Green Product Certification and Consumer Trust Mechanism in the E-Business Environment

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Abstract. Green consumption, as a significant part of "new consumption", advocates healthy, reasonable, and green organic consumption methods, gradually becoming a consumption concept accepted by people. When the quality information of consumers purchasing green products (GP) is incomplete, the certification signal transmission of GP quality by the seller can offset the negative impact of information asymmetry, reduce the perceived risk of consumers, and promote better matching between consumers and products. The effectiveness and evaluation of GP certification are important measures to improve the quality of GP certification work and enhance the credibility of GP certification. This article constructs an interactive model between GP authentication and consumer trust mechanism in the e-business environment. This model takes GP authentication as an input variable, which affects consumer cognition and evaluation, thereby influencing consumer trust as an output variable. The experimental results indicate that GP authentication has a positive impact on consumer trust mechanisms. For e-business platforms and merchants, actively promoting GP certification not only helps to enhance consumer trust, but also promotes sales, enhances brand influence, and reduces return costs.

Keywords: E-business environment; Green product certification; Consumer trust mechanism

1 Introduction

With the accelerated growth of modern information technology and the improvement of people's living standards, consumer demand for products is also shifting from quantity to quality [1]. In the process of promoting ecological civilization construction and green transformation of consumption patterns in China, both enterprise marketing practices and consumer behavior cannot be separated from the important marketing concept of green marketing [2]. Currently, GP is increasingly valued by people in daily life, but consumers' willingness to pay has not been improved, mainly due to the low level of trust [3]. Consumers stand at the end of the product sales industry chain, and their purchasing behavior and feedback information are closely related to market growth [4]. The effectiveness evaluation of GP certification is an important measure to improve the quality of GP certification work and enhance the credibility of GP certification [5]. When constructing the product evaluation index system, there is no unified solution for the effective processing of massive evaluation information and the selection of the simplest indicators. In the e-business market, products

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with certain brand awareness have a first mover advantage, can gain consumer trust, and have stable sales; On the contrary, products with low brand awareness are difficult to gain consumer trust, resulting in poor sales. Exploring the internal relationship of the growth of best-selling products in e-business has become a hot research issue in the field of marketing [6].

Since its entry into China in the 1990s, the concept of green marketing has gradually received attention from Chinese scholars and business practitioners. Especially in marketing practice, many enterprises have integrated the concept of green marketing into their business management and strategic growth [7]. With the increasing awareness of environmental protection among consumers, many enterprises have transformed their existing brands into green or launched new green brands to cater to this consumption trend. On the one hand, they have packaged their products in green, and on the other hand, they promote their green concepts, making consumers believe that enterprises have implemented environmental protection and effective resource utilization measures in their production and management processes [8]. The promotion and certification of GP are important measures taken by the Chinese government to implement environmental protection strategies and promote industrial restructuring. They have achieved good results in enhancing China's manufacturing competitiveness, leading green consumption, and fulfilling international emission reduction commitments. The implementation of GP certification integrates various "green" certifications currently established separately, which has a positive effect on reducing the selection barriers of the public and improving the public acceptance of GP, and can significantly enhance consumers' intention to purchase GP [9].

The growth of GP is not only a necessary path for industrial innovation, but also influenced by various factors such as policies, funds, environment, and technology, leading many traditional enterprises to shift to other production methods [10]. In the context of industrial transformation and upgrading, driving domestic and international dual circulation, promoting enterprises to actively participate in GP certification and enhancing the international discourse power of China's GP certification standards is an effective means to enhance the brand awareness and market competitiveness of "Made in China". Brand identity, with its memory advantage, can help consumers distinguish products from different companies, while also strengthening their impression of the company. This article constructs an interactive model between GP authentication and consumer trust mechanism in the e-business environment, and deeply explores the interrelationships and interactive effects between these two elements.

2 Methodology

2.1 GP Authentication and Consumer Trust Mechanism

With the increasingly prominent environmental issues, people are also paying more and more attention to environmental protection and maintaining ecological balance [11]. Certification and accreditation is an important task for the country to ensure product quality, protect consumer rights, and promote economic growth [12]. There are numerous GPs in the market, such as green food, energy-saving appliances, green clothing, green daily chemical products, etc. [13]. Establishing a unified GP standard, certification, and identification system is a massive and complex system engineering. The lack of unified certification results in a wide

variety of certification marks, which is not conducive to consumer identification and differentiation, and also restricts consumer recognition and acceptance of GP certification, thereby seriously hindering the promotion and popularization of GP certification. The existing certification indicators have not fully taken into account the differences between industries and products, and equal quantities of products need to be sampled during the certification process. This leads to a significant increase in certification costs for industries with high product prices, which seriously restricts the enthusiasm of these enterprises to participate in certification. In the subsequent stages of promotion, sales, and credit, the government lacks effective support policies, which have not enabled participating enterprises to receive corresponding economic returns, thus hindering the promotion and popularization of GP certification. In China, the acquisition of green labels can effectively reduce information asymmetry in the product market and the resulting adverse selection, making high-quality GPs stand out. The green certification mechanism for products relies on the rationality of the indicator system, which directly determines the quality of the evaluation results and also determines the correctness of the green certification results for products. This article constructs an indicator system and authentication evaluation principle using grey dynamic clustering and rough set reduction theory, as shown in Figure 1.

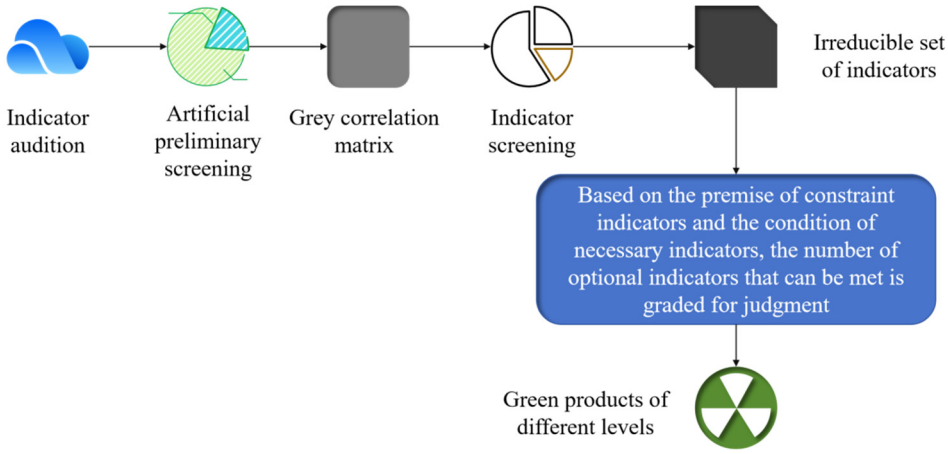

Figure 1: Construction of GP certification indicator system

Sociological research regards trust as a fundamental element of social relationships. In the context of e-business, it is crucial to establish consumer trust to stabilize social relationships between the two parties and reduce transaction risks. Consumer behavior refers to the process in which consumers subjectively measure and choose products that meet their specific needs. Through their own judgment and understanding of the products, they collect information for evaluation, and obtain greater benefits with less cost. The level of information held by producers, operators, and consumers is different. The more complete the information, the higher the degree of benefit, and the higher the willingness of consumers to pay. When one party in a transaction has more information, they occupy a favorable position and have a better advantage. On the contrary, the party with less information is in a more disadvantaged position. Information asymmetry can be divided into two categories: pre transaction and post transaction. Green marketing integrates concepts such as environmental concern,

environmental protection, and sustainable growth into the marketing theory system. Through a series of related marketing activities, while achieving its strategic goals, it can achieve the unity of enterprise performance, consumer needs, and environmental sustainable growth. With the widespread application of trust in management and the flourishing growth of green marketing, the concept of trust is gradually playing an important role in influencing the green growth of enterprises and consumer green consumption behavior in green marketing. For GP, companies are increasingly emphasizing the impact of brands on consumer psychology. Consumers can perceive a sense of security from the brand, thereby increasing trust.

2.2 Model Building

Fuzzy clustering analysis is a method of clustering objective things based on their characteristics, degree of familiarity, and similarity, by establishing fuzzy similarity relationships. This article adopts the fuzzy clustering analysis method to screen out the categories of factors that affect the effectiveness of GP certification with similar characteristics, and then manages, improves, and enhances the certification effectiveness indicators in a targeted manner. Determine classification objects and standardize sample data. Select the scoring sequence of 10 groups of experts on the importance of effectiveness influencing factors as the domain $u = \{u_1, u_2, u_3, \cdots, u_{25}, u_{26}, u_{27}\}$; The standard deviation formula used for data standardization is:

$$x_{ij} = \frac{x'_{ij} - \bar{x}'_j}{S_j} \quad (1)$$

According to the grey dynamic clustering method, the initial indicator set data is first standardized, and the indicators are divided into positive indicators and negative indicators. Positive indicators indicate that products with large data have better green evaluations, and the green evaluations of products are negatively correlated with the numerical values of negative indicators. The standardization of indicators refers to the mathematical processing of the initial values of indicators into relative values. The standardized formula for positive indicators is:

$$y_{ij} = \frac{x_{ij} - \max\limits_{1 \le i \le n} x_{ij}}{\max\limits_{1 \le i \le n} x_{ij} - \min\limits_{1 \le i \le n} x_{ij}} \quad (2)$$

The standardized formula for negative indicators is:

$$y_{ij} = \frac{\max\limits_{1 \le i \le n} x_{ij} - x_{ij}}{\max\limits_{1 \le i \le n} x_{ij} - \min\limits_{1 \le i \le n} x_{ij}} \quad (3)$$

In the formula, x_{ij} represents the initial data of the j th indicator of the i th evaluation sample; y_{ij} is the scoring data for the j th indicator of the i th evaluation sample; n is the number of evaluation samples.

Establish fuzzy similarity relationships. Similarity relationship R is a fuzzy measurement method that measures the degree of similarity between samples. It is a fuzzy similarity matrix, and there are many methods to determine the r_{ij} value. This article adopts the Euclidean distance method, and its mathematical model is

$$r_{ij} = 1 - c\sqrt{\sum_{k=1}^{m}\left(x_{ik} - x_{jk}\right)^2} \quad (4)$$

Where c is a constant that can make $0 \le r_{ij} \le 1$, $i, j = 1,2,\cdots,n$.

The quality certification signals that consumers can use when purchasing products mainly refer to the quality and safety signs or systems established by third-party certification agencies by enterprises to transmit product quality information to consumers. Due to the fact that the dependent variable in this article is an ordered categorical variable of consumer trust in the quality certification signals of aquatic products, namely "very distrust=1", "distrust=2", "general=3", "comparative trust=4", and "very trust=5". Therefore, this article will use SPSS 20.0 to construct an ordered logistic model to quantitatively analyze the main factors affecting consumer trust.

$$Y_1 = \beta_0 + \sum \beta_j X_j, j = 1,2,\cdots,n \quad (5)$$

Among them, Y_1 represents the degree of trust of the dependent variable in the product quality certification signal, divided into 5 levels; β_0 represents the parameter intercept; X_j represents the independent variable; β_j represents the regression coefficient.

To evaluate the implementation effect of GP certification, it is necessary to comprehensively consider the impact of certification on various entities. GP certification involves various entities such as enterprises, consumers, certification agencies, and government departments, and has different impacts on these entities. This article adopts a multi indicator scoring weighted synthesis method, which first constructs an indicator system to comprehensively reflect the multifaceted impact of GP certification on various entities; Secondly, assign weights to different indicators to reflect their relative importance; Finally, a weighted calculation is performed to obtain the overall score that reflects the comprehensive effect of GP certification implementation. The specific calculation process is as follows. The formula for calculating the weighted score of the i first level indicator is:

$$A_i = \sum w_{ik} a_{ik} \quad (6)$$

Among them, W_{ik} is the weight of the secondary indicators included in the primary indicators; The calculation formula for the total score S is:

$$S = \sum v_i A_i \quad (7)$$

Among them, V_i is the weight of the primary indicator.

Structural Equation Modeling (SEM) is an extension of general linear models, mainly used to study the structural relationships between unobservable variables (latent variables), which need to be reflected through measurable variables. The regression equation of the model is as follows:

$$\begin{aligned} \eta_2 &= \beta_{21}\eta_1 + \gamma_{21}\xi_1 + \gamma_{22}\xi_2 + \zeta_2 \\ \eta_1 &= \gamma_{11}\xi_1 + \gamma_{12}\xi_2 + \zeta_1 \end{aligned} \quad (8)$$

Among them, ξ_1, ξ_2 is an external latent variable, representing interpersonal trust and institutional trust respectively; η_1, η_2 is an endogenous latent variable that represents behavioral attitude and behavioral intention, respectively; β_{21} represents the degree to which the latent variable η_1 has an impact on η_2 ; γ_{21}, γ_{22} represents the degree of influence of ξ_1, ξ_2 on η_2 ; γ_{11}, γ_{12} represents the degree of influence of ξ_1, ξ_2 on η_1 , respectively; ζ_1, ζ_2 is the residual term of the equation.

3 Result analysis and discussion

The confirmatory factor analysis is a part of the structural equation model. Before analyzing the structural equation model, this article uses AMOS software to conduct reliability analysis on each latent variable dimension. The model includes three latent variable dimensions: GP certification, perceived value, and brand trust. Among them, perceived value is a second-order dimension. The reliability analysis results for the latent variable dimension are shown in Figure 2, and the load on all dimensions is significant, The reliability of its composition ranges from 0.7 to 0.9, indicating that each latent variable construct has good reliability. GP certification has a positive impact on consumer trust mechanisms.

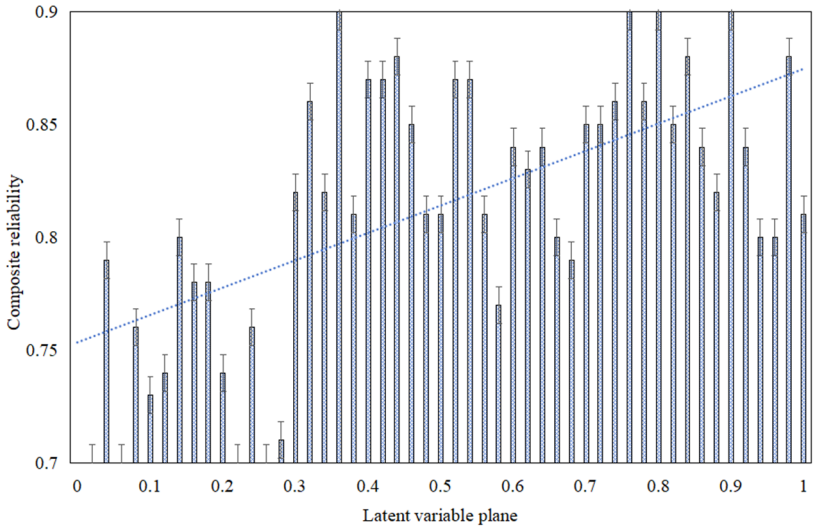

Figure 2: Analysis of the reliability of potential facets

Manufacturers have optimal combination decisions, namely optimal greenness and inventory factors, to maximize their expected profits. From Figure 3, it can be seen that the optimal greenness of the manufacturer's product increases with the increase of the manufacturer's inventory factor. This is because the manufacturer signs consignment contracts with retailers, which can share market demand information with them. Manufacturers can determine their own production volume based on market performance, and market demand is directly related to the greenness of the product. Therefore, if the manufacturer's production volume increases, This means that manufacturers must enhance the greenness of their products in order to cater to consumer purchasing intentions.

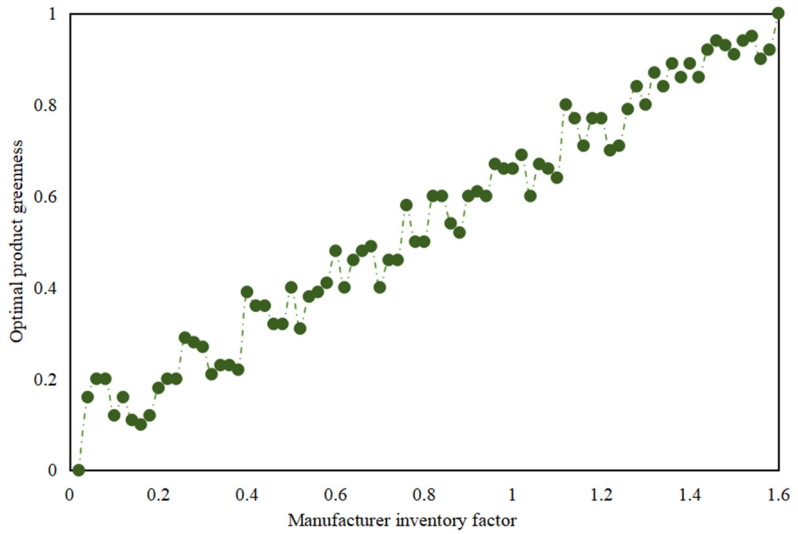

Figure 3: Relationship between manufacturer inventory factor and product greenness

Figure 4 shows the comprehensive trust assessment of electronic order financing for supply chain (SC) sellers. The points in the figure represent the comprehensive trust of SC and the initial trust of recyclers under different transaction satisfaction levels after each transaction. From Figure 4, it can be seen that if the traditional financing model credit standards are adopted, only considering the initial trust of the recycler, as a small and medium-sized enterprise, the recycler is far from meeting the financing standards. However, in the financing of SC seller electronic orders, GP certification and manufacturer trust are introduced, which enhances the overall trust of the SC and enables it to obtain loans under the premise of controllable risk in commercial banks, solving the financing difficulties of recyclers.

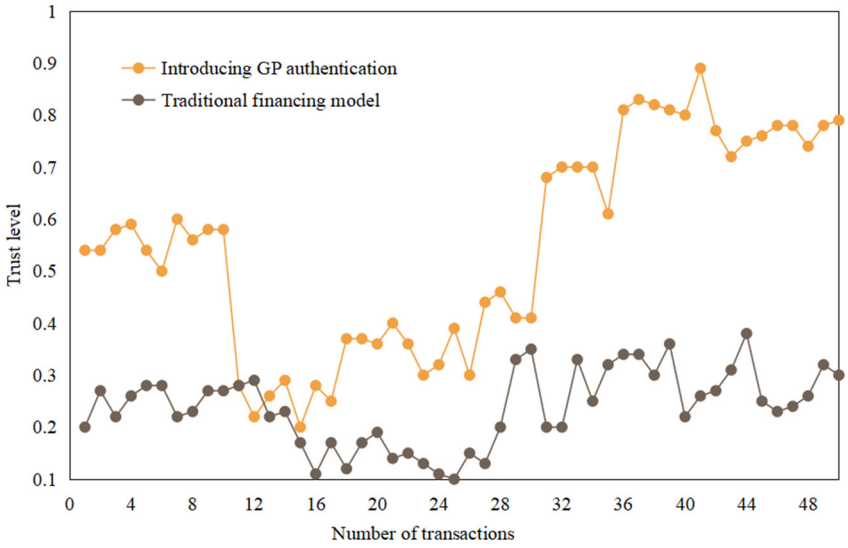

Figure 4: Trust comparison

The effectiveness and fitting effect of the model in this article were validated using AMOS software, and the results are shown in Table 1. The degree of freedom ratio is within the range of 1-3, and the values of GFI and AGFI are both greater than 0.9, while the RMSEA values are less than 0.08. The fitting index and estimated parameters are within an acceptable range, indicating that the measurement model construction is reasonable. In addition, the estimated correlation coefficients between all latent variables were below the critical threshold of 0.9, indicating that the constructed model has good discriminant validity.

Table 1: Model Validity Analysis Results

Freedom	GFI	AGFI	RMSEA
2	0.935	0.971	0.063

By analyzing and processing experimental data, it was found that the presence of GP certification has an impact on brand trust, with GP certification leading to higher brand trust in consumer products compared to non GP certification. Integrating relevant certifications and forming a unified GP certification standard is conducive to promoting GP certification on a large scale and effectively, eliminating cognitive confusion caused by various certifications for consumers, thereby improving the authority of certification and increasing its popularity.

As the enterprise responsible for GP production or sales, in addition to ensuring excellent objective quality, it is also important to attach importance to improving the perceived quality of consumers.

4 Conclusion

In the current context of actual marketing in enterprises, many have realized the demand of consumers for sustainable growth of the environment. Enterprises build product brands to build consumer trust in brands, mainly to develop marketing strategies based on GP certification in the Internet environment, improve consumers' perceived value of brand products, and create brand products that consumers trust. This article constructs an interactive model between GP authentication and consumer trust mechanism in the e-business environment. This model takes GP authentication as an input variable, which affects consumer cognition and evaluation, thereby influencing consumer trust as an output variable. The experimental results indicate that GP authentication has a positive impact on consumer trust mechanisms. For e-business platforms and merchants, actively promoting GP certification not only helps to enhance consumer trust, but also promotes sales, enhances brand influence, and reduces return costs. Under the conditions of informatization, policy improvement and conceptual innovation have led to diversified growth of the sharing economy, and the environmental protection policies implemented by the country have a positive promoting effect on green consumption. Enterprises should actively respond to and utilize national policies, combined with promoting the importance of GP certification, to promote the transformation of consumers towards green consumption methods. At the same time, digital media should be fully utilized to expand marketing channels, increase promotion of GP certification and high-quality product quality, and deepen consumer social recognition of the brand. The GP market is bound to achieve sustainable growth in the context of the sharing economy.

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