International Journal for Housing Science and Its Applications
Publish August 10, 2025. Volume 46, Issue 4 Pages 2663-2675

https://doi.org/10.70517/ijhsa464223

Research on the Promotion Effect of Digital Marketing Strategies of Cross border E-commerce Enterprises on Brand Internationalization

Wanying Dong[1,*]
[1] School of Economics and Engineering, Heilongjiang Institute of Technology, Jixi, Heilongjiang, 158100, China
Corresponding authors: (e-mail: siwanying576@163.com).

Abstract This study examines digital marketing's role in cross - border e - commerce brand internationalization. Using a macroscopic approach, we developed a coupled model to assess brand internationalization status under digital marketing's push. The model factors in digital marketing transaction scale, international brand registration numbers, and international market complexities. In the empirical phase, we crafted a double - difference estimation model. Here, the natural logarithm of Chinese overseas brands' influence in destination - country industries is the dependent variable, while the explanatory variable is the interaction between the dummy variable for digital marketing policy implementation timing and the national industry processing cluster identification variable. We also included multiple control variables to enhance result accuracy. Acknowledging the difficulty in obtaining true values for predicting brand internationalization effects, we proposed an innovative two - step quantile regression method. This offers a solution and provides reliable technical support for our research. We used panel data from 1573 cross - border e - commerce digital marketing enterprises from 2011 - 2024 as our sample. After rigorous processing, we got 5206 valid observations. Results show marketing performance significantly and positively drives brand internationalization. It directly propels the process and indirectly accelerates it by boosting sales growth. Also, higher inventory turnover fosters brand internationalization and enhances marketing performance's driving effect.

Index Terms Cross border e-commerce, Digital marketing, Brand internationalization, Regression analysis, Marketing performance, coupled model

I. Introduction

In the era of the pervasive digital revolution that is currently engulfing the globe, Chinese cross - border e - commerce enterprises have demonstrated a remarkable and robust growth trajectory within the realm of digital marketing. Their prowess in this area has propelled them to the forefront of the global stage, establishing them as pioneers with a competitive edge that sets them apart from many of their international counterparts [1], [2]. As the market landscape undergoes an unremitting and dynamic transformation, the digital marketing approaches adopted by cross - border e - commerce enterprises have witnessed far - reaching alterations. These enterprises have gradually shifted their operational paradigm from the initial low - cost competitive strategy, which was prevalent in the early stages, to the contemporary differentiated competitive model.

Throughout this evolutionary journey, brand cultivation and advancement have emerged as the central pillars of digital marketing initiatives for cross - border e - commerce export firms. In recognition of this pivotal shift, a substantial number of cross - border e - commerce companies have substantially augmented their resource allocation towards brand - building endeavors, aiming to establish a distinct and competitive brand identity in the global marketplace [3]. Actively exploring overseas markets through digital marketing methods, promoting and carefully shaping corporate brand image in all aspects, has become a key path for Chinese enterprises to enter the international market and achieve high-end value chain leaps. Unlike the gradual development process of brand internationalization experienced by developed countries and mature market enterprises in Europe and America, as representatives of emerging market countries, the brand internationalization process of Chinese enterprises has unique internal logic and significant characteristics [4]. The traditional path of enterprise internationalization often relies on international trade activities and the global layout of large multinational corporations, while the digital marketing of cross-border e-commerce enterprises directly targets international end buyers and consumers, building a market pattern that can quickly cover the world and achieve leapfrog development. This new market model has led to the internationalization of Chinese companies' brands no longer following the traditional path of Western companies, but presenting a unique trend of multi-stage parallel development and leapfrog promotion.

Although the development momentum of digital marketing for cross-border e-commerce enterprises is unstoppable and brand building has become a top priority, research on digital marketing for cross-border e-commerce enterprises, an emerging phenomenon of brand internationalization, is relatively lagging behind in the context of globalization. The depth and breadth of research need to be further improved [5], [6]. In view of this, the system has sorted out and conducted in-depth research on relevant literature, and constructed a theoretical framework and analytical model for the internationalization of digital marketing brands in cross-border e-commerce enterprises. This is not only of great significance for promoting the theoretical development of this field, but also provides practical guidance and reference for the brand internationalization practice of cross-border e-commerce enterprises.

In the contemporary Chinese economic landscape, a well - defined cluster of cross - border e - commerce enterprise digital marketing industrial belts has emerged, centered around the strategically established comprehensive pilot zones for cross-border e-commerce digital marketing. These zones serve as pivotal catalysts, fostering a robust foundation for the aggregation and development of a highly specialized digital marketing industrial cluster within the cross-border e-commerce domain. The digital marketing practices of cross - border e - commerce enterprises have achieved a profound level of synergy and integration with industries distributed across various regions in China. This integration is characterized by the active involvement of manufacturing entities, trading firms, and circulation enterprises, all of which are increasingly embracing cross - border e - commerce as a key growth avenue. Traditional cross - border e - commerce enterprises operating in sectors such as electronic manufacturing, automotive components, toys, apparel, and accessories have demonstrated a remarkable competitive edge in the digital marketing arena. These industries have adeptly harnessed digital marketing tools and techniques to enhance their brand visibility, expand their customer base, and optimize their supply chain management on a global scale. Their success stories underscore the transformative power of digital marketing in driving the internationalization and growth of cross-border e-commerce businesses. Currently, there is a discernible shift towards the development of digital marketing business for cross - border e-commerce enterprises specializing in high - tech products, agricultural produce, and bulk commodities. This strategic expansion reflects a broader trend towards diversification and innovation within the cross - border e - commerce sector. By leveraging digital marketing channels, these enterprises aim to unlock new market opportunities, enhance their product differentiation, and achieve sustainable competitive advantages in the global marketplace. Overall, these developments highlight the dynamic and evolving nature of digital marketing within the Chinese cross - border e - commerce ecosystem.

II. Model Assumptions

In the realm of business operations, achieving exemplary marketing outcomes holds paramount importance for enterprises. It serves as a testament to an enterprise's proficiency in precisely and efficiently communicating the fundamental values of its brand to the intended target audience. This proficiency can significantly augment the brand's prominence within the market, thereby attracting a more diverse and expansive international consumer base spanning various countries and regions. For cross-border e-commerce enterprises, which heavily rely on digital marketing platforms, the implementation of effective marketing strategies is a critical determinant of success. When these enterprises strategically deploy well-crafted marketing approaches on these platforms, they are frequently rewarded with remarkable marketing results. These results not only bolster the brand's market position but also contribute to long-term business growth and sustainability in the highly competitive global e-commerce landscape [7]. For example, with precise market positioning, companies can accurately target their customer base; Using innovative and unique promotion methods can attract consumers' attention; At the same time, engaging in deep and meaningful interactions with consumers can help enhance the stickiness between consumers and brands. Through these measures, companies can significantly increase brand exposure and influence in the market. This positive marketing effect will gradually translate into the brand's recognition and acceptance in the international market, effectively promoting the brand's internationalization process. Content marketing plays a crucial role in the digital marketing performance of cross-border e-commerce enterprises [8]. From a theoretical perspective, in-depth analysis shows that the improvement of digital marketing performance of cross-border e-commerce enterprises will help them shape a brand image with strong influence and appeal in the global market, significantly enhance their competitiveness in the international market, and ultimately help them achieve their strategic goal of brand internationalization. Based on the in-depth exploration and analysis of the above theoretical levels, this article proposes the following hypotheses [9]:

Assumption 1: There is a positive correlation between the performance of cross-border e-commerce enterprises in digital marketing and their brand internationalization process. When the sales growth rate of a company shows an upward trend, it will greatly enhance consumers' trust and loyalty to the brand, thereby giving rise to a positive brand reputation effect. Consumers, in the process of purchasing products or services, if they have a good experience, often spontaneously share this positive feeling with potential consumers around them through word-of-

mouth communication. The power of word-of-mouth communication should not be underestimated, as it can attract more potential consumers to pay attention to the brand, thereby expanding the brand's influence in the market. In addition, the increase in sales growth rate also indirectly reflects the strong competitiveness of the enterprise in the international market and its ability to adapt to market changes, which undoubtedly lays a solid and reliable foundation for the international development of the brand.

Assumption 2: The sales growth rate plays a crucial mediating role between the digital marketing performance and brand internationalization of cross-border e-commerce enterprises. A higher inventory turnover rate indicates that the enterprise has efficient operational capabilities, which can quickly convert inventory goods into sales revenue, effectively avoiding inventory backlog and capital occupation, thereby improving the enterprise's liquidity and response speed to market changes. Rapid inventory turnover enables enterprises to adjust their product supply chain and market strategies more flexibly, timely meeting the constantly changing needs of consumers in the international market. This flexible market response capability helps improve the marketing performance of the brand, enhance its competitiveness in the international market, and accelerate the internationalization process of the brand.

Assumption 3: Inventory turnover plays a moderating role in the relationship between digital marketing performance and brand internationalization of cross-border e-commerce enterprises. The impact of digital marketing performance of cross-border e-commerce enterprises on brand internationalization may vary significantly among different types of enterprises, especially between state-owned and non-state-owned enterprises. State owned enterprises often rely more on their strong resource background and policy support advantages when carrying out digital marketing for cross-border e-commerce enterprises. They strive to enhance the brand's visibility and recognition in the international market through large-scale advertising, active participation in international exhibitions, and government cooperation. However, this resource driven development model may have certain limitations, such as relatively insufficient flexibility and innovation, making it difficult to quickly adapt to the rapidly changing and diverse demands of the international market. On the contrary, non-state-owned enterprises usually place more emphasis on innovation and flexibility due to the lack of strong resource support. They gradually enhance the brand's influence in the international market through precise market positioning, personalized content marketing, and active use of social media to interact with consumers.

Assumption 4: There are significant differences in the impact of digital marketing performance on brand internationalization among different types of enterprises in cross-border e-commerce.

III. Model Setting and Variable Explanation

III. A. Model Setting

In digital marketing of cross-border e-commerce, factors like entrepreneurial propensity, international experience, adventurous spirit, diversified business capacity, and market competitiveness greatly impact brand internationalization [10]. When going international, brand strategy formulation and execution face constraints from industry traits, enterprise strategy, and product tiering. Integrating brand and innovation positioning boosts brand performance, fortifying market position and fostering innovation to keep up with market trends. The core of excellent brand performance is deep integration of these two positionings. High growth small and medium sized enterprises are proactive in brand internationalization. Customer relationships are pivotal in brand management. Brand innovation should evolve from service - to solution - oriented. International brands must prioritize consumer - brand relationship building [11]. Enterprises should establish stable, lasting relationships to enhance consumer loyalty.

In view of this, from the macro perspective of the digital marketing brand incubation of cross-border e-commerce enterprises [12], we can construct a coupled model to analyze the interaction between the internationalization of digital marketing brands of cross-border e-commerce enterprises (this indicator system includes two key indicators: the digital sales transaction volume of export cross-border e-commerce enterprises and the number of international brand registrations) and the international market environment, manufacturing industry cluster status, international trade environment, e-commerce development environment, cross-border logistics environment, economic foundation environment, development driving force environment, and policy and legal environment (the specific model is shown in Figure 1).

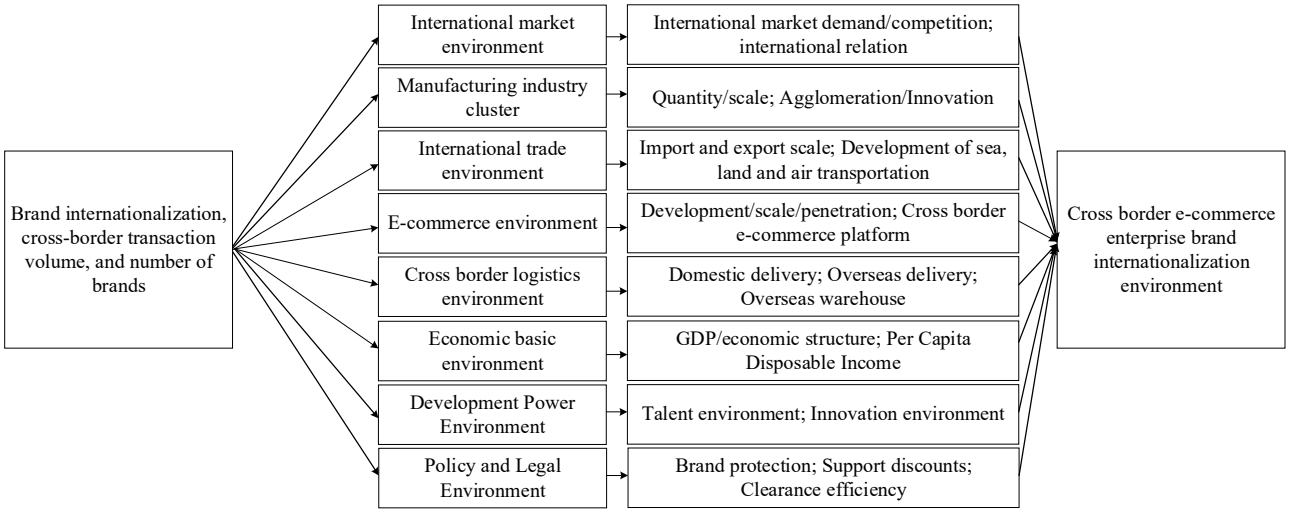

Figure 1: Environmental Coupling Model for Digital Marketing and Brand Internationalization

To explore the impact of digital marketing on brand internationalization in cross-border e-commerce enterprises from an empirical perspective, this paper carefully constructs the following double difference estimation model based on the research methods adopted by fully drawing on existing relevant research results:

$$\ln Y_{jkt} = \beta X_{jt} + \gamma Z_{jkt} + \eta Post_t \times Treat_{jk,11} + \mu_t + \gamma_{jk} + \alpha_j + \lambda_k + \varepsilon_{jkt} \quad (1)$$

where, *j* represents the destination country targeted by China's overseas brand effect, *t* is used to indicate the specific year, and *k* corresponds to the industry category involved in China's overseas brand effect. $Post_t$ is set as an identification variable for digital marketing policies of cross-border e-commerce enterprises, used to accurately capture the key information of policy implementation. $Treat_{jk,11}$, as a treatment group identification variable, aims to distinguish different research groups. $\ln Y_{jkt}$ represents the logarithmic value of the number of trademark applications filed by China in industry k in country j in year t. This indicator can intuitively reflect the brand's trademark layout in specific markets and industries. X_{jt} is a country year control variable, which controls for the annual characteristics at the national level to eliminate interference from macroeconomic factors such as the overall development trend and macroeconomic policies of the country on the research results. Z_{jkt} is a country industry year control variable, which further refines the control dimensions and considers the interactive effects between the country and industry in different years, ensuring that the model can more accurately capture the unique characteristics of specific countries and industries in specific years. To effectively control the impact of unobservable heterogeneity factors on research results, various fixed effects were introduced into the model. λ_k stands for industry fixed effects, aimed at eliminating the potential impact of inherent characteristics of different industries on research variables; α_j is a national fixed effect used to control inherent differences at the national level, such as cultural, institutional, and other factors; μ_t is a fixed year effect to eliminate the interference of common factors at the year level, such as time trends and macroeconomic cycles, on the research results; γ_{jk} is a country industry cross fixed effect that comprehensively considers the interaction between the country and the industry, further improving the accuracy of the model. ε_{jkt} is a random perturbation term used to capture random factors in the model that are not covered by the explanatory and control variables. In model (1), η is the core coefficient that this article focuses on.

III. B. Variable Description and Data Source

(1) The selected dependent variable for this study is the logarithmic form (denoted as $\ln Y_{jkt}$) of the overseas brand effects generated by China in various industries in the destination country. In the process of data processing, we fully draw on the mature practices of existing related research [13], specifically by accurately matching the nice classification system to the International Standard Industrial Classification (ISIC) standard industry classification system. Based on this matching method, this article successfully obtained overseas brand effect data for 22 manufacturing industry segments in 135 countries and regions in China from 2010 to 2024. Among them, the data

related to overseas trademarks are all sourced from the World Intellectual Property Organization (WIPO) database.

(2) The core explanatory variable of this study is set as the interaction term (referred to as $Post_t \times Treat_{jk,11}$) between the virtual variable of the implementation time of digital marketing policies for cross-border e-commerce enterprises and the identification variable of the national industry processing group [14]. When determining the policy window year, this study fully referred to the mature practices of relevant research and designated 2020 as the starting year for the implementation of digital marketing industry policies for cross-border e-commerce enterprises. Based on this setting, for the samples from 2010 to 2019, the corresponding $Post_t$ variable is assigned a value of 0; For the samples from 2020 to 2024, the $Post_t$ variable is assigned a value of 1.

$Treat_{jk,11}$ is set as the identification variable for the national industry processing group. During the research process, this study fully drew on mature ideas and methods from existing research in related fields [15]. After the implementation of digital marketing policies for cross-border e-commerce enterprises, if the specific industry k of trading partner country j engages in more frequent and active digital marketing transactions with Chinese cross-border e-commerce enterprises, it can be reasonably inferred that the country's industry will also be more affected by the implementation of digital marketing industry policies for cross-border e-commerce enterprises. This means that the digital marketing industry policies of cross-border e-commerce enterprises are likely to have a more significant and prominent impact on the brand effect of China's related industries in China. This study, based on the "List of Cross border E-commerce Retail Imported Goods (2016 Edition)" [16], conducted a detailed calculation of the proportion of digital marketing exports of cross-border e-commerce enterprises between China and trading partner countries in the manufacturing industry segment in 2024. Based on this calculation result, the processing group was further accurately identified, providing solid data support and analysis foundation for subsequent research.

(3) The control variables selected in this study mainly cover the following aspects [17]: Gross Domestic Product ($\ln GDP_{jt}$) of trading partner countries: This indicator is used to measure the domestic economic scale and level of economic development of trading partner countries. The Gross Domestic Product (GDP) serves as an indicator that encapsulates the ultimate results of the production endeavors undertaken by all resident entities within a given country or region over a specific timeframe. Leveraging this metric enables us to acquire a more profound comprehension of the economic prowess and developmental trajectories of trading - partner nations. Subsequently, we can scrutinize its potential association with the digital marketing strategies and the overseas brand impacts of cross - border e - commerce enterprises.

Population size of trading partner countries ($\ln POP_{jt}$): This variable is used to measure the population size and market capacity of trading partner countries. Population size is one of the important factors affecting market demand, and a larger population size often means broader market space and potential consumer groups. Studying this indicator can help evaluate the acceptance and potential impact of cross-border e-commerce enterprises' digital marketing and brand effects in the markets of trading partner countries.

Internet penetration rate ($insdist_{jt}$): measured by the proportion of the population of trading partner countries using the Internet in the total population. In the digital era, the Internet penetration rate reflects the improvement of the country's digital infrastructure and the public's acceptance of digital applications. The high Internet penetration rate means that more consumers can easily participate in cross-border e-commerce activities, which has an important impact on cross-border e-commerce enterprises' digital marketing and overseas brand effects.

The institutional distance ($insdist_{jt}$) between China and partner countries: represented by $insdist_{jt} = \left(\sum_{m=1}^{6} \left| I_{ctm} - I_{jtm} \right| \right) / 6$, where I_{ctm} and I_{jtm} respectively represent the scores of China and trading partner countries in the institutional dimension m in year *t*. This study selected six dimensions of indicators provided by the World Bank's World Governance Indicators, including civil rights, political and social stability, government efficiency, social regulation, laws and regulations, and corruption control, to measure institutional distance. Institutional distance reflects the differences in institutional environments among different countries, which may have an impact on the operating costs, market access, and brand promotion of cross-border e-commerce enterprises, thereby affecting overseas brand effects.

The total value of China's exports to the world in the *k* industry ($\ln cn_{\text{world\_kt}}$): This indicator is used to measure the total export value of China's *k* industry. The larger the scale of *k* industry's exports from China to the world, the stronger its competitiveness in the international market, and the more likely it is to carry out overseas brand building activities, thereby generating overseas brand effects. By analyzing this indicator, we can understand the status and development trends of specific industries in China in the international market, as well as their relationship with overseas brand effects.

Total imports of trading partner countries in industry *k* ($\ln part_{world\_kt}$): used to measure the level of demand of trading partner countries in industry *k*. The total import value of a trading partner country in a certain industry reflects the scale of its demand for products or services in that industry. A higher import value means that the country's market has a greater potential for demand for products or services in that industry. This indicator helps evaluate the market opportunities of cross-border e-commerce enterprises in specific industries in the country, as well as their driving effect on overseas brand effects.

IV. Two step quantile regression estimation

In the research scope of exploring the promotion effect of digital marketing strategies of cross-border e-commerce enterprises on brand internationalization, obtaining accurate and real values of predictive variables for brand internationalization effects often faces many difficulties [19]. Given this reality, in the actual research process, we usually use the observed brand internationalization effect impact variable w_{it} to replace the originally difficult to accurately obtain x_{it}. In this context, w_{it} is generally defined as a substitute variable. We assume that the deviation between w_{it} and x_{it} is u_{it}. Based on this assumption, we construct a brand internationalization effect impact data model that includes error factors, and its mathematical expression can be presented as:

$$\begin{cases} y_{it} = \alpha_i + x_{it} \cdot \beta + \varepsilon_{it} \\ w_{it} = x_{it} + u_{it} \end{cases} \tag{2}$$

where, $E(u_{it}) = 0$, $\mathrm{Var}(u_{it}, u_{js}) = \sigma_u^2 (i = j; t = s)$, $\mathrm{Var}(u_{it}, u_{js}) = 0$ (otherwise).

If the predictive variable x_{it} of brand internationalization effect can be accurately obtained, that is, in the absence of error interference in the model, regression method can be an effective means of parameter estimation. However, when errors u_{it} are mixed into the predictive variables of brand internationalization effects, the estimated parameters obtained by traditional methods are difficult to ensure their unbiasedness. In this case, the factor scoring method can be considered to eliminate the adverse effects of errors [20]. Specifically, the factor scoring method is first used to process data containing errors in order to eliminate error interference. On this basis, a new error free data regression model is constructed based on the processed variables. Afterwards, regression methods will be used to estimate the parameters in the internationalization effect model of the brand. Through this series of steps, the accuracy and reliability of parameter estimation can be improved to a certain extent, providing a more solid analytical foundation for further exploring the effects of brand internationalization.

Step 1: Represent the variables in the brand internationalization effect evaluation model in matrix form:

$$\begin{cases} Y_i = e^{\mathrm{T}} \alpha_i + X_i \cdot \beta + \varepsilon_i \\ W_i = X_i + U_i \end{cases} \tag{3}$$

where, Y_i is the response variable of brand internationalization effect; X_i is a *p*-dimensional vector that explains the effect of brand internationalization; α_i is a *T*×1 vector, representing the individual effect of the *i*-th brand internationalization; ε_i is a *T*×1 vector, *e* is a *T*×1 vector, and all elements are 1.

Step 2: Estimate X_i. On the basis of the impact model equation (2) of brand internationalization effect, introduce the working variable Z_i, which satisfies:

$$Z_i = \nu_{0i} + \nu_{1i} X_i + \delta_i \tag{4}$$

Combining equations (3) and (4), we obtain:

$$\begin{pmatrix} W_i \\ Z_i \end{pmatrix} = \begin{pmatrix} 0 \\ V_{0i} \end{pmatrix} + \begin{pmatrix} 0 \\ V_{1i} \end{pmatrix} X_i + \begin{pmatrix} u_i \\ \delta_i \end{pmatrix} \tag{5}$$

Assuming $\mathrm{Var}(u_i) = \mathrm{Var}(\delta_i) = \psi_i^2$ and $\mathrm{Var}(X_i) = \gamma_i^2$, there are $\mathrm{cov}(W_i, Z_i) = \Sigma_i = \gamma_i^2 \Lambda_i \Lambda_i' + \Psi_i$. Among them, $\Lambda_i = (1, \nu_{1i})$, $\Psi_i = \mathrm{diag}(\psi_i^2, \psi_i^2)$.

Use the moment estimation method to solve the following brand impact effect models, in order to calculate the estimated values of ν_{1i} and γ_i^2:

$$\begin{cases} s_{i11} = \gamma_i^2 + \psi_i^2 \\ s_{i12} = v_{1i}\gamma_i^2 \\ s_{i22} = v_{1i}^2\gamma_i^2 + \psi_i^2 \end{cases} \tag{6}$$

The solution of the equation is: $\hat{v}_{1i} = \left[(s_{i22} - s_{i11}) + \sqrt{(s_{i22} - s_{i11})^2 + 4s_{i12}^2} \right] \Big/ 2s_{i12}$ and $\hat{\gamma}_i^2 = s_{i12} / \hat{v}_{1i}$. The factor score X_i can be expressed as:

$$X_i = A_i (W_i, Z_i - \hat{v}_{0i}) \tag{7}$$

where, $A_i = \gamma_i^2 \Lambda_i' \Sigma_i^{-1}$.

Step 3: Estimate v_{0i} through expectation, i.e.:

$$E(Z_i) = v_{1i} E(X_i) + v_{0i} = v_{1i} E(W_i) + v_{0i} \tag{8}$$

where, the estimated $\hat{v}_{0i}$ of v_{0i} can be expressed as $\hat{v}_{0i} = \overline{Z}_i - \hat{v}_{i1}\overline{w}$. Obtain A_i by estimating γ_i, Λ_i, Σ_i, and v_{0i}, and combine it with equation (7) to obtain X_i estimation. Therefore, the response variable model of brand internationalization effect is expressed as:

$$y_{it} = \alpha_{it} + \hat{x}_{it} \cdot \beta + \varepsilon_{it} \tag{9}$$

Step 4: Use $\hat{x}_{it}$ as the predictor variable for brand internationalization effects after eliminating errors, and estimate β using the FEQR method.

For the FEQR method, the fixed brand internationalization effect impact data model based on the average value is represented as:

$$\overline{y}_i = \alpha_i + \overline{x}_i \cdot \beta + \overline{\varepsilon}_i \tag{10}$$

where, $\overline{y}_i = \sum_{t=1}^{T} y_{it} / T$, $\overline{\varepsilon}_i = \sum_{t=1}^{T} \varepsilon_{it} / T$, $\overline{x}_i = \sum_{t=1}^{T} \hat{x}_{it} / T$.

For each individual *i* affected by the internationalization effect of a brand, α_i is fixed in different periods, so the mean of each individual t period should be subtracted, that is:

$$y_{it} - \overline{y}_i = (\hat{x}_{it} - \overline{x}_i)\beta + \varepsilon_{it} - \overline{\varepsilon}_i \tag{11}$$

The brand influence effect model can be expressed as:

$$y_{it}' = x_{it}'\beta + \varepsilon_{it}' \tag{12}$$

where, $y_{it}' = y_{it} - \overline{y}_i$, $x_{it}' = \hat{x}_{it} - \overline{x}_i$, $\varepsilon_{it}' = \varepsilon_{it} - \overline{\varepsilon}_i$.

The corresponding quantile regression model is:

$$Q_{y_{it}'}(\tau | x_{it}') = x_{it}'\beta \tag{13}$$

Then, the estimated values of each quantile β can be calculated by solving the following optimization problem:

$$\min_{\beta \in \mathbf{R}} \sum_{i=1}^{N} \sum_{t=1}^{T} \rho_\tau (y_{it}' - \beta x_{it}') \tag{14}$$

The loss function is:

$$\rho_\tau(u) = (1-\tau) u I_{(-\infty,0)}(u) - \tau u I_{[0,\infty)}(u) \tag{15}$$

For the FDQR method, after incorporating factors such as $\Delta y_{i1} = y_{i2} - y_{i1}$, $\Delta y_{i2} = y_{i3} - y_{i2}$, $\Delta y_{it-1} = y_{it} - y_{it-1}$, etc., the impact model of brand internationalization effect can be constructed in the following form:

$$\Delta y_{it} = \Delta \hat{x}_{it} \cdot \beta + \Delta \varepsilon_{it} \tag{16}$$

Then, β can be calculated by solving and optimizing the following equation:

$$f = \min_{\beta \in \mathbf{R}} \sum_{i=1}^{N} \sum_{t=1}^{T} \rho_{\tau} \left(\Delta y_{it} - \beta \Delta \hat{x}_{it} \right) \tag{17}$$

The specific operation process of the two-step quantile regression algorithm is as follows:

Step 1: For dataset $\{X, Y\}$, use factor scoring method to eliminate the error interference in the variables affecting the brand internationalization effect. After this processing step, the revised brand internationalization effect impact data can be obtained and recorded as $\{X, Y\}$.

Step 2: Incorporate the revised brand internationalization effect impact predictor variables and target variables into the analysis framework, and use first-order difference quantile regression or fixed effects transformation quantile regression methods for modeling and analysis. These two regression methods each have their own characteristics and can mine data features from different perspectives, providing reliable basis for subsequent parameter estimation.

Step 3: Solve the optimization problem equation (14) or equation (17). Through this solving process, the parameter β can be accurately estimated under different quantile conditions, providing quantitative support for a deeper understanding of the impact mechanism of brand internationalization effects.

V. Empirical analysis

V. A. Data sources

This research delves into the digital marketing domain of cross - border e - commerce enterprises. We collected panel data spanning from 2011 to 2024, encompassing 1573 cross - border e - commerce digital marketing enterprises located within the "Cross - border E - commerce Comprehensive Pilot Zone". The primary sources of these data are the official website of the National Bureau of Statistics, the database of the General Administration of Customs of China, and the WIND financial terminal database. During the data processing phase, to guarantee the data quality and the credibility of the analysis outcomes, several operations were implemented. Initially, we excluded samples of companies labeled as ST and * ST, along with the relevant data from the year of their listing. Subsequently, we removed samples of companies that suffered from significant data loss. Moreover, to effectively manage outliers, we employed a tail - trimming approach at the 1% level for both the upper and lower ends. After undergoing these sequential data processing procedures, we ultimately obtained 5206 valid observations.

In terms of variable selection, the specific steps are as follows [21], [22]:

(1) The dependent variable is brand internationalization (ms). This variable is measured by the proportion of cross-border e-commerce enterprises' digital marketing sales in overseas markets to their total sales. This ratio can intuitively reflect the brand's influence and market penetration in the international market, and is an important indicator for evaluating the degree of brand internationalization.

(2) Explanatory variable: Marketing performance (roi). Using the return on marketing investment as a measurement standard, the effectiveness of marketing investment is evaluated by calculating the ratio of the total revenue of the enterprise to the total marketing cost over a certain period of time. The higher the return on investment in marketing, the more ideal the input-output ratio of the enterprise in marketing, and the better the marketing performance.

(3) Mediating variable: sales growth rate. It refers to the growth rate of a company's sales revenue over a certain period of time, which can clearly reflect the changing trend of the company's sales performance. The change in sales growth rate can reveal a company's competitiveness and development potential in the market.

(4) Adjusting variable: Inventory turnover rate (itr). This variable represents the number of times a company has inventory turnover during a certain period, and is an important indicator for measuring the efficiency of inventory management and sales capability of the company. The higher the inventory turnover rate, the faster the inventory turnover speed of the enterprise, the higher the inventory management efficiency, and the stronger the sales ability.

(5) Control variables: This study selected digital transformation (digital), innovation investment (rd), asset liability ratio (lev), company size (size), total asset turnover ratio (ato), and whether it is a state-owned enterprise (soe) as control variables. These variables may have an impact on the dependent variable, and by introducing control variables, the relationship between the explanatory variable and the dependent variable can be analyzed more accurately, eliminating interference from other factors.

V. B. Result Analysis

(1) Descriptive statistical analysis. This study first conducted descriptive statistical analysis on all variables, and the relevant statistical results are detailed in Table 1.

As for brand internationalization (ms) as the dependent variable, its minimum value reaches 0.048, the maximum value is 0.930, and the median is 0.140. This statistical result reflects that the internationalization level of most

companies' brands is relatively low, but there are still some companies that have demonstrated excellent competitiveness in the international market and achieved a high degree of brand internationalization. For marketing performance (roi) as an explanatory variable, its mean is 1.888, the minimum value is 1.046, the maximum value is as high as 12.266, and the median is 1.487. From these data, it can be seen that the marketing investment return rate of most enterprises is at a medium to low level, and only a few enterprises can achieve a high return rate. This difference may be related to significant differences in marketing strategy formulation, resource investment scale, and market positioning among different enterprises. In addition, other variables also show varying degrees of differences. These differences lay a solid data foundation for further exploration of the relationships between variables and conducting related research.

Table 1: Descriptive Statistics of Variables

index	Obs	Mean	SD	Min	Median	Max
ms	5206	0.182	0.160	0.048	0.140	0.930
roi	5206	1.876	1.483	1.046	1.487	12.266
growth	5206	0.173	0.316	-0.368	0.145	1.576
itr	5206	7.743	12.352	0.562	3.742	53.926
roa	5206	0.087	0.072	-0.133	0.063	0.335
digital	5206	3.564	1.065	1.097	3.564	6.142
rd	5206	0.076	0.078	0.000	0.047	0.475
lev	5206	0.319	0.172	0.044	0.295	0.751
size	5206	21.437	1.036	18.732	21.355	35.656
ato	5206	0.682	0.387	0.114	0.575	2.360
soe	5206	0.105	0.307	0.000	0.000	1.000

(2) Regression analysis of digital marketing performance and brand internationalization of cross-border e-commerce enterprises. To verify hypothesis 1, this study used panel regression analysis to evaluate the impact of marketing performance (roi) on brand internationalization (ms). The results of the relevant regression analysis are presented in Table 2.

Table 2: Regression Analysis Results

index	(1)	(2)
	ms	ms
roi	0.003***	0.003***
	(4.226)	(6.820)
digital	--	-0.001
	--	(-0.374)
rd	--	0.120***
	--	(3.180)
lev	--	-0.057***
	--	(-4.290)
size	--	0.006
	--	(1.421)
ato	--	-0.019**
	--	(-2.567)
Constant	0.212***	0.127
	(7.228)	(1.374)
Observations	5206	5206
R-squared	0.460	0.362
Number of id	1573	1573
ID RE	YES	YES
Year FE	YES	YES

Note: * indicates p<0.1, * * indicates p<0.05, * * * indicates p<0.01, the same applies below.

In the regression model (1) that did not include control variables, there was a significant positive correlation between marketing performance (roi) and brand internationalization (ms). This means that the improvement of marketing performance will simultaneously drive the internationalization of the enterprise brand. After introducing control variables, the impact of marketing performance (roi) on brand internationalization (ms) remains significant, and the estimated coefficient increases to 0.003 (corresponding to a t-value of 6.8280). Taking into account the above two situations, regardless of whether other variables are controlled, the significant positive impact of marketing performance (roi) on brand internationalization (ms) has been strongly validated, which fully indicates that e-commerce marketing performance plays a key role in the process of enterprise brand globalization. Hypothesis 1 is confirmed. This result reflects that implementing effective marketing strategies can effectively

reduce the cost of entering the international market for enterprises. By precise market positioning and diversified marketing methods, we aim to increase the brand's penetration rate in the international market and enhance consumer awareness of the brand. With the improvement of brand awareness and reputation, the company's share in the international market is gradually expanding, and its profitability is also enhanced, which effectively promotes the internationalization process of the brand.

(3) Analysis of intermediary effect. To verify hypothesis 2, this study used mediation analysis to explore, and the relevant analysis results are presented in Table 3.

Table 3: Analysis of Mediating Effects

index	(1)	(2)
	growth	ms
roi	0.050***	0.004***
	(5.154)	(6.730)
growth	--	0.002***
	--	(3.460)
digital	0.001	-0.001
	(0.150)	(-0.365)
rd	-1.108***	0.122***
	(-7.760)	(3.213)
lev	0.368***	-0.058***
	(9.373)	(-4.310)
size	0.202***	0.005
	(12.360)	(1.283)
ato	0.749***	-0.020**
	(26.350)	(-2.538)
Constant	-4.7189***	0.136
	(-13.463)	(1.441)
Observations	5206	5206
R-squared	0.417	0.3635
Number of id	1573	1573
ID RE	YES	YES
Year FE	YES	YES

In column (1) of the regression model, e-commerce marketing performance (ROI) shows a significant positive effect on sales growth rate (growth), with an estimated coefficient of 0.050, and passed the test at a significance level of 1% (corresponding to a t-value of 5.154). This result clearly indicates that the improvement of e-commerce marketing performance can significantly promote the increase of enterprise sales growth rate, that is, e-commerce marketing performance has a positive promoting effect on the growth of enterprise sales performance. In column (2) of the regression model, both sales growth rate (growth) and e-commerce marketing performance (ROI) have a significant positive impact on brand internationalization (MS), and both are significant at the 1% significance level. This discovery strongly confirms hypothesis 2, indicating that marketing performance not only directly has a positive impact on the process of brand internationalization, but also indirectly promotes brand internationalization by increasing sales growth rates. This fully validates the crucial role of marketing performance in enhancing brand market competitiveness and international influence, highlighting the importance of marketing performance for corporate brands to enter the international market.

(4) Adjustment effect analysis. To verify hypothesis 3, this study used moderation analysis method and selected inventory turnover rate (ITR) as the moderating variable for analysis. The relevant results are shown in Table 4.

Table 4: Analysis of Regulatory Effects

index	(1)	(2)
	ms	ms
roi	0.004***	0.005***
	(6.836)	(7.372)
itr	0.002**	0.003***

	(2.497)	(2.910)
roi*itr	--	0.001***
	--	(3.644)
digital	-0.001	-0.001
	(-0.346)	(-0.394)
	0.118***	0.118***
	(3.145)	(3.131)
lev	-0.057***	-0.057***
	(-4.283)	(-4.253)
size	0.006	0.006
	(1.419)	(1.455)
ato	-0.017**	-0.019**
	(-2.445)	(-2.501)
Constant	0.127	0.123
	(1.380)	(1.332)
Observations	5303	5303
R-squared	0.363	0.363
Number of id	1573	1573
ID FE	YES	YES
Year FE	YES	YES

In the regression model of column (1) of Table 4, both e-commerce marketing performance (ROI) and inventory turnover rate (ITR) have a significant positive impact on brand internationalization (MS). This result indicates that a higher inventory turnover rate helps promote the internationalization process of a company's brand, indicating that inventory turnover itself plays a positive role in the internationalization of a company's brand. In the regression model of column (2) of Table 4, the interaction term between inventory turnover rate (itr) and e-commerce marketing performance (roi) is introduced. The results showed that the interaction term had a significant positive impact on brand internationalization (ms), with an estimated coefficient of 0.001, and passed the test at a significance level of 1% (corresponding to a t-value of 3.644), confirming hypothesis 3. This indicates that the improvement of inventory turnover not only has a positive impact on brand internationalization itself, but also enhances the driving effect of marketing performance on brand internationalization. This reflects that efficient inventory management can optimize the resource allocation of enterprises, enabling them to allocate resources more reasonably in the marketing process, improve marketing efficiency, and promote the expansion and penetration of brands in the international market.

VI. Conclusion

This article focuses on panel data of 1573 cross-border e-commerce digital marketing enterprises from 2011 to 2024, and deeply analyzes the impact mechanism of digital marketing performance of cross-border e-commerce enterprises on brand internationalization. The empirical research results show that marketing performance has a significant positive impact on brand internationalization, which strongly verifies hypothesis 1. The sales growth rate plays a significant mediating role between marketing performance and brand internationalization, providing strong support for hypothesis 2. The higher sales growth rate not only directly promotes the internationalization process of the brand, but also amplifies the positive effects of marketing performance by enhancing consumers' trust and loyalty to the brand. In addition, the study also found that inventory turnover has a significant moderating effect between marketing performance and brand internationalization, thus confirming hypothesis 3. The heterogeneity test results indicate that the impact of marketing performance on brand internationalization is significant in both state-owned and non-state-owned enterprises, but it is more prominent in non-state-owned enterprises, which supports hypothesis 4. Based on the above research conclusions, in order to further improve the digital marketing performance of cross-border e-commerce enterprises and promote brand internationalization, the following issues need to be addressed in the future:

(1) Improve the policy support system and accelerate the pace of brand internationalization. The government should focus on providing solid policy guarantees for the brand internationalization process of digital marketing for cross-border e-commerce enterprises. Currently, most of the digital marketing export enterprises in China's cross-border e-commerce industry are small and medium-sized enterprises, facing complex challenges in language, culture, policy environment, and other aspects in the process of brand internationalization, which are significantly

different from the domestic environment. Therefore, it is necessary for the government to provide comprehensive support and guidance for export enterprises to help them develop steadily in the international market.

(2) Strengthen legal awareness and standardize the international operation of brands. The E-commerce Law, promulgated and implemented in 2019, regulates and constrains the digital marketing market of cross-border e-commerce enterprises from multiple dimensions such as clarifying the responsibilities of operators, improving management systems, and promoting international cooperation, providing strong guarantees for the healthy development of the industry. Cross border e-commerce enterprises should actively respond to legal and regulatory requirements, regulate their own operational behavior, and promote the compliant development of brand internationalization process.

(3) Strengthen the cultivation of professional talents and empower the international development of brands. Against the backdrop of the rapid development of digital marketing and brand internationalization in cross-border e-commerce enterprises, export enterprises urgently need composite talents with knowledge in foreign languages, foreign trade, e-commerce, and other fields to support their business operations and brand management. Therefore, enterprises should increase their efforts in talent cultivation, and build a high-quality and professional brand international talent team through internal training, external introduction, and other methods.

(4) Optimize the service ecosystem to ensure the brand's foothold in overseas markets. After cross-border e-commerce enterprises go global in digital marketing, they need to continuously strengthen their brand marketing efforts and ensure service quality. Enterprises should pay attention to the construction of product and service quality, optimize customer shopping experience, deeply understand the cultural development and customs of exporting countries, etc., in order to cultivate digital marketing brands of Chinese cross-border e-commerce enterprises with international influence. In addition, brand effect is closely related to scientific marketing. Enterprises should pay attention to the comprehensive improvement of after-sales links, ensure that quality assurance, maintenance and other work meet the relevant standards of the exporting country, so as to win customer satisfaction and trust, and cultivate a loyal customer base.

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