Factors and Formation Path of Cross-Border E-Commerce Logistics Mode Selection

Zejian Li, Guangrong Gao, Xiong Xiao and Hongwu Zuo

Abstract: Choosing a suitable cross-border logistics mode is the foundation for cross-border e-commerce enterprises to achieve sustainable development. Based on an analysis of the literature, the cross-border logistics modes are summarized as postal parcel, international express, overseas warehouse, and special line logistics modes. Using the multi-value set qualitative comparative analysis (mvQCA) method to explore the factors and formation paths of logistics mode selection of cross-border e-commerce enterprises, the results include the following: (1) The choice of logistics mode is the result of multiple condition variables, and the formation paths of different logistics mode selection vary. (2) The postal parcel mode is most selected by small and medium-sized B2C cross-border e-commerce enterprises; the overseas warehouse and special line modes are most selected by large and medium-sized ones with high logistics service capacity. (3) The international express mode is selected by B2C cross-border e-commerce enterprises of all sizes, and there is no typical formation path. The results indicate that cross-border e-commerce enterprises should have clear positioning and select the most suitable logistics mode, as only in this way can cross-border e-commerce and logistics enterprises jointly achieve sustainable development.

Keywords: cross-border e-commerce; cross-border logistics; logistics mode; multi-value qualitative comparative analysis (mvQCA)

1. Introduction

In recent years, with the emergence of the Internet economy, the development of cross-border e-commerce and the logistics of cross-border e-commerce to achieve sustainable development have become increasingly prominent. Based on the data from the E-commerce Research Center of the Net Society, the market size of China’s cross-border e-commerce reached CNY 19.8 trillion in 2021, up 15% year on year. Meanwhile, the data in the Postal Industry Development Statistics Bulletin 2021 show that the total business volume of the postal industry reached CNY 1.37 trillion in 2021, up 25.1% year on year. In this respect, there is a symbiotic relationship between cross-border e-commerce and cross-border logistics to supplement each other.

Traditional e-commerce refers to the behavior of trading activities on online platforms between sellers and buyers, and its main e-commerce mode is B2C, that is, business to consumer [1]. The cross-border trade demand caused by the growth of e-commerce promotes the development of cross-border e-commerce. Cross-border e-commerce refers to an electronic business model of free trade between customers and sellers from different countries [2], whose typical participants include buyers, sellers, e-commerce platforms and other third-party service enterprises. The main cross-border e-commerce modes include business-to-business (B2B), business-to-customer (B2C) and customer-to-customer (C2C) [3]. The differences between them in logistics mode, customer relationship and payment mode make the selection of cross-border e-commerce mode extremely important [4].
Cross-border e-commerce has greatly promoted the development of China’s international e-commerce, and the government has actively provided support. As an example, Yunnan Province of China is located in the southwestern frontier with unique geographical advantages for cross-border e-commerce. With the approval of the Yunnan Free Trade Zone (YFTZ) and national policies, Yunnan Province actively organized investment promotion conferences for YFTZ in August 2019, and cross-border e-commerce enterprises of all sizes were allowed to promote the development of a cross-border e-commerce industry in Yunnan Province through competition and cooperation. However, with the development of cross-border e-commerce, homogenization competition in China’s cross-border e-commerce industry is increasingly fierce [5], and the negative impact caused by the obvious lag in the development of cross-border logistics is becoming more and more obvious. The problems with China’s cross-border logistics, such as starting late, poor overall organization, and ineffective functions of logistics import and export, also hinder the development of cross-border e-commerce in China to a large extent [6]. The immaturity of cross-border logistics makes the pilot of cross-border e-commerce in China limited to the initial test stage [7]. Despite the strong support of the government, the development of cross-border trade in Yunnan Province is still in the initial stage, and the imperfect infrastructure, imperfect logistics system, and significant regional differences have become the biggest obstacles to the development of cross-border e-commerce in Yunnan Province [8–10]. In addition, the eager and sloppy economic development pattern has caused irreversible damage to the environment [11], which blocks the sustainable development of enterprises and the environment. Therefore, it is urgent to strengthen the overall layout of cross-border logistics and cross-border e-commerce, improve cross-border logistics infrastructure and explore the best cooperation and development mode of cross-border e-commerce and cross-border logistics.

The purpose of this paper is to help cross-border e-commerce enterprises choose the right logistics mode by studying the influencing factors and mechanism of cross-border logistics mode selection. The theory of this paper is that the choice of appropriate cross-border logistics mode can bring positive feedback to the sustainable development of cross-border e-commerce enterprises. Meanwhile, the comprehensive impact of relevant logistics factors will influence the cross-border e-commerce enterprises’ selection of logistics mode, and the number of relevant logistics factors complicates the influencing mechanism. In fact, different authors classify these factors differently when analyzing the selection mechanism of e-commerce logistics mode. This paper summarizes this classification in previous literature and further divides the factors (conditional variables) into four primary indicators and seven secondary indicators. In addition to qualitative analysis, a total of 70 questionnaires of logistics-related professionals in the Yunnan Free Trade Zone were used for quantitative analysis. Considering the theory and data size in this study, the mvQCA, which combines qualitative analysis and quantitative analysis, was used to find out the factors that cross-border e-commerce enterprises need to consider and the formation path when choosing an appropriate cross-border logistics mode.

The rest of this paper is organized as follows: In Section 2, the literature related to cross-border e-commerce and cross-border logistics is collected, classified and analyzed. In Section 3, the research methods, questionnaire collection, and variables are introduced. In Section 4, values are assigned to the variables, and QCA is used to analyze the formation path of each resulting variable. In Section 5, the research conclusions and suggestions for future research are given.

The main contributions of this work are summarized as follows:

1. This study contributes to the theory and practice of cross-border e-commerce logistics mode selection and provides a cooperation mode between cross-border e-commerce and cross-border logistics suitable for the long-term development of China.
2. This paper offers specific paths leading to cross-border e-commerce logistics mode selection, which can be used by practitioners to improve the ways they communicate with their users.
(3) This paper employs the mvQCA to enrich the theoretical methods of cross-border logistics-related research.

2. Literature Review

“No logistics, no e-commerce” has become the basic principle of the cross-border e-commerce industry, and “Logistics 4.0” provides the sustainable basis for many emerging business models, including cross-border e-commerce [12]. With the progress of science and technology, cross-border e-commerce has gradually become one of the main means of economic cooperation in various countries. As the carrier of cross-border e-commerce transactions, cross-border logistics undertakes the task of assisting cross-border e-commerce enterprises to achieve sustainable development. It is generally believed that there is a sustainable development relationship between cross-border e-commerce and cross-border logistics. Cross-border e-commerce enterprises need cross-border logistics to realize transnational transportation and trading, and they can cooperate with cross-border logistics enterprises to enhance global liquidity and competitiveness [13]. In the logistics trade, cross-border logistics enterprises can optimize the supply chain in terms of time and cost, provide better logistics mode services, and realize long-term development in terms of market competitiveness. In addition, cross-border logistics enterprises with sufficient capital can afford to construct and improve logistics infrastructure for more logistics modes, and realize green logistics that perfectly combines environmental utilization and logistics facilities on the basis of environmental protection [14]. At the same time, the optimization of cross-border logistics mode and efficiency will also bring more profits and long-term development to cross-border e-commerce enterprises that choose them [15]. It is a virtuous circle which will ultimately promote the sustainable development of cross-border e-commerce and logistics enterprises and even the cities where these enterprises are located [16]. Several scholars have chosen to verify the synergistic relationship between cross-border e-commerce and cross-border logistics. Peiju Wu and Kunchen Lin et al. (2018) analyzed the synergistic relationship between those two by constructing a big data model from a theoretical point of view [17]. Meanwhile, from an empirical point of view, Yugang He and Renhong Wu et al. (2021) directly verified the mutually reinforcing relationship between international logistics and the long-term development of cross-border e-commerce trade by using data from the Organization for Economic Cooperation and Development member countries from 2000 to 2018 [18]. In addition, the significant correlation between the components of international trade and cross-border logistics performance can be verified from the international trade status quo of Korea [19]. Cross-border logistics is the support of cross-border e-commerce, and cross-border e-commerce drives the development of cross-border logistics. Cross-border e-commerce enterprises should choose a suitable cross-border logistics enterprise to enhance import and export competitiveness for sustainable development. Cross-border logistics enterprises should cooperate with cross-border e-commerce enterprises to achieve green logistics by optimizing logistics cost, logistics time and other factors.

Logistics refers to the strategic management process of procurement, transportation and storage of materials, parts and finished products, as well as the relevant information flow through the organization and its marketing channels [20]. With the increasing consideration of environmental protection, green logistics with high efficiency, low cost and minimal harm to the environment have become the main goal of logistics enterprises [21], including cross-border logistics enterprises. In order to meet the logistics needs of cross-border e-commerce enterprises in terms of logistics cost, transportation distance and product diversity, each cross-border logistics enterprises provide different logistics mode services. Different logistics modes are different in terms of effectiveness, cost and logistics resources, which makes the selection mechanism of logistics mode complicated for cross-border e-commerce enterprises. It is extremely important for cross-border e-commerce enterprises to choose the appropriate logistics mode to maximize resource utilization and profit, so as to achieve long-term development.
Compared with traditional logistics, cross-border logistics are more complex, and there are many classifications to classify cross-border logistics modes. Among these classification methods, the most intuitive is dividing cross-border logistics modes into water transportation, air transportation, and land transportation according to the forms of logistics transportation [22], and this classification is mostly accepted by the public. As crucial indicators of cross-border logistics efficiency, logistics cost, logistics time, customs clearance capacity, and service quality can also be the classification indexes of the cross-border logistics mode, and these factors can classify cross-border logistics into international postal parcels, international commercial express, cross-border railway logistics, the overseas warehouse model, and the transshipment mode [23]. At the same time, as the main body of the cross-border logistics industry, the combination of logistics enterprises can be the classification index of the cross-border logistics mode. From the main body of the logistics enterprises and locations, the cross-border logistics mode can be divided into third-party logistics, logistics alliances, overseas warehouses, goods collection logistics, and bonded area logistics [24]. Furthermore, if considering the cooperation pattern of e-commerce enterprises and logistics enterprises, cross-border e-commerce logistics can be divided into drop-shipping, fulfillment, and one-stop e-commerce [25]. This study does not take the cooperation pattern between cross-border e-commerce enterprises and cross-border logistics enterprises into consideration. The characteristics of cross-border transport also make it inappropriate to divide cross-border logistics modes from the perspective of transport vehicles. Therefore, based on the research of scholars Yang, Y [23], we summarize the logistics modes suitable for this study, namely postal parcel, international express and overseas warehouse. In addition, with the Belt and Road Initiative, Yunnan has begun to increase cross-border trade with neighboring countries. According to interviews with logistics personnel in Yunnan Province, the cross-border trade of special products makes special line logistics become one of the main modes of cross-border logistics in Yunnan Province [26].

The connection between cross-border logistics and cross-border e-commerce also makes the development of cross-border e-commerce closely related to the choice of cross-border logistics mode. Choosing the right cross-border logistics mode can help cross-border e-commerce enterprises achieve long-term development. Overseas warehouse mode can better help the long-term development of B2C and B2B cross-border e-commerce enterprises [27]. However, cross-border e-commerce enterprises need to forecast the market demand before choosing overseas warehouse mode [28]. The lower price of postal parcels is more suitable for cross-border e-commerce enterprises with a low-cost development strategy. However, due to its low effectiveness and poor ability to handle special cases, large cross-border logistics enterprises rarely provide postal parcel service [29]. The long logistics time and long distance of international express increase logistics costs, and the complexity of the logistics process leads to higher logistics risks [30]. Therefore, enterprises need to improve their ability to predict risks and their management before choosing international express. In addition, the convergence effect of multiple logistics modes is also important. Fang Ji and Xiaheng Zhang suggested that cross-border e-commerce enterprises choose two or more logistics modes to achieve the aggregation effect [31], which can reduce logistics costs to achieve sustainable development [32].

Due to the complexity of cross-border logistics modes and their classifications, there are controversies about the factors influencing the selection of cross-border logistics modes. Logistics costs and time are the most critical factors [33]. Transportation speed and the related cost of cross-border logistics are connected to the sustainable development of cross-border e-commerce enterprises and logistics, which are the considerations when selecting logistics modes. Meanwhile, logistics risk, as the factor of cost in the process of cross-border logistics, also indirectly affects the selection of logistics modes [34]. As the international trade between several large countries, related trade transactions and entry/exit security policies also affect the mode of transportation and related costs, which ultimately affect the selection of logistics modes [35,36]. In addition, factors such as
freight scale, geographical location, logistics distance, service quality, carbon emission costs, and consistency of transportation means are considered to influence the profits and development of cross-border e-commerce enterprises directly or indirectly by influencing the logistics costs and effectiveness [24,37]. In this study, logistics cost is selected as a factor because it directly affects the profits of cross-border e-commerce enterprises. Secondly, the cross-border logistics market environment also affects the choice of cross-border e-commerce enterprises, which are more willing to follow the development trend of the market. Thirdly, the cross-border enterprises producing special products must compromise product specificity and choose logistics modes that meet the special needs of products [38]. Finally, logistics service capability directly determines customers’ purchase evaluation, and better logistics services make it easier to catch more customers. Therefore, logistics market environment, product specificity, logistics costs and logistics service capability were selected as the primary indicators of the cross-border logistics mode selection model. On this basis, seven secondary indicators (conditional variables) are subdivided to further refine the influence mechanism.

In summary, there are three deficiencies in the existing literature. Firstly, the existing studies have mainly analyzed, at the theoretical level, the current situation and ways to optimize the efficiency of cross-border logistics, while neglecting the internal influence mechanism of logistics mode selection. Secondly, the studies have been macroscopic while ignoring the systematic influence mechanism of cross-border logistics and cross-border e-commerce on logistics mode selection. Thirdly, these studies have lacked systematic and scientific research methods; most of them have primarily used theoretical methods, which lack universality in practical application. Therefore, a questionnaire collection and QCA were used to research the factors of cross-border logistics mode selection. The innovations of this study include the following: Firstly, questionnaires were collected from 50 cases of relevant personnel in the free trade zone of Yunnan Province, which, at a practical level, verifies the connection between the cross-border logistics mode factors and selection with more persuasion. Secondly, a method combining qualitative and quantitative approaches—mvQCA—was applied to analyze the factors and formation paths of different logistics mode selections, which provides a theoretical reference for e-commerce enterprises to optimize logistics modes. Thirdly, this study further refined the factors of cross-border logistics mode selection with four primary indicators and seven secondary indicators, and systematically studied the synergistic mechanism between cross-border e-commerce and cross-border logistics, which, in turn, puts forward reliable suggestions for sustainable development.

3. Research Methodology
3.1. Methods

The method of qualitative comparative analysis (QCA) with multiple value sets was used in this study, and the analysis procedure of mvQCA is shown in Figure 1.
Step 1 of mvQCA: Case collection and analysis. According to the research design of this paper, appropriate cases are collected and analyzed. Step 2 of mvQCA: Calibration of conditional and outcome variables. The relationship between necessity and adequacy can be further analyzed only after the original data is calibrated into a set membership score [39]. Step 3 of mvQCA: Analysis of conditional variables. Analyze the logical necessity of the conditional variable to the selection result [40]. Step 4 of mvQCA: truth tables and configuration analysis are employed to determine the configuration variables that cause the result. Step 5 of mvQCA: Robustness test. This includes a series of robust analyses of the mvQCA results.

Regarding the research subject, logistics practitioners account for a small proportion of cross-border e-commerce enterprises, and the number of logistics professional researchers at the university is also relatively limited. Thus, the appropriate investigable samples are relatively few and pertain to a medium sample, which makes qualitative comparative analysis (QCA) the most appropriate method.

Regarding the research problem, the selection of cross-border logistics modes is not influenced by a single factor. The processes of selection are filled with causal complexity and instability, which means a nonlinear relationship between cause and effect. Thus, different combinations of condition variables in the selection of different cross-border logistics modes are regarded as strategies. QCA can replace correlation with an aggregation relationship to turn a linear analysis into an aggregation analysis. Meanwhile, the outcome variables—the selection of cross-border logistics modes—are categorical variables, and mvQCA can analyze multi-valued variables by reasonably assigning values to the outcome variables.

Regarding the factors, the selected factors included quantitative indicators such as “information construction”, “product specificity”, and “logistics resources”, and qualitative indicators such as “logistics costs”, “enterprise scale”, “cross-border e-commerce mode”, and “logistics timeliness”. A combination of qualitative and quantitative analysis was needed, making qualitative comparative analysis (QCA) the most suitable method for the data analysis.

3.2. Sampling Methods

This study takes the factors of cross-border logistics mode selection as the condition variable and cross-border logistics mode as the result variable to design the questionnaire. Cross-border e-commerce logistics industry employees in the Yunnan Free Trade Zone were selected as the objects of the questionnaire.

At the initial stage of the questionnaire phase, Yunnan Energy Investment Logistics Co., Ltd. (Kunming, China) and Yunnan Zhengzhu Trading Co., Ltd. (Kunming, China) were interviewed. The interviewees were managers related to cross-border logistics and cross-border e-commerce. The interview focuses on the current situation and problems of e-commerce development and the interaction between cross-border logistics and cross-border e-commerce. Add logistics costs and logistics timeliness as condition variables and add special line logistics as outcome variables according to the opinions of respondents. The pre-questionnaire was prepared according to the interview results.

In the pre-questionnaire phase, pre-survey questionnaires were distributed to employees of representative cross-border e-commerce enterprises in Yunnan Province and teachers of logistics-related majors at Yunnan university and Kunming university of science and technology. The pre-questionnaire was improved according to the collection of the pre-survey questionnaires and the experts’ opinions, and the formal questionnaire was obtained.

In the formal questionnaire phase, taking Yunnan Free Trade Zone as the scope of questionnaire distribution, 80 questionnaires were distributed to personnel of logistics and e-commerce enterprises, and 71 questionnaires were obtained. One invalid questionnaire was eliminated, and 70 valid questionnaires were obtained, which was in line with the expectations of a recovery rate of 87.5%.
3.3. Variables

3.3.1. Condition Variables

The logistics market environment, product specificity, logistics cost, and logistics service capability were studied as the factors of cross-border logistics mode selection. Seven conditional variables (secondary indicators) were extracted from the literature further to analyze the influencing mechanism of cross-border logistics mode selection.

1) Informatization construction. Logistics information construction is an important platform for integrating logistics resources to realize green logistics, and the logistics informatization level is an important indicator of logistics market maturity. A common manifestation of logistics informatization is intelligent logistics, which uses the Internet of Things and information technology to combine information, intelligence, and systems to achieve efficient and low-cost intelligent operations [41]. Qian Huang and Weichuan Yin et al. (2020) pointed out that the logistics information platform maximized real-time bidding, freight information, one-stop service management of operators, and logistics information sharing, which was the best way to improve cross-border logistics [42].

2) Enterprise size. Different cross-border e-commerce enterprises of different scales and different payment capacities may differ in choosing logistics modes [43]. Enterprises with large scale and abundant capital are more inclined to build their own logistics distribution system such as overseas warehouses [44]. While small cross-border e-commerce enterprises that cannot afford the high costs of overseas warehouses can only choose the traditional cross-border transportation mode or cooperate with other enterprises to build oversea warehouses [45].

3) Cross-border e-commerce mode. Ying Wang and Fu Jia et al. (2018) found that when cross-border e-commerce enterprises make business model innovations, relevant supply chains will make corresponding adjustments [46], i.e., changes in cross-border e-commerce modes will influence the selection of cross-border logistics modes. For example, there are huge transactions between cross-border e-commerce enterprises in B2B mode, so enterprises are more inclined to choose special line logistics or overseas warehouses. While, for C2C and B2C models with small and fragmented transaction volumes, postal parcels may be a better choice.

4) Logistics costs. Logistics costs include transportation and warehousing costs, facilities and equipment costs, time and management costs, extra taxation costs, and customs clearance costs. Logistics cost is a key factor for enterprises to maximize profits and achieve long-term development. Stephen C.H. Leung and Yue Wu et al. (2002) pointed out that different cross-border e-commerce enterprises should choose appropriate logistics modes with the lowest cost based on the comprehensive analysis of the costs of logistics modes [47] and improve the efficiency of logistics operations by optimizing logistics costs.

5) Product specificity. Due to product specificity, cross-border e-commerce enterprises have to choose the most appropriate logistics mode to reduce logistics losses and costs, so as to ensure long-term development. For example, in the transport of agricultural products, freshness is the main factor to be considered during transportation. Jiani Wu and Hans-Dietrich Haasis (2018) proposed and verified the most suitable transportation and logistics mode of agricultural products for China’s sustainable development [48].

6) Logistics resources. George Q. Huang et al. (2019) pointed out that the logistics resources of enterprises include logistics-related assets, such as warehouses and distribution vehicles, and human and financial resources used for the management of the logistics business. Enterprises with abundant logistics resources tend to establish a complete logistics system, while enterprises with fewer logistics resources are more inclined to cooperate with third-party logistics enterprises for more logistics resources [49].
Logistics timeliness. Abuduaini Abudureheman and Aishanjiang Nilupaer (2021) considered logistics timeliness as one of the decisive factors for the operational efficiency of logistics enterprises [50], and in the context of COVID-19, cross-border logistics modes with higher timeliness are more favored by cross-border e-commerce enterprises. Cong Li and Zhenlin Wei (2021) proposed that cross-border logistics enterprises can optimize logistics modes by improving logistics timeliness [51].

The sources of the condition variables and the basis for their division are shown in Table 1.

Table 1. The sources of the condition variables and the basis of division.

<table>
<thead>
<tr>
<th>Primary Indicators</th>
<th>Secondary Indicators</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics market environment</td>
<td>Informatization construction</td>
<td>XiuLi Tang (2020) [41]; Qian Huang, etc. (2020) [42]</td>
</tr>
<tr>
<td></td>
<td>Enterprise size</td>
<td>Huiying Zhang, etc. (2021) [43]; Xuefei Shi, etc. (2022) [45]</td>
</tr>
<tr>
<td></td>
<td>Cross-border e-commerce mode</td>
<td>Ying Wang, etc. (2018) [46]</td>
</tr>
<tr>
<td>Logistics costs</td>
<td>Logistics costs</td>
<td>Jiani Wu, etc. (2019) [48]</td>
</tr>
<tr>
<td>Logistics service capability</td>
<td>Logistics resources</td>
<td>George Q. Huang, etc. (2019) [49]</td>
</tr>
<tr>
<td></td>
<td>Logistics timeliness</td>
<td>Abuduaini Abudureheman, etc. (2021) [50]; Cong Li, etc. (2021) [51]</td>
</tr>
</tbody>
</table>

3.3.2. Outcome Variables

The outcome variables are the selection of cross-border logistics modes. This paper classifies cross-border logistics modes into the postal parcel, international express, overseas warehouse, and special line logistics and takes them as the outcome variables to study the main factors and influencing mechanisms of the cross-border logistics mode selection.

4. Qualitative Comparative Analysis and Results

4.1. Variable Assignment

This study had four categorical outcome variables—the postal parcel, international express, overseas warehouse, and special line logistics—which were assigned as 0, 1, 2, and 3, respectively.

This study had seven conditional variables, including four category variables and three scale variables, which were assigned, respectively. When assigning values to variables, the values are assigned based on the collected case data and based on the stratification of the case data range, respectively [52]. In this research, most of the surveyed cross-border e-commerce enterprises are small and medium-sized enterprises. The logistics cost budget of most enterprises is between 500,000 and 5 million yuan, and none of them exceeds 10 million yuan. The logistics timeliness expectations of most enterprises are between 7 and 30 days. The categorical variables of the enterprise size included small, medium, and large, which were assigned as 0, 1, and 2, respectively. The categorical variables of cross-border e-commerce modes included B2B, B2C, and C2C, which were assigned as 0, 1, and 2, respectively. The variables of the logistics costs were measured by the annual logistics cost budget and divided into less than CNY 500,000, CNY 500,000–5 million, CNY 5–10 million, and more than CNY 10 million, which were assigned as 0, 1, 2, 3, respectively. The variables of logistics timeliness were divided into three intervals of within 3 days, 3–7 days, and 7–30 days, which were assigned as 0, 1, and 2, respectively.

The assignment of the scale variables needed to consider the score of each variable in the questionnaire. Although the questionnaires used were Likert five-point scales, the division of thresholds should consider the actual collected data rather than a uniform threshold. In terms of information construction, according to the collected data, the respondents were the most optimistic about the information construction of enterprises, with an average score of 3.5, which was taken as the threshold of this variable. If the average score of individual cases is below 3.5, the value is 0, which indicates a low degree of information
construction; if the average score of individual cases is greater than or equal to 3.5, the value is 1, which indicates a high degree of information construction. In terms of product specificity, the respondents’ evaluation of product specificity was generally low, with an average score of 2.03, which was taken as the threshold of this variable. If the average score of individual cases is below 2.03, the value is 0, which indicates a low degree of product specificity; if the average score of individual cases is greater than or equal to 2.03, the value is 1, which indicates a high degree of product specificity. In terms of the logistics resources, the respondents’ evaluation of logistics resources was generally high, with an average score of 3.44, which was taken as the threshold of this variable. If the average score of individual cases is below 3.4, the value is 0, which indicates a low level of logistics resources; if the average score of individual cases is greater than or equal to 3.4, the value is 1, which indicates a high level of logistics resources (Table 2).

**Table 2.** The assignments of outcome variables and condition variables.

<table>
<thead>
<tr>
<th>Types</th>
<th>Name</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome variables</td>
<td>Postal parcel</td>
<td>If cross-border e-commerce enterprises choose postal parcel, the value is 0.</td>
</tr>
<tr>
<td></td>
<td>International express</td>
<td>If cross-border e-commerce enterprises choose international express, the value is 1.</td>
</tr>
<tr>
<td></td>
<td>Overseas warehouse</td>
<td>If cross-border e-commerce enterprises choose overseas warehouses, the value is 2.</td>
</tr>
<tr>
<td></td>
<td>Special line logistics</td>
<td>If cross-border e-commerce enterprises choose special line logistics, the value is 3.</td>
</tr>
<tr>
<td>Condition variables</td>
<td>Information construction</td>
<td>If the average score is below 3.5, the value is 0; if the average score is greater than or equal to 3.5, the value is 1.</td>
</tr>
<tr>
<td></td>
<td>Enterprise size</td>
<td>Small, medium and large enterprises are assigned as 0, 1, and 2, respectively.</td>
</tr>
<tr>
<td></td>
<td>Cross-border e-commerce mode</td>
<td>B2B, B2C, and C2C modes are assigned as 0, 1, and 2, respectively.</td>
</tr>
<tr>
<td></td>
<td>Logistics costs</td>
<td>Less than CNY 500,000, CNY 500,000 to 5 million, CNY 5 to 10 million and more than CNY 10 million are assigned 0, 1, 2 and 3, respectively.</td>
</tr>
<tr>
<td></td>
<td>Product specificity</td>
<td>If the average score is less than 2.03, the value is 0; if the average score is greater than or equal to 2.03, the value is 1.</td>
</tr>
<tr>
<td></td>
<td>Logistics resources</td>
<td>If the average score is less than 3.4, the value is 0; if the average score is greater than or equal to 3.4, the value is 1.</td>
</tr>
<tr>
<td></td>
<td>Logistics timeliness</td>
<td>Within 3 days, 3–7 days and 7–30 days are assigned 0, 1, and 2, respectively.</td>
</tr>
</tbody>
</table>

**4.2. Truth Table**

The conditional variables are information construction (IC), enterprise size (ES), cross-border e-commerce mode (CEM), logistics cost (LC), product specificity (PS), logistics resources (LR), and logistics timeliness (LT), and the outcome variable is the cross-border logistics model (CLM). There are multi-valued variables that cannot be dichotomized to represent different values in the condition variables because the outcome variables are multi-valued. Compared to the traditional TOSMANA software, fm-QCA software is closer to multi-valued set analysis when the outcome variables cannot be analyzed by dichotomous analysis [33], so fm-QCA software was used for qualitative comparative analysis. According to the condition variables and outcome variables in Table 2, the cases were assigned to obtain the original data table of the condition variables and outcome variables. According to the QCA method, multiple conditional concurrent causes increased exponentially with the increase in the conditional variable, which is not listed in this paper. The valid outcome cases are listed directly.

After inputting the original data table in fm-QCA software, the threshold of the number of cases greater than or equal to 1 and the consistency threshold greater than or equal to 0.8 were set to obtain the corresponding truth table. Consistency refers to the similarity between the empirical case data and the set-theoretical relationships. Ragin (2006) set a lower consistency threshold of 0.75 at first [39]. However, with the deepening of the research, 0.8 has been proposed as the consistency threshold [52], which has been recognized by most scholars [40]. Therefore, in this study, 0.8 is selected as the consistency threshold, and only the cases whose consistency threshold was greater than or equal to 0.8
were retained. Fm-QCA software was used to synthesize the original data table, and the cases whose consistency threshold was lower than 0.8 and did not occur were eliminated. Finally, 37 valid cases were retained in the truth table, as shown in Table 3.

### Table 3. Results of multi-value set qualitative comparative analysis.

<table>
<thead>
<tr>
<th>Logistics Modes</th>
<th>Condition Combination</th>
<th>Raw Coverage</th>
<th>Unique Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (Postal parcel)</td>
<td>ES(0)<em>LC[1]<em>LT[2]</em>~IC</em>~PS</td>
<td>0.57058824</td>
<td>0.24529412</td>
</tr>
<tr>
<td></td>
<td>ES(0,1)*CEM[1]<em>LC[1]<em>LT[2]</em>~IC</em>~PS</td>
<td>0.41176470</td>
<td>0.05882353</td>
</tr>
<tr>
<td></td>
<td>ES(0)*CEM[1]*LC[1]<em>LT[2]</em>~PS</td>
<td>0.35294120</td>
<td>0.05882353</td>
</tr>
<tr>
<td></td>
<td>ES(1)*CEM[1]<em>LC[1]<em>LT[2]</em>~IC</em>~LR</td>
<td>0.23529412</td>
<td>0.05882353</td>
</tr>
<tr>
<td></td>
<td>ES(1)*CEM[1]<em>LC[1]<em>LT[2]</em>~PS</em>~LR</td>
<td>0.17647060</td>
<td>0.00000000</td>
</tr>
<tr>
<td>solution coverage</td>
<td></td>
<td>1.00000000</td>
<td></td>
</tr>
<tr>
<td>1 (International express)</td>
<td>ES[1,2]*CEM[0]<em>LC[2]<em>IC</em>PS</em>LR</td>
<td>0.27777780</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[2]*CEM[0]<em>LC[2,3]<em>IC</em>PS</em>LR</td>
<td>0.27777780</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[0]<em>LC[1]<em>LT[2]</em>~IC</em>~PS</td>
<td>0.22222222</td>
<td>0.11111111</td>
</tr>
<tr>
<td></td>
<td>ES[0,1]*CEM[1]<em>LC[1]<em>LT[2]</em>~IC</em>~PS</td>
<td>0.16666667</td>
<td>0.00000000</td>
</tr>
<tr>
<td></td>
<td>ES[0]*CEM[1]*LC[1]<em>LT[2]</em>~PS</td>
<td>0.16666667</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[1]*CEM[1]<em>LC[1]<em>LT[2]</em>~IC</em>~LR</td>
<td>0.11111111</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[1]*CEM[1]<em>LC[1]<em>LT[2]</em>~PS</em>~LR</td>
<td>0.11111111</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[2]*CEM[0]*LC[2]*LT[0]<em>IC</em>LR</td>
<td>0.11111111</td>
<td>0.05555556</td>
</tr>
<tr>
<td></td>
<td>ES[2]*CEM[0]*LC[2]<em>LT[0]<em>IC</em>PS</em>LR</td>
<td>0.05555556</td>
<td>0.05555556</td>
</tr>
<tr>
<td>solution coverage</td>
<td></td>
<td>1.00000000</td>
<td></td>
</tr>
<tr>
<td>2 (Overseas warehouse)</td>
<td>ES[2]*LC[2]<em>LT[0]<em>IC</em>PS</em>LR</td>
<td>0.50000000</td>
<td>0.33333334</td>
</tr>
<tr>
<td></td>
<td>ES[2]*CEM[0]*LC[2]*LT[0]<em>IC</em>LR</td>
<td>0.33333334</td>
<td>0.33333334</td>
</tr>
<tr>
<td></td>
<td>ES[1]*CEM[0]*LC[2]<em>LT[0]<em>IC</em>PS</em>LR</td>
<td>0.16666667</td>
<td>0.16666667</td>
</tr>
<tr>
<td>solution coverage</td>
<td></td>
<td>1.00000000</td>
<td></td>
</tr>
<tr>
<td>3 (special line logistics)</td>
<td>ES[1]*CEM[0]*LC[2]<em>LT[1]<em>IC</em>PS</em>LR</td>
<td>0.66666667</td>
<td>0.33333334</td>
</tr>
<tr>
<td></td>
<td>ES[1]*CEM[0]*LC[3]<em>LT[1]<em>IC</em>PS</em>LR</td>
<td>0.16666667</td>
<td>0.16666667</td>
</tr>
<tr>
<td>solution coverage</td>
<td></td>
<td>1.00000000</td>
<td></td>
</tr>
</tbody>
</table>

"*" stands for logical and refers to the sum, that is, multiple conditions that work together; "~" stands for logical non, which means it does not exist. The variables of information construction, product particularity, and logistics resource richness in this paper are dichotomous variables, so the software used ~IC, ~PS, and ~LR to represent IC(0), PS(0), and LR(0).

### 4.3. Results

Three combination schemes of oversimplified, intermediate, and complex conditions were generated using fm-QCA software. Considering that variable assignment is not always a simple dichotomous treatment, it will produce a large number of combined schemes lacking case support, so the intermediate scheme was selected to analyze the results.

### 4.4. Conditional Combination Analysis

According to the results shown in Table 3, the influence mechanism and formation path of cross-border logistics mode selection could be analyzed.

#### 4.4.1. The Formation Path of Postal Parcels

In Table 3, there are five formation paths of the postal parcel mode, with a total coverage of 100%, indicating that these five paths cover all the cases whose logistics mode selections are postal parcels.

Path 1: “ES(0)*LC[1]*LT[2]*~IC*~PS”, which means “small enterprises size * the logistics costs are CNY 50–5 million * the logistics timeliness is 7–30 days * low degree of information construction * low degree of product specificity”. The original coverage rate
of this path was 0.57058824, which means path 1 can explain more than half of the cases whose logistics mode selection was postal parcels, which also means more than half of the e-commerce enterprises that meet these conditions are inclined to choose postal parcels. This is a typical path in the postal parcel mode selection.

Path 2: “ES[0,1]*CEM[1]*LC[1]*LT[2]~IC~PS”, which means “small and medium enterprises size * B2C cross-border e-commerce mode * the logistics costs are CNY 500–5 million * the logistics timeliness is 7–30 days * low degree of information construction * low degree of products specificity”. The original coverage rate of this path was 0.41176470, which means more than 40 percent of the e-commerce enterprises that meet these conditions are inclined to choose postal parcels.

Path 3: “ES[0]*CEM[1]*LC[1]*LT[2]~PS” and path 4: “ES[0]*CEM[1]*LC[1]*LT[2]~IC~LR” have a common section: “ES[0]*CEM[1]*LC[1]*LT[2]”. The original coverage rate of this path was 0.58823532, which means about 60 percent of small B2C e-commerce enterprises are inclined to choose the postal parcel mode if these enterprises’ expected logistics costs are CNY 500–5 million and the expected logistics timeliness is 7–30 days.

Path 5: “ES[1]*CEM[1]*LC[1]*LT[2]*~PS~LR”, which means “medium enterprises size * B2C cross-border e-commerce mode * the logistics costs are CNY 500–5 million * the logistics timeliness is 7–30 days * low degree of product specificity * low degree of logistics resources”. The original coverage rate of this path was 0.17647060, which means path 5 can explain less than 20 percent of the cases who select the postal parcel mode.

It is easy to see that the cross-border e-commerce enterprises involved in these five paths are all small and medium-sized. The remaining four paths, excluding the typical path, have a common section: “CEM[1]*LC[1]*LT[2]”, which means these e-commerce enterprises cases all have common characteristics: B2C e-commerce mode, the logistics costs are CNY 500–5 million, and the logistics timeliness is 7–30 days. Part “LC[1]” and “LT[2]” are included in all the paths, which means that “a logistics cost budget of CNY 500–5 million” and “a logistics time expectation of 7–30 days” are the necessary conditions for enterprises to choose the postal parcel mode.

4.4.2. The Formation Path of International Express

The international express mode mainly refers to some multinational companies in the international scope to provide international transportation logistics services, such as the internationally well-known UPS, DHL, FedEx, TNT Express, and other international express companies. There are also fast and slow lines in terms of timeliness, which apply to all types of cross-border e-commerce enterprises.

In Table 3, there are 11 formation paths of the international express mode, and the total coverage of these 11 paths is 100%, which means that these 11 paths can cover all the cases for which the logistics mode selection is the international mode. Considering that there are too many paths of the international express mode and the original coverage rate of each path is lower than 0.3, this indicates that there is no typical formation path for this mode, and the formation path of the international express mode is complicated and lacks commonality.

4.4.3. The Formation Path of Overseas Warehouse

The overseas warehouse mode refers to the cross-border logistics mode in which warehouses are built overseas or cross-border enterprises ship goods to overseas warehouses in advance according to demand prediction so that overseas customers can directly implement local distribution after placing orders. In Table 3, there are three formation paths in the overseas warehouse mode. The total coverage of these three paths is 100%, i.e., these three paths can describe all cases that choose the overseas warehouse mode.

Path 1: “ES[2]*LC[3]*LT[0]*IC*PS*LR”, which means “large enterprises size * the logistics costs are more than CNY 10 million * the logistics timeliness is within 3 days * high degree of information construction * high degree of product specificity * high degree of logistics resources”. The original coverage rate of this path was 0.50000000, which means
path 1 can explain exactly half of the cases that choose the postal parcel mode, which also means that about half of the e-commerce enterprises that meet these conditions are inclined to choose the postal parcel. This is a typical path in the overseas warehouse mode selection.

Path 2: “ES[2]*CEM[0]*LC[2]*LT[0]*IC*LR”, which means “large enterprise size * B2B cross-border e-commerce mode * the logistics costs is CNY 5–10 million * the logistics timeliness is within 3 days * high degree of logistics resources”. The original coverage rate of this path was 0.33333334, which means path 2 can explain more than 30 percent of the cases that choose the postal parcels mode, which also means that about a third of e-commerce enterprises that meet these conditions are inclined to choose the overseas warehouse mode.

Path 3: “ES[1]*CEM[0]*LC[2]*LT[0]*IC*PS*LR”, i.e., “medium-sized enterprises * B2B cross-border e-commerce mode * the logistics costs is CNY 5–10 million * the logistics timeliness is within 3 days * high degree of logistics resources”. The original coverage rate of this path was 0.16666667, which means this path can explain more than 15 percent of the cases that choose the postal parcels mode, which also means that about one in six e-commerce enterprises that meet these conditions are inclined to choose the overseas warehouse mode.

It is easy to see that these three paths have a common section: “LT[0]*IC*LR”, which means that “the logistics timeliness is within three days”, “a high degree of information construction”, and “a high degree of logistics resources” are the necessary conditions for cross-border e-commerce enterprises to choose the overseas warehouse mode. Meanwhile, the enterprises involved in the three paths are all large and medium-sized enterprises whose cross-border logistics cost budget is more than CNY 5 million.

4.4.4. The Formation Path of Special Line Logistics

The special line logistics mode means that the logistics companies use their own trucks, cargo ships, or air resources to deliver goods to destinations via fixed routes. In Table 3, there are three formation paths in the special line logistics mode. The total coverage of these three paths is 100%, indicating that these three paths can describe all the cases that choose the special line logistics mode.

Path 1: “ES[1]*CEM[0]*LC[2]*LT[1]*PS”, which means “medium-sized enterprises * B2B cross-border e-commerce mode * the logistics costs are CNY 5–10 million * the logistics timeliness is 3–7 days * high degree of product specificity”. The original coverage rate of this path was 0.66666667, which means this path can explain more than 66 percent of the cases that choose the special line mode, which also means that more than 66 percent of e-commerce enterprises that meet these conditions are inclined to choose the special line mode. This is a typical path in the special line mode selection.

Path 2: “ES[1]*CEM[0]*LC[1]*LT[1]*IC*PS*ALR”, i.e., “medium-sized enterprise * B2B cross-border e-commerce mode * the logistics costs are CNY 500–5 million * the logistics timeliness is 3–7 days * high degree of product specificity * high degree of logistics resources”. The original coverage rate of this path was 0.16666667, which means this path can explain about 16 percent of the cases that choose the special line mode, which also means that about one in six e-commerce enterprises that meet these conditions are inclined to choose the special line mode.

Path 3: “ES[2]*CEM[0]*LC[3]*LT[1]*IC*PS*ALR”, which means “large enterprises size * B2B cross-border e-commerce mode * the logistics costs are more than CNY 10 million * the logistics timeliness is 3–7 days * high degree of information construction * high degree of products specificity * high degree of logistics resources”. The original coverage rate of this path was 0.16666667, which means this path can explain about 16 percent of the cases that choose the special line mode, which also means that about one in six e-commerce enterprises that meet these conditions are inclined to choose the special line mode.

It is easy to see that the enterprises involved in these three paths are all large and medium-sized and they all have a common section: “CEM[0]*LT[1]”, which means that the “large and medium enterprise sizes”, “B2B cross-border e-commerce mode”, and “the
logistics timeliness is 3–7 days” are the necessary conditions to choose the special line logistics mode.

5. Conclusions and Suggestions

5.1. Conclusions

Although there is some research on factors of cross-border logistics mode selection [27,29,31], the factors and formation paths of cross-border logistics modes have not been explained effectively. In terms of research methods, existing researches mainly focus on theoretical analysis or single case analysis, and there is no systematic introduction of social science research methods, resulting in a lack of universality of research. This study introduced mvQCA, analyzed four cross-border logistics modes and the formation paths, and expanded the research in the field of cross-border logistics. The collaborative mechanism of cross-border logistics mode selection by various factors is deeply analyzed, and the typical formation path of each cross-border logistics mode is found, which makes up for the deficiency of the existing cross-border e-commerce enterprises’ cross-border logistics mode selection mechanism. It enriches the research framework for the coordinated development of cross-border e-commerce and cross-border logistics. The results are as follows:

(1) The choice of the logistics mode results from the combination of different condition variables, and the formation paths of different logistics mode choices are different. Except for the international express mode, the other three cross-border logistics modes all have typical formation paths with a high original coverage rate. Enterprises can choose the most suitable cross-border logistics mode according to their development situation, and adjust the logistics mode selection during the process of continuous development. In the early stage of development, cross-border e-commerce enterprises can choose postal parcel and international express to expand enterprise scale through low-cost strategies. At the same time, they can offer better services to customers by leasing or purchasing overseas warehouses and special line services provided by other enterprises. When enterprises reach a certain scale, they can choose to establish overseas warehouses to protect their market positions and achieve long-term development.

(2) Postal parcel mode is the choice of many small and medium-sized B2C cross-border e-commerce enterprises because of its broad coverage, door-to-door delivery, and low price. In the case of a low degree of logistics timeliness requirements, enterprises tend to choose the postal parcel mode. Although the postal parcel mode is not as efficient as others, it is economical and affordable and can provide door-to-door service. It is the most suitable mode for many small B2C and C2C enterprises with a low logistics budget and low logistics timeliness requirements. The typical formation path is “small enterprises size * the logistics costs are CNY 500–5 million * the logistics timeliness is 7–30 days * low degree of information construction * low degree of product specificity”.

(3) Due to the low specificity, the international express mode is more developed in the world and has a large number of customers, and there is no typical formation path for this mode. By visiting local cross-border e-commerce enterprises in Yunnan Province, it was found that most cross-border e-commerce enterprises have one or more long-term logistics partners for better international express services. Because of the variety of logistics services and prices, the size of international express logistics enterprises varies, as do the e-commerce enterprises they work with.

(4) The overseas warehouse mode is the cross-border logistics mode with the highest logistics time efficiency by realizing local distribution and shortening the transportation distance. However, building overseas warehouses requires massive investment and high management costs. Therefore, it has become the most choice of large and medium-sized cross-border e-commerce enterprises with solid capital and a high expectation of logistics timeliness. In addition, small and medium-sized enterprises can also provide overseas warehouse mode services by leasing the overseas warehouses
of these enterprises. The typical formation path is “large enterprises size * the logistics costs are more than CNY 10 million * the logistics timeliness is within 3 days * high degree of information construction * high degree of product specificity * high degree of logistics resources”.

(5) The special line mode has fixed transport routes, which makes its logistics time efficiency higher than that of the international express mode and postal parcel mode. However, there is still a gap compared to the overseas warehouse mode. It requires a large amount of centralized transportation to reduce logistics costs and achieve more benefits, making it the most suitable choice for many large and medium-sized B2B cross-border e-commerce enterprises. The typical formation path is “medium-sized enterprises * B2B cross-border e-commerce mode * the logistics costs are CNY 5–10 million * the logistics timeliness is 3–7 days * high degree of product specificity”.

5.2. Suggestions

(1) Postal parcels and international express are better options to achieve low-cost development. For small and medium-sized cross-border e-commerce enterprises with weak financial strength, the main considerations should be the cost and coverage of the cross-border logistics mode. Compared to the overseas warehouse and special line logistics modes, the postal parcel and international express modes could be better choices due to lower logistics costs. However, before choosing these two logistics modes, cross-border e-commerce enterprises should clarify consumers’ requirements for logistics timeliness and service quality to avoid customer loss. In addition, on the premise of correctly predicting the market environment, small and medium-sized cross-border e-commerce enterprises can choose overseas warehouse services provided by cross-border logistics enterprises to save the cost of establishing overseas warehouses.

(2) Overseas warehouses and special line logistics are better options for long-term development. They both require huge investments at the early stage, but once realized, they can provide enterprises with better logistics services in terms of effectiveness, timeliness and product specificity. Therefore, for medium and large-sized cross-border e-commerce enterprises with strong financial strength, these two modes may be better choices for long-term and sustainable development. Medium and large-sized cross-border e-commerce enterprises can get rid of their dependence on external resources and other enterprises through overseas warehouses. In addition, the construction of overseas warehouses and cross-border logistics platforms can enrich regional logistics infrastructure and bring convenience to cross-border e-commerce enterprises and logistics services in the whole region. After constructing the overseas warehouse, these enterprises can provide relevant services by leasing these overseas warehouses to generate revenue, and enterprises that cannot afford the cost of building overseas warehouses may improve their logistics services by purchasing existing overseas warehouses.

(3) Clear positioning and choose the most appropriate logistics mode. Cross-border e-commerce enterprises should clarify the positioning of the enterprise scale, resources, products, and consumers, then choose an appropriate logistics mode based on this information. An appropriate logistics mode can help cross-border e-commerce enterprises improve the utilization rate of logistics resources, reduce logistics costs, maximize profits and achieve long-term sustainable development. They should have a sense that only by cooperating with the appropriate cross-border logistics enterprises and choosing the appropriate logistics mode can they achieve sustainable development. At the same time, cross-border logistics enterprises should use the resources of cross-border e-commerce enterprises to improve the logistics service ability, optimize the logistics mode, and enhance their market competitiveness. On this basis, attach importance to the utilization and protection of environmental resources, enrich and improve the local logistics infrastructure, and finally realize green logistics. Therefore,
the cross-border e-commerce industry and cross-border logistics industry should deepen cooperation with each other, maximize the utilization of market resources, and realize the joint development of the two industries.

(4) Establish an information platform to achieve the sustainable development of multiple industries. Cross-border e-commerce and logistics enterprises should realize the integration and sharing of resources and information such as logistics environments, industry development trends, industrial competitiveness and regional factors through the construction and improvement of logistics information platforms. Through this platform, cross-border e-commerce enterprises can obtain more logistics information, choose the logistics modes they need, and bring convenience to the long-term development of enterprises. Cross-border logistics enterprises can utilize the resources of cross-border e-commerce enterprises to optimize logistics mode and logistics infrastructure, and finally, realize the transformation to green logistics. The strengthening connection between the cross-border e-commerce industry and the cross-border logistics industry is the basis for the sustainable cooperation and development of these two related industries. Through the construction and improvement of information platforms, the sharing and utilization of resources are more convenient, and the sustainability of the joint development of the two industries is realized.

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