

Quantitative Analysis of China's Provincial Live streaming e-commerce Policies from the Perspective of Policy Tools -- based on LDA Topic Social Network Analysis

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Abstract. [Research purpose] With the rapid development of live streaming e-commerce, local governments have promulgated local regulations and normative documents for the development of live streaming e-commerce in combination with local development. Carry out the research on the policy of live streaming e-commerce at the provincial level, trying to provide a reference for the development and policy formulation of live streaming e-commerce in China. [Research methods] This paper makes a text analysis of 54 relevant policies of live broadcast e-commerce at the local government level, mainly using unsupervised LDA (Latent Dirichlet Allocation) Topic model method and social Semantic network analysis method. [Research Conclusion] The key points and difficulties in the development of live streaming e-commerce are concentrated in three aspects: live streaming e-commerce to help poverty alleviation, live streaming e-commerce industry supervision system improvement, and live streaming e-commerce talent training support system. The existing live streaming e-commerce policies radiate all areas of society, mainly focusing on improving the regulatory system and avoiding marketing risks, but there is a lack of demand-oriented policy tools, and the proportion of policy tools used is unbalanced. To this end, optimizing the configuration of policy tool structure, strengthening policy analysis, and promoting the benign coupling of policy objectives, implementation and system have become the future development path of live streaming e-commerce policies at the provincial level in China.

Keywords: live streaming e-commerce; Policy instruments; Policy text; LDA topic model; Social network analysis; Text mining.

1. Introduction

Electronic commerce (EC) has become the most critical business activity globally, drawing the attention of scholars and experts across various fields. In China, the forms of electronic commerce continue to evolve, with the fast-emerging trend of live e-commerce transforming the online shopping experience.

Live streaming e-commerce, the advanced and the latest form of e-commerce, is expected to become a new essential in e-commerce promotion [1] that enables salespersons to sell their products via live broadcasting. According to a report released by the Ministry of Commerce of the People's Republic of China in 2022, more than twelve million e-commerce live broadcasts were implemented in mainland China with 1.1 million active anchors and 515 million viewers (accounting for more than half of China's whole Internet population) over ninety-five million products on the shelves [2]. Also, the growth rate of transactions on major live-streaming e-commerce platforms in 2022 is higher than that of traditional e-commerce platforms, indicating that the development trend of Live e-commerce is unstoppable.

At the same time, it is important to note that China still faces challenges in the development of live e-commerce. For instance, some streamers engage in false advertising during live streaming, leading to frequent complaints of "exaggerated claims." [3] The streamers' inability to convey accurate product information may decrease consumers' purchase intent or exacerbate trust issues [4]. Additionally, some live-streaming platforms rely on WeChat Pay or Ali Pay as their primary transaction methods to evade regulation, making it challenging for consumers to contact merchants

for returns or replacements. The numerous issues in live e-commerce highlight the difficulty in protecting consumers' rights. Therefore, it is necessary for the Chinese government to establish a regulatory system specifically focused on live e-commerce to address these issues.

Based on Rothwld and Zegveldt's theory of policy instruments, our article uses the LDA model and social network analysis method to analyze 54 currently valid policy texts of 28 provinces as of June 2023 to answer the following questions: What policies have been adopted by provincial governments? Have there been any differences in the policies adopted by different provinces? And how effective have the policies been in controlling and prompting the development of Live e-commerce? By answering the above questions, we hope to offer some constructive guidance on how to optimize provincial governments' policies on Live e-commerce.

2. Literature Review

2.1 Live Streaming

Live streaming shows great significance in multiple fields and e-commerce live streaming has become an important business model [5] that enables streamers and audiences to interact more frequently. It seems that selling products through live-streaming e-commerce is an emerging marketing method that contributes a lot to promoting economic gain. Therefore, live-streaming e-commerce is gaining more and more attention today. [6] Evaluating China's live-streaming e-commerce is particularly significant with respect to Chinese content, scholars have conducted studies on various aspects of this emerging phenomenon, including its impact on consumer behavior [7], marketing strategies, and policy implications [8]. Existing research shows that the current live streaming mode has been upgraded from "E-commerce + live streaming" to "Internet celebrity + star + official + E-commerce + live streaming" [9], which means that multiple subjects like government, Internet celebrities, and stars are involved in this flourishing industry.

Although the live-streaming industry plays an influential role in economic revitalization, however, the problems such as fraudulent advertising, poor quality, and soaring complaints [10] remind us of the importance of standard supervision and a series of policies has been adopted by the Chinese government with the aim of regulating the live streaming e-commerce industry.

However, there remains a notable lack of further analysis of related policies although it will be helpful to provide support for improving the live-streaming e-commerce system. Relevant research on this topic is scarce and inconclusive, especially when it comes to empirical analysis [11]. And always aim to figure out effective ways of government regulation from a macro perspective [12]. For example, T Chen et al suggested that governments should pay more attention to actual regulatory problems and intensify efforts to implement normative policies by analyzing online comments related to live-streaming e-commerce based on the LDA models [13]. And Zhao pointed out the importance of establishing a public hierarchy model for the policy based on the qualitative and quantitative analysis of a live-streaming policy in a city in China. The number of relevant research is still limited and this paper wants to further quantitatively analyze the live-streaming e-commerce political texts deeply.

2.2 Analysis of political texts

Compared with policy quantitative analysis, content analysis can produce more reproducible and effective inferences, and its method focuses on the definition and coding of the analysis unit. [14] Domestic scholars have applied this method to analyze national policies in many fields. For example, Huang Xinping [15] et al studied the development policies of science and technology finance in China through Maxqda qualitative analysis software from the perspective of policy tools. As a classic method of sociology, social network analysis has gradually entered the field of policy research in recent years, and has attracted the attention of some scholars. Wang Jie et al. introduced this method for the first time to analyze 38 industry-university-research cooperation policies in Jiangsu Province. [16] Chenmei et al. adopted the effect word analysis method and the LDA topic model to conduct

unsupervised machine learning analysis on the comprehensive policy texts in effect in 24 provinces as of December 2022 to clarify the implicit relationship between the various policy texts. At the same time, the correlation degree of topic feature words is calculated with the help of social network analysis, and the results of LDA model are verified from the visual level. [17] However, through literature review, it is found that in the field of text analysis of live streaming e-commerce policies, no scholars have analyzed and discussed the digital economy policies at the provincial level by analyzing the distance network of words.

3. Research Method

3.1 Research Theory

This paper makes a text analysis of 54 relevant policies of live broadcast e-commerce at the local government level, mainly using unsupervised LDA (Latent Dirichlet Allocation) Topic model method and social Semantic network analysis method. On one hand, this paper uses the LDA model of Unsupervised learning to extract topics of the policy text. The provincial level live broadcast e-commerce policy text is divided into different research topics, and the characteristic words are consolidated to explore the relationship between the provincial policy texts. On the other hand, this paper uses social Semantic network analysis to continue to explore and verify the degree of association between LDA mining topic characteristics. Specifically, on the basis of realizing unsupervised machine mining of long policy text into short text of each word under three topics through LDA Topic model, this paper measures the degree of association between the three topic key words under LDA results. The basic idea of using Python to draw co-occurrence network diagrams is to determine whether two words are co-occurred by comparing their index positions in the text and determining whether their absolute distance is 0 or 1. If so, it is considered that two words co-occur once, indicating a strong correlation. If not, it is considered that the two words do not co-occur.

3.2 Description of samples

As it is important for the samples to be representative, consistent and integral, the article takes the relevant policy documents and regulations issued by provincial and local governments around e-commerce live streaming as the research object, and comprehensively grasps the development characteristics of e-commerce live streaming. This article excludes some detailed policy documents and only retains those with macro development significance.

As of June 1, 2023, according to the standards mentioned above, a total of 54 currently valid documents that satisfy the requirements have been screened from the public data and government affairs on the websites of Peking University's magic weapon and local governments in various provinces, covering 28 provinces (municipalities or autonomous regions) nationwide, as shown in below figure:

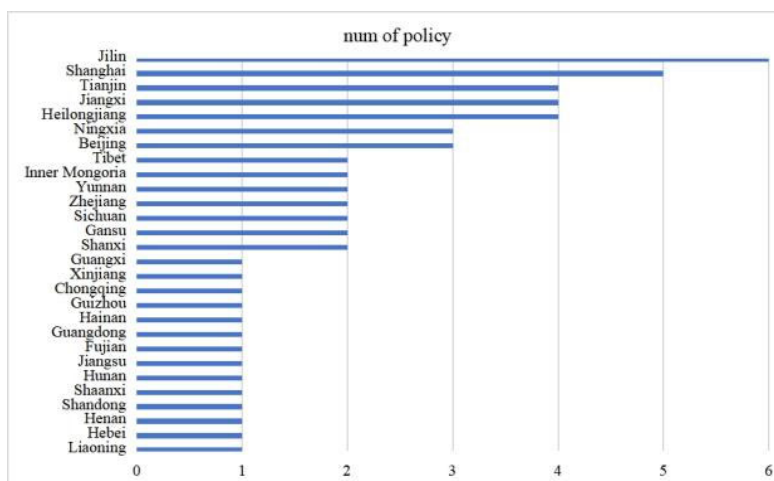


Figure 1. Numbers of policies in 28 provinces

In the above figure, we can conclude that:

1. Most provinces (municipalities or autonomous regions) have released 1-2 policies or regulations related to the development of e-commerce live streaming, but a quarter of provinces have released more policy documents. Jilin Province has released the most documents, with 6 copies; Shanghai followed by 5.

According to the Chi-squared test, there is no significant difference in the number of documents in the live broadcast e-commerce in terms of quantity. The table is shown as below.

Table 1. Chi-squared test

value		Degree of freedom	P-value
Pearson square	140.000	135	.367
Likelihood ratio	76.103	135	1.000
Num of valid cases	28		

4. Analysis and results of Research

4.1 The paper constructs the Text processing and determining the number of topics

4.1.1 Text processing

The database for text analysis is constructed from the above 54 policy texts, and the Chinese word segmentation tool Jieba is called in python for word segmentation preprocessing. Before word segmentation, in order to improve the accuracy and credibility of the segmentation results, we first deleted words with no practical meaning such as articles and prepositions from the database, and then unified the capitalization and singular and plural of the same word.

Table 2. Examples of processing

Examples of words	Processing methods
The\the\ a\an	Delete
In\At	Delete
City\city	city
Service\services	services

4.1.2 Determine the number of topics

This paper uses two methods of consistency score and Perplexity curve to comprehensively determine the optimal number of topics for the sample. Extract the number of high-frequency themes in the text through the score of theme consistency, and the results are shown below.

The paper use confirmation measure marked as:

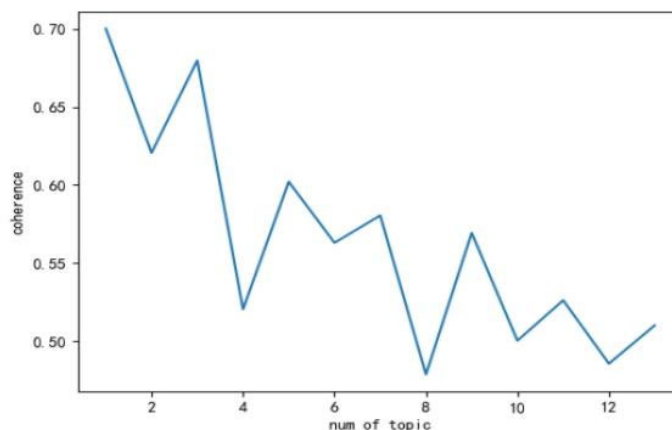


Figure 2. Coherence varies with the num of topic

In order to ensure the robustness of determining the optimal number of topics, this study continues to calculate the Perplexity of the policy text through the formula.

$$perplexity(D_{test}) = e^{-\frac{\sum_{d=1}^M \log p(W_d)}{\sum_{d=1}^M N_d}} \tag{1}$$

$$p(W) = \sum_z p(z)p(z|W)$$

e Perplexity curve as shown below.

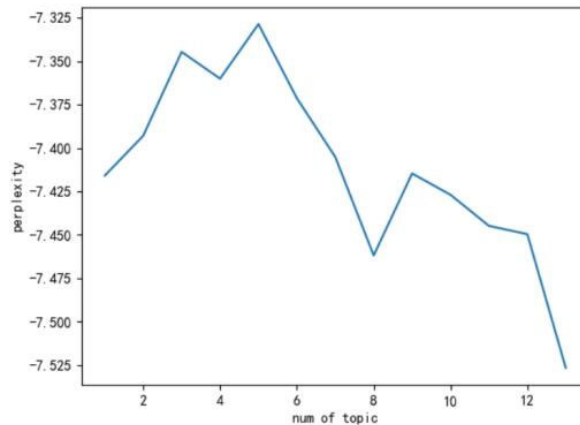


Figure 3. Perplexity varies with the num of topic

Combining the two figures, we find that when the number of topics increases, the overall coherence shows a downward trend, and Perplexity is also declining, but the degree of Perplexity decline is not as dramatic as the coherence. Therefore, this paper chooses coherence as the chief consideration factor while Perplexity as the subordinate factor. In this paper, we finally determine the number of topics as 3. Under this condition, the coherence is higher, about 0.68, and Perplexity is -7.34, which is acceptable.

4.2 Analysis of LDA Topic Model

After setting the number of topics to 3, unsupervised machine mining crawling was conducted on 54 policy documents, and an LDA model was constructed using Python's Gensim module. PyLDAvis module was also used for visual presentation.

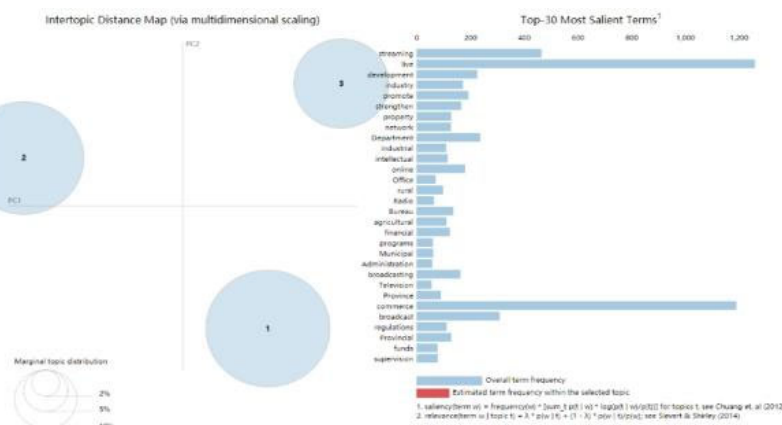


Figure 4. Intertopic distance map and Top-30 most salient words

When the number of topics is 3, the circles of each topic are far apart and distributed in three quadrants, which means the three topics modeled by LDA are relatively mutually exclusive, reflecting the good results of the original policy text.

The right side of the above image shows the top 30 topic feature words with a high frequency in the text. It can be seen that high-frequency words cover fields of topics with a wide coverage, involving verbs, adjectives and nouns, including multiple fields such as economy, politics, agriculture and so on. The degree of homogenization of these topic words is relatively low, and the segmentation effect is good. The model reflects the situation truthfully and reliably.

There is no doubt that “live” “broadcast & broadcasting” and “commerce” are higher than others because they are our research subject roles. It is notable that “services” and “streaming” follow behind. The reason “service” has become a high-frequency word is that live e-commerce was born out of the desire to provide better service to consumers thereby influencing their buying decisions. And the subsequent series of live policy guidance are around to enhance the consumer shopping experience to develop. Such as 5G, 4K, VR is a new-generation information technology, will effectively solve the problems such as video lag, unclear product detail, and delay of network transmission, make the product get a more perfect and realistic presentation in detail, and make the consumers can get more fluent and clear viewing experience, it will be beneficial to improve the consumer shopping experience in live streaming e-commerce. It's not hard to understand why streaming appears as another high-frequency word. Streaming is the basis for the development of live e-commerce, and the promotion of live supporting facilities is mentioned in all policy texts.

Table 3. For each topic, we select the top 20 high-frequency words as the key features of the topic, as listed in the table below.

Typology	Tool name	Meaning
Supply-based	Infrastructure	Government to promote the development of live e-commerce and the construction of a "one-stop" e-commerce live base and special zone to promote content manufacturing, video technology, live scenes, etc.
	Capital	Government support for the development and transformation of live e-commerce industries through financial subsidies, price instruments and special funds
	Talents	The government improves the education system and training system at all levels to provide live e-commerce special talent protection, and regularly conducts competitions to select talents.
	Information	The government builds a platform for sharing relevant information resources, safeguards the free flow of data and the safety of data subjects, and improves the live e-commerce ecosystem
Environmental-based	Public Service	The government continues to optimise the environment for the development of live e-commerce and gather professional service providers
	Internal support	The government clarifies the development plan of live e-commerce, and provides financial support and tax incentives for the relevant main linkage
	External safeguards	The government maintains market order in the live e-commerce industry and prevents intellectual property infringement through regulatory guidelines
	Government-purchases	Government Priority Procurement of Relevant Products and Services in the Government Live E-Commerce Project
Demand-based	Collaborative - Exchanges	Government explores economic co-operation between live e-commerce and public-private sector
	Foreign trade	The government builds a cross-border trading platform for live e-commerce, and creates a new model of cross-border e-commerce through live e-commerce with "a service organisation + a number of application scenarios + a number of foreign pavilions".
	Market mechanism	According to the principle of "government-enterprise linkage and market operation", integrating resources from the government, business associations and enterprises.

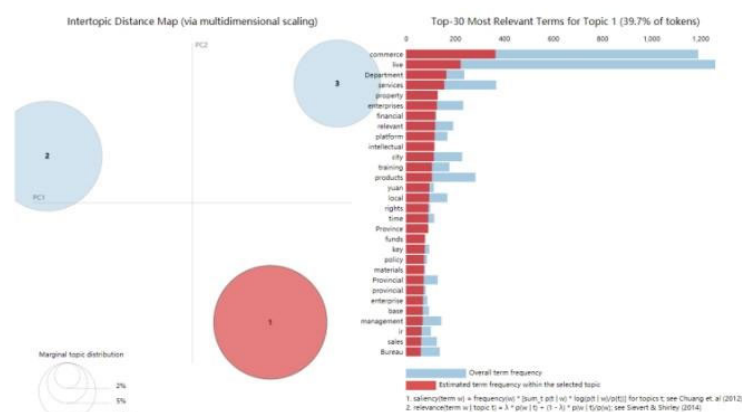
It can be intuitively observed that the features of the three themes partially overlap, with Theme 1 accounting for the largest proportion of 39.7%, followed by Theme 2 accounting for 37%. Overall, the distribution of the three themes is relatively uniform. The following figure lists the key feature words and their frequency ratios for each theme.

The focus of the three themes is how to promote the healthy development of live streaming e-commerce through the formulation of relevant policies, so as to stimulate the well-ordered growth of the local economy. The focus of the three types of subject words is different:

The main areas concerned by the first type of theme words are remote and poor areas. This kind of theme words can better see the difficulties and challenges in the development of live e-commerce in these areas, and relevant policies mainly focus on the industry to be deepened, poor supply quality, changes in residents' consumption and the transformation of rural tourism enterprises. In the process of promoting relevant policies, it is also necessary to deal with the complex situation of coexistence of economic development opportunities and hidden risks, and overcome comprehensive problems such as technical gaps and lack of talents. Taking the policies related to the development of live broadcast conveyor industry to help rural revitalization in Tibet as an example, it is not difficult to find that e-commerce helps rural revitalization by forcing the upgrading of industrial infrastructure in relevant areas and reconstructing traditional resource factors and development modes.

The second category of keywords focuses on how to standardize the live streaming e-commerce industry and improve the relevant regulatory system. As a newly developed field, some behaviors of live streaming e-commerce have hidden risks, such as the risk of sales misdirection in relevant live streaming marketing behaviors, so policies and regulations are needed to regulate them. The theme emphasizes that the government needs to strengthen the monitoring and guidance of live streaming e-commerce platforms and business behaviors, promote streamers to carry out live streaming e-commerce in accordance with the law, urge platforms to assume the corresponding regulatory responsibilities of online stores, content ecology, transaction security, advertising, etc., encourage the establishment of industry credit rating, reward and punishment mechanisms, strive to protect the legitimate rights and interests of consumers, and prohibit the sale of counterfeit and shoddy products. Promote the healthy, orderly and innovative development of live streaming e-commerce.

The third category focuses on the construction of live streaming e-commerce talent support system, including multiple dimensions such as talent certification and talent training. Relevant policies have issued a number of special lectures and skill training notices around the training of live streaming e-commerce talents, and promoted relevant colleges and universities to deepen cooperation with enterprises or service institutions, and actively reserve live streaming e-commerce talents. At the same time, through the holding of relevant competitions to select and certify the relevant talents. Still taking Tibet as an example, Tibet wants to develop "e-commerce + live broadcast", the lack of local talents. Limited by special geographical environment, language communication barriers and other factors, foreign e-commerce merchants are difficult to retain in Tibet, and it is particularly important to strengthen the training of local rural e-commerce merchants.



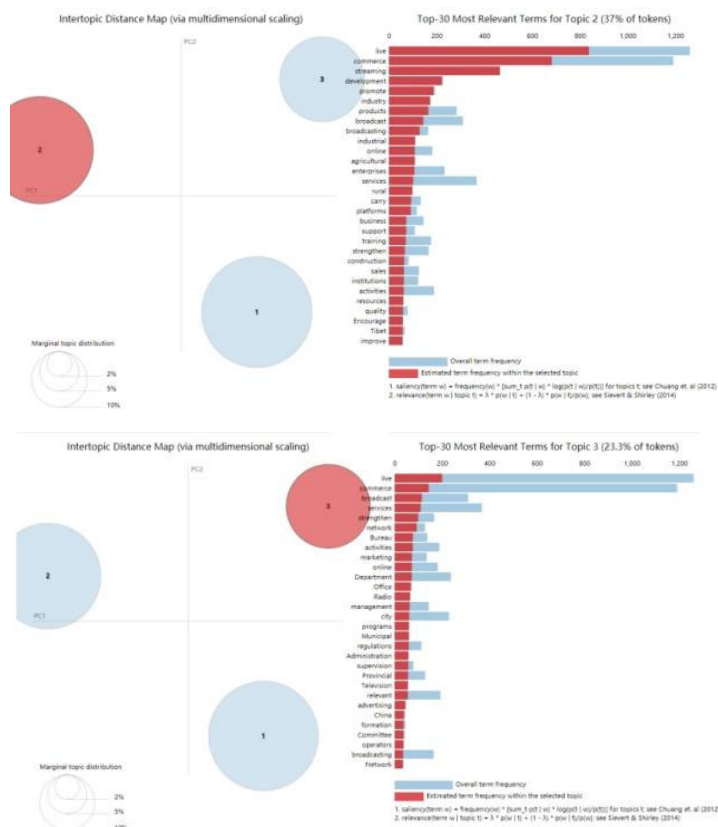


Figure 5. Top-30 most relevant terms for 3 topics

At the same time, a word cloud is created based on the frequency of the topic feature words appearing in the entire text, as shown below:



Figure 6. Word cloud

It can be found that words such as “live”, “commerce”, “city”, “department” and “services” are leading, which is in line with policy formulation laws. Moreover, “promote”, “product”, “development” and “agricultural” shows the purpose of e-commerce live streaming is to promote common progress in economic, agricultural, and other fields through this method, thereby promoting national development.

4.3 Semantic social network analysis of LDA topics

Based on the results of word segmentation in data processing, the paper select the top twenty keywords with the highest frequency of occurrence, and calculate the keyword co-occurrence matrix.

According to the matrix, we then draw the following co-occurrence network relationship diagram shown as below. The more connections between keywords, the closer they become, indicating a higher frequency of co-occurrence.

From the figure, we know that:

The co-occurrence network diagram covers the main keywords of three themes; The high density and complexity of the connecting line segments between each node indicates that the feature words of each topic are frequently shared in various policy texts.

Above two points indicate that the LDA model comprehensively reflects the common themes of various policy texts, and now local policies related to e-commerce live streaming can provide strong visual evidence for the robustness and reliability of LDA model results.

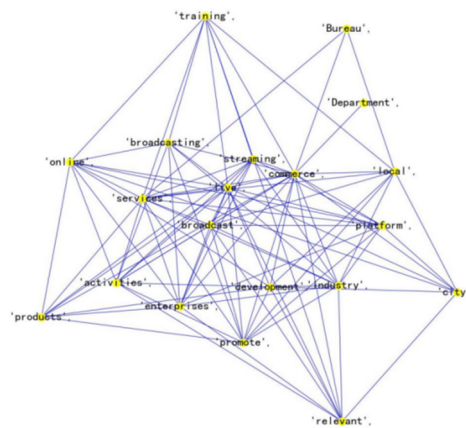


Figure 7. Co-occurrence network between the Top-20 frequent words

As can be seen from the above figure, firstly, the emergence of "local" and "city" shows that there is a lack of relevant policy guidelines for cross-regional cooperation and even transnational business of live broadcasting e-commerce, and most of them are still focusing on the development of local characteristics of live broadcasting e-commerce to stimulate local economic development; at the same time, the high degree of complexity of the intensive connection between "enterprise" and "industry" indicates that live e-commerce is closely related to the relevant offline platform enterprises, and the development of the "online attraction" and "physical consumption" is a key factor in the development of live e-commerce. + entity consumption" new model, expand C2M business, relying on offline platform resources to improve the conversion rate of live e-commerce; "Bureau" "Department" is not a large number of co-occurring, reflecting policy The small number of "Bureau" and "Department" reflects an imbalance in the proportion of tools used, pending the intervention of "flexible governance". The use of non-coercive market tools to stimulate the autonomy, initiative and motivation of the main players in the digital economy once again provides evidence to support the results of the above LDA model analysis.

4.4 Results of LDA Topic Model

Based on Rothwld and Zegveldt's theory of policy instruments, combined with the results of the LDA model, word cloud diagrams and 54 original policy texts, this paper comes up with the following analyses to contour the policy focuses and policy paths of provincial live e-commerce policies.

4.4.1 Policy content themes cover all areas of society

The LDA analysis reveals key themes in current provincial live e-commerce policies. First, there's a drive to digitally transform industries like industry, agriculture, and services, enhancing production and marketing across all facets, thereby enriching the region's live ecosystem. This fosters "people-goods-field" synergy, boosting traditional sectors, and elevating economic transformation. Second, enhancing the live e-commerce market system's design and processes is a priority. An industry think

tank will publish reports, advancing regional and live e-commerce coordination. Third, diverse social fields linked to live e-commerce demand tailored approaches. Fourth, digital government initiatives elevate governance standards, aligning with evolving public expectations. Fifth, businesses and service groups drive live e-commerce growth. Policies center on businesses, with the government fostering collaborations, incubating branded products, and nurturing local markets to generate growth.

4.4.2 Improving the regulatory system and avoiding marketing risks become policy hotspots

In order to regulate live e-commerce marketing activities, protect the legitimate rights and interests of consumers, maintain fair competition in the market order, and promote the healthy development of live e-commerce activities, government departments in different provinces and cities coincidentally promulgated relevant management and regulatory measures, which regulate the subject compliance of live marketing platforms, operators within the platforms, operators of live broadcasting booths, hosts, and hosting service providers; and consumers pay attention to the screening of the relevant subject Qualification and marketing may be hidden in the sales of misleading and other risk tips; from the perspective of adhering to the correct orientation, prohibit malicious marketing, to ensure fair competition, shall not be false propaganda, regulate the release of advertisements, express price, regulate the promotional activities, protection of intellectual property rights, the protection of minors and the elderly, to protect the consumers' right to know and right to choose, the disposal of disputes, damages and other perspectives on the live broadcasting e-commerce industry to make the norms.

4.4.3 Absence of demand-type policy tools, imbalance in the proportion of policy tool use

From the artificial matching of the results of each theme to the main use of the type of policy tools, the policy tool selection of the current provincial live e-commerce policy is mainly based on the supply-type and environment-type policy tools, while the demand-type policy tools are relatively less used, and there is a certain degree of imbalance in the proportion of the use of policy tools. China's current live e-commerce is not dependent on the government to lead, the relevant policy started late, the complete policy system has not yet formed.

5. Suggestions

5.1 Model Improve the system of policy tools and adjust and optimize the structure of policy tools

Firstly, the formulation of China's live e-commerce development policy involves multiple government departments. [18] A centralized management body should be identified, and a coordinated mechanism established among these different departments. Simultaneously, specific regulations should be introduced to promote the development of live streaming e-commerce. Policy tools need to be elevated to the legal level to enhance their implementation effectiveness. Recognizing the irreplaceable roles of industry associations and relevant enterprises in the development of live e-commerce, it is necessary to gradually establish an industry management system that facilitates information sharing and mutually beneficial outcomes among various stakeholders. This system should fully harness the motivating power of policy tools, stimulate the proactive engagement of enterprises and related service industries in technological innovation. Consequently, refining the development policy tool system for live e-commerce should progress from strategic planning, legal frameworks, to industry management.

Secondly, it is imperative to establish a logically structured comprehensive system for the coordinated utilization of policy tools, aiming to form an efficient and optimal policy framework. Firstly, appropriate reductions in the intensity of supply-driven policy tools, accompanied by internal structural optimizations, should be pursued. Emphasis should be placed on enhancing the utilization of tools such as talent development. Clear policy orientations and requirements for talent cultivation must be defined, along with the establishment of supporting mechanisms to provide intellectual and

human resources for the advancement of live e-commerce. Secondly, a judicious increase in the frequency of environment-oriented policy tools is recommended. This involves broadening the policy pathways for societal resource participation in the live e-commerce market. Encouragement of the live streaming industry to establish a robust system of self-regulation is crucial, fostering a conducive environment for healthy development. Thirdly, elevating the proportion of demand-driven policy tools is vital. Collaborative efforts and trade interactions should be leveraged to induce market-driven effects on live e-commerce. A combination of corresponding policy tools should be deployed to regulate market demand, ensuring stability and highlighting the role of demand-driven policy tools in driving and stabilizing live e-commerce development.

Secondly, we should establish a comprehensive use system of policy tools with reasonable structure to form effective and optimal policies. According to the policy objectives, the selection of policy tools should be holistic, systematic and coordinated, give full play to the direct promotion and indirect guidance role of supply and environmental policy tools, and the pull role of demand policy tools, establish a balanced framework among the three, and realize the synergistic effect between different policy tools. First, appropriately reduce the intensity of the use of supply-oriented policy tools and optimize its internal structure, focus on increasing the use of tools such as talent training, clarify the policy orientation and needs of talent training, establish a supporting mechanism for professional talent training, and provide intellectual and talent support for the development of live streaming e-commerce. The second is to reasonably increase the frequency of use of environment-based policy tools, broaden the policy path for social resources to participate in the live streaming e-commerce market, encourage the live streaming industry to establish and improve the industry self-discipline system, promote the construction of scientific and technological financial intermediary service system, scientific and technological enterprise credit evaluation and investment and financing mechanism, and create a good environment conducive to healthy development. The third is to increase the proportion of demand-oriented policy tools, through cooperation and trade to play the market's pulling effect on live streaming e-commerce, and the corresponding combination of policy tools to adjust market demand, ensure market stability, highlighting the demand-oriented policy tools on the development of science and technology and financial development of the driving and stabilizing role.

5.2 Strengthen policy analysis and promote the benign coupling of policy objectives, implementation and system

First of all, the principle of "data-driven decision-making" should be followed, and data and statistical information should be fully utilized in the policy making process to conduct in-depth analysis of the status quo, trends and potential problems of the live streaming e-commerce industry. Through data support, industry demand and development bottlenecks can be more accurately understood, which is conducive to the formulation of scientific and reasonable policies. At the same time, policy makers should fully communicate with live e-commerce industry representatives, experts, scholars, entrepreneurs and other aspects to listen to the opinions and suggestions of all parties. Establish a coordination mechanism for policy formulation to ensure policy consistency and stability. Finally, it is necessary to strengthen the training and publicity of the policy, encourage relevant innovation and pilot, copy and promote successful pilot cases, summarize the experience of unsuccessful ones, and constantly improve the content formulation.

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