EasyChair Preprint

№ 8463

Influence of Traceability Information Display on Consumption Behaviour in Cross-Border E-Commerce

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July 24, 2022

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Abstract

The introduction of traceability information on cross-border e-commerce platforms reduces information asymmetry and improves consumers' perception of trust. In this study, we combined the data-driven and model-driven methodologies, created a new index of traceability information display degree, and constructed econometric models to analyze the influential effect and marginal effect of traceability information display degree on consumer consumption behaviour about cross-border e-commerce products. Furthermore, we examined the moderating effect of platform on the display degree of traceability information and conducted a robustness test using propensity score matching (PSM). This paper provides a new perspective on traceability information and makes recommendations for how to improve the construction of traceability systems on cross-border e-commerce platforms.

Keywords: Traceability information display, Cross-border e-commerce products, Consumption behaviour, PSM

1. Introduction

With the strong support of internet marketing and national policies, cross-border e-commerce has developed rapidly. Consumers urgently need a reliable, credible mechanism to provide a strong basis when purchasing. The quality traceability system based on blockchain technology addresses this issue by enabling the full cycle monitoring of product production, transportation, and consumption. Tmall.com and JD.com, the two Chinese e-commerce platforms, have introduced traceability information into product display pages. JD.com has created a full-process anti-counterfeiting traceability system through joint brand companies, monitoring agencies, governments, and other departments.

Traceability information includes product-related production, transportation information, etc., which can improve supply chain transparency (Sodhi and Tang 2019), reduce information asymmetry (Liu *et al.* 2018), and improve consumers' trust perception (Suhandoko *et al.* 2021). Scholars chose food traceability information as the research object, such as fresh agricultural products (Yu *et al.* 2021). They have demonstrated that the perceived quality of traceability information has a beneficial influence on purchase intention toward organic food (Wu *et al.* 2021), and the food traceability system positively affects purchase intention (Yuan *et al.* 2020).

However, the traditional traceability information mainly focuses on the production chain, and there maybe exists information fraud. The traceability information of cross-border e-commerce products can display the information of production, transportation, and other chains' information, which is more abundant. What's more, this traceability information on cross-border e-commerce platforms is guaranteed by blockchain technology, providing a trustworthy and difficult to counterfeit quality signal to consumers (Connelly *et al*. 2011).

Information exposure refers to the number of times the information is repeated (Campbell and Kevi 2003). We discovered that there are various ways to display traceability information on cross-border e-commerce platforms. The quantity of information display will affect consumers' recognition and attitude towards products, but there is no consistent conclusion on the effect (Guo *et al.* 2021, Li and Zheng 2021). In terms of research methods, most scholars conducted research using questionnaire surveys, qualitative research, and other methods to carry out research, without truly realizing quantitative research of information display. To fill in this gap, we attempt to further excavate the traceability information, complete the measurement of the display degree of traceability information, and explore the causal relationship between the display degree of traceability information and consumption behaviour.

For the above purposes, we combined the data-driven and model-driven methods in this study. First, we integrated the structured data and unstructured data to measure the traceability information display degree. Second, we used econometric models to examine the relationship between traceability information and cross-border e-commerce consumption behaviour. Finally, we discussed the causal relationship by using the propensity score matching method.

2. Data and variable selection

The data originated from the International Channel of JD.com Mall. We gathered the information on the product pages using the API. Three important categories of cross-border e-commerce products were gathered including milk powder, cosmetics, and health care products. Following a series of selections, a total of 1536 products were reserved. Text preprocessing was performed on the obtained text data, including product introduction and Q&A text.

Given the important impact of brand value on product sales, we measured product brands according to the China Brand Power Index (CBPI). CBPI can be used to measure the brand power index that affects consumer purchase behaviour. For the products that were not on the CBPI list, we assigned a brand value based on the influence of the products on JD.com. There is a platform self-operated in JD.COM, which means that the platform directly procures and sells cross-border products, and provides a series of guarantees in terms of quality, transportation, and after-sales service. Consumers' perceptions about the quality of whether the products are platform self-operated also differ, so we also get this label.

There are six major variables in this study. We found product traceability information up to nine different display modes, the information could be a label, and may also be a specific text description. If the product has the traceability information of this part, it is marked as 1; otherwise,

it is marked as 0. Finally, this product's traceability information display degree is the total number of nine-part traceability information appears. We cannot directly obtain the sales volume of the products on the platform. Considering that consumers will comment after purchasing, the system will give default praise to those who have not commented. So, we selected the number of comments as the proxy index of product sales. In order to compress the dimension of variables, and weaken the collinearity and heteroscedasticity, log transformations were made to price, the total number of reviews, brand power index, and sales to make the model results more robust.

3. Empirical analysis

3.1 Effect analysis of traceability information display degree (TIDD)

3.1.1 Influence on the sales

The traceability information display degree (TIDD) is treated as the independent variable and product sales as the dependent variable. The control variables included product price, whether are platform self-operated products, brand power index, and the total number of reviews on search pages. We constructed a multiple regression model as illustrated in Equation (1), to analyze the influence of the TIDD on the sales of cross-border e-commerce products.

$$\ln \_sales = \beta_0 + \beta_1 Trace + \beta_2 \ln \_price + \beta_3 self + \beta_4 \ln \_all\_num + \beta_5 \ln \_C\_BPI + \epsilon \quad (1)$$

The core variable and other variables were added in sequence using Hierarchical Regression. When only TIDD was in the model, each additional unit of TIDD resulted in a 41.2% increase in product sales. As the number of control variables increase, the *R*^2 of the model improves steadily, and the explanatory power of product sales becomes more muscular. Additionally, all models pass the F-test (p <0.001).

Considering that the influence of the TIDD on sales may be different for different products, we divided the products into three groups: milk power, cosmetic, and health care products, and conducted a Grouped Regression. The TIDD has been demonstrated to have a beneficial influence on product sales in all three product categories. However, the coefficient of influence and platform effect is smaller in health care products (χ^2=0.219, p<0.01) than in milk powder (χ^2=0.394, p<0.001) and cosmetics (χ^2=0.359, p<0.001), which may be a result of the unique nature of health care products, where the key concern of customers is about the product function.

We introduced a platform self-operated dummy variable and constructed an interaction term with the TIDD to investigate the possible platform effect. The regression model is shown in Equation (2). The results show that the regression coefficients are significant for both overall and specific products, which means that when the products belong to the platform self-operated, the TIDD is more likely to promote the sales of cross-border products. So, the platform effect exists.

$$\ln \_sales = \alpha_0 + \alpha_1 Trace + \alpha_2 self + \alpha_3 Trace * self + \alpha_4 \ln \_price + \alpha_5 \ln \_all\_num + \alpha_6 \ln \_C\_BPI + \delta \quad (2)$$

We further understood the marginal effect of different levels of traceability information display on product sales by dividing the sample into three groups based on the degree of traceability

information display, namely the high display group (HTrace), the medium display group (MTrace), and the low display group (LTrace). Then set dummy variables with the low display group as the base group and conducted regression analysis. The results showed the MTrace regression coefficient of 0.549 (p<0.001) and 0.880 for Htrace (p<0.001). Compared to the low display group of traceability information, the marginal effect of medium and high display is gradually increasing. However, the overall display degree of traceability information on the platform is currently not high enough and may not have reached the peak of the declining marginal effect. So, the marginal effect may level off or even appear to decline in the future as the overall display degree of traceability information increases.

3.1.2 Influence on the scale effect

We already know that the degree of traceability information display has a positive effect on the sales of cross-border e-commerce products via linear OLS regression and regression coefficient testing. But we have yet to understand the trend and change in the degree of traceability information display's influence on sales. As a result, we used Quantile Regression which is indicated in Equation (3), to gain a better understanding of the differences and patterns of change in the influencing factors for products with varying sales volumes.

$$Q_{(q)}(y_{sales}|x_i) = \beta_q x_i' + \mu_q \quad (3)$$

$Q_{(q)}(y_{sales}|x_i)$ denotes sales at quantile q conditional on the explanatory variable being x_i, μ_q is the random disturbance term, and β_q is the regression coefficient at quantile q. As q changes, the conditional distribution of y_{sales} on x_i can be obtained.

The results show that the influence of TIDD on cross-border e-commerce product sales is basically significantly positive, but there exist situations where TIDD fails to work. When product sales are between the 0.4 and 0.5 quartiles, traceability information has a negligible effect on product sales, which may be because other influencing factors interest customers more than traceability information. The influence of traceability information presentation on product sales is strong for niche products and products with a large market share, demonstrating that customers care about the quality traceability when purchasing these products. The impact coefficient is most significant for products in the 0.1 quartiles, demonstrating that the degree of traceability information display is a significant factor impacting sales of highly niche products.

3.2 Propensity Score Matching (PSM)

While the display of traceability information has an effect on cross-border e-commerce product sales, the degree to which it is displayed is not random and is determined by a number of factors, including national policy regulation, improved e-commerce platform governance, and product characteristics. To further investigate the effect of the degree of traceability information display on product sales, control groups must be established for comparison. The control groups that are as similar to the treated group as possible are identified using propensity score matching (PSM).

This method allows for some control of observable heterogeneity factors and reduces selectivity bias.

In this section, we regarded the samples with TIDD greater than or equal to 7 as the treated group, considered them as products with high TIDD, and categorized the other samples as the control group. We set product price, whether are platform-owned products, brand power index, and the total number of reviews on search pages as covariates. Then established a logistic regression model, and estimated propensity scores. Propensity score matching was then performed, and the matching success rate was 99.676%, which was a good matching result.

As can be observed, the absolute values of standardized bias were all less than 20% following matching, indicating a significant reduction in standardized bias. The t-tests unmatched were all significant ($p<0.05$), whereas the t-tests conducted after matching were not significant ($p >0.05$), indicating that the characteristics of the treated and control groups remained essentially identical after matching. All in all, the matching effect was generally good.

The average treatment effect of traceability information display on product sales was calculated based on the matched treatment and control group samples. The difference between the treated and control groups before matching was 1.764 and statistically significant ($p <0.001$). After propensity score matching, the difference was 1.487, which is less than that before matching but is still significant at the 0.1% level, indicating the robustness of the findings.

4. Discussion

This study examined the influence of the traceability information display degree on consumers' consumption behaviour for cross-border e-commerce products using a combination of data-driven and model-driven methods and empirically analyses data for 1,536 products. In the data-driven aspect, some textual data were analyzed and combined with structured data to create a variable for traceability information display degree and to improve the quantification of the degree of traceability information display. In the model-driven aspect, OLS regression and Grouped Regression were used to verify the significant influential effect and the marginal effect of the TIDD on consumers' consumption behaviour of cross-border e-commerce products. Quantile Regression was used to verify the scale effect of the TIDD on consumers' consumption behaviour. Finally, the robustness test was completed by propensity score matching.

For cross-border e-commerce platforms, it is necessary to increase the degree of display and publicity of traceability information. Encourage consumers to pay attention to and participate in discussions about traceability information, which can increase the platforms' influence. Simultaneously, the display of traceability information should be differentiated by product type and sales volume. For example, for niche products and products with a large market share, the display of traceability information should be increased further. For products in the middle of the market, consider introducing additional strategies to increase product sales.

There are still some unresolved issues in this study. Firstly, only three product categories were analyzed and the research findings may not yet be applicable to other cross-border e-commerce

products. Secondly, the traceability information in comments and product detail pages were not considered. In the future, natural language processing technology and image analysis technology are considered to improve the construction of traceability information display index. Finally, the degree of traceability information display is not weighted, but different traceability information indicators should have different weights in practice.

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Notes

The work described in this paper was supported by the National Natural Science Foundation of China (NSFC: 72171187).

Yimeng Qi and Minna He are joint third authors.