ICIC Express Letters
Volume **14**, Number **1**, January **2020**

 ISSN 1881-803X
pp. **97–102**

STUDY ON THE DYNAMIC RELATIONSHIP OF BIG DATA SUPERVISION OF TOURISM ENTERPRISES UNDER THE INTERNET ENVIRONMENT

Te Ma

School of Tourism
Dalian University
No. 10, Xuefu Street, Jinzhou New District, Dalian 116622, P. R. China
717126748@qq.com

Received July 2019; accepted October 2019

Abstract. *With the rapid development of Internet technology, all kinds of new marketing methods have been emerging and used as marketing tools in the field of tourist attraction. The characteristics of new media and tourism marketing have a lot in common, which conforms to the characteristics of target market in tourist attraction marketing. Using new media to carry out marketing has increased the coverage of information, lowered the cost, and evidently enhanced the interactivity. The using of it has also made communication more convenient, thus improving the marketing efficiency. However, new media marketing also has certain risks – some aspects have certain limitations. In order to successfully apply this double-edged sword to promote the tourist attraction marketing, a few steps are needed: summarize new media exploration and practice about tourist attraction, introduce integrated marketing, relationship marketing, viral marketing, event marketing and other advanced marketing ideas, propose a set of effective methods and strategies of new media marketing operation. As tourism network penetration and user viscosity gradually increase, more merchants picked up from the travel application of new media marketing opportunities. While scalping and Internet navy in tourism have become tools for illegal enterprises to profit, tourism enterprises of platforms still have not profited since their establishment. The contradictions have become increasingly obvious. In view of the rapid development of tourism in China, this paper analyzes the problems of users' supervision. Relationships between tourism enterprises, regulators, and users are analyzed. In the numerical simulation of evolutionary game of the three parties, how they deal with strategy choices is analyzed.*
Keywords: Tourism, Tourism enterprises, Users, Regulations

1. **Introduction.** As the Internet technology develops rapidly, the digital network media, mobile terminals, and other new communication channels have penetrated into the public life. They have even become a dominant and comprehensive cultural landscape. Due to Flickr, NICE, LOFTER, micro lens, In, and other graphical social platforms, and the rise of tourism social platforms, the sharing of tourism experience, photos, and videos have become more convenient than ever. Using new media to share and disseminate visual content has become a global phenomenon. The attraction image represents the sum of the tourists' perceptions, beliefs, thoughts, and impressions of the attraction. The information delivering the attraction image includes both texts and various visual materials.

The relevant research on Internet regulation involves multidisciplinary direction, so researchers in different professional directions have made different analysis on the related evolution of Internet control. Friederike et al. [5] have studied the high speed innovation environment such as social networking sites on the Internet. When dealing with emergencies, Weibo uses twitter to play a more important role than other traditional media. Chen

DOI: 10.24507/icicel.14.01.97

[11] found out that the longer the time the users of twitter occupy in their applications, the more the user wants informal communication. Zhang et al. [6], through the study of environmental pollution that received extensive attention in 2011, discussed the relation between the involved enterprises and the media and Internet users' network public opinion. Fang et al. [7] studied the collaborative model of public opinion of the Internet and incorporated the Markoff chain into the study of speech control on the Internet, and proposed a collaborative Markoff model based on Internet speech. Jin [9] researched on the infringement in Weibo and the management of the rumor. The research found that the real name system of Weibo should not only be implemented and regulated by laws, but also be carried out with the real self-purification management mechanism of Weibo. The users should be self-managed.

It is urgent to use technology to take self-discipline control. Among them, technical regulation plays a crucial role in the restraint of Weibo. Therefore, based on that, effective management to regulate the violation of the users is established. Tourism enterprises can restrict public opinion, forwarding, certification, and other controllable means through technological advantages.

2. **Evolutionary Game Model Hypotheses.** The decision-making environment of the game between tourism enterprises and illegal users is complex. In order to facilitate analysis, the following assumptions are made.

1) There are only three players in the game: the tourism enterprises, users, and the regulatory authorities. The three parties are bounded rationality. Bounded rationality refers to the ability of all parties to have certain analytical ability and to benefit from different strategies, but lacks the ability to predict beforehand, which lies between rational and imperfect rationality. Therefore, the three parties of the game are bounded rationality.

2) Behavioral strategy: the strategy of whether or not to punish enterprises according to users' violation. Regulators will be inspecting when facing release of illegal information by users. Tourism enterprises should also cooperate with regulators to make investigations. They will be punished by regulators if the former did not undertake inspections because if the release of illegal information is not discovered, the regulators will have a loss.

3) Proportion of behavioral strategies. During the initial stage of the three-party game, assuming that the probability of supervision by the regulatory authorities is X, then the probability of the supervision department not implementing regulations is $1 - X$; If the probability of tourism enterprises implementing inspections is Y, then the probability of it not implementing inspections is $1 - Y$; If the probability of users publishing harmful information is Z, then the probability of them not publishing it is $1 - Z$.

4) Parameter hypothesis and basic explanation: c_1 as supervision fee of the regulatory department; c_2 as inspection fee of tourism enterprises; c_3 as loss of regulatory departments from users releasing harmful information; c_4 as the punishment to the tourism enterprises by regulatory departments when the former is not inspecting; c_5 as the punishment to users by regulatory departments when tourism enterprises are not inspecting; c_6 as gain of users for releasing harmful information; c_7 as loss of users after inspections. For the convenience of this study, A represents the supervision department; B represents tourism enterprises; C represents users; Y represents the implementation strategy; N represents the non-implementation strategy.

3. **Evolutionary Game Model Constructions.** When tourism enterprises implement actions to investigate and punish illegal users, regulatory departments can choose to take investigation. If investigations are to be implemented, the cost and loss of irregularities influence need to be taken into consideration. Investigations by regulatory authorities will bring a fairly big cost and lower the degree of freedom of the enterprise. If investigations are not implemented, certain violations will be caused by investing a large amount of

supervision. Based on the assumptions above, the analysis shows that there are 8 groups of game combination strategies in the supervision department, tourism enterprises, and users: (supervision, investigation, publishment), (supervision, investigation, no publishment), (supervision, no investigation, publishment), (supervision, no investigation, no publishment), (no supervision, investigation, publishment), (no supervision, investigation, no publishment), (no supervision, no investigation, publishment), (no supervision, no investigation, no publishment).

The gains from these eight portfolio strategies are: $(-c_1+c_3,-c_2,-c_7)$, $(-c_1,-c_2,0)$, $(-c_1+c_3+c_4,-c_4,-c_7)$, $(-c_1+c_4,-c_4,0)$, $(-c_3,-c_2,-c_7)$, $(0,-c_2,0)$, $(-c_3,0,c_6)$, $(0,0,0)$.

According to the hypotheses above and game combination strategies, the expected revenue of the regulator is:

$$\begin{aligned} E_{AY} &= YZ(-c_1+c_3)-Y(1-Z)c_1+(1-Y)Z(-c_1+c_3+c_4) \\ &\quad +(1-Y)(1-Z)(-c_1+c_4) \\ E_{AN} &= XYZ(-c_1+c_3)-XY(1-Z)c_1+X(1-Y)Z(-c_1+c_3+c_4) \\ &\quad +X(1-Y)(1-Z)(-c_1+c_4)-(1-X)Zc_3 \end{aligned}$$

The expected return of tourism enterprises:

$$\begin{aligned} E_{BY} &= -XZc_2-X(1-Z)c_2-(1-X)Zc_2-(1-X)(1-Z)c_2 \\ &= -[XZ+X(1-Z)+(1-X)Z+(1-X)(1-Z)]c_2 \\ &= -c_2 \\ E_{BN} &= -XYZc_2-XY(1-Z)c_2-X(1-Y)Zc_4-X(1-Y)(1-Z)c_4 \\ &\quad -(1-X)YZc_2-(1-X)Y(1-Z)c_2 \\ &= -Yc_2-X(1-Y)c_4 \end{aligned}$$

Expected benefits of users:

$$\begin{aligned} E_{CY} &= -XYc_7-X(1-Y)c_7-(1-X)Yc_7+(1-X)(1-Y)c_6 \\ &= -[X+(1-X)Y]c_7+(1-X)(1-Y)c_6 \\ E_{CN} &= -XYZc_7-X(1-Y)Zc_7-(1-X)YZc_7+(1-X)(1-Y)Zc_6 \\ &= -[XYZ+X(1-Y)Z+(1-X)YZ]c_7+(1-X)(1-Y)Zc_6 \end{aligned}$$

4. **Evolutionary Game Model Analyses.** By evolutionary game theory, if the fitness of a strategy or the payout is higher than the average fitness of the population, then the strategy will continue to evolve in the population. Therefore, the replication dynamic equation can be retrieved from the formula above.

The dynamic replication equation of the regulatory departments:

$$\begin{aligned} F(X) &= \frac{dX}{dt} = X(E_{AY}-E_{AN}) \\ &= X(1-X)[YZ(-c_1+c_3)-Y(1-Z)c_1+(1-Y)Z(-c_1+c_3+c_4) \\ &\quad -(1-Y)(1-Z)(-c_1+c_4)-Zc_3] \end{aligned}$$

The dynamic replication equation of tourism enterprises:

$$\begin{aligned} F(Y) &= \frac{dY}{dt} = Y(E_{BY}-E_{BN}) = Y[-c_2+Yc_2+X(1-Y)c_4] \\ &= Y(1-Y)(-c_2+Xc_4) \end{aligned}$$

The dynamic replication equation of users:

$$F(Z)=\frac{dZ}{dt}=Z(E_{CY}-E_{CN})=Z(1-Z)[(1-X)(1-Y)c_6-(X+Y-XY)c_7]$$

The equilibrium study of dynamic replication equations is shown as follows.

1) Regulatory departments equilibrium analysis

A. When $c_1 > c_4$ and $Z < 0.5$, the punishment from regulatory departments is less than the supervision fee and the probability of users publishing information is less than 0.5:

i) When $Y = \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) When $Y \neq \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$ can derive $X = 0$. $X = 1$ is a stability point of X. From $\frac{dF(X)}{dX} = (1-2X)[YZ(-c_1+c_3) - Y(1-Z)c_1 + (1-Y)Z(-c_1+c_3+c_4) - (1-Y)(1-Z)(-c_1+c_4) - Zc_3]$:

a) When $Y > \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} < 0$, thus $X = 1$ becomes the stability point.

b) When $Y < \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} < 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} > 0$, thus $X = 0$ becomes the stability point.

B. When $c_1 = c_4$ or $Z = 0.5$, the punishment from regulatory departments is equal to the supervision fee and the probability of users publishing information is equal to 0.5:

i) At $Y = 0$, $F(X) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) At $Y \neq 0$, $F(X) = 0$. $X = 0$ can be derived. $X = 1$ is a stability point of X. From $\frac{dF(X)}{dX} = -(1-2X)Yc_1$: when $y > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=0} < 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} > 0$, thus $X = 0$ is the stability point.

C. When $c_1 < \frac{1}{2}c_4$ and $Z < \frac{c_4-2c_1}{2(c_4-c_1)}$:

i) When $Y = \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) When $Y \neq \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$. $X = 0$ can be derived. $X = 1$ is the stability point of X. From $\frac{dF(X)}{dX} = (1-2X)[YZ(-c_1+c_3) - Y(1-Z)c_1 + (1-Y)Z(-c_1+c_3+c_4) - (1-Y)(1-Z)(-c_1+c_4) - Zc_3]$:

a) When $Y > \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} < 0$, thus $X = 1$ is the stable point.

b) When $Y < \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} < 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} > 0$, thus $X = 0$ is the stable point.

D. When $\frac{1}{2}c_4 \leq c_1 < c_4$ and $\frac{c_4-2c_1}{2(c_4-c_1)} \leq Z < 0.5$: when $Y > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=0} > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} < 0$, thus $X = 1$ is the stable point.

E. When $c_1 > c_4$ and $Z > \frac{2c_1-c_4}{2(c_1-c_4)}$:

i) When $Y = \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) When $Y \neq \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $F(X) = 0$. $X = 0$ can be derived. $X = 1$ is the stability point of X. From $\frac{dF(X)}{dX} = (1-2X)[YZ(-c_1+c_3) - Y(1-Z)c_1 + (1-Y)Z(-c_1+c_3+c_4) - (1-Y)(1-Z)(-c_1+c_4) - Zc_3]$:

a) When $Y > \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} > 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} < 0$, thus $X = 1$ is the stable point.

b) When $Y < \frac{(c_1-c_4)(1-2Z)}{c_1+(c_1-c_4)(1-2Z)}$, $\left.\frac{dF(X)}{dX}\right|_{X=0} < 0$, $\left.\frac{dF(X)}{dX}\right|_{X=1} > 0$, thus $X = 0$ is the stable point.

F. When $c_1 > c_4$ and $0.5 < Z < \frac{2c_1-c_4}{2(c_1-c_4)}$: when $Y > 0$, $\frac{dF(X)}{dX}\Big|_{X=0} > 0$, $\frac{dF(X)}{dX}\Big|_{X=1} < 0$, thus $X = 1$ is the stable point.

2) Tourism enterprises equilibrium analysis

A. When $c_2 < c_4$, the supervision fee of the tourism enterprises is less than the punishment cost from regulatory departments:

i) When $X = \frac{c_2}{c_4}$, $F(Y) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) When $X \neq \frac{c_2}{c_4}$, $F(Y) = 0$, $Y = 0$ can be derived. $Y = 1$ is the stability point of X. From $\frac{dF(Y)}{dY} = (1-2Y)(-c_2+c_4X)$:

a) When $X > \frac{c_2}{c_4}$, $\frac{dF(Y)}{dY}\Big|_{Y=0} > 0$, $\frac{dF(Y)}{dY}\Big|_{Y=1} < 0$, thus $Y = 1$ is the stable point.

b) When $X < \frac{c_2}{c_4}$, $\frac{dF(Y)}{dY}\Big|_{Y=0} < 0$, $\frac{dF(Y)}{dY}\Big|_{Y=1} > 0$, thus $Y = 0$ is the stable point.

B. When $c_2 = c_4$, the supervision fee of the tourism enterprises is equal to the punishment cost from regulatory departments:

i) When $X = 1$, $F(Y) = 0$. This means that all levels are at a stable stage, that is, no matter what strategies tourism enterprises and users adopt, the regulatory department will not adjust its strategy.

ii) When $X \neq 1$, $F(Y) = 0$, $Y = 0$ can be derived. $Y = 1$ is the stable point of X. From $\frac{dF(Y)}{dY} = (1-2Y)(-c_2+c_4X)$: when $X < 1$, $\frac{dF(Y)}{dY}\Big|_{Y=0} < 0$, $\frac{dF(Y)}{dY}\Big|_{Y=1} > 0$, thus $Y = 0$ is the stable point.

C. When $c_2 > c_4$, the supervision fee of the tourism enterprises is less than the punishment cost from regulatory departments. From $\frac{dF(Y)}{dY} = (1-2Y)(-c_2+c_4X)$, $\frac{dF(Y)}{dY}\Big|_{Y=0} < 0$, $\frac{dF(Y)}{dY}\Big|_{Y=1} > 0$, thus $Y = 0$ is the stable point.

3) Users equilibrium analysis

A. When $X = 1$ or $X = \frac{c_6}{c_6+c_7}$: $F(Z) = \frac{dZ}{dt} = Z(E_{CY} - E_{CN}) = -Z(1-Z)c_7$, $F(Z) = 0$ can derive $Z = 0$, $Z = 1$. From $\frac{dF(Z)}{dZ} = -(1-2Z)c_7$: $\frac{dF(Z)}{dZ}\Big|_{Z=0} < 0$, $\frac{dF(Z)}{dZ}\Big|_{Z=1} > 0$, thus $Z = 0$ is the stable point. In other words, when regulatory authorities implement supervision, users will choose not to release harmful information.

B. When $\frac{c_6}{c_6+c_7} < X < 1$, $(1-X)(1-Y)c_6 - (X+Y-XY)c_7 < 0$, thus $Z = 0$ is the stable point.

C. When $0 < X < \frac{c_6}{c_6+c_7}$ and $0 < Y < \frac{c_6-(c_6+c_7)X}{(c_6+c_7)(1-X)}$, $(1-X)(1-Y)c_6-(X+Y-XY)c_7 > 0$, thus $Z = 1$ is the stable point.

5. Conclusions and Recommendations.

In the new media age, the updating and replacement of online visual contents have become more rapid, which puts the attraction images in the state of being reconstructed by the society. Researchers can collect the visual representation of the attraction images in a certain period of time and adopt vertical research to discover the process of attraction images being dynamically constructed. The open tourism sharing community helps the tourism entrepreneurs receive authentic acknowledgement and attitude of those attractions from tourists. Researches can also take experimental methods, using visual materials from attraction officials or commercial channels as stimulators, to test potential tourists' response to the attraction images. This will encourage tourism operators to have more emotional resonance of the market and brand trust in the visual representation of the attractions, thus giving full play to the "soft power" of the attraction images.

Content audit system. This can effectively control the dissemination of information in an orderly and safe way. The editorial system needs to be strengthened in areas such as

pictures, words, and comments. If harmful information is found, such as pornography, violence, reactionary speech, and rumor, they need to be added to the backstage immediately to notify the user to remove the information or directly block it. If illegal information mentioned above is distributed in publication, a message of "fail to send, please check again" needs to be sent; If the information is published, it needs to be removed and the user should receive a warning. In addition to strengthening the supervision of content, it is also necessary to seriously and immediately deal with complaints about violations and initiate the public to supervise false information on their own.

Self-disciplined users in initiation. A committee of self-regulatory commissioners would better monitor the dissemination and operation; representatives from the network security office expressed that they would try to guide Internet users to resist harmful information on their own.

REFERENCES

[1] G. P. Cachon and S. Netessine, Game theory in supply chain analysis, *Tutorials Operations Research Informs – New Orleans*, pp.1-34, 2005.

[2] Y. A. Luo, Coopetition perspective of global competition, *Journal of World Business*, vol.42, no.1, pp.129-144, 2007.

[3] Y. Zhang, J. Qi, J. Ma and B. Fang, Network public opinion and unconventional emergencies, mechanism of action: Modeling and analysis based on system dynamics, *Intelligence Magazine*, vol.29, no.9, pp.1-6, 2010.

[4] Y. Lan and X. Deng, Research on the evolution law model of network public opinion of emergent events, *Intelligence Magazine*, vol.30, no.8, pp.47-50, 2011.

[5] S. Friederike, U. Sonja and G. Anja, Is the medium the message? Perceptions of and reactions to crisis communication via twitter, blogs and traditional media, *Public Relations Review*, vol.37, pp.20-27, 2011.

[6] Q. Zhang, J. Wu and C. Wu, A study on the evolution of network public opinion crisis based on enterprise pollution behavior: A case study of environmental events, *Intelligence Magazine*, vol.31, no.10, pp.53-58, 2012.

[7] W. Fang, L. He and L. Song, Research on prediction modeling and simulation of public opinion spread on Internet, *Computer Science*, vol.39, no.2, pp.203-205, 2012.

[8] C. Tang, An empirical study on the evolution of Internet emotion, *Intelligence Magazine*, vol.31, no.10, pp.48-52, 2012.

[9] P. Jin, The rumor spreading and eliminating in micro-blog, *Editorial Friend*, no.4, pp.41-44, 2013 (in Chinese).

[10] Y. Yang, J. Li, B. Liu and X. Kong, Research on driver's choice behavior based on evolutionary game model of improved replication dynamics, *International Journal of Innovative Computing, Information and Control*, vol.14, no.4, pp.1537-1544, 2018.

[11] G. M. Chen, Tweet this: A uses and gratifications perspective on how active Twitter use gratifies a need to connect with others, *Computers in Human Behavior*, vol.27, no.2, pp.755-762, 2011.