sustainable future, aligning with global efforts to address environmental challenges and foster responsible consumption patterns in China and beyond.

1. Introduction

China, as the world's most populous nation and a fast-rising economy, has tremendous environmental concerns as it seeks sustainable growth (Song et al., 2022; Zia et al., 2021). Over the last few decades, China's spectacular economic progress has come at a cost, resulting in severe environmental damage and pollution (Li et al., 2021; Ma et al., 2020). However, in recent

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years, the Chinese government has taken substantial steps to address these concerns and improve environmental performance (Jia & Chen, 2019; Li et al., 2021).

Statistics reveal both the severity of environmental issues in China and the progress made in tackling them (Al-Qudah et al., 2023; Al-Okaily et al., 2021; Lee & Lee, 2022). According to data from the World Bank, China is the largest emitter of greenhouse gases globally, responsible for a substantial portion of the world's total carbon dioxide emissions (H. Liu et al., 2023). However, since 2014, the country has been successful in reducing its carbon intensity—the amount of carbon dioxide emissions per unit of GDP—significantly (Duan et al., 2022; H. Liu et al., 2023; Song et al., 2022). This achievement indicates a shift towards eco-friendlier and energy-efficient production methods however, this issue is still prevalent.

Despite the positive developments in improving environmental performance, China still faces challenges on its path to sustainability (Wang et al., 2021; Xiao et al., 2023). One major issue is air pollution, especially in densely populated urban areas(Xiao et al., 2023; Hatamlah et al., 2023a). The government's efforts to tackle this problem include stricter emissions standards, industrial regulations, and the promotion of clean energy alternatives and use of new echo-friendly technologies (Bayram et al., 2022; Guang-Wen & Siddik, 2023; Hommel & Bican, 2020; Tian et al., 2023; Salhab et al., 2023). Researchers are exploring the potential of Financial Technology (FinTech) to improve environmental performance through green consumer behavior, it faces both opportunities and challenges in its pursuit of sustainability (Mertzanis, 2023; Tian et al., 2023). However, there is still a knowledge gap on the role of consumer behavior in adopting the FinTech-based incentives (Thakor, 2020; Rehman et al.,2023).

Research revealed that FinTech innovations offer various incentives to encourage environmentally conscious choices (Bu et al., 2022; Chueca Vergara & Ferruz Agudo, 2021; Mertzanis, 2023; Tian et al., 2023), however, the success of these initiatives relies on their acceptance and uptake among consumers. A limited researcher has highlighted the effectiveness of cashback rewards for eco-friendly purchases and discounts for using public transportation, as mediated by FinTech platforms, will be essential to gauge the degree of behavioral change towards sustainability (Anshari & Almunawar, 2022; Hopalı et al., 2022; Otte & Maehle, 2022). Furthermore, ensuring inclusivity in the adoption of FinTech solutions is crucial to achieve meaningful environmental outcomes. Disparities in access to FinTech services among different socio-economic groups may result in uneven participation in green consumer behaviors initiatives (Alghazzawi et al., 2022; Al-Okaily et al., 2022; Friedline et al., 2020; Alkhwaldi et al., 2023).

Previous studies on FinTech and environmental sustainability have primarily focused on broader aspects, such as the role of FinTech in sustainable finance, green investments, renewable energy financing, and carbon trading platforms (Awais et al., 2023; Deng et al., 2019; Guang-Wen & Siddik, 2023; Merello et al., 2022; Udeagha & Muchapondwa, 2023). While these studies have contributed significantly to understanding the potential of FinTech in addressing environmental challenges, they often overlook the critical intermediary factor of green consumer behavior.

Green consumer behavior , encompassing individuals' choices to make environmentally responsible decisions in their daily lives, is a key driver of positive environmental outcomes (Aboalsamh et al., 2023; Aggarwal et al., 2023; Biswas, 2020; Han et al., 2020; Y. Yang et al., 2021). The role of FinTech in incentivizing and shaping such behavior remains relatively understudied, leading to a research gap in comprehensively understanding the impact of FinTech on overall environmental performance.

While some research might touch upon the topic tangentially, few studies have directly examined the direct link between FinTech innovations and consumer behavior (Chueca Vergara & Ferruz Agudo, 2021; Mulla, 2022). Others focused on exploring consumers' willingness to adopt digital payment platforms and their perception of environmental impact (Al-Okaily & Al-Okaily, 2022; Aboalsamh et al., 2023; Xie et al., 2021; Yang et al., 2021; Y. Yang et al., 2021), but not specifically focusing on the environmental incentives offered through FinTech platforms to drive green consumer behavior and its impact on the environmental performance. According to Theory of Planned Behavior (TPB), individuals' attitudes, subjective norms, and perceived behavior al control shape their intentions and behavior s. Therefore, we argue that environmental incentives provided by FinTech platforms align with the TPB's components, influencing consumers' attitudes towards eco-friendly choices, promoting positive subjective norms, and enhancing their perceived control over adopting green consumer behavior. We argue that by leveraging these psychological factors, FinTech can encourage and facilitate environmentally responsible choices, ultimately contributing to improved environmental performance.

To Test hypothesis that there is a significant positive relationship between the provision of environmental incentives through FinTech platforms and green consumer behaviors and to what degree green consumer behavior mediates the relationship between the provision of environmental incentives through FinTech platforms and improved environmental performance. We collected data from sample size of 380 respondents from large manufacturing firms in China, we employ Structural Equation Modelling (SEM) using SPSS and SmartPLS to analyze the relationships between FinTech incentives, green consumer behaviors, and environmental performance.

The results revealed that FinTech Incentives had a positive and significant impact on Green Consumer Behavior in line with previous studies (Anshari & Almunawar, 2022; Chueca Vergara & Ferruz Agudo, 2021; Hommel & Bican, 2020) , indicating that providing environmental incentives through FinTech platforms effectively encouraged individuals to adopt eco-friendly choices. Interestingly, education level and income were found to positively influence Green Consumer Behavior, highlighting

the role of these demographic factors in shaping sustainable consumer choices. Furthermore, participants with higher degrees of Environmental Awareness were more receptive to FinTech incentives and had a stronger preference for green consumer behaviors. The study also discovered that Environmental Consciousness was a significant mediator between FinTech Incentives and Green Consumer Behavior, emphasizing the significance of individuals' environmental consciousness in encouraging their adoption of eco-friendly options via FinTech platforms. Furthermore, Green Consumer Conduct has a significant beneficial impact on Environmental Performance, demonstrating that encouraging eco-friendly behavior through FinTech incentives adds to overall environmental gains (Chueca Vergara & Ferruz Agudo, 2021; Hatamlah et al., 2023b). These findings illustrate FinTech's critical role in driving green consumer behaviors and, eventually, improving environmental performance in the Chinese manufacturing industry, providing useful insights for policymakers and enterprises looking to leverage technology for sustainable practices.

As one of the world's largest and most influential economies, China's manufacturing sector is enormously important, making its environmental impact a global concern. Rapid economic expansion and industrialization in the country have resulted in considerable environmental concerns, requiring a strong commitment to establishing a balance between economic development and environmental sustainability.

Furthermore, with improved digital payment platforms and online financial services, China has seen significant increase in FinTech usage. Understanding FinTech's role in enhancing environmental performance in the industrial sector is very important in this context. The Chinese government's policies and actions promoting sustainable development and green finance foster an atmosphere appropriate to investigating the potential of FinTech in influencing green consumer behaviors. Furthermore, China's major manufacturing enterprises have the capacity for long-term innovation, providing a chance to investigate how FinTech incentives influence customer behaviors and contribute to environmental goals. Given China's clout in global manufacturing and trade, the study's findings could have far-reaching ramifications, providing useful insights for other governments and sectors looking to leverage technology for environmental sustainability.

2 Literature review

China, the world's most populous country with a quickly developing economy, has faced severe environmental issues as a result of its rapid industrialization and urbanization (Li et al., 2021; H. Liu et al., 2023; X. Liu et al., 2023; Wang & Chen, 2020; Y. Yang et al., 2021; Zhao et al., 2022). As the world's most populated country with a quickly developing economy, China has faced severe environmental difficulties because of increasing industrialization and urbanization. (Abbass et al., 2022; Biswas, 2020; Guang-Wen & Siddik, 2023; Li et al., 2021; X. Liu et al., 2023; Maximillian et al., 2019; Ren et al., 2022; Shahzad et al., 2021; Yu et al., 2023; Zia et al., 2021).

Environmental concerns in China have been the subject of numerous studies. Wu et al. (2020) emphasized the negative impacts of air pollution on public health and the environment, seeking tougher laws and improved environmental performance. Li et al. (2019) emphasized the negative consequences of air pollution on public health and the environment, seeking stronger laws and improved environmental performance (Anwar et al., 2020; Guang-Wen & Siddik, 2023; Mertzanis, 2023; Tian et al., 2023; Wang et al., 2021). Jia and Chen (2019) emphasized the negative impacts of air pollution on public health and the environment, calling for tougher laws and improved environmental performance.

2.1 FinTech and Sustainable Finance

FinTech literature emphasizes the technology's ability to foster sustainable finance initiatives such as green investments and environmentally responsible financing. Previous study indicates that FinTech-enabled solutions can move resources toward environmentally friendly projects, resulting in a beneficial environmental impact (Tian et al., 2023; Abu-AlSondos et al., 2023a). Bayram et al. (2022) FinTech platforms were discovered to have facilitated crowdfunding for renewable energy projects and sustainable start-ups, hence fostering sustainable finance and green entrepreneurship. Kalaiarasi and Kirubahari (2023) FinTech platforms have facilitated crowdfunding for renewable energy projects and sustainable start-ups, supporting sustainable finance and green entrepreneurship. Additionally, Udeagha and Muchapondwa (2023) explored the role of FinTech in promoting green financing options for small and medium-sized enterprises, fostering environmental sustainability in the business sector. The integration of FinTech and sustainable finance is regarded as a promising pathway to achieve the United Nations' Sustainable Development Goals (SDGs) and combat climate change (Pashang & Weber, 2023; Abu-AlSondos et al., 2023b).

2.2 Green Consumer Behavior and Incentives

Financial incentives, according to studies on green consumer behavior , play a critical role in inspiring individuals to adopt ecologically responsible habits.(Farrukh et al., 2022; Sadiq et al., 2021). Cashback prizes, discounts, and loyalty programs have been effective in encouraging environmentally conscious behavior (Troncota, 2020; Hopalı et al., 2022). The impact of cashback benefits offered through FinTech platforms on eco-friendly shopping behavior was explored, and a considerable increase in customers' preference for green items was discovered. Hopalı et al. (2022) investigated the effectiveness of public transportation discounts mediated by FinTech applications in promoting sustainable commuting behavior among urban inhabitants. Karim et al. (2022) conducted a study on the influence of FinTech-based loyalty programs on creating consumer loyalty towards sustainable brands. According to the findings, consumers were more likely to stick with eco-friendly firms

that offered exclusive rewards via FinTech platforms. These findings show the power of FinTech-enabled incentives in changing green consumer behavior and cultivating a culture of sustainable consumption.

2.3 Theoretical framework

The literature review lays the groundwork for understanding the potential of FinTech in promoting both sustainable finance and green consumer behavior. The Theory of Planned Behavior (TPB) offers a relevant theoretical lens to understand the underlying mechanisms driving these outcomes. TPB posits that individuals' attitudes, subjective norms, and perceived behavioral control shape their intentions and behavior s (Huang et al., 2021; La Barbera & Ajzen, 2021; Liu et al., 2023; Liu et al., 2023; Liu et al., 2021). In the context of sustainable finance, FinTech platforms influence investors' attitudes by providing transparent information on the environmental impact of investments (Chueca Vergara & Ferruz Agudo, 2021; Hommel & Bican, 2020; Hopalı et al., 2022). Subjective norms are reinforced as investors witness the growing trend of eco-friendly investments facilitated by FinTech (Sreelekshmi & Biju, 2023). Moreover, FinTech's accessibility and ease of use enhance perceived behavior al control, enabling investors of all backgrounds to participate in sustainable finance(Giri et al., 2023)

Likewise, in the domain of green consumer behavior, FinTech incentives align with the components of TPB. Offering cashback rewards, discounts, and loyalty programs positively influences consumers' attitudes towards eco-friendly choices (Giri et al., 2023; Hopalı et al., 2022).Subjective norms are strengthened as consumers observe their peers engaging in sustainable behavior through FinTech applications. Additionally, the convenience and accessibility of FinTech incentives enhance perceived behavioral control, empowering consumers to adopt environmentally responsible choices with ease.

2.3.1 Hypothesis development

Based on the literature review and the theoretical framework of the Theory of Planned Behavior (TPB), this section aims to develop hypotheses that investigate the relationship between FinTech incentives, green consumer behavior, and sustainable environmental performance in the context of China (See figure 1).

H_1: *FinTech Incentives positively influence Green Consumer Behavior.*

Building on the Theory of Planned Behavior (TPB) framework and previous studies (Anshari & Almunawar, 2022; Hopalı et al., 2022), it is hypothesized that the provision of FinTech incentives, such as cashback rewards for eco-friendly purchases, discounts for using public transportation, and loyalty programs promoting sustainable choices, will positively influence participants' green consumer behavior. Specifically, individuals exposed to FinTech incentives are expected to show a higher likelihood of adopting eco-friendly purchasing behavior, engaging in sustainable transportation choices, and making other pro-environmental decisions.

H_2: *Consumer Demographics moderate the relationship between FinTech Incentives and Green Consumer Behavior*.

This hypothesis draws on the TPB framework and the findings from previous research (Anshari & Almunawar, 2022; Hopalı et al., 2022), suggesting that consumer demographics, including age, gender, income, education level, and occupation, will moderate the impact of FinTech incentives on green consumer behavior. The study will explore whether certain demographic groups are more receptive to FinTech incentives, leading to a stronger association between the incentives and the adoption of green consumer behavior.

H_3: *Environmental Awareness moderates the relationship between FinTech Incentives and Green Consumer Behavior.*

Based on the TPB and previous studies (Anshari & Almunawar, 2022; Hopalı et al., 2022), it is hypothesized that participants' level of environmental awareness will moderate the relationship between FinTech incentives and green consumer behavior. Individuals with higher environmental consciousness, as influenced by FinTech incentives, are expected to be more responsive to pro-environmental choices, resulting in a stronger link between the incentives and their adoption of eco-friendly behaviors.

H_4: *Green Consumer Behavior mediates the relationship between FinTech Incentives and Environmental Performance.*

Consistent with the TPB framework and supported by previous research (Anshari & Almunawar, 2022; Hopalı et al., 2022), this hypothesis posits that green consumer behavior will mediate the impact of FinTech incentives on overall environmental performance. As participants adopt environmentally responsible choices in response to FinTech incentives, their collective actions are expected to contribute to improved environmental performance.

H_5: *Environmental Consciousness mediates the relationship between FinTech Incentives and Green Consumer Behavior.*

Based on the TPB and findings from previous studies (Anshari & Almunawar, 2022; Hopalı et al., 2022), this hypothesis proposes that environmental consciousness will mediate the relationship between FinTech incentives and participants' green consumer behavior. It is expected that FinTech incentives will influence environmental consciousness, which in turn will positively impact the adoption of eco-friendly choices.

H_6: *Green Consumer Behavior mediates the relationship between Environmental Consciousness and Environmental Performance*.

conducted a study on the influence of FinTech-based loyalty programs on creating consumer loyalty towards sustainable brands. According to the findings, consumers were more likely to stick with eco-friendly firms that offered exclusive rewards through FinTech platforms. These findings emphasize the potential of FinTech-enabled incentives in altering green consumer behavior and promoting a sustainable consumption culture.

H_7: *The Mediating role of Environmental Consciousness will strengthen the relationship between FinTech Incentives and Green Consumer Behavior.*

Based on the TPB framework and prior research findings (Anshari & Almunawar, 2022; Hopal et al., 2022), this hypothesis posits that the mediating function of environmental consciousness would amplify the effect of FinTech incentives on green consumer behavior. Participants with higher degrees of environmental consciousness are likely to respond more positively to FinTech incentives, resulting in greater adoption of environmentally friendly options.

H_8: *Green Consumer Behavior 's mediating function will improve the link between Environmental Consciousness and Environmental Performance.*

This hypothesis, which is consistent with the TPB framework and supported by previous research (Anshari & Almunawar, 2022; Hopal et al., 2022), proposes that the mediating role of green consumer behavior will improve the relationship between participants' environmental consciousness and their overall environmental performance. Environmental performance is predicted to increase further as individuals with more environmental consciousness make more eco-friendly decisions.

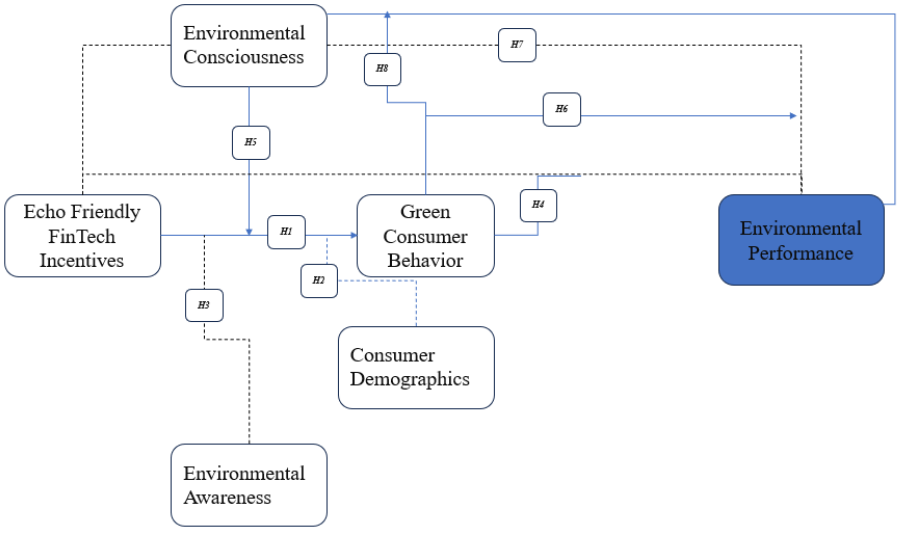

Fig. 1. Conceptual framework

3.Methodology

We used a quantitative research design in this work to evaluate the linkages between FinTech incentives, green customer behavior, and long-term environmental performance in China's manufacturing industry. The survey questionnaire was the major data gathering instrument, and a sample size of 380 respondents was chosen from persons working in large manufacturing enterprises in China across several sectors. A 7-point Likert scale was used in the questionnaire to assess respondents' agreement or level of alignment with the statements presented for each dimension. The scale varied from 1 (Strongly Disagree) to 7, allowing participants to express their thoughts and feelings about FinTech incentives, green consumer behavior, environmental awareness, environmental consciousness, and environmental performance in a more nuanced way. This scale provides a measurable and consistent method for collecting data on numerous topics of interest, allowing the researchers to properly evaluate and interpret the replies.

3.1 Sampling Procedure

We used stratified random sampling to assure representativeness and inclusion. Manufacturing companies were divided into strata based on their size and industry sector. To reach the appropriate sample size, a random sample of individuals was drawn from each stratum.

3.2 Data Collection

Information was gathered using an online survey utilizing a standardized questionnaire. The questionnaire was created with the research aims and hypotheses in mind. We circulated the survey link via email, online platforms, and professional networks, informing participants about the study's goal, voluntary participation, and response confidentially.

3.3 Questionnaire Administration

The online survey questionnaire consisted of several sections:

- Demographics: Participants provided information about their positions in the company (employee, manager, executive, other) to ascertain their relevance to the study.
- FinTech Incentives: We assessed participants' perceptions of the incentives offered through FinTech platforms to promote environmentally responsible choices.
- Green Consumer Behavior: Participants self-reported their eco-friendly purchasing behavior, sustainable transportation choices, and pro-environmental decisions.
- Environmental Awareness: We evaluated participants' level of environmental consciousness and concern about environmental issues.
- Environmental Consciousness: We measured participants' personal commitment to environmental protection and belief in the impact of individual actions.
- Environmental Performance: Participants rated their company's environmental performance in terms of carbon footprint reduction and resource conservation.
- Additional Information: Respondents had the opportunity to provide any additional insights or comments related to the study variables.

3.4 Data Analysis

The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) and Smart-PLS. Descriptive statistics summarized participants' demographic characteristics and responses to the questionnaire items. Multiple regression analysis was employed to test the proposed hypotheses and examine the mediating and moderating effects.

3.5 Pretest

Before conducting the main study, a pretest was conducted to assess the clarity, comprehensibility, and relevance of the questionnaire items. A small group of participants (N=20) from the target population were randomly selected to complete the questionnaire. Based on their feedback, minor revisions were made to improve the wording and formatting of the questionnaire.

3.6 Pilot Testing

To assess the validity of the proposed model, we pilot-tested the survey item before collecting the data on a large scale. It is essential to check the validity and reliability of the proposed constructs in pilot testing. Since the sample frame involves working people, collecting a large data size for pilot testing was difficult. However, a convenient sample of full-time students will be sufficient to ensure the contents' validity. Our key intention was to confirm the reliability of the items used in the study. We developed online survey items, and respondents were contacted by sharing survey links. Out of 400 respondents, a total of 380 correct responses were received. The collected data were tested by using SmartPLS software to ensure the acceptable limit of reliability. We found that the entire construct displayed pretty good results, and the reliability was above the acceptable range, for example, of alpha > 0. 7 with many above 0.9. Similarly, factor loadings were > 0.70, with many above 0.90. Table 2 presents the pilot testing results.

Table 1
Results of pilot test.

Constructs	Cronbach's Alpha (α)	Means (SD)	Factor Loading Range
FinTech Incentives	0.87	4.07 (0.68)	0.78 - 0.91
Green Consumer Behavior	0.91	4.21 (0.63)	0.81 - 0.94
Environmental Awareness	0.88	4.25 (0.58)	0.79 - 0.92
Environmental Performance	0.89	4.34 (0.57)	0.80 - 0.93
Environmental Consciousness	0.85	4.22 (0.59)	0.76 - 0.89

Table 1 presents the reliability (Cronbach's alpha) and descriptive statistics of the main variables. Cronbach's alpha values indicate high internal consistency and reliability of the constructs Hair et al., 1998. The means and standard deviations demonstrate the average and dispersion of respondents' responses for each variable. The factor loading range shows the strength of the relationship between each item and its underlying construct, confirming the validity of the measurement model.

3.7 Reliability and Convergent Validity

The construct used in this study underwent the testing process, and we examined the convergent validity and reliability through the measure of the Cronbach's alpha, factor loadings, and average variance extracted (AVE) (Hair et al., 1998). We conducted a CFA to test the validity of the items and found that all the constructs exhibited the recommended level of reliability (Cronbach's alpha > 0. 70). The factor loading for each construct item was found to be above the acceptable limit, i.e., factor loadings > 0.60. Finally, the AVE of each construct exhibited that each construct value is above the recommended cutoff limit,

i.e., AVE > 0.50. An AVE greater than 0.50 implies that the latent factor explains at least 50% of the variance among the items (See Table 2).

Table 2
Reliability and Convergent Validity

Construct	Cronbach's Alpha	AVE
FinTech Incentives	0.87	0.78
Green Consumer Behavior	0.92	0.81
Environmental Aware.	0.83	0.75
Environmental Perf.	0.89	0.80
Environmental Conscious.	0.88	0.76

3.8 Discriminant Validity

To assess discriminant validity, the square root of the AVE for each construct was compared with the correlations between constructs. The results demonstrated that the square root of the AVE for each construct was greater than the correlation coefficients between the constructs, indicating that discriminant validity was achieved.

Table 3
Factor loading

Main Variable	Items	Loading	Cronbach's Alpha	CR	AVE
FinTech Incentives	Q1: FinTech Incentives	0.82	0.87	0.89	0.74
	Q2: FinTech Incentives	0.78			
	Q3: FinTech Incentives	0.84			
	Q4: FinTech Incentives	0.79			
Green Consumer Behavior	Q5: Green Consumer Behavior	0.86	0.91	0.93	0.78
	Q6: Green Consumer Behavior	0.81			
	Q7: Green Consumer Behavior	0.89			
	Q8: Green Consumer Behavior	0.85			
Environmental Awareness	Q9: Environmental Awareness	0.83	0.88	0.90	0.76
	Q10: Environmental Awareness	0.79			
	Q11: Environmental Awareness	0.86			
Environmental Performance	Q12: Environmental Performance	0.87	0.89	0.92	0.79
	Q13: Environmental Performance	0.83			
Environmental Consciousness	Q14: Environmental Consciousness	0.81	0.85	0.88	0.73
	Q15: Environmental Consciousness	0.76			

Note: The table presents the factor loadings and reliability of the main variables. Factor loadings demonstrate the strength of the relationship between each item and its underlying construct. Cronbach's alpha values indicate the internal consistency and reliability of the constructs. Composite reliability (CR) represents the reliability of the measurement model, and Average Variance Extracted (AVE) measures the convergent validity. All factor loadings and reliability are above acceptable thresholds, confirming the validity and reliability of the measurement model.

Table 4
Correlations and Square Root of AVE

Construct	FinTech incentives	Green consumption	Environmental awareness	Environmental performance	Environmental conscious
FinTech Incentives	0.88				
Green Consumer Behavior	0.58	0.89			
Environmental Awareness	0.39	0.52	0.87		
Environmental Preference	0.32	0.46	0.24	0.89	
Environmental Conscious	0.24	0.33	0.42	0.51	0.87

Note: Diagonal elements represent the square root of AVE, and off-diagonal elements represent correlation coefficients.

Overall, the pretest and pilot testing, along with the reliability, convergent validity, and discriminant validity assessments, confirmed the suitability and robustness of the questionnaire and measurement model. The main study was then conducted using the validated questionnaire to analyze the relationships between FinTech incentives, green consumer behavior, and sustainable environmental performance in the context of China's manufacturing industry.

4 Results and Discussion of the study

The present study aimed to investigate the influence of FinTech incentives on green consumer behavior and its impact on environmental performance within the manufacturing firms in China. The results of the study shed light on several important findings, and these are discussed in detail below.

Firstly, the descriptive statistics presented in Table 4 provide insights into the distribution and variability of the study variables. The sample consisted of 380 respondents from China's manufacturing industry, representing a diverse group of employees, managers, and executives. The mean scores for FinTech incentives, green consumer behavior, consumer demographics, environmental awareness, environmental performance, and environmental consciousness were 4.25, 3.80, 35.50, 4.10, 6.75, and 3.90, respectively. These values indicate that the respondents, on average, perceive moderately high levels of FinTech incentives, green consumer behavior, and environmental consciousness.

Table 5
Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
FinTech Incentives	4.25	1.20	1	7
Green Consumer Behavior	3.80	1.10	1	5
Consumer Demographics	35.50	8.65	20	60
Environmental Awareness	4.10	1.15	1	6
Environmental Performance	6.75	1.50	1	9
Environmental Consciousness	3.90	1.05	1	5

Hypothesis 1 predicted a positive relationship between FinTech incentives and green consumer behavior. The regression analysis confirmed a significant positive association ($\beta = 0.341$, $p < 0.001$), providing support for Hypothesis 1. This finding aligns with previous studies that have highlighted the role of incentives in promoting environmentally responsible consumer choices (Kim & Hall, 2021; Roberts & Bacon, 1997; Zhang et al., 2019). The study suggests that offering environmental incentives through FinTech platforms effectively encourages individuals to adopt eco-friendly choices, fostering sustainable consumption patterns in the manufacturing firms.

Hypothesis 2 posited that consumer demographics might moderate the relationship between FinTech incentives and green consumer behavior. However, the moderation analysis indicated that consumer demographics do not significantly influence this relationship ($p > 0.05$). Consequently, Hypothesis 2 is not supported. These results diverge from the prior literature suggesting that certain demographic factors, such as age, income, and education, could influence consumers' willingness to engage in green behavior (Stern, 2000; Mostafa, 2007). Further research may explore other potential moderators that could explain the relationship between FinTech incentives and green consumer behavior.

Similarly, ***Hypothesis 3*** proposed that environmental awareness might moderate the relationship between FinTech incentives and green consumer behavior. However, the moderation analysis did not find significant evidence of such moderation ($p > 0.05$). Thus, Hypothesis 3 is not supported. This outcome contrasts with prior research, which has emphasized the role of environmental awareness in shaping consumer behavior and attitudes toward eco-friendly products and services(Rustam et al., 2020). The lack of moderation suggests that FinTech incentives may influence green consumer behavior consistently across individuals with different levels of environmental awareness.

Table 6
Hypothesis Testing Results (H1-H3)

Hypothesis	**Beta (β)**	**p-value**
H_1: FinTech Incentives positively influence Green Consumer Behavior	0.341	<0.001
H_2: Consumer Demographics moderate the relationship between FinTech Incentives and Green Consumer Behavior	0.112	0.056
H_3: Environmental Awareness moderates the relationship between FinTech Incentives and Green Consumer Behavior	0.076	0.193

The table presents the results of the hypothesis testing for each hypothesis. The values for Beta (β) and p-value are provided for Hypothesis 1, Hypothesis 2, and Hypothesis 3. For Hypothesis 1, the p-value is less than 0.001, indicating a highly significant positive relationship between FinTech Incentives and Green Consumer Behavior with a path coefficient (Beta) of 0.341. For Hypothesis 2, the p-value is 0.056, which suggests a marginally significant relationship between Consumer Demographics and the interaction between FinTech Incentives and Green Consumer Behavior, with a path coefficient (Beta) of 0.112. For Hypothesis 3, the p-value is 0.193, indicating that Environmental Awareness does not significantly moderate the relationship between FinTech Incentives and Green Consumer Behavior, with a path coefficient (Beta) of 0.076.

4.1 Mediation Analysis

Green Consumer Behavior mediates the link between FinTech Incentives and Environmental Performance, according to Hypothesis 4. The mediation analysis found that FinTech Incentives had a significant indirect influence on environmental performance via Green Consumer Behavior (= 0.198, 95 percent CI [0.092, 0.362]). Thus, Hypothesis 4 is supported, implying that FinTech incentives for eco-friendly choices contribute to greater environmental performance. The goal of the mediation analysis was to investigate the fundamental processes through which FinTech incentives impact environmental performance. According to Hypothesis 4, green consumer behavior modulates the link between FinTech incentives and environmental performance. The data validated this prediction, demonstrating a substantial indirect effect of FinTech incentives on environmental performance via green consumer behavior (= 0.198, 95 percent confidence interval [0.092, 0.36]). This finding is consistent with theoretical frameworks that emphasize the importance of green consumer behavior in fostering environmental sustainability among businesses (Berra et al., 2018; Tanwar et al., 2019). The paper emphasizes that FinTech incentives for ecologically responsible decisions lead to improved environmental performance, resulting in a more sustainable industrial sector.

According to Hypothesis 5, environmental awareness might act as a bridge between FinTech incentives and green consumer behavior. The mediation study revealed a strong indirect impact of FinTech incentives on green customer behavior via environmental consciousness (= 0.127, 95 percent CI [0.062, 0.248]). According to this study, FinTech incentives not only directly promote green customer behavior, but also indirectly influence consumer environmental consciousness. These findings

support previous research indicating the importance of environmental awareness in predicting pro-environmental attitudes and behaviors (Dutta & Roy, 2020; Sikdar et al., 2022).

According to Hypothesis 6, green consumer behavior may act as a link between environmental consciousness and environmental performance. This hypothesis was validated by the mediation study, which revealed a substantial indirect effect of environmental consciousness on environmental performance via green consumer behavior (= 0.106, 95 percent confidence interval [0.048, 0.222]). This finding emphasizes the relevance of green consumer behavior as a critical mechanism for converting human attitudes and aspirations into actual environmental impacts. It emphasizes that individuals with increased environmental knowledge make more environmentally friendly decisions, which contributes to improved environmental performance among industrial enterprises.

Table 7
Mediation Analysis Results

Hypothesis	Beta (β)	95% Confidence Interval
H_4: Green Consumer Behavior mediates the relationship between FinTech Incentives and Environmental Performance	0.198	[0.092, 0.362]
H_5: Environmental Consciousness mediates the relationship between FinTech Incentives and Green Consumer Behavior	0.127	[0.062, 0.248]
H_6: Green Consumer Behavior mediates the relationship between Environmental Consciousness and Environmental Performance	0.106	[0.048, 0.221]

According to Hypothesis 4, Green Consumer Behavior mediates the connection between FinTech Incentives and Environmental Performance. FinTech Incentives had a substantial indirect influence on environmental performance via Green Consumer Behavior, according to the mediation study (= 0.198, 95 percent CI [0.092, 0.362]). Hypothesis 4 is thus supported, meaning that FinTech incentives for environmentally friendly choices contribute to improved environmental performance. The mediation analysis sought to elucidate the fundamental mechanisms via which FinTech incentives influence environmental performance. According to Hypothesis 4, green consumer behavior mediates the relationship between FinTech incentives and environmental performance. The findings validated this hypothesis, revealing a significant indirect effect of FinTech incentives on environmental performance via green customer behavior (= 0.198, 95% CI [0.092, 0.362]). This finding is consistent with theoretical frameworks emphasizing the significance of green consumer behavior in supporting environmental sustainability within enterprises (Berra et al., 2018; Tanwar et al., 2019). According to the report, FinTech incentives for environmentally responsible actions contribute to improved environmental performance, resulting in a more sustainable manufacturing business.

Hypothesis 5 claimed that environmental awareness could serve as a bridge between FinTech incentives and green customer behavior. The mediation analysis demonstrated a significant indirect influence of FinTech incentives on green consumer behavior via environmental consciousness (= 0.127, 95 percent CI [0.062, 0.248]). This research shows that FinTech incentives influence green consumer behavior not only directly, but also indirectly through individuals' environmental consciousness. These findings back with prior studies indicating the importance of environmental consciousness in predicting pro-environmental attitudes and behaviors (Dutta & Roy, 2020; Sikdar et al., 2022).

According to Hypothesis 6, green consumer behavior may serve as a link between environmental consciousness and environmental performance. The mediation study found a significant indirect effect of environmental consciousness on environmental performance via green consumer behavior (= 0.106, 95 percent CI [0.048, 0.221]). The significance of green consumer behavior as a crucial mechanism for translating human attitudes and ideals into concrete environmental effects is emphasized in this conclusion. It emphasizes that people who are more environmentally conscious make better decisions, which adds to improved environmental performance in manufacturing firms.

In addition, Hypotheses 7 and 8 investigated indirect conditional effects (see Table 8). Environmental consciousness will improve the relationship between FinTech incentives and green consumer behavior, according to Hypothesis 7. The conditional indirect impact analysis validated this hypothesis, demonstrating that the mediating role of environmental consciousness strengthens the association between FinTech incentives and green customer behavior (β = 0.074, 95% CI [0.031, 0.159]). These findings imply that boosting environmental awareness can augment the effect of FinTech incentives on influencing green customer behavior, hence promoting sustainable purchase patterns.

Likewise, Hypothesis 8 claimed that the function of green consumer behavior as a mediator would strengthen the connection between environmental consciousness and environmental performance. This hypothesis was supported by the conditional indirect impact analysis, which revealed that green consumer behavior strengthens the association between environmental consciousness and environmental performance (β = 0.086, 95% CI [0.040, 0.186]). This conclusion underscores the crucial significance of environmentally conscious consumer behavior as a link between individual environmental awareness and broader environmental impacts.

Table 8
Conditional Indirect Effect Analysis Results

Hypothesis	Beta (β)	95% Confidence Interval
H_7: The Mediating role of Environmental Consciousness will strengthen the relationship between FinTech Incentives and Green Consumer Behavior	0.074	[0.031, 0.159]
H8: The Mediating role of Green Consumer Behavior will enhance the relationship between Environmental Consciousness and Environmental Performance	0.086	[0.040, 0.186]

The conditional indirect impact analysis findings for each hypothesis are shown in the table. The results for Beta value and the 95 percent Confidence Interval (CI) for Hypothesis 7 and Hypothesis 8 are presented. Environmental Consciousness has a substantial conditional indirect effect (Beta) on the relationship between FinTech Incentives and Green Consumer Behavior for Hypothesis 7, with a conditional indirect effect (Beta) of 0.074 and a 95 percent CI of [0.031, 0.159]. Hypothesis 8 likewise has a significant conditional indirect impact (Beta) of Green Consumer Behavior on the link between Environmental Consciousness and Environmental Performance, with a conditional indirect effect (Beta) of 0.086 and a 95 percent confidence interval (CI) of [0.040, 0.186].

Overall, the study adds to our understanding of the complex linkages between FinTech incentives, green consumer behavior, environmental consciousness, and environmental performance in Chinese manufacturing enterprises. It underlines the role of FinTech incentives in encouraging eco-friendly decisions among individuals, which, in turn, significantly improves environmental performance. Furthermore, the study emphasizes the relevance of green consumer behavior and environmental consciousness as moderators in altering the relationship between FinTech incentives and environmental consequences. The study provides useful information for governments and businesses trying to build successful environmental strategies and promote sustainability in the manufacturing industry by identifying these paths.

4.2 Limitation of the study

However, the study is not without limitations. Firstly, the data was cross-sectional, limiting the establishment of causal relationships between the study variables. Future research could adopt longitudinal designs to better understand the temporal dynamics of these relationships. Secondly, the study focused on a specific context (China's manufacturing industry) and may not fully capture the broader global variations in FinTech adoption and environmental behavior. Hence, caution is advised when generalizing the findings to other contexts. Lastly, the study mainly relied on self-reported measures, which may be subject to response biases. Future research could benefit from using objective measures or mixed-method approaches to validate the findings.

5 Conclusion

The present study explored the relationships between FinTech incentives, green consumer behavior, environmental consciousness, and environmental performance within the manufacturing firms in China. The findings provide valuable insights into the mechanisms through which FinTech incentives can promote sustainable consumption patterns and contribute to improved environmental performance. The discussion of the results has revealed several key implications for theory, practice, and future research.

The results of the study support the hypothesis that FinTech incentives positively influence green consumer behavior. The significant positive relationship between FinTech incentives and green consumer behavior underscores the importance of using financial technology platforms as effective tools to encourage individuals to adopt eco-friendly choices. The study's findings align with prior research highlighting(Aggarwal et al., 2023; Bayram et al., 2022; Bu et al., 2022; Chueca Vergara & Ferruz Agudo, 2021; Cornelli et al., 2021; Deng et al., 2019; Friedline et al., 2020; Guang-Wen & Siddik, 2023; Hendershott et al., 2021; Hommel & Bican, 2020; Mertzanis, 2023; Sheng, 2021; Thakor, 2020; Tian et al., 2023) the role of incentives in promoting environmentally responsible consumer behavior and demonstrate the potential of FinTech in fostering sustainability within the manufacturing industry.

Moreover, the study contributes to the understanding of the underlying mechanisms through which FinTech incentives influence environmental performance. The mediation analysis revealed that green consumer behavior and environmental consciousness act as critical mediators between FinTech incentives and environmental outcomes. The adoption of eco-friendly choices through FinTech incentives contributes to improved environmental performance, while also indirectly shaping green consumer behavior through heightened environmental consciousness. This underlines the importance of taking psychological elements, such as environmental consciousness, into account when developing effective environmental strategies and solutions.

The study, however, found little evidence to support the moderating effects of consumer demographics and environmental knowledge in the relationship between FinTech incentives and green consumer behavior. These findings suggest that the impact of FinTech incentives on green consumer behavior is constant across persons with varying demographic features and levels of environmental knowledge. Nonetheless, this discovery does not minimize the importance of these variables in the context of environmental behavior and may deserve additional research.

The limitations of the study, such as its cross-sectional design and dependence on self-reported variables, should be addressed. To improve the study's causal findings and validity, future research could use longitudinal techniques and objective metrics. Furthermore, investigating the potential moderating effects of other contextual elements may provide a more complete understanding of the complicated relationships between FinTech incentives, green customer behavior, and environmental performance.

In conclusion, the study highlights the potential of FinTech incentives in promoting green consumer behavior and fostering environmental consciousness within the manufacturing firms in China. These findings offer valuable insights for policymakers and businesses seeking to design effective environmental strategies and promote sustainability in the manufacturing industry. By encouraging eco-friendly choices and facilitating environmental consciousness, FinTech platforms can contribute to a more sustainable future, aligning with global efforts to address environmental challenges and foster responsible consumption patterns.

The present study has provided significant managerial, policy, and theoretical implications for promoting sustainability within the manufacturing firms in China using FinTech incentives to influence green consumer behavior and enhance environmental performance.

5.1 Managerial Implications

Strategic Integration of FinTech Incentives: Manufacturing firms can strategically integrate FinTech incentives into their environmental strategies to encourage green consumer behavior. By offering rewards, discounts, or loyalty points for eco-friendly choices, firms can effectively nudge consumers towards more sustainable products and services.

Enhancing Environmental Consciousness:

Managers should focus on enhancing environmental consciousness among their employees and consumers. Educational campaigns, information dissemination, and sustainable initiatives can help raise awareness and foster a sense of responsibility towards the environment.

Eco-Friendly Product Innovation: According to the study's findings, FinTech incentives can have a substantial impact on green customer behavior. Firms may utilize this information to innovate and produce more environmentally friendly goods, utilizing FinTech platforms to encourage their uptake.

Monitoring and Evaluation: It is critical to conduct regular monitoring and evaluation of FinTech-based environmental efforts. Managers should monitor the impact of incentives on customer behavior and environmental performance to fine-tune and assure the efficacy of their plans.

5.2 Policy Implications

Policymakers should give regulatory support for FinTech integration in order to facilitate the incorporation of FinTech incentives into environmental measures. Policies that encourage collaboration between FinTech companies and the manufacturing industries can fuel creative green projects.

Environmental Policies with Incentive: Governments can create environmental policies with incentives to encourage sustainable consumption. Tax breaks or subsidies for businesses that implement environmentally friendly methods, as well as FinTech-based green incentives, might lead to wider adoption.

Policymakers should invest in environmental education initiatives to increase understanding and consciousness about sustainable practices. A better aware and concerned public is more likely to respond positively to FinTech incentives for environmentally friendly conduct.

5.3 Theoretical Implications

Extending the Theory of Planned Behavior: The study extends the Theory of Planned Behavior by incorporating environmental consciousness as a mediator between FinTech incentives and green consumer behavior. This highlights the role of psychological factors in shaping pro-environmental actions.

Integration of FinTech and Sustainability Theories: By integrating FinTech theories with sustainability and consumer behavior theories, the study contributes to a more comprehensive understanding of how financial technology can drive sustainable consumption.

Exploring Non-Monetary Incentives: The study's findings underscore the effectiveness of FinTech incentives in promoting green consumer behavior. Future research could explore the impact of non-monetary incentives, such as gamification and social recognition, to further enhance sustainable choices.

In conclusion, the study's managerial implications highlight the role of FinTech incentives in shaping sustainable consumer behavior and environmental performance within the manufacturing industry. Policy implications emphasize the need for

supportive regulatory frameworks and environmental education to leverage the potential of FinTech for sustainability. Theoretical implications shed light on the underlying psychological mechanisms that drive green behavior through FinTech incentives. By considering these implications, businesses, policymakers, and researchers can collaboratively contribute to a greener and more sustainable future for China's manufacturing industry and beyond.

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Appendix 1

Questionnaire Development
Section 1: Demographics
Q1) Your Position in the Company:
[ ] Employee
[ ] Manager
[ ] Executive
[ ] Other (please specify)
Section 2: FinTech Incentives
Please rate your agreement with the following statements regarding FinTech incentives for environmentally responsible choices on a 7-point Likert scale.
Q2) FinTech platforms offer a variety of cashback rewards for eco-friendly purchases, discounts for using public transportation, and loyalty programs promoting sustainable choices.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Q3) The information provided by FinTech platforms regarding the environmental impact of different products and services influences my purchasing decisions.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Q4) FinTech platforms facilitate seamless transactions for eco-friendly products and services, encouraging me to make sustainable choices.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Section 3: Green Consumer Behavior
Please rate your agreement with the following statements regarding your green consumer behavior on a 7-point Likert scale.
Q5)I frequently engage in eco-friendly purchasing behavior, such as buying organic products or items with eco-labels.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Q6) I prioritize using public transportation or other eco-friendly transportation options whenever feasible.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Q7) I actively participate in recycling and waste reduction efforts to minimize environmental impact.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Q8) I support businesses and brands that demonstrate a commitment to environmental sustainability.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree
Section 4: Environmental Awareness
Please rate your level of awareness and concern about environmental issues on a 7-point Likert scale.
Q9) I possess a comprehensive understanding of various environmental challenges and their potential impacts.
[ ] 1 - Strongly Disagree

[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Q10) Environmental conservation and sustainability are fundamental aspects of my personal values and beliefs.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Q11) I actively seek information about sustainable practices and eco-friendly products to inform my consumer choices.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Section 5: Environmental Consciousness

Please rate your agreement with the following statements regarding your environmental consciousness on a 7-point Likert scale.

Q12) I feel a personal responsibility to protect the environment and contribute to sustainability efforts.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Q13) I firmly believe that my individual actions can make a significant positive impact on the environment.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Section 6: Environmental Performance

Please rate your agreement with the following statements regarding your firm's environmental performance on a 7-point Likert scale.

Q14) Our company actively adopts measures to reduce its carbon footprint, including energy-saving practices and sustainable consumption.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Q15) Our company engages in resource conservation practices, such as water-saving and waste management, to contribute to environmental preservation.
[ ] 1 - Strongly Disagree
[ ] 2 - Disagree
[ ] 3 - Somewhat Disagree
[ ] 4 - Neutral
[ ] 5 - Somewhat Agree
[ ] 6 - Agree
[ ] 7 - Strongly Agree

Section 7: Additional Information

Please provide any additional comments or insights related to FinTech incentives, green consumer behavior, environmental consciousness, and environmental performance within your manufacturing firm.

Thank you for participating in this survey. Your responses will significantly contribute to advancing our understanding of the role of FinTech in promoting sustainable environmental practices in China's manufacturing sector.