Article

Analysis of the Public Opinion Evolution on the Normative Policies for the Live Streaming E-Commerce Industry Based on Online Comment Mining under COVID-19 Epidemic in China

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Abstract: Recent years have witnessed the intensive development of live streaming E-commerce, an emerging business mode. Although it contributes to economic growth, various forms of chaos show up and disturbs the market order. Therefore, from 1 July 2020, the official release of the first domestic document on live streaming E-commerce, *the Code of Conduct for Online Live Streaming Marketing*, to the end of the first half of 2021, China has witnessed so intensive release of relevant policies that are rare over the past years. Introducing these policies will inevitably attract the general public's attention and discussions. Based on online comments, this paper uses the LDA models to extract topics from online comments related to live streaming E-commerce and identifies sentiment polarity and sentiment intensity by the analysis models of different emotion dictionaries to study policy implementation effects and the main topics of concern before and after the policy implementation. The analysis results show that people between the age of 20 and 40 attach more importance to the implementation of the normative policy for live streaming E-commerce. Women, the main force of live streaming users, are less enthusiastic about the policy implementation than men. Moreover, the analysis results of the LDA models and online HDP (online hierarchical Dirichlet process) models demonstrate that the most discussed topics are the contribution of live streaming E-commerce to traditional economic transformation, public welfare activities, resumption of work and production, and poverty alleviation, as well as fraud, counterfeit goods, supervision, rights protection and other incidents in this industry. Overall, the majority of the public holds a positive attitude towards the policy implementation. After further analysis of comments under the relevant topics, it is found that compared with the first two policies released on 1 July and 5 November in 2020, although the proportion of netizens with positive emotions during the implementation of the follow-up policy has increased, the increment is not significant, indicating that the implementation of the new normative policy in a short term will hardly curb the occurrence of industry chaos. In turn, the governments should transfer their attention to actual regulatory problems, and intensify efforts to implement normative policies.

Keywords: online comments; live streaming E-Commerce; LDA models; sentiment analysis; public opinion evolution

MSC: 62P25

1. Introduction

Live streaming E-commerce is a new manner of commodity sales, integrating merchants, online celebrities, and consumers. It combines live streaming with E-commerce and connects people, goods, places, and other elements, forming a new model of "E-commerce + live

streaming". Based on mature, stable, and efficient mobile Internet, mobile payment, advanced intelligent technology, and modern logistics system, it attracts younger users, expands the size of consumers, and enhances interactivity.

In particular, the current COVID-19 pandemic has affected most parts of the world, bringing unprecedented challenges to the economy. Research by Wu et al. [1] showed that the COVID-19 epidemic had caused significant economic losses in the manufacturing industry, transportation industry, service industry, import and export trade, etc. It can be seen that the epidemic has had a significant impact on residents' travel and social output. Therefore, live streaming E-commerce, as a new consumption mode, is gaining more and more attention with the advantages of online social commerce. Qing and Jin [2] proposed that the COVID-19 pandemic had affected all aspects of retail, but the rapid development of live streaming E-commerce, as a new consumer model in the residential and non-contact economies, has not only quickly met the market demand in the context of the current epidemic but also further promoted the development and innovation of online businesses. It can be seen that the outbreak of the COVID-19 epidemic in late 2019 has objectively accelerated the upsurge of online consumption. Coupled with the government's advocacy for stimulating consumer demand, live streaming E-commerce has become an important means for solving material supply and people's daily necessities. Its purpose and inherited nature have also extended from the sharing and entertainment to new fields such as product sales, cultural tourism promotion, poverty alleviation, and agricultural assistance. The current live streaming mode has been upgraded from "E-commerce + live streaming" to "Internet celebrity + star + official + E-commerce + live streaming", forming "government-led, E-commerce-centered, social assistance, fan consumption, and economic development". It is undeniable that live streaming advances economic development, expands domestic demand, and contributes to poverty alleviation and employment. However, there are still a lot of problems and risks. Huang and Wu [3] show that many problems, such as false publicity, data falsification, counterfeit and inferior products, and lack of after-sales service, occur frequently in the live streaming E-commerce, and the industry norms and regulatory system need to be improved. Xia and Song [4] also showed that although, under the special background of the post-epidemic situation, the popularity and acceptance of the new retail mode of "live streaming E-commerce" had been greatly improved, and the platform economy has been given new vitality, the illegal chaos and improper supervision hidden in the industry cannot be ignored. Therefore, for the healthy development of the industry, various national departments have issued normative policies in succession, such as *the Code of Conduct for Online Live Streaming Marketing*, *Guiding Opinions of the State Administration for Market Regulation on Strengthening the Supervision of Online Live Streaming Marketing Activities*, and other policies issued by the State Administration for Market Regulation. All of them are used to protect consumers' rights and interests while stimulating economic recovery and regulating the live streaming E-commerce industry.

Compared with traditional industries, live streaming E-commerce features a low entry threshold, wide participation scope, and huge influence. Today, as Internet technology is becoming more and more mature, live streaming E-commerce significantly impacts social and economic structures. With the improvement of the professionalization of hosts and the surge in the number of participants, the industry's problems have become increasingly prominent, seriously affecting consumers' interests, and even threatening the future development of live streaming E-commerce. Therefore, the public's call for its governance and regulation has become stronger and stronger. Based on this, introducing these normative policies will inevitably attract great attention from the public, who will express their opinions on the effects of these policies from various perspectives. Promptly discussing the public's attitudes before and after the policy implementation and studying the voice of the public can effectively analyze the policy implementation effect, reduce potential risks in the development of the live streaming E-commerce industry, and lay down a solid foundation for regulating the live streaming E-commerce. Moreover, online social networking platforms have huge advantages in terms of scope and speed of information dissemination, so

they can better obtain public opinion and use adopted data mining and natural language processing technology to explore public opinion from multiple dimensions and provides a theoretical basis for the implementation of the policy and the development of the industry. Chakraborty and Sharma [5] proposed that Weibo, a service called Twitter, has become a popular platform for people to express their opinions on different issues and that analyzing tweets discussing government policies can help to understand the public's views on different government decisions. Zhou et al. [6] used the public's decision on the country to build large infrastructure to analyze the degree of public support and the implementation effect of government policies.

Meanwhile, Guo et al. [7] proposed that live streaming E-commerce has become an important driver of global trade, but limited attention has been paid to this area. Sun et al. [8] also pointed out that although people were increasingly interested in live streaming E-commerce, relevant research is still limited, and scholars mainly analyze the development of the live streaming E-commerce industry based on the behavioral intentions of consumers. It can be seen that at present, there are relatively few studies on the implementation effect of the live streaming E-commerce policies both in domestic and international research, let alone analyzing the implementation effect of policies in this industry by using online comments. Based on this, this paper collects Sina Weibo data, integrates it with topic modeling and sentiment analysis methods, explores the evolution of online public opinion before and after the policy implementation, analyzes the public's attitude and attention to these normative policies, and studies the social effects of various policy implementations.

The structure of the paper is organized as follows: Section 2 is a literature review. Section 3 is the collection and processing of data related to the live streaming E-commerce industry. Section 4 uses online comment data to analyze the changes in public attention before and after the policy implementation based on the LDA models and online HDP models. Section 5 uses three emotional dictionaries to construct different sentiment analysis models respectively, conducts sentiment analysis on the collected comment data, explores the changes in public sentiment before and after the policy implementation, and studies their satisfaction with the policy implementation. Section 6 is the summary of the full text and the prospect of future work.

2. Literature Review

At present, the live streaming E-commerce industry is at a stage of rapid development, playing a practical and effective role in economic revitalization, poverty alleviation, and expanding employment. However, during the booming development, the problems and drawbacks, such as soaring complaints, poor quality, fraudulent advertising, and non-standard supervision, are prominent. Based on this, the Chinese government successively issued a series of policy documents aimed at regulating the live streaming E-commerce industry, providing a legal basis for managing its chaos. This section analyzes the literature from the perspectives of live streaming E-commerce policies and online public opinion.

(1)   Live streaming E-commerce policy

At present, the analysis of the policy implementation effects is mostly concentrated in the fields of medical and health care, environmental protection, and industrial manufacturing. Courtney and Lorie [9] explored the policies of Canadian nursing regulatory bodies and associations on nursing practice specific to environmental health. Through publicly available position statements and competency documents regarding health and the environment coded inductively and thematically analyzed, their study found a gap between nursing policies and competencies directing nursing action related to the health of the environment across Canada. Yuan et al. [10] performed a thematic framework and content analysis to analyze the related policies about disease control and prevention systems in China from 2000 to 2020 based on the theory of policy instruments. The results showed that in the policy formulation process, the government should strengthen the comprehensive application of multiple policy instruments, particularly about the inducement instrument and symbolic and hortatory instrument, for stimulating internal motivation. Albulescu et al. [11]

used a quantile fixed-effect panel data approach and OECD (Organization for Economic Co-operation and Development) data to investigate how environmental policy stringency affects CO2 emissions in a set of 32 countries from 1990 to 2015. Results showed that an increase in policy stringency had a negative impact on emissions and that environmental stringency had a more powerful impact in countries with lower levels of carbon emissions. Based on city-level panel data from China, Liu et al. [12] applied a difference-in-difference (DID) model and a bootstrap panel Granger causality test to investigate the relationship between two types of environmental regulations and industrial growth. Their results showed the following: (1) Command-and-control environmental regulation (CAC) had a significant inhibitory effect on industrial growth. (2) In most regions, there was no significant Granger causality between market-based incentive environmental regulation (MBI) and industrial growth. (3) Compared with CAC, MBI allowed more flexibility for enterprises, which was more beneficial for technological innovation. Wang [13] used social network analysis, content analysis, and other methods to explore the sustainable evolution law of China's cloud manufacturing policies from the perspectives of policy issuing departments, policy focus topics, and policy tools. The results illustrated that the evolution of cloud manufacturing policies showed obvious stage characteristics, i.e., it mainly went through three stages of "encouraging development-top level design-implementation guidance". Meanwhile, China's cloud manufacturing industry was still in the development stage, and it was urgent to introduce policies that directly affected the industry. Zheng et al. [14] estimated the treatment effects of the differential electricity pricing (DEP) policy through the method of propensity score matching and difference in differences (PSM-DID). The results indicated a significant negative effect of the DEP on the TFP of energy-intensive industries shortly after the DEPs implementation. Moreover, the role of the DEP policy played a transition from increasing costs to stimulating technology improvement for energy-intensive industries. Based on the PASS approach (P: prepare-protect-provide; A: avoid-adjust; S: shift-share; S: substitute-stop), Zhang et al. [15] classified the 418 COVID-19 policy measures issued by Australia, Canada, Japan, and New Zealand in 2020 and developed a dynamic Bayesian multilevel generalized structural equation model to represent dynamic cause-effect relationships between policymaking, its influencing factors, and its consequences. The results showed that "Prepare-protect-provide" policy measures had dominated in practice; about 40% of all 418 measures could be judged as effective, and the UK showed the best performance, followed by Japan and Australia.

However, there are very limited studies on the effects of its policy implementation in the live streaming E-commerce industry. Scholars mostly analyze various factors affecting the development of the industry from the perspectives of sales strategies and consumer behavioral intentions and propose relevant policy suggestions accordingly. From the seller's perspective, Assarut et al. [16] used a mixed quantitative and qualitative approach to analyze Facebook data of live streaming sellers to assess the nature and extent of engagement metrics, and delineated the dynamic, interactive live streaming sales process. Finally, they identified four sales approaches and twelve strategies adopted in acquiring and retaining customers and provided a framework for the government and various live streaming platforms to understand the relationship mechanism in live streaming commerce. Niuet al. [17] found that Machiavellianism was positively associated with gift-giving in live video streaming through the mediating role of desire for control; the mediating effect of desire for control was moderated by materialism, with this relation being stronger for individuals with a higher level of materialism. According to the characteristics of network live broadcast and agricultural products, Chen et al. [18] used the means of case analysis and questionnaire survey to analyze the policy of live broadcast with goods to help agriculture and found that the main problems under the current policy were the imperfect service guarantee system and the lack of specialization of anchors. Zhang et al. [19] applied the grounded theory method to analyze semi-structured interviews of 96 consumers, identified the eight characteristics of E-commerce live streaming anchors (expertise, attractiveness, credibility, interactivity, popularity, price support, affinity, and responsiveness), and further classified

them into four roles (opinion leader, spokesperson, interactive friend, and salesperson), providing a clear framework for the management and training of anchors. At the same time, many scholars have noticed that the hidden risks in the industry are constantly eroding the trust of consumers and overdrawing the future potential of the industry. Therefore, they use this as a breakthrough to provide a theoretical basis for the improvement of industry policies. Lu and Chen [20] examined how live streaming affected consumers' purchase intentions (PI) by considering product uncertainty reduction and trust cultivation between consumers and broadcasters. Based on a structured survey data set and an unstructured interview data set from live streaming commerce users in China, they used structural equation modeling as well as qualitative analyses to verify the research model. The results showed that there were significant impacts of product fit uncertainty, product quality uncertainty, and trust on PI, and trust was more important compared with product fit and quality uncertainty in affecting PI. Guo et al. [21] examined how the affordance of live streaming affected consumer behavior in the cross-border E-commerce context based on the information transparency perspective. Results showed that although live streaming did not directly affect consumers' cross-border purchase intentions, it could increase consumers' purchase intentions through increasing perceived information transparency. Wang and Lin [22] adopted a multiple-case grounded methodology to build a theoretical framework for helping live streaming E-commerce to "resist evil and follow good" through analyzing the comments of the 12 live streaming E-commerce "roll over" events, in order to provide a theoretical basis for standardizing the behavior of live streaming E-commerce.

In addition, according to the above literature analysis, it is not difficult to find that most scholars' research on policy is mostly based on policy tools, text content, questionnaire analysis, and data analysis of relevant influencing factors, but rarely analyzes the policy implementation effect through data mining of online comments. The chaos in this industry has seriously affected the vital interests of consumers. Therefore, the normative policies issued by relevant departments have quickly attracted the attention of the public, and a large number of live streaming E-commerce users have shared personal experiences with the policies on online social media platforms. Based on this, analyzing the attitudes and emotional tendencies of the public in the process of implementing these normative policies through network public opinion can effectively analyze the policy implementation effects.

(2)   Online public opinion on social hot events

At present, the analysis of public opinion on social hot events generally starts with public opinion surveys based on questionnaires and interviews, and then uses traditional qualitative and quantitative methods to analyze the data. For example, Jony et al. [23] analyzed predictors of control measures and psychosocial problems associated with COVID-19 pandemic through questionnaires. Their findings suggest that health authorities must promote health education and implement related policies to disseminate COVID-19awareness that can prevent and control the spread of COVID-19 infection. James [24] argued that a survey poll was more likely a way of representing a small group of individuals' viewpoints rather than public opinion or social opinion. Bian et al. [25] thought that since the survey polls were conducted in a private environment and due to the time required for and high capital costs involved in data collection for survey polls, data quantity was usually limited, restricting the openness of public opinion and the representativeness of the findings to a large extent. Fortunately, with the popularity of the Internet, social media platforms have provided a new way of expressing and measuring public opinion, namely, online opinion. This new form of the opinion-gathering method increases the size of the datasets obtained, enables sample diversity, reduces the associated costs, and speeds up data collection. Ceron and Negri [26] believed that online public opinion could provide decision makers with meaningful information, and it provided a cheap and efficient way to monitor and evaluate public opinion. Over the past few decades, social media-based network opinion analysis has been applied in various fields, including social sciences, politics, education, and medicine. Zheng and Tuo [27] found that Weibo had become the most popular channel for political discussions in China as almost all government agencies at the local, regional,

and central levels had opened official Weibo accounts. This unique characteristic motivates scholars to use it to conduct public opinion analyses on Chinese issues. Liesbeth et al. [28] used data extracted from online (social) media to provide monitoring of prominent opinions on health policy among the public at certain times and helped public health institutes immediately respond appropriately to these public concerns.

In recent years, scholars have proposed many methods for online public opinion analysis. Dong and Lian [29] thought that the temporal and spatial distribution analysis, sentiment analysis, and viewpoint analysis were the three most commonly applied approaches in previous studies. Lozano et al. [30] developed a distributed geo-aware streaming latent Dirichlet allocation model and used it for automatic discovery and geographical tracking of election topics during parts of the 2016 American presidential primary elections. Their results showed that the online discussion topics' locations correlated with the actual election locations and that the model provided a better geo location classification approach. Taking the Three Gorges project (TGP) as a case study, Jiang et al. [31] proposed a project sentiment analysis (PSA) system using a lexicon-based method. This system collected user opinions from social networking sites, established emotion dictionaries, and built basic rules that calculated those sentiment values embodied in a collection of messages. Their results showed that about half of the collected messages expressed negative emotions towards the TGP, while the other messages were positive or neutral. Jiang et al. [32] combined sentiment analysis and topic modeling, and spatiotemporal analysis to establish a systematic framework for the assessment of large infrastructure projects and transformed unstructured online public opinions on large infrastructure projects into sentimental and topical indicators. Their results showed that sentiment polarity and major topics of public opinion were strongly associated with the spatiotemporal distribution. Barachi et al. [33] constructed a two-way LSTM (long short-term memory) network model containing online latent semantic indexes with regularization constraints to extract multiple emotions from a large number of online posts about climate change. In addition, their findings of the study indicated that chosen topics, cultural sensitivities, and posting frequency all played critical roles in public reactions to the posts and the subsequent perspectives they adopted.

To sum up, with the popularity of live streaming E-commerce blossoming in the country, most scholars have explored the factors affecting the development of the industry as well as the chaos in related industries and then proposed many policy suggestions based on analysis. However, there is very limited analysis of online public opinion on policies. Using large text corpora obtained from social media platforms to analyze public opinion can more effectively capture the attention and emotional tendencies of the public. Based on this, this paper takes Weibo as the online comment data collection platform, uses the LDA and online HDP models to extract topics, identifies sentiment polarity and sentiment intensity values based on the analysis models of different emotion dictionaries, explores the changes in public attention before and after the policy implementation, and analyzes the policy implementation effect, providing a pivotal basis for optimizing the normative policy of live streaming E-commerce.

3. Research Framework and Methods

The public may have different concerns and emotional tendencies during the implementation of the normative policies in the live streaming E-commerce industry. Therefore, this paper analyzes the changes in public opinion during this period from these two perspectives and studies the implementation effects of the normative policies. The research consists of the following three parts: data collection, data preprocessing, and data analysis.

Firstly, this paper analyzes the current situation of the live streaming E-commerce industry and the most important policy texts in the industry and finds out the biggest existing problems in the industry and the planning of government policy schemes. Secondly, the collection scope of online comments is determined by analyzing the content of policies, and the comment data from 1 January 2020 to 31 August 2021 is crawled from Sina Weibo by Python crawler technology based on the implementation time of the policy, and the data

preprocessing is carried out after the statistical analysis of the attention intensity difference of comments. Third, taking 1 July 2020 as the time node, when the first live streaming E-commerce industry normative policy, *the Code of Conduct for Online Live Streaming Marketing*, was implemented, the timeline was divided into the time window before and the time window after the implementation of this policy, and the released dates of subsequent normative policies are added on this basis (5 November 2020, 9 February, 1 May, and 25 May 2021) to analyze comments. Fourthly, the topic extraction model and sentiment analysis model are adopted to study the changes in online public opinion before and after the policy implementation and to explore the implementation effect of the normative policies for the live streaming E-commerce industry as follows: In order to analyze the development trend of public opinion on the live streaming E-commerce standard policy, it is necessary to identify the focus of public attention during this period. In this paper, the LDA model is used to extract topics from online comment data, and the results of the online HDP model are compared and supplemented to identify potential topics, analyze possible problems in policy implementation, and ensure the effective implementation of policies. Additionally, by mining users' views and analyzing users' emotional tendencies, we can deeply understand users' attitudes and emotions towards events. This paper analyzes the emotional changes before and after the implementation of the industry standard policies, studies the public's attitude and tendency toward these policies, and provides suggestions for how the government can guide the development of public opinion, so as to effectively guarantee the healthy development of the live streaming industry.

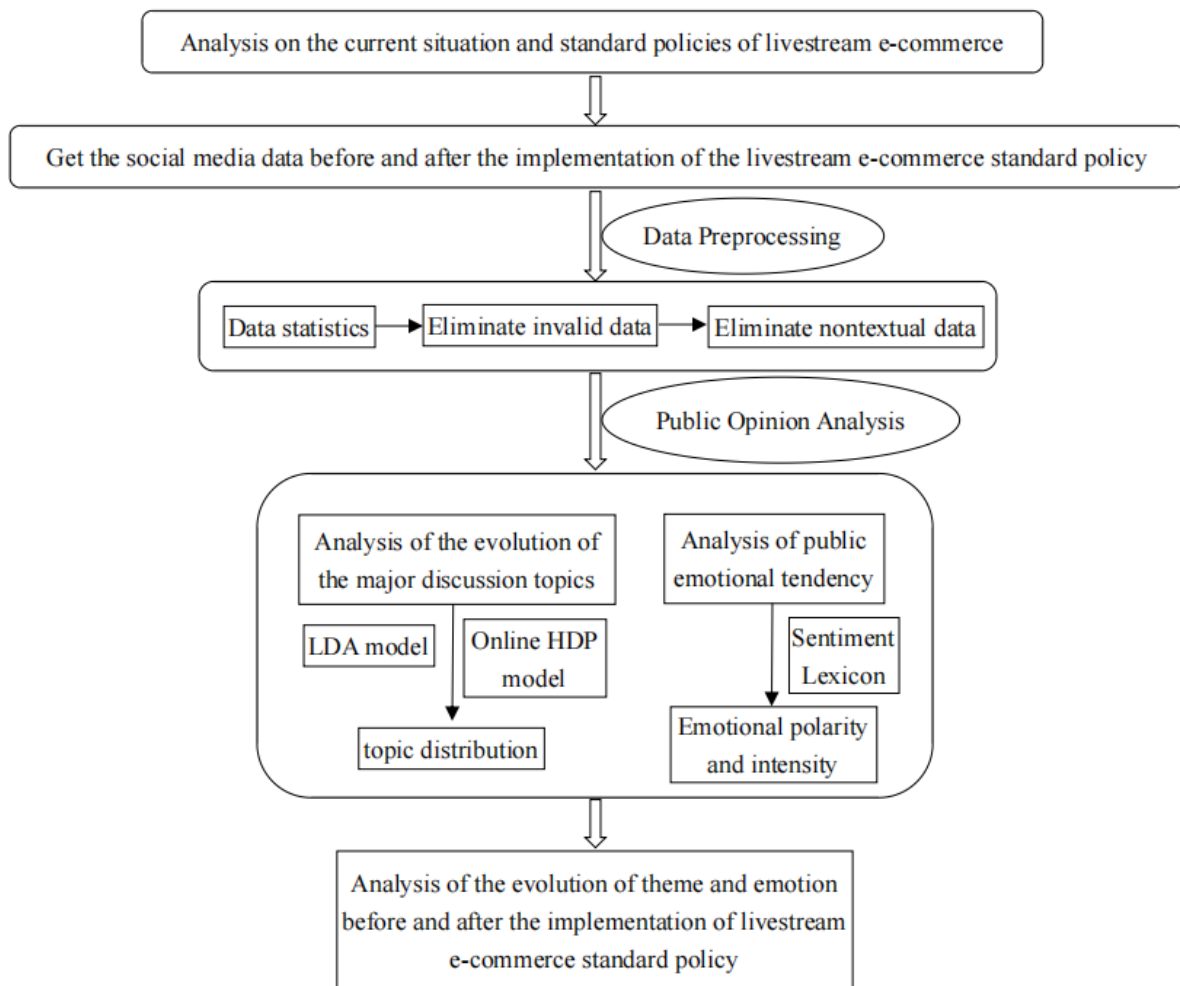The specific research framework is shown in Figure 1.

Figure 1. Research framework.

4. Materials Collection and Statistics

4.1. A Brief Analysis on the Current Live Streaming E-Commerce Industry

In recent years, as a new business model using live broadcast for close-range display, consultation, and providing shopping guides through the Internet platform, live streaming E-commerce has attracted the attention of many industries. According to data from the Ministry of Commerce of China, up to the end of 2020, a total of 8862 live streaming E-commerce-related enterprises in China had registered, an increase of 360.8% over the end of 2019. The number of hosts reached 1.234 million, an increase of 348.7%. The transaction volume of live streaming E-commerce was 1288.1 billion Yuan, with an annual growth rate of 197.0%. The penetration rates in the total retail sales of consumer goods and the online shopping retail markets were 3.2% and 10.6%. At the same time, the number of E-commerce live streaming users reached 388 million, accounting for nearly 40% of the total netizens, and nearly two-thirds of users purchased goods after the live streaming. It indicates that live streaming E-commerce has represented the mainstream trend of E-commerce development.

However, with the vigorous development of live streaming E-commerce, the under-performance problems contained in this extensive development are increasingly emerging. According to the data released by the State Administration for Market Regulation, in the first three quarters of 2020, the relevant complaints on live streaming received by 12,315 platforms expanded 479.60 percent year-on-year to 21,900, among which nearly 60% were complaints directly about live streaming E-commerce. The 2021 China Live Streaming E-commerce Industry Research Report also explains the following main reasons why consumers do not use live streaming E-commerce: worries about the quality of products, after-sales problems, remote shopping process, unsafe payment, and rights protection. Therefore, to ensure the healthy development of the live streaming E-commerce industry, the hidden safety hazards should not be overlooked.

At present, although laws and regulations such as the Advertising Law, the Consumer Rights Protection Law, the Interim Measures for the Administration of Internet Advertising, and the E-commerce Law implemented in 2019 describe the responsibilities and obligations of operators in online transactions, there are still many loopholes in the specific definition of responsibilities and the applicability of standards for various business entities in the live streaming E-commerce industry. Therefore, to protect the rights and interests of consumers and regulate this industry, relevant departments must pay great attention to this matter. On 1 July 2020, the first live streaming E-commerce normative policy *the Code of Conduct for Online Live Streaming Marketing* was released and implemented, and a series of policies were released to further supplement and improve. How much impact do these policies have on the development of live streaming E-commerce? Can it effectively solve various problems in the current industry? Can the public feel the changes brought about by the policy? The above issues attract the concerns of experts, scholars, and ordinary people.

4.2. Analysis on the Normative Policies for the Live Streaming E-Commerce Industry

Table 1 shows the normative policies for the live streaming E-commerce industry at the national level. It can be seen that from *the Code of Conduct for Online Live Streaming Marketing* to recent *Live Streaming Marketing Management Measures (Trial)*, the responsibility division, supervision and management, and protection of rights and interests become perfect, and the legal effect is continuously strengthened. This also stimulates local governments at all levels to issue many regional regulatory policies, such as *the Code of Conduct for Online Trading Platform Operators to Implement Legal Responsibilities* in Chongqing, *Regulations on Further Strengthening the Supervision of Online Live Streaming Marketing Activities* in Shanghai, *Plan for Optimizing the Business Environment, and Better Serving Market Entities* in Beijing. Based on this, this paper focuses on the changes in public opinion before and after the implementation of normative policies for the live streaming E-commerce industry.

Table 1. Relevant normative policies for the live streaming E-commerce industry.

Policy	Main Content	Implementation Time
The Code of Conduct for Online Live Streaming Marketing	Provide behavioral guidelines for entities such as merchants, hosts, platforms, live streaming service agencies, and users participating in marketing interactions engaged in live streaming activities, and clearly state that marketing entities shall not use fraudulent methods such as brushing orders and speculation to tamper with transaction data and user evaluations information; no false or misleading publicity to deceive or mislead consumers.	1 July 2020
Regulations on Further Strengthening the Supervision of Online Live Streaming Marketing Activities	Clarify the legal responsibilities and obligations of online platforms, commodity operators, and hosts in live streaming E-commerce, and require the investigation and punishment of eight common illegal acts in live streaming E-commerce, including product quality violations, advertising violations, and violations of consumers' legitimate rights and interests. It provides a legal basis for regulating law enforcement and promoting industry norms.	15 November 2020
Guiding Opinions on Strengthening the Standardized Management of Live Streaming	Strengthen the positive guidance and normative management of the online live streaming, standardize the value orientation and live streaming content, and further clearly stipulate the main responsibility of the platform, the legal responsibility of the host, the industry system, and other content, and urge the platform to implement rectification, intensify punishment, and increase enterprise trial mistake cost.	9 February 2021
The Measures for the Supervision and Administration of Online Transaction	Adhere to the principle of online and offline integrated supervision, and strengthen the combination of online transaction supervision and the protection of consumers' legitimate rights and interests. Clearly clarify provisions on key issues such as the registration of network operators, the supervision of new business formats, the responsibility of platform operators, consumer protection, and personal information protection, refine consumer rights protection measures, and intensify supervision over unfair competition.	1 May 2021
Live Streaming Marketing Management Measures (Trial)	Include all kinds of subjects and elements of online live streaming marketing into the scope of supervision, and clearly state that live streaming marketing platforms should establish and improve standardized systems such as account and marketing function registration and cancellation, information security management, marketing behavior norms, personal protection, consumer rights protection, personal information protection, network, and data security management.	25 May 2021

4.3. Data Collection

Sina Weibo is a popular networking platform integrating the functions of Twitter and Facebook. Comments here are open to the public, and real-name mobile phone numbers are required to log in, which better avoids the existence of Internet trolls. As such, this paper chooses Sina Weibo as the social media platform for collecting raw data. In addition, Leiner et al. [34] proposed that most social networking services, including Facebook, Sina Weibo, and Twitter, provide an available application programming interface (API), where keywords can be searched through the API. Therefore, based on Python crawler technology and API, the keywords are set as the words related to live streaming E-commerce and its specification policy. Table 2 shows the results of the two stages before and after the policy implementation. A total of 490,827 Weibo posts were obtained. In addition to Weibo and comments, related data such as Weibo ID, user gender, and release date were also captured and recorded into the data set.

Table 2. Number of comments on Sina Weibo.

Stage	Data	Weibo Posts
Before policy implementation	1 January 2020–30 June 2020	108,626
After policy implementation	1 July 2020–31 August 2021	382,201
Total	1 January 2020–31 August 2021	490,827

(1)   Differences in the intensity of attention before and after policy implementation

The public opinion period before the implementation of normative policies for the live streaming E-commerce industry is from 1 January 2020 to 31 June 2020, with a total of 108,626 relevant comments on Weibo. The public opinion period after the policy implementation is from 1 July 2020 to 31 August 2021, with a total of 382,201 relevant comments. With the commercialization of the 4G network, live streaming E-commerce is becoming a new battlefield for major brands to sell goods. Many industries and practitioners have begun to move online and seized new chances. Even officials have become Internet celebrities to boost the local economy. Especially under the impact affected by the epidemic, despite restricted travel and the frustrated real economy, the live streaming E-commerce industry broadens sales channels for all kinds of businesses and speeds up the resumption of work and production. As can be seen from the change in the number of online comments in Figure 2 since January 2020, the public's attention to live streaming E-commerce has been soaring.

Figure 2. Number of Weibo comments before and after policy implementation.

However, the rapid development witnessed a large number of problems, such as infringed rights and interests of consumers, sales of counterfeit goods, and shirking responsibilities. Therefore, the public eagerly calls for rectifying the live streaming E-commerce industry. The implementation of the first normative policy for the live streaming E-commerce industry on 1 July 2020, ignited a fierce debate among the public, which was in stark contrast to the number of comments before the policy implementation. Subsequently, to strengthen the supervision, on 5 November 2020, the *Guiding Opinions on Strengthening the Supervision of Online Live Streaming Marketing Activities* was released, which also attracted a lot of attention from the public. Afterward, to improve the normative policies for live streaming E-commerce, different normative policies were released on 9 February 2021, 1 May, and 25 May 2021. As can be seen from Figure 2, the number of Weibo comments fluctuated significantly before and after the implementation of these policies, especially in May 2021. Due to the continuous release of the two policies, the number of Weibo comments was the highest in all periods. In addition, it can be seen that the daily average number of comments after the policy's implementation is also higher than before the implementation. These phenomena show that the normative policies for live streaming E-commerce greatly impact the public, and the public pays great attention to the policies and has urgent expectations for regulating the live streaming E-commerce industry.

(2)   Differences in the audience before and after policy implementation

As can be seen from Figure 3a, in the comment data before and after the policy implementation, there is a significant change in the gender ratio. Before implementing the policy, 47.64% of the comment users were male and 52.36% were female. It is consistent with the conclusion that women are the main buyers in live streaming E-commerce in the *2020 Live Streaming E-commerce Industry Market Status and Development Trend Report* released by the China Business Industry Research Institute. However, after implementing the policy,

57.63% were male and 42.37% were female. This shows that despite weak consumption desires, male consumers grow slowly and raise their attention to live streaming during the development of live streaming E-commerce. In addition, they have more questions about various issues in this industry. In terms of age structure, the distribution of the two periods is relatively similar, basically concentrated between 20 and 40 years old, accounting for more than 70% of the total number of comments, as shown in Figure 3b. In fact, as the main force of social labor, young people are relatively more receptive to trendy shopping methods and have the economic strength to satisfy their consumption. At the same time, they are more responsive to various problems in this industry and better at using laws to protect their rights and interests. Therefore, an emerging industry can gain more economic benefits from catering to this group. Government can accurately grasp the problems arising in the development of the live streaming E-commerce industry and lay down a realistic foundation for optimizing the formulation of normative policies by adopting the opinions of this group.
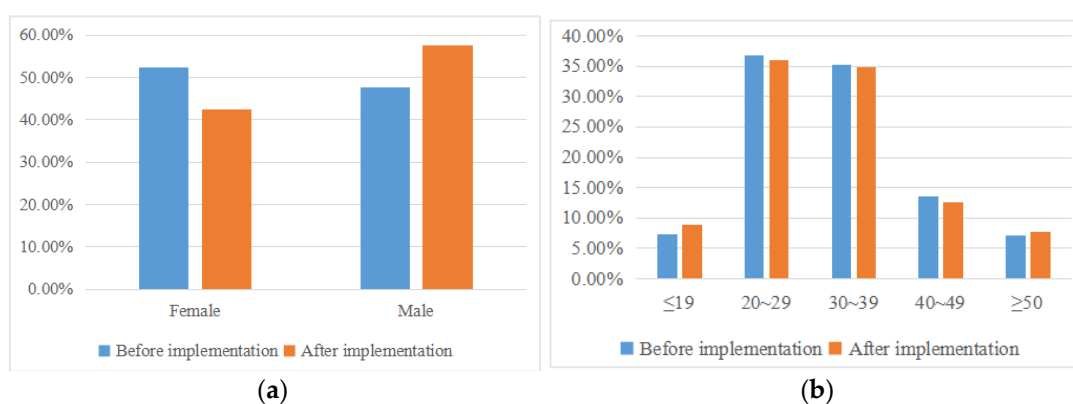

(**a**)   (**b**)

Figure 3. Change of audience before and after policy implementation. (**a**) Gender; (**b**) Age.

5. LDA Model Result: The Evolution of the Online Topics of the Normative Policies for the Live Streaming E-Commerce

To analyze the evolution of public opinion on the policy for regulating live streaming E-commerce, it is necessary to identify the attention of the public during this period. In order to accurately find out the potential topics of the public's online comments, this section comprehensively considers the analysis results of the LDA topic extraction model and online HDP model to identify the potential topics of comments, analyze the possible problems in policy implementation, and ensure the effective implementation of policies.

5.1. Data Preprocessing

Through the analysis of the raw data, it can be found that many users have made Weibo comments on the released live streaming E-commerce normative policy, reflecting the public's great interest. They express views or emotions by frequently commenting, liking, and forwarding the official Weibo. To accurately extract public opinion from these comments, data must be preprocessed before analysis. The specific process is as follows:

(1) Leave out invalid, duplicate, or incomplete data by filtering. For example, only "ha ha ha" and the other two or three words of meaningless comments, other website links, advertisements, illogical text disorderly code, and other comments are all invalid and incomplete texts.

(2) The forwarded Weibo usually shares the same viewpoint as the original Weibo. If the forwarded Weibo does not add any meaning, the original Weibo will be kept and the forwarded Weibo will be deleted to avoid duplication of data.

(3) Remove noise information. In Weibo, nicknames usually follow the @ symbol. If nicknames appear frequently, it will affect the results of topic extraction, and the emotional information contained in them will also affect the results of sentiment analysis.

(4) Exclude non-text data. The evolution of public opinion is analyzed from the perspective of textual information, while pictures, charts, animations, emojis, and other non-text elements are not considered.

Through the above processing, a total of 308,751 pre-processed data were finally verified and stored in the data set, among which 68,161 were before policy implementation and 240,590 were after implementation. This paper uses the Jieba Chinese word segmentation module in Python to segment each preprocessed dataset and remove the stop words in it to prepare it for the topic and sentiment analysis.

5.2. LDA Models

As a natural language processing (NLP) technique, topic modeling can be used for information retrieval and classification of large-scale documents or corpora. Asmussen and Moller [35] proposed that LDA models were not only the preferred method for topic modeling but also the most advanced tool for exploratory analysis of a particular subject with textual material. Blei's [36] research also proposed that the LDA topic modeling algorithms were the most convenient of the several possible generative models that can be used for topic modeling. Therefore, this paper also uses this model to conduct the topic extraction of the policy text.

5.2.1. Construction of LDA Models

Document modeling in the LDA model is Unigram Model believes that the generation process is constantly taking a document from a bag of words, that is, choosing a topic with a certain probability, and then with a certain probability to choose a word from the topic, and finally, in the case of known text words, through the probability method to derive the topic distribution of the text set, for the clustering of documents. Blei et al. [37] proposed that this method ignores the word order in the modeling process, which further simplifies the complexity of the model and is suitable for the modeling of massive text data with heterogeneous characteristics. The process of the LDA model is shown in Figure 4.
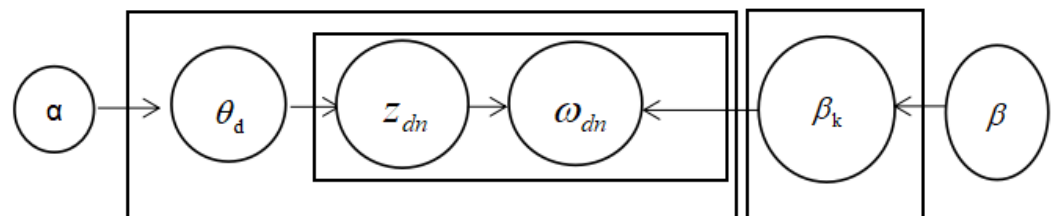

Figure 4. Best number of topics.

Where K is the number of topics, D is the number of documents, and N is the number of words. For the nth word of the dth document, the topic distribution θ_d corresponding to the document is first generated by the prior distribution (Dirichlet distribution) of the topic, and a topic Z_{dn} is extracted the refrom. According to the current topic Z_{dn}, the distribution β_k of the word is then generated from the prior distribution β (Dirichlet distribution) of the word, and a word ω_{dn} is extracted from the distribution. After N repetitions of previous steps, it will obtain a document with N words. The joint probability of LDA modeling is defined in Equation (1) as follows:

$$p(\theta, z, \omega | \alpha, \beta) = p(\theta | \alpha) \prod_{n-1}^{N} p(z_{d,n} | \theta_d) p(\omega_{dn} | z_{d,n}, \beta), \tag{1}$$

In this paper, the topic modeling is constructed by the related modules of the LDA models in Python and Java to analyze the changes in public attention before and after the policy implementation and to discuss the implementation effect of the policy.

5.2.2. Selecting the Best Number of Topics

Before building the LDA models, perplexity and coherence tests are necessary to determine the number of topics. The perplexity is a measurement of how well a probability distribution or probability model predicts a sample. A low perplexity indicates the probability distribution is good at predicting the sample. Coherence judges the semantic consistency of word statistics between different texts, which can solve the problem of model overfitting caused by perplexity. A higher coherence represents the topic model with a higher quality. The results of the best number of topics in the two-stage public opinion evolution process are shown in Figure 5 below.
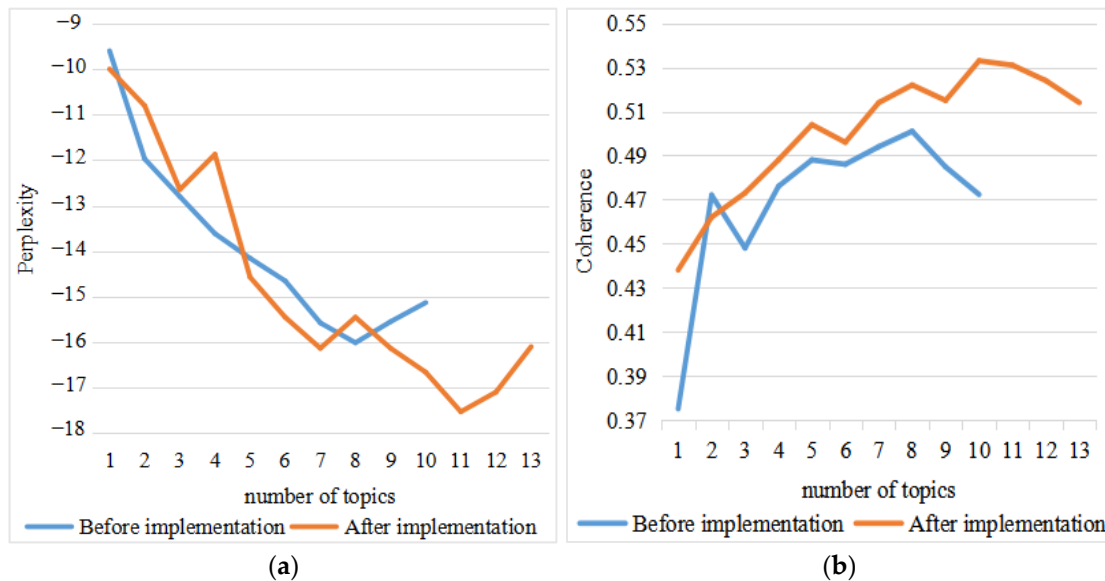

Figure 5. Best number of topics. (**a**) Perplexity; (**b**) Coherence.

Figure 5 shows the changes in the perplexity and coherence of LDA models under the different number of topics before and after policy implementation. Figure 5a,b shows that before the implementation, when the number of topics is 8, the perplexity score is the lowest and the coherence score is the highest, so the best number of topics for the LDA models at this stage is 8. After the implementation, when the number of topics is 11, the perplexity obtains the minimum value. When the number of topics is 10, the coherence score is the highest, but there is not much difference between the results when the number of topics is 11. Therefore, after comprehensive consideration, the minimum value of the LDA models after the implementation is set at 11.

5.3. Online HDP Models

Compared to standard LDA models, which require a manual search for the number of motifs, the HDP model can automatically infer the number of topics according to the document collection, which greatly increases the robustness of the algorithm. Tang et al. [38] proposed that for large data sets, users generally did not determine how many topics they contain. Therefore, the hierarchical Dirichlet process (HDP) was proposed after LDA by Blei [39] to enable the investigation of and representation of more complex corpus/data. The Wang and Al-Rubaie [40] study gave the following specific process of the HDP model: The HDP was a stochastic process that could be used to define a nonparametric distribution on an assortment of mixtures model; that is, each grouping of data was drawn from a mixture model, and the mixture components were shared among the different groups. Using a hierarchy of Dirichlet processes enables the number of mixture components to be inferred from the data.

However, Wang et al. [41] pointed out that one limitation of HDP analysis was that existing posterior inference algorithms require multiple passes through all the data as

follows: these algorithms are intractable for very large-scale applications. So, they proposed an online variational inference algorithm for the HDP—online HDP. Moreover, the HDP model module in the genshim package in Python software is built with this algorithm as its core, so in this paper, this module is used to build the model and enhance the identification of topics by comparing it with the results of the LDA model. Then, since the online HDP model is an unsupervised model, no number of topics was set before the construction, and the keywords within the different topics in the results output by Python are partially repeated or similar in meaning. Therefore, this paper selects the top 20 topics in the output results based on the keywords in the topic, ata rate of more than 60% of the topic as the same topic, and the keywords selected the top 15 keywords as the keyword content of the topic.

5.4. Result Analysis

After constructing the topic model before and after the policy implementation, the results are shown in Tables 3–5 as follows:

(1)　Topic models before policy implementation

Table 3. LDA models before policy implementation.

No.	Keywords	Proportion	Topic
1	consumption, economy, development, consumers, internet, digital services, sell goods, influencers, marketing, encouragement, E-commerce, network traffic, tradition, channels, new formats, celebrities	35.20%	Live streaming E-commerce drives the economy
2	live streaming E-commerce, development, internet celebrity, industry, base, economy, talent, building, leading host, MCN organization, innovation, Internet, cooperation, advantages, resources, training	15.92%	Local governments promote live streaming E-commerce
3	poverty alleviation, agricultural products, sales, slow-selling, live streaming E-commerce, farmers, rural revitalization, epidemic, helping farmers, poverty reduction, development, rural areas, employment, mayors, driving, leading cadres	12.57%	Contribute to poverty alleviation
4	live streaming E-commerce, online shopping, norms, anchor, live streaming, industry, consumption, standard, video, consumer, supervision, live streaming marketing, guarantee, implementation, service, platform	10.49%	Normative policies for live streaming E-commerce industry will be implemented
5	epidemic, online, offline, live broadcast, sales, store, enterprise, industry, channel, entity, retail, prevention and control, resumption of work and production, economy, recovery, market	10.44%	Contribute to resumption of work and production
6	Hubei, live streaming, bring the goods, public welfare, CCTV, Wuhan, help, come on, People's Daily, netizens, Li Jiaqi, group buying, special products, recovery, cooperation, activities	5.62%	Contribute to public welfare and economic recovery
7	Consumer, host, product, advertisement, platform, chaos, service, network, operator, false, sales, transaction, consumption, legal, rollover, internet celebrity	5.40%	Industry chaos
8	Activities, travel, products, tourists, life, consumption, hotels, food, shopping, publicity, holidays, recovery, online, intangible cultural heritage, Ctrip, rural	4.36%	Contribute to the transformation of all walks of life

Table 4. Example text under the LDA sequence topic before policy implementation.

No.	Example Text
1	In the wave of new economic development, even physical stores are catching up with this bus, making "live streaming + physical stores" the new consumption form that can bring goods most.
2	In order to further improve the development level of Yiwu's internet celebrity live streaming and actively cultivate new business forms and modes, Yiwu set about building an innovative base for internet celebrity live streaming E-commerce.

Table 4. *Cont.*

No.	Example Text
3	Live streaming E-commerce helps farmers "sell goods"! Guangzhou creates a new model of "live streaming E-commerce + poverty alleviation".
4	"live streaming E-commerce" exaggerates propaganda, falsifies data, and worries about quality. It needs to be further standardized!
5	Helping to resume work and production—1688 Chaozhou live streaming E-commerce Festival officially kicked off.
6	Make orders for Hubei, selling goods by live streaming E-commerce, and improve the strength.
7	Selling seconds at best quality prices, hanging up a sheep's head and sell dogmeat, and all kinds of fake goods are rampant. It should have been managed long ago.
8	Now traditional garment enterprises are actively transforming, opening up live streaming E-commerce, and expanding new retail channels.

Table 5. Online HDP models before policy implementation.

No.	Keywords	Topic
1	epidemic, enterprise, develop, activity, industry, live streaming, E-commerce, internet celebrity, economy, domain, sell, physical store, lead, network traffic, life, online	Live streaming E-commerce drives the economy
2	epidemic, agricultural products, agricultural products, sell, Hubei, public welfare, activity, help, network traffic, peasant, network, slow-selling, serve, economy, online	Live streaming E-commerce to help local public welfare
3	economy, develop, internet celebrity, digitalize, marketing, internet, new form of industry, trend, network traffic, hurricane, commerce, sell goods, internet celebrity economy, flexible employment, change	Live streaming E-commerce to promote new business forms of the Internet economy
4	marketing, examine, keep your eyes bright, compensate, swindler, entrap, business, false, seller, Taobao, false propaganda, law, rollover, anchors, joint responsibility	Industry chaos
5	safeguard rights, economy, China Consumers' Association, develop, market, chaos, protect, ensure, plaint, legal right, norm, tricks, enterprise, supervise, field	Consumer rights protection
6	industry, norm, internet, standard, service, operate, business, live streaming E-commerce, Integrity service system, implement, economy, protect legitimate rights and interests, advertising law, supervise, market	Normative policies for live streaming E-commerce industry will be implemented
7	market, supervision department, legal right, internet, supervise, litigation, advertising, safeguard rights, economy, protect, the State Administration for Market Regulation, severe attack, country, illegal act, illegal, fight against illegal	Government regulation

Tables 3 and 4 above are the LDA topic model results, and Table 5 is the online HDP model results, where the topic overview is obtained by the synthesis of the keywords within the topic and the comments under that topic. It can be seen that the content of the two topic models is basically the same, which both focus on the economic drive, poverty alleviation and public welfare, industry development, chaos, and standardization. Additionally, the LDA results are more detailed on the economic side, while the online HDP model complements the topic of industry chaos; for example, topics 5 and 7 in Table 5 identify consumer rights protection and a government crackdown on illegal activities.

From the results of the topic models before the implementation of the normative policies, and with the rise of the live streaming E-commerce industry, the public fully realizes the potential value of this industry. Especially during the epidemic and economic recovery, live streaming E-commerce experiences an explosive development, which broadens sales channels for all kinds of businesses, explores new living spaces, and accelerates the resumption of work and production. Mainstream media such as CCTV News also give full play to the role of social responsibilities, cooperate with major E-commerce and live streaming platforms, and create various online public welfare promotion activities on live streaming platforms to enrich economic vitality for areas seriously affected by the epidemic or underdeveloped economy and transportation. In addition, the "Internet + rural retail" mode

has become the main means of revitalizing the rural economy. Many village officials even personally participate in live streaming events for their agricultural products to contribute to poverty alleviation. In addition, local governments also issue a number of promotion measures for the live streaming E-commerce industry, such as the construction of Internet celebrity bases, the introduction of live streaming hosts, and host training, as discussed by the public in LDA models' Topic 2. However, grassroots celebrities, celebrity entrepreneurs, and local governments face problems, such as "roll over" events, exaggerated publicity, and false advertisements discussed in LDA models' topic 7. Moreover, the difficult problems of consumer rights protection are mined by topic 5 in the online HDP models.

Finally, according to the proportion of topics obtained by the LDA module in Python in Table 3, before the implementation of the normative policy for the live streaming E-commerce industry, the main topics discussed by netizens were related to the economic driving capacity of the industry. In topics 1, 2, 3, 5, and 6, topic 1 accounted for the highest proportion of discussions, up to 35.20%, which was related to the government's support for the live streaming E-commerce industry in the first half of 2020. However, topics 4 and 7 also accounted for 15.89% of the discussions on industry chaos and industry norms, indicating that the current industry norms have seriously affected people's consumption experiences and require government control. To analyze the public's discussion on the industry normative issues of live streaming E-commerce before the policy implementation, this paper further extracts the comment data under topics 4 and 7in Table 3. The results are shown in Table 6 below.

Table 6. Topic extraction of comment data under LDA models topics 4 and 7.

No.	Keywords
1	live streaming E-commerce, consumers, norms, industry, supervision, shopping, network, platform, economy, host, live streaming platform, standards, chaos, security, society, complaints
2	Sinba, Kuaishou, selling goods, live room, energy, bring the goods, rewarding, official, cheat, Internet celebrity, Fan Bingbing, fake goods, bottom line, hype, popularity, rectification
3	Live streaming, bring the goods, celebrities, roll over, netizens, Luo Yonghao, products, Li Jiaqi, host, sales, Internet celebrities, public, questioning, apology, sales, fakes
4	live streaming E-commerce, consumption, tricks, rights protection, network, video, shopping, difficult, rights protection public opinion, China Consumers Association, exposure, delivery, management, counterfeiting, 315, cheat
5	Internet celebrity, advertising, online celebrity marketing, product, platform, service, sales, information, host, legal, Internet celebrity host, shopping, business, publicity, operator, false
6	Live streaming, host, Taobao, data, business, Kuaishou, sell goods, live streaming platform, traffic, sales, audience, fraud, occupation, official, sales volume

From Table 6, it can be seen that the public calls for the release of normative policies. Before the policy implementation, the public was mainly concerned about supervision, Internet celebrity host behavior, counterfeit and shoddy products, rights protection, false publicity, and other issues. During this period, the live hosts, such as Simba, Luo Yonghao, Fan Bingbing, and other "roll over" events, generated animated discussions among the public. The chaos in the industry is gradually eroding the public's sense of trust, and the implementation of normative policies is imminent.

(2)   Topic models after policy implementation

From the results of the LDA models after the policy implementation in Tables 7 and 8, it can be seen that, compared with before the policy implementation, although there are also a lot of discussions on economic development, the proportion of topics related to normative policy has increased significantly, accounting for 42% of the total number of comments. It reflects that the introduction of government policies guides online public opinion.

Table 7. LDA models after policy implementation.

No.	Keywords	Proportion	Topic
1	development, enterprise, consumption, economy, service, upgrade, innovation, digitization, internet, market, mass, policy, occupation, society, employment, security, training	30.88%	Live streaming E-commerce contributes to economic transformation and upgrading
2	live streaming E-commerce, internet celebrities, live streaming, sales, public welfare, Wuhan, help, energy, bring the goods, donations, love, epidemic, online celebrity marketing, CCTV, Hongxing Erke, variety shows	8.19%	Live streaming E-commerce contributes to public welfare during the epidemic
3	Sinba, bird's nest, products, fake sale, Xinxuan, fakes, false publicity, apology, host, Wang Hai, roll over, netizens, sugar water, consumers, questioning, punishment	8.01%	Xinba was fined due to the sales of fake bird's nest
4	TikTok, products, E-commerce, marketing, platform, network traffic, operations, merchants, sales, channels, social networking, Taobao, Jingdong, Kuaishou, monetization, entrepreneurship	7.82%	Multi-platform development promotes live streaming E-commerce
5	live streaming E-commerce, regulation, behavior, data, counterfeiting, news, traffic, false publicity, brushing, exposure, speculation, dissemination, influence, merchants, rewards, chaos	7.56%	Standardize policies to standardize all kinds of data fraud problems
6	network, regulation, consumer, transaction, advertisement, market, norm, operator, rectification, responsibility, subject, consumption, State Administration for Market Regulation, information, false, illegal	7.22%	Normative policies contribute to regulation and management
7	fakes, merchants, stars, scams, overturns, cheap, hype, fake and shoddy, tricks, internet celebrities, interests, entrap, cheating, consumers, bottom line, report	6.81%	"Roll over" events of celebrities reflected chaos in live streaming E-commerce industry
8	Consumers, merchants, shopping, live streaming E-commerce, products, platforms, rights protection, complaints, advertising, responsibility, quality, information, service, legal, after-sales, China Consumers Association	6.78%	Rights protection and complaints generated heat discussions
9	poverty alleviation, agricultural products, sales, agriculture, E-commerce, development, rural areas, rural revitalization, farmers, helping agriculture, poverty reduction, revitalization, consumption, driving, assistance, public welfare	6.29%	Live streaming E-commerce contributes to poverty alleviation
10	live streaming E-commerce, netizens, Pan Changjiang, video, questioning, stars, breaking the news, Zhang Chenguang, controversy, fake wine, acting, embarrassment, virtual, friendship between Pan and Ga, roll over, making money	5.62%	Celebrities participating in live streaming E-commerce generated heat discussions
11	E-commerce, market, enterprise, growth, consumption, epidemic, industry, delivery, retail, platform, cross-border, traditional, overseas, flow, economy, online	4.82%	Cross-border stimulates overseas economy

Table 8. Example text under the LDA sequence topic after policy implementation.

No.	Example Text
1	I think live streaming E-commerce will help to form a new pattern of online and offline integrated development, achieve new breakthroughs in industrial economic transformation and upgrading, and have broad development prospects.
2	I'm looking forward to this public welfare live broadcast! This form of live broadcasting of public figures and the government is very good! I'm going to have a look.
3	Xinba's "bird's nest incident" refunded 61,983,040 Yuan and spent more than 60 million yuan to buy lessons! Are there any infringements on the rights and interests of consumers and are they legally liable!
4	In the future, Kuaishou and Jingdong retail will continue to implement the "double 10 billion subsidy" and build a healthy and open new ecology of live streaming E-commerce.
5	With "soft constraints", we need "hard rules". Today, *the Code of Conduct for Online Live Streaming Marketing* was officially implemented.

Table 8. *Cont.*

No.	Example Text
6	live streaming E-commerce is entering a period of strict supervision, and the corresponding regulations and policies issued are no longer macro guidance
7	It's very normal that stars often overturn with their goods. Many people fabricate their data. The moisture is too big.
8	The live broadcast process is too fast, and with the support of the anchor, it is easy to make impulsive consumption. When you buy it, you find that it is unnecessary or has quality problems, and it is difficult to safeguard your rights.
9	It's really not easy to make live streaming E-commerce contribute positive energy to the society. It's really meaningful to help the poor and farmers.
10	Pan Changjiang once advised him to engage in art well, not to be blinded by interests, still less to sell fake goods! But look at this again, poor trick of bringing goods, full of swearing! Spoil such a classic screen image.
11	Amazon, AliExpress and other cross-border E-commerce platforms are copying "Taobao live" overseas.

Combined with the supplementary analysis of Table 9 about online HDP models, it can be seen that the live streaming E-commerce industry has contributed a lot to the digital transformation and upgrading of many industries in the post-epidemic period, and has also achieved great results in poverty alleviation, local economy and cross-border exchanges. However, with the gradual emergence of chaos, such as lack of after-sales service, brushing, counterfeit goods, and difficulty in safeguarding rights, people's trust in live streaming E-commerce continues to shrink, and the future of the industry is full of uncertainty. Internet celebrities and grassroots merchants are stuck in "roll-over" events, false publicity, and brushing, not to mention the difficulties in safeguarding rights and nowhere to complain, all of which make the public doubt this industry. In particular, the following topics are contained in both models: Simba, one of the top hosts, sold fake bird nests, and Pan Changjiang, a well-known artist, sold fake wine, which made the public deeply aware of the many problems in the industry. Many netizens express that live streaming E-commerce needs to keep the bottom line of the law based on continuously enriching the live streaming content. *The Code of Conduct for Online Streaming Marketing,* implemented in July 2020, regained confidence in the live streaming E-commerce industry. Later, *the Rectification Action of the State Administration for Market Regulation* rectified many violations in the industry. In October 2020, the State Administration for Market Regulation even announced *the Measures for the Supervision and Administration of Online Transactions (Draft for Comment)* to solicit public opinions. In 2021, *the Measures for the Supervision and Administration of Online Transaction* was officially released, clarifying the laws of relevant subjects. It indicates that the legal provisions of the live streaming E-commerce industry are becoming gradually optimized. Especially, topic 8 in the online HDP models shows that people who sell fake goods with live streaming E-commerce can be sentenced to up to 10 years imprisonment. This mandatory law has deterred many unscrupulous businesses.

Table 9. Online HDP models after policy implementation.

No.	Keywords	Topic
1	live streaming E-commerce, develop, internet, sell, company, stars, industry, network traffic, market, internet celebrities, property, economy, online, digitization, upgrade	Live streaming E-commerce contributes to economic transformation and upgrading
2	public welfare, poverty alleviation, epidemic, help, internet celebrities, hometown, helping agriculture, Hubei, society, official, company, propaganda, activity, Taobao, media	Live streaming E-commerce contributes to public welfare during the epidemic
3	industry, regulation, focused renovation, account classification, live streaming E-commerce, live streaming platform, management rules, administrative guidance, data, network traffic, reward cooling off period, playback retention, advertising law, false publicity, immaturity	Normative policy leads to discussion

Table 9. *Cont.*

No.	Keywords	Topic
4	bird's nest, syrup, event, business, roll over, internet celebrities, Xinba, false publicity, data, fakes, supervise, network traffic, counterfeiting, rights protection, China Consumer Association	Xinba was fined due to the sales of fake bird's nest
5	internet, norm, transaction supervision and management, focused renovation, data, live streaming E-commerce, market, regulation, supervise, Supreme People's Procuratorate, the State Administration for Market Regulation, manage, fair competition, China Consumer Association, Anti-vice office	Normative policies contribute to regulation and management
6	star, counterfeiting, internet celebrities, network traffic, industry, deception misleading, roll over, brushing, mentioned by China Consumer Association, Luo Yonghao, Wanghan, query, exposure, bottom line, hype	Internet Celebrities frequently roll over, causing heated discussion
7	star, commerce, data, Pan Changjiang, roll over, query, Zhang Chenguang, counterfeiting, complained, influence, adulterated wine, Gazi, regret, shameful, return goods	Celebrities participating in live streaming E-commerce generated heat discussions
8	internet celebrities, sell, Ten years' imprisonment, official media, star, false publicity, network traffic, fakes, responsibility, civil compensation, penalties, illegal gains, penal code, rights protection, fake	Live streaming E-commerce sell fake goods can be sentenced to 10 years
9	poor area, sell, propaganda, develop, live streaming E-commerce, sell products, associate director, poverty alleviation, agricultural product, farmer, county magistrate, helping agriculture, cooperate, business, honest	Village officials sell goods for their hometown

In addition, to better analyze the concerns of the public on normative policies, the following further analyzes the comments belonging to normative problem topics in the LDA models.

(3)   The evolution of major topics related to normative issues after policy implementation

The evolution of topics of concern can better reflect the changes in public attention and contribute to the formulation of more specific and effective industry management measures in the future.

Table 10 shows the keywords with the highest proportion of comments on normative issues for each month from 1 July 2020 to 31 August 2021. It can be seen from Table 10 that after the implementation of the normative policy, with the improvement of laws and the strengthening of supervision, more and more chaos in the industry has been exposed. The most discussed topics are host fraud, sales of fake goods, supervision, and "roll-over" events. Among them, the incident caused by Sinba was the most hotly debated and lasted the longest period. This incident, to a large extent, promoted the implementation of normative policies, thereby raising the public's awareness of the need to crack down on counterfeiting and safeguard their rights. In the month when the policy was released and implemented, the public's attention was basically focused on the content of the policy itself, which showed that the public held great support for the implementation of the policy. However, there is a hot discussion on fake host sales and industry supervision every month after policy implementation. It can be seen that the implementation of the policy may not be thorough enough due to the excessive coverage of the entire live streaming E-commerce industry. All kinds of businesses can use live streaming to expand their sales channels, which makes it difficult for the government to implement management requirements. Therefore, it comes up with higher requirements for improving various laws and regulations. Government departments need to combine the laws and regulations of other industries to clarify the responsibilities of various stakeholders in the live streaming E-commerce industry, and it is necessary to continuously revise existing laws or formulate new regulations. Finally, compared with positive events, negative events tend to generate more heated discussions in the short term, and they can be regarded as a leading indicator for predicting the development trend of the industry. Therefore, the analysis of public opinion in the early stage can help predict the evolution of topics in the later period, provide

a reference for the active guidance of public opinion and the improvement of policies, and timely and properly solve the shortcomings of the current policy.

Table 10. Major topics of concern related to normative issues after policy implementation.

Data	July 2020	August 2020	September 2020	October 2020	November 2020
Keywords	norms, data, roll over, supervision, counterfeiting, bring the goods, scams, traffic, advertisement, complaints	host, bring the goods, norms, administration, account classification, industry, rectification, Xinba, standards, roll over	host, norms, market, administration, platform, scams, supervision, false, rights protection, quality	supervision, norms, risks, regulation, cheat, fake goods, Supervision and Administration, tricks, case of selling fake goods, police	Standard, industry, data, counterfeiting, supervision, inflated, Simba sells fake bird's nest, sell fake goods, complaints, after-sales
Data	**December 2020**	**January 2021**	**February 2021**	**March 2021**	**April 2021**
Keywords	Xinba, punish, roll over, norms, refund, false publicity, responsibility, question legal validity, chaos, crack down on counterfeits	Xinba, fakes, complaints, rights protection, China Consumers Association, false publicity, supervision, crack down on counterfeits, tricks, immaturity	internet celebrities, supervision, consumers, legitimate interest, good and bad are intermingled, norms, rewards, regulation, guidance, report	315, regulation, transaction, complaints, norms, supervision, rights protection, security, illegal, advertisement	supervision, norms, adverse comments, delete, mislead, fake goods, Xinba comeback, complaints, illegal, punish
Data	**May 2021**	**June 2021**	**July 2021**	**August 2021**	
Keywords	new regulations, supervision, transaction, issue, norms, acting, fake sale, ban, scams, penalty	consume, responsibility, subject, data falsification, norms, supervision, sentences, false publicity, ten years' imprisonment, scams	the state administration for market regulation, brushing, exposure, false publicity, scams, publicity stunt, anchor, fakes, supervision, law	star, falsification, tricks, supervision, script, cheat, roll over, bring the goods, false publicity, embarrassed	

6. Sentiment Analysis Model Result: The Evolution of Public Opinion and Emotional Tendencies during the Development of Live Streaming E-Commerce

Social media serves as a significant channel for people to express their interests and emotions, allowing the public to express their opinions on different topics. Network public opinion can be seen as a collection of network comments, i.e., an online comment can be regarded as the basic unit of network public opinion, and these resources can be used to monitor public opinion during the occurrence of different hot events. By mining the user's viewpoints and analyzing the user's emotional tendencies, the user's attitude and emotion towards the event are analyzed. Through the analysis of the public's emotional changes before and after policy implementation, the results reflect the public's attitude towards these policies, guide the development of public opinion, and ensure the sound development of the live streaming E-commerce industry.

6.1. Sentiment Analysis Model

There are two common sentiment polarity analysis methods at present, namely, the following: the method based on machine learning and the method based on emotion dictionary. This paper uses a predetermined emotion dictionary for sentiment analysis. Due to the development of Internet vocabulary, the words contained in a single emotion dictionary cannot cover all the words in the current dataset, so this paper uses three popular Chinese emotion dictionaries to enhance the credibility of the sentiment analysis model by determining the sentiment of the extracted text through BosonNLP, DUTIR, and HOWNET dictionaries. BosonNLP Dictionary [42] is an emotion dictionary based on data sources such

as Weibo, news, and forums, and is suitable for processing social media sentiment analysis. DUTIR [43] is an emotion dictionary of the Information Retrieval Laboratory of Dalian University of Technology, which describes a Chinese word or phrase from different perspectives, including word part-of-speech type, sentiment category, sentiment intensity, and sentiment polarity. HOWNET Dictionary [44] is an online common-sense knowledge-based unveiling of inter-conceptual relationships and inter-attribute relationships of concepts as connoting in lexicons of the Chinese and their English equivalents. These three sentiment analysis methods are applied to the processed text data to find out the sentiment of the text, respectively. Considering the different amounts of review data in each stage, 6816 and 24,059 review data were selected for the two stages respectively, accounting for 10% of the total comments. After manually annotating the sentiment polarity of the test data set, it is compared with the output obtained by each sentiment analysis method. To find out the overall accuracy of these methods, general evaluation indicators are accuracy, precision, recall, and F-value [45].

6.2. Test Results

Table 11 shows the sentiment scores of each sentiment method for six Weibo. As can be seen from Table 11, since each sentiment analysis method has different scoring standards, the sentiment scores of comments also vary. However, in terms of sentiment polarity, the results of the three sentiment analysis models based on different emotion dictionaries are basically the same.

Table 11. Sentiment scores based on different methods.

Comments	Sentiment Score		
	BosonNLP	**DUTIR**	**HOWNET**
An expert in live streaming and public affairs, thank you	5.6	5	6
Thanks for the live streaming for poverty alleviation in so many places, very positive energy	2.2	3	3
I also did a live streaming before going home, and now I can be host of live streaming	0.7	0	0
Why have your soulgone over tothedarkside?	−0.8	−1	0
The leading hosts have a strong influence, but others fish in the troubled waters who cheap companies	−2.0	−3	−4
It was so stupid tonight to watch live streaming by Yin Shihang for more than three hours	−3.0	−7	−5

Table 12 shows the precision, accuracy, recall, and F-value of each method. It indicates that the effects of the three models are good, and the average indicators of various types are around 0.9. Among them, HOWNET has the highest F value, due to the more specific structure and richer vocabulary of the dictionary.

Table 12. Evaluation indicators for different methods.

Method	Accuracy	Precision	Recall	F-Value
BosonNLP	0.900	0.905	0.915	0.905
DUTIR	0.952	0.941	0.946	0.943
HOWNET	0.941	0.962	0.964	0.963

6.3. Empirical Analysis on the Development of Live Streaming

(1) Analysis of daily sentiment score before and after policy implementation

The sentiment score of each comment is determined and aggregated based on the emotion dictionary to obtain a daily overall score SS_d^m, which is similar to the study conducted by Collins et al. [46]. d represents the date, and m represents three dictionaries. Since the sentiment score given by each dictionary is different, SS_d^m needs to be normalized

according to the score range given by the dictionary. RS^m is obtained by the absolute difference between the maximum and minimum scores of the comments analyzed by the dictionary. In addition, considering that the number of comments obtained varies from day to day, SS_d^m needs to be normalized based on the number of comments n_d per day. The final normalized sentiment score NSS_d^m is given by Equation (2).

$$NSS_d^m = \frac{SS_d^m}{n_d \times RS^m},$$ (2)

The change of NSS_d^m reflects the change in the sentiment score before and after policy implementation. The results are shown in Figure 6, and Table 13 reflects the sentiment scores after normalization.
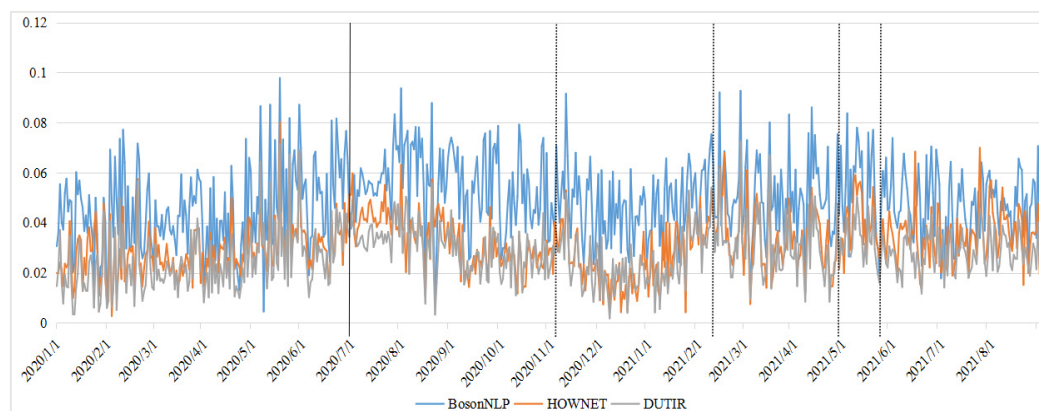

Figure 6. Trend of daily sentiment scores obtained by each method.

Table 13. Sentiment intensity of positive and negative comments before and after the implementation of industry normative policies for live streaming.

Sentiment Score	BosonNLP		DUTIR		HOWNET	
	Before Implementation	After Implementation	Before Implementation	After Implementation	Before Implementation	After Implementation
Total sentiment scores of positive comment	3651.28	12,491.41	2116.07	7707.06	2319.35	8710.90
Total sentiment scores of negative comment	−37.02	−264.96	−158.37	−1123.30	−168.47	−1315.68
Average sentiment scores of positive comment	0.059	0.060	0.047	0.051	0.045	0.051
Average sentiment scores of negative comment	−0.007	−0.009	−0.017	−0.024	−0.019	−0.028

It can be seen from Figure 6 that, except for the difference in scores caused by different sentiment models, the trend of sentiment scores obtained by each method is similar, illustrating the reliability of the sentiment model from another aspect. At this time, although people are enthusiastic about the live streaming E-commerce industry in its early stages, they are concerned about the future development of physical stores and criticize the chaos in this industry. Therefore, the sentiment score fluctuates frequently, with a slight increase in general. Until the end of June 2020, it was announced that *the Code of Conduct for Online Live Marketing* would be officially implemented in July, the sentiment score began to rise significantly, indicating that the public held a positive attitude towards the implementation of the normative policy. After that, as the popularity of the policy eroded, the score decreased slightly, but it was still higher than the score before the implementation. With the implementation of *the Guiding Opinions on Strengthening the Supervision of Online Live Streaming Marketing Activities* on 5 November 2020, although the sentiment score rose in a

short period, the industry problems caused by the strengthened industry supervision have caused hot discussions among many people, especially the phenomenon mentioned above, such as counterfeited products, "roll over" events, and brushing, which have caused a lot of negative sentiment among the public. However, under the continuous strengthening of supervision, public sentiment has begun to develop positively. The normative policies implemented in February and May 2021 have finally stabilized the sentiment score at a slightly higher level than before policy implementation. It reflects that policy implementation regulates chaos in the industry and receives good public perception. However, the irregularities that occur in the industry from time to time still stimulate the public, which promotes the government to further intensify policy implementation, strengthen supervision, and improve people's satisfaction.

Table 13 presents the sentiment intensity of positive and negative comments before and after policy implementation. The absolute value of the average positive and negative sentiment scores after policy implementation is larger than that before the implementation, indicating that the public is more satisfied with the policy. However, although the problems are resolved during the policy implementation, some people still hold negative emotions. It indicates that when implementing normative policies, it is necessary to strengthen supervision, ensure the effective implementation of policies, promptly rectify violations of laws and disciplines, eliminate the impact of negative events on the public, and guide the positive development of public opinion to ensure the healthy development of the live streaming E-commerce industry.

(2) Analysis of the change of public attitude under the normative theme before and after the policy implementation

To more clearly analyze the implementation effect of normative policies, combined with the results of the LDA model in Section 4, the emotional polarity of public comments on normative issues before and after the implementation of the policy was extracted, and the results are shown in Figure 7. It shows that after policy implementation in July and November 2020, the proportion of positive sentiment rose significantly, and the proportion of negative sentiment decreased. After the policy's implementation in January and May, the proportion of sentiment polarity did not change, obviously, and the results were related to people's expectations for the policy. In the period of the explosive development of live streaming E-commerce, the lack of a clear normative system in the industry has led to frequent chaos and unsuccessful rights protection. Therefore, the public had great enthusiasm for the first normative policy implemented in July 2020. The proportion of positive sentiment was high and lasted for a long time. The second normative policy released in November 2020 improved the supervision and law enforcement clauses for illegal acts in the live streaming E-commerce industry and strengthened supervision, thereby exposing a large number of illegal acts such as the sale of counterfeit goods and false publicity, which have caused a lot of negative sentiment among the public. Thanks to the effective implementation of the normative policies, the proportion of negative sentiment quickly declined, indicating effective implementation of the policy. However, the normative policies released from February to May 2021 did not generate heated discussions. Combined with the content changes in Table 10, it can be seen that although industry problems have been addressed, related illegal acts continue to appear, and regulatory issues continue to emerge. It has always been the focus of public discussion, so relevant government departments need to further strengthen supervision. At the same time, in the long run, this phenomenon is related to the improvement of the epidemic situation and the convenience travel, which has led to a decline in the popularity of live streaming E-commerce and people's enthusiasm for such topics.
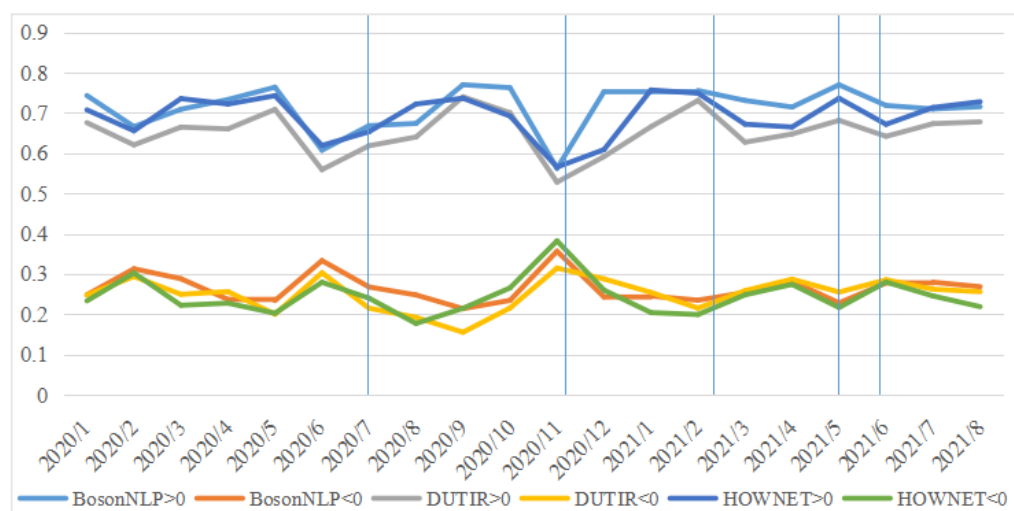
Figure 7. Changes in sentiment polarity of comments before and after policy implementation.

7. Conclusions

This paper takes the implementation of the first normative policy on 1 July 2020 as the time node, divides the government's rectification action on the live streaming E-commerce industry into two periods (before and after policy implementation), and adopts online comment data [47] to construct LDA models [48] and sentiment analysis models, exploring the changes in topics and attitudes in the two stages. In addition, this paper analyzes the implementation effect of the normative policy for live streaming E-commerce and provides important support for the improvement of the policy. Through analysis, the paper draws the following conclusions:

(1) As a new digital economic mode of "online promotion + physical consumption", live streaming E-commerce breaks the traditional pattern of commercial sales and becomes a new development hotspot, but it also raises many potential security risks. Through the collection of online data, it is found that there are significant differences in the ratios in terms of the age and gender of users who post reviews. People in the 20–40 ages pay more attention to the normative policies for live streaming E-commerce. As the main force of social labor and consumption, they have a higher acceptance of new consumption models, and after experiencing live streaming E-commerce, they are prone to finding problems, so the discussion on policy implementation is also more intense. It is worth noting that women's discussion on normative policies is less than that of men, which shows that although men have weaker consumption desires, they are not less concerned about live streaming E-commerce, and even have a higher interest in various issues within the industry. The reason is not only the growth of the male consumer group but also more rational consumption [49].

(2) Based on LDA and online HDP models, it indicates that before the policy implementation, the discussion on promoting consumption by live streaming E-commerce accounted for the majority, and the specific topics were traditional economic transformation, public welfare activities with live streaming E-commerce, resumption of work and production, poverty alleviation, etc., reflecting the contribution of live streaming E-commerce to economic revitalization and a favorable impression of the public. However, while encouraging live streaming E-commerce, there are also many discussions about the chaos in the industry, and the contradictions between the main objects in the industry are becoming increasingly acute. After policy implementation, discussions on the normative issues of live streaming E-commerce increased rapidly, and related comment topics accounted for 42% of the total at this stage, nearly three times that before the implementation. Among them, the most discussed topics are host fraud, sales of counterfeit goods, supervision, "roll over" events, and other topics, and especially supervision, is mentioned every month after the policy implementation.

It demonstrates that the policies are not thoroughly enforced, which is related to the large coverage of the entire live streaming E-commerce industry and the unclear responsibility division of relevant business entities. This requires the government to carefully sort out the responsibilities of various entities in the industry, improve the transparency of the industry, and further strengthen the supervision of illegal acts.

(3) The rapid development of the live streaming E-commerce industry greatly impacts the economy, resulting in serious harm to the public caused by industry chaos. Through the sentiment analysis of people's online comments, it is found that after the policy implementation, the sentiment score significantly increased, and finally stabilized at a high score, indicating that the public holds a positive attitude towards the normative policies for live streaming E-commerce and is satisfied with the implementation effects of these policies. The negative sentiment intensity is lower after the policy implementation. By analyzing the changes in the sentiment polarity of comments, it is found that compared with the policies implemented in the second half of 2020, the changes in sentiment polarity caused by policies implemented in the first half of 2021 are not very significant. There are many reasons for the difference in people's sentiment fluctuations. Firstly, the backgrounds for the implementation of different policies vary. In this period of accelerated development of the live streaming E-commerce industry and frequent chaos, the implementation of the first normative policy definitely receives a lot of attention from the public, whose sentiments will cause huge fluctuations. With the continuous implementation of normative policies and the relaxation of epidemic travel restrictions, the public's enthusiasm for the live streaming E-commerce industry and its policies is gradually going down. Secondly, after the policy implementation, although the problem of industry norms is optimized, problems such as "rollover," false publicity, and after-sales rights protection still appear frequently, making the public doubt the effect of the policy implementation. Generally speaking, negative events tend to generate more animated discussion in the short term than positive events. Under the long-term control measures, simply introducing new policies and norms is hard to play a significant role in the chaos of the industry. At this time, the government should intensify the policy implementation, strengthen supervision, and improve the transparency of the industry; at the same time, facing the public's doubt caused by negative events, the government needs to provide timely guidance to improve public satisfaction. In addition, the government can provide sufficient rewards and penalties for merchants and platforms, allowing them to voluntarily monitor and manage violations so as to reduce the regulatory loopholes caused by the overly large and complicated industry.

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