The Role of Chinese Internet Celebrity Live Streaming Industry in E-commerce Economy Based on VAR Model

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Abstract. With the development of e-commerce technology and the popularization of mobile networks, Internet live streaming platforms have emerged, and the emergence of a large number of Internet celebrities have created great economic benefits for today's society. The intrinsic connection between China's Internet celebrity live streaming industry and e-commerce is deeply analyzed through VAR model, using ADF test, Granger test and impulse response function. Research has shown that the live streaming industry of internet celebrities plays an important role in the e-commerce economy, and there is a mutual influence between the two.

Keywords: internet celebrity, e-commerce, var model, Internet

1 Introduction

With the rapid development of Internet technology and the popularization of mobile networks, the live streaming industry is rapidly emerging. Nowadays, Internet celebrity live streaming has even become an emerging cultural phenomenon and economic industry, and has changed the traditional e-commerce model. With the continuous progress of 5G, big data, artificial intelligence and other technologies, the combination of Internet celebrity live streaming industry and e-commerce is increasingly close[1]. This paper uses a VAR model to select three variables: e-commerce transaction volume, the size of the internet celebrity live streaming industry, and the number of online users. Based on time series data from 2005 to 2023, it deeply analyzes the inherent relationship between China's live streaming industry and e-commerce. The structure of the article is shown in Fig. 1.

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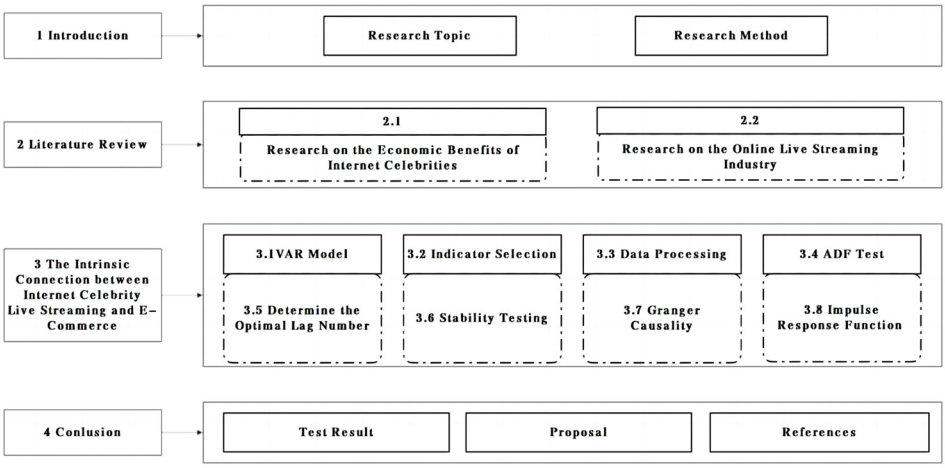

Fig. 1. Thesis structure diagram.

2 Literature Review

2.1 Research on the Economic Benefits of Internet Celebrities

The concept of Internet celebrity economy was proposed in 2015, and as more and more people notice the business development potential behind Internet celebrity and Internet celebrity economy, the related research on the benefits of Internet celebrity economy shows a growing trend. Most of the existing studies on the economic benefits of Internet celebrity are based on the analysis of the business model of Internet celebrity economy. Liang Liming [2] pointed out that the Internet celebrity economy is through the use of content output by Internet celebrities to influence the values and decision-making behaviors of their fans, thus realizing the transformation of economic value. Xiao Zanjun and Kang Lijie [3] believe that the essence of Internet celebrity economy lies in the perfect combination of "content + community + e-commerce": the content aggregates fans with the same interests, the community provides a space for them to communicate and interact, and ultimately realizes the traffic cash through e-commerce. Huang Lizhi and Liang Xiao-zhong [4] attribute the Internet celebrity economy to three modes of realization: "Internet celebrity + e-commerce", "Internet celebrity + social" and "Internet celebrity + offline activities".

Although the Internet celebrity economy is a new thing in China in recent years, it does not mean that there is no Internet celebrity economy abroad, in fact, the Internet celebrity economy in foreign countries is more mature compared with the domestic development. In Europe, Internet celebrity economy is mainly guided by "fashion bloggers", Kim H.Y. Hahn, Eun-Jung Lee [5] found that fashion bloggers increase the purchase intention of their products by narrowing the psychological proximity perception with their fans. Suwan Juntiwasarakij [6] pointed out that the establishment of Internet celebrity fan groups with common interests is a good way to increase the purchasing

power of the Internet celebrities. Internet celebrity fan base with common hobbies is the most important channel to promote and sell products.

2.2 Research on the Online Live Streaming Industry

Web live streaming is another widely spread form after microblogging and weibo. In recent years, with the widespread popularization of social media and the rapid development of e-commerce, the main direction of the webcasting industry is changing from game live streaming to e-commerce live streaming. Most scholars' studies on live streaming mainly focus on depicting the current development of the live streaming industry, analyzing in depth the many problems encountered by e-commerce live streaming in the process of development, and proposing strategic suggestions for future development on this basis. For example, Lee, Se-Jin [7] found that the reaction and consumption psychology of webcast viewers change with the change of live streaming content; Shen, Guo-Liang [8] argued that e-commerce live streaming is the next stage of the webcasting industry's strategic direction of development; and Sheng Zou [9] pointed out that, in order to enable the live streaming industry to achieve a more far-reaching development, it is necessary to carry out a careful division of labor in the live streaming process, and to give rise to more specialized segments of the occupations, thus focusing more precisely on the specialization of live streaming. Ding Meiling [10] summarized the impact of the "Internet celebrity + live streaming + e-commerce" model on consumers by analyzing their behavior.

3 The Intrinsic Connection between Internet Celebrity Live Streaming and E-Commerce

3.1 Research Method

The tool used in this experiment is STATA17.

The VAR model, also known as vector autoregressive model, in which all variables are regarded as endogenous and all equations have the same explanatory variables with the lagged variables of the explanatory variables as the corresponding explanatory variables so as to study the dynamic links between the variables and make predictions.

Assuming that the lag order is q order, the standard expression of VAR model is as follows.

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots + A_q Y_{t-q} + \varepsilon_t + C \quad (1)$$

where Yt is a q-dimensional vector of endogenous variables, q is the lag order, the number of samples is t, εt is a q-dimensional perturbation variable, and C is a q-dimensional vector of constants.

3.2 Indicator Selection

Referring to the research of Wei Yanqiu, Gao Shouhua [11], Chen Bin [12], Li Huaizheng [13], Liu Xin [14], the e-commerce turnover (EC), the scale of live streaming industry of Internet celebrity (IC), and the number of people accessing the Internet (NET) are selected as the research indicators. Among them, the scale of Internet celebrity industry is the sum of the number of live streaming platforms and the number of MCN organizations. Based on the change of the number of Internet celebrities, the role of live streaming in e-commerce is comprehensively evaluated by studying the relationship between the scale of live streaming industry and e-commerce turnover. Taking into account the history of the development of Internet celebrity live streaming and e-commerce, the availability of data and the stability of the model, the length of the sample selected for this experiment is 2005-2023, and the data used are from the China Statistical Yearbook for the corresponding years and the relevant content in the Research Data on the Development of China's MCN Industry and the Behavior of Live Streaming E-commerce Users published by iiMedia Research. The specific data are shown in Table 1.

Table 1. Descriptive values of the main variables

Year	E-commerce turnover (trillion yuan)	Number of people with Internet access (billion)	Internet celebrity live streaming industry size (hundred)
2005	1.3	1.11	0.06
2006	1.55	1.37	0.1
2007	2.17	2.1	0.1
2008	3.14	2.98	0.13
2009	3.67	3.84	0.15
.....	.....	.....	.....
2019	34.81	9.04	146.46
2020	37.21	9.89	281.46
2021	42.33	10.32	341.46
2022	43.83	10.67	405.72
2023	49.76	10.92	473.23

3.3 Data Processing

In order to eliminate the impact of the various influencing factors due to different units, this paper chooses to take the logarithm of the original data to process the original data, which is convenient for its later modeling.

3.4 ADF Test

Pseudo-regression often occurs in time series. Therefore, to ensure the accuracy of the analysis, the smoothness of the data should be verified first. In this study, the ADF test is chosen, and the test results are shown in Table 2

According to the test results, it can be seen that all the variables belong to the smooth time series after the IC is differenced by two orders, and the ADF test is passed, and the VAR model can be constructed.

Table 2. ADF test results

Variable name statis-tics	Test statis-tic	The critical value for the 1% condition	The critical value for the 5% condition	The tovalues for the 10% condition	P
EC	-3.074	-3.75	-3	-2.63	0.0286
NET	-7.184	-3.75	-3	-2.63	0
IC	0.656	-3.75	-3	-2.63	0.9889
dIC	-1.647	-3.75	-3	-2.63	0.4589
d1IC	-5.149	-3.75	-3	-2.63	0

Adding d before the variable represents first-order difference,
Adding d1 before a variable represents a second-order difference

3.5 Determine the Optimal Lag Number

The number of lag orders in the VAR model needs to be estimated and determined before building the VAR model. In order to ensure that the model has good explanatory ability, the lag order should completely reflect the dynamic characteristics of the model, generally the more orders, the more complete the degree of reflection. In this paper, AIC information criterion, HQIC information criterion, SBIC information criterion and LR test are used to determine the number of lag orders of the VAR model, and the test results are shown in Table 3.

According to the AIC criterion, HQIC information criterion, SBIC information criterion, LR test and the completeness of the degree of response, the final judgment is to choose the third order as the optimal lag order.

Table 3. Lagged order test results

Lag	LL	LR	df	p	AIC	HQIC	SBIC
0	-17.4728				2.7297	2.72819	2.87131
1	76.1494	187.24	9	0	-8.55325	-8.55929	-7.98681
2	83.6526	15.006	9	0.091	-8.35368	-8.36423	-7.3624
3	116.236	65.167*	9	0	-11.4981*	-11.5132*	-10.082*

*Represent the lag order determined by the corresponding conditions

3.6 Stability Testing

After constructing the VAR model, the stability of the model needs to be tested to determine if the model is well built. If the final results all fall within the unit circle, i.e., the mode of the inverse of the unit root is less than 1, it means that the model is very stable and can be analyzed in the next step. Otherwise, it means that the model is not stable enough and needs to be adjusted. The results of the stability test of the model are shown in Fig. 2. It can be seen that all the results are located within the unit circle, indicating that the VAR model passes the stability test.

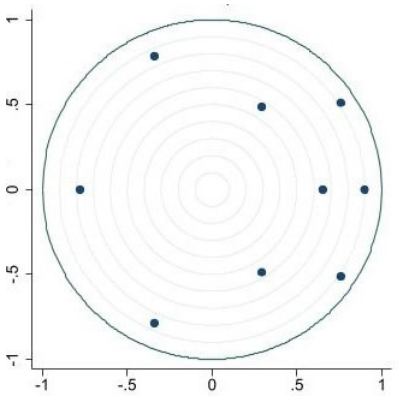

Fig. 2. Unit root test for VAR models

3.7 Granger Causality

Granger causality test was used to analyze whether there is a causal relationship between the serial variables. The results of the test are shown in Table 4.

Table 4. Granger causality test

Equation	Excluded	chi2	df	Prob>chi2
EC	NET	99.306	3	0
EC	IC	40.399	3	0
EC	ALL	152.14	6	0
NET	EC	3.4292	3	0.33
NET	IC	25.002	3	0
NET	ALL	58.103	6	0
IC	EC	184.85	3	0
IC	NET	111.31	3	0
IC	ALL	285.97	6	0

As can be seen from Table 4:

Net celebrity live streaming industry scale and e-commerce turnover are Granger causes of each other, which shows that the two have produced a very strong link be-

tween them, the expansion of the scale of the Net celebrity live streaming industry promotes the increase of e-commerce turnover, and the increase of e-commerce turnover makes the capital increase the investment in the Net celebrity live streaming industry. The role of Internet celebrity live streaming industry in e-commerce is very important.

The number of Internet celebrities is the Granger reason for the size of e-commerce turnover and live streaming industry, which indicates that the popularization of mobile network is the foundation of e-commerce and live streaming industry, and the latter two will not develop without the Internet as a channel.

E-commerce transaction volume is not the Granger cause of the number of Internet users, which indicates that the expansion of e-commerce transaction scale will not significantly expand the Internet user group, and the link between the two is unidirectional. The scale of Internet celebrity live streaming industry is the Granger cause of the number of Internet celebrities, which indicates that the scale of Internet celebrity live streaming industry is expanding due to the popularization of mobile network, and at the same time, its own attraction and economic benefits make more and more people lift the Internet to understand and experience the Internet live streaming industry.

3.8 Impulse Response Function

The impulse response function describes the impact of one endogenous variable in the model on other endogenous variables, through the impulse response function can further determine the authenticity of the causal relationship between the variables, and more intuitively determine whether it is a positive or negative impact. The impulse response function is used to deeply analyze the degree of connection between the Internet celebrity live streaming industry, e-commerce and mobile network. The impulse response results are shown in Fig. 3.

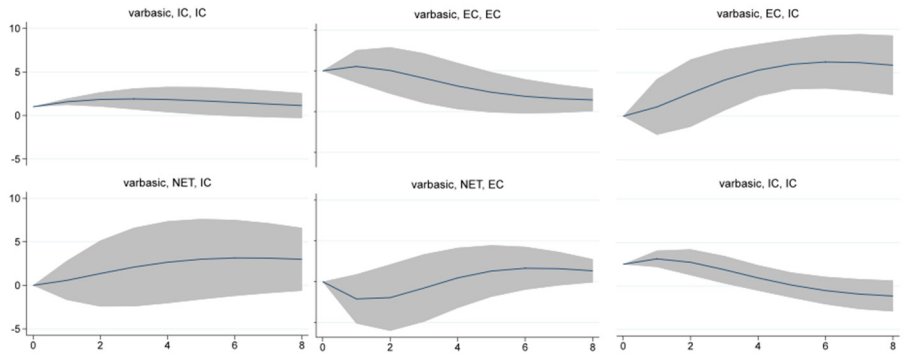

Fig. 3. Impulse response function analysis results

As can be seen in Fig. 3, the number of Internet users and e-commerce transactions throughout the positive impact on the size of the Internet celebrity live streaming industry, which indicates that technology and the economy are the basis for the emergence of the Internet celebrity live streaming industry, the development of technology

has expanded the channels for the dissemination of the live streaming of the Internet celebrities, and economic growth has made the Internet users to have the funds and willingness to pay for the Internet celebrities. The number of Internet users has a negative impact on e-commerce transactions at the beginning, and then gradually plays a positive role, which shows that the popularity of the Internet does not mean the popularity of e-commerce, in the initial stage, some people do not dare to try to contact e-commerce transactions, with the continuous improvement of e-commerce system gradually use the e-commerce platform for transactions.

4 Conclusion

This paper uses the VAR model and selects the data from 2005 to 2023 for 19 years to analyze the development of China's Net celebrity live streaming and e-commerce industry by studying the intrinsic relationship between the three indicators: the size of the Net celebrity live streaming industry, e-commerce turnover, and the number of people using the Internet. A long-term stable relationship between the three variables was concluded through the ADF test. Through Granger test, it is concluded that there is a significant mutual influence relationship between e-commerce turnover and the scale of Internet celebrity live streaming industry, which further proves the important position of Internet celebrity live streaming industry in e-commerce. The impulse variable response function analysis concludes that the mobile network and e-commerce turnover have a significant positive impact on the size of the Internet celebrity live streaming industry, which proves the basis of the development of the Internet celebrity live streaming industry.

Although the Internet celebrity live streaming industry plays an important role in e-commerce, there are still some problems and challenges.

In response to the large growth of the Internet celebrity industry, more and more ordinary people are investing in the Internet celebrity live streaming industry may produce industry regulation problems, it is recommended that the relevant departments set up a special regulatory agency, strengthen supervision, and formulate strict industry standards and norms to ensure that the content is healthy and legal, and to put an end to vulgarity, false propaganda and other undesirable phenomena.

For the sustainable development of the Internet celebrity live streaming industry, it is recommended that the platform side strengthen self-discipline and optimize the content ecology. Webcasting platforms can attract more users by introducing more quality content creators and improving the diversity and quality of live content.

Nowadays, Internet celebrities live streaming has a wide range of influence and audience, however, compared with it, the popularity of e-commerce system is relatively low, and this mismatch has led to consumers encountering a lot of inconvenience in purchasing and transacting with products and services promoted by live streaming, which limits the potential of live streaming to promote the development of e-commerce. It is recommended to strengthen cross-industry cooperation and communication, and

establish a cooperative relationship between e-commerce platforms and Internet celebrity live streaming platforms to jointly promote commodities and realize mutual benefits and win-win situations.

In view of the challenges of the future development of the Internet celebrity live streaming industry, it is recommended that live streaming platforms introduce more advanced live streaming technology, data analysis technology, etc., to enhance the technological content and competitiveness of the industry, as well as to improve and enrich the industry industry chain, and promote the diversified development of the industry.

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