

The Sustainable Interaction Analysis of Cause Marketing and Ethical Consumption in Electric Business Platform: Based on Game Theory and Simulation Analysis

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Abstract. Based on evolutionary game theory and simulation analysis, the paper studies the sustainable interaction of cause marketing in electronic business platform, which constructs the evolutionary game model of cause marketing and ethical consumption, and studies the existence and stability of the equilibrium in the four situation interaction system, and also verifies results by Netlogo. The main contributions are that ethical consumption is the precondition of sustainable cause marketing development, reducing costs is the key to promote sustainable interaction development, electric business platform should vigorously promote social responsibility consciousness, and promote the policy support. Finally the paper constructs the theory frame for the realization of benign sustainable interaction.

Keywords: Cause marketing · Ethical consumption · The evolutionary game model · Simulated analysis

1 Introduction

In recent years, the development rate of China's e-commerce is 2–3 times of GDP (7% 9%). China's B2C online shopping market deals reached 609.67 billion yuan in the second quarter of 2016. With the rise of e-commerce, the businessman tried to introduce a cause marketing methods to get more customers focus on their homogeneous products, for example, some businesses join the public welfare plan of Taobao platform. Cause marketing dated from the public welfare activity of "Renovation of the statue of liberty" by the cooperation of American Express Company and Alice Island Foundation, and then it obtained the widespread attention and development. Nowadays, more and more traditional corporations have been successfully performed the corporate social responsibility by the form of cause marketing. The cause marketing is not only contributing to society, but also obtaining the business interests [1, 8], for example, the cause marketing activity of "buy a bottle of water, donate a penny" improved Nongfu

spring's product sales, and Nongfu Spring raised more than 5 million yuan, 361° "ONE CARES ONE" also promoted sales of especially-made shoes and expanded brand influence. Cause marketing, also known as charity Marketing or cause-related Marketing, is a special form of donation. It depends on the purchasing behavior of consumers, and donates the amount of a certain percentage of business to the special public welfare project. Cause marketing has become one of the important way of charity enterprises to perform social responsibility in many countries. Cause marketing can promote sales, social responsibility image and brand awareness [9, 13]. In E-commerce platform, corporations, which successfully continue to push the cause marketing, not only can achieve the aim of marketing businesses, but also can effectively promote the healthy development of Chinese social and economic. However, focusing on E-commerce situation, businesses joined the cause marketing activities in E-commerce platform, and didn't get a good response of consumers.

From the practice experience of western countries, the benign interaction between the enterprise and the consumer is the key to successfully propel the corporate social responsibility [12]. The concept of ethical consumption is that consumers not only consider the commercial value of product, but also consider the beneficial impact of their purchasing behavior on society, environment, and so on [5], that effectively promote the corporate cause marketing to fulfill the social responsibility better. The sustained interaction of cause marketing and ethical consumption can ensure that businessmen get more consumer approval ratings in order to cover cost and promote sales and corporate image. According to the survey in U.S. market, 78% of consumers are willing to buy products with cause marketing, 66% of consumers willing to switch brands to support cause marketing [3], and 96.6% consumers also incline to choose homogeneous products with good corporate social image [6] in China market. However, consumers are also "rational economic man". Because of the higher perceived risk in the E-commerce platform, consumers are not willing to fulfill the ethical consumption with much cost in order to balance the benefit and the cost [11], so there is often the inconsistent phenomenon about the consumer ethical attitude and behavior.

The relationship researches of cause marketing and ethical consumption mainly focus on two aspects: the first is the relationship of cause marketing and ethical consumption based on the investigation method and experiment method [1, 9], the second is the cause of the inconsistent about consumers' ethical attitude and behavior based on the interview and other qualitative methods [2]. However, few scholars' researches focus on the interaction mechanism, especially the research of systemic balance and dynamic evolution in the E-commerce platform. It belongs to a kind of gambling behavior that cause marketing and ethical consumption. This research constructs the evolutionary game model based on evolutionary game theory and systematically explores the evolution rules. The research result not only enriches the existing theory research of cause marketing and ethical consumption, but also provides valuable advice on sustainable promoting the cause marketing and ethical consumption in the E-commerce platform.

2 Evolutionary Game Model Building

Evolutionary game theory emphasizes the dynamic equilibrium. It can real reaction behavior diversity and complexity of the body combined the game theory analysis and the dynamic evolution process analysis [7, 10]. Based on evolutionary game theory, this research adopts the method that two kinds of group repeated game and replication dynamic evolutionary game, and puts forward the evolutionary game model to research like the assumptions:

Hypothesis 1: The two types of players are businesses and consumers in the E-commerce platform, and they are the rational “economic individuals”. The businesses behavior sets are cause marketing and non cause marketing and the consumers behavior sets are ethical consumption and unethical consumption.

Hypothesis 2: The proportion of businesses with cause marketing is x , and the other is $1 - x$; the proportion of consumers with ethical consumption is y , and the other is $1 - y$.

Hypothesis 3: The product is homogeneous, the product cost for cause marketing is C_1 and product sales price is P_1 , The endogenous utility, the brand image and perceived social contribution and so on, and the E-commerce platform support utility are F ; the product cost for non cause marketing is C_2 and product sales price is P_2 , and C_1 is higher than C_2 .

Hypothesis 4: The social responsibility consciousness of consumers is strengthened with the development of society, the ethical consumption not only meets the basic demand for products, but also makes consumers additional utility of social contribution, the utility is V , and K is the additional cost that consumers need to pay higher for ethical consumption than unethical consumption.

Based on the above assumptions, businesses’ revenue is as follows:

- (1) When businesses adopt cause marketing and consumers adopt ethical consumption, businesses’ revenue is $P_1 - C_1 + F$;
- (2) When businesses adopt cause marketing and consumers adopt unethical consumption, businesses’ revenue is $-C_1 + F$;
- (3) When businesses adopt non cause marketing and consumers adopt ethical consumption, businesses’ revenue is $-C_2$;
- (4) When businesses adopt non cause marketing and consumers adopt unethical consumption, businesses’ revenue is $P_2 - C_2$.

Consumers’ revenue is as follows:

- (1) When consumers adopt ethical consumption and businesses adopt cause marketing, consumers’ revenue is $V - K$;
- (2) When consumers adopt ethical consumption and businesses adopt non cause marketing, consumers’ revenue is $-V$;
- (3) When consumers adopt unethical consumption and businesses adopt cause marketing or non cause marketing, consumers’ revenue is 0. Payoff matrix for gaming revenue are shown in Table 1.

Table 1. Payoff matrix for gaming revenue about businesses and consumers.

	Type	Consumers	
		Ethical consumption (y)	Unethical consumption ($1 - y$)
Businesses	Cause marketing (x)	$P_1 - C_1 + F, V - K$	$-C_1 + F, 0$
	Non cause marketing ($1 - x$)	$-C_2, -V$	$P_2 - C_2, 0$

Expected returns of cause marketing and non cause marketing respectively are U_0^1, U_0^2 , the average return of businesses is \bar{U}_0 :

$$U_0^1 = y(P_1 - C_1 + F) + (1 - y)(-C_1 + F) = yP_1 - C_1 + F, \tag{1}$$

$$U_0^2 = y(-C_2) + (1 - y)(P_2 - C_2) = (1 - y)P_2 - C_2, \tag{2}$$

$$\bar{U}_0 = xU_0^1 + (1 - x)U_0^2. \tag{3}$$

Expected returns of ethical consumption and unethical consumption respectively are U_1^1, U_1^2 , the average return of consumers is \bar{U}_1 :

$$U_1^1 = x(V - K) + (1 - x)(-V) = x(2V - K) - V, \tag{4}$$

$$U_1^2 = x \cdot 0 + (1 - x) \cdot 0 = 0, \tag{5}$$

$$\bar{U}_1 = yU_1^1 + (1 - y)U_1^2. \tag{6}$$

According to the above expressions, we can know the replicated dynamic equations respectively are:

$$\dot{x} = \frac{dx}{dt} = x(U_0^1 - \bar{U}_0) = x(1 - x) [y(P_1 + P_2) + F - C_1 - P_2 + C_2], \tag{7}$$

$$\dot{y} = \frac{dy}{dt} = y(U_1^1 - \bar{U}_1) = y(1 - y) [x(2V - K) - V]. \tag{8}$$

3 Evolutionary Game Model Analysis

3.1 Equilibrium Point and Stability Analysis

Make $\frac{dx}{dt} = 0$ and $\frac{dy}{dt} = 0$, based on results of replicated dynamic equation of the interaction between the businesses and the consumers, we can get five local equilibrium points: $(0, 0), (1, 0), (0, 1), (1, 1)$ and (p^*, q^*) , and

$$p^* = \frac{V}{2V - K}, \tag{9}$$

$$q^* = \frac{C_1 - F + P_2 - C_2}{P_1 + P_2}. \tag{10}$$

Friedman proposed that the stability of the equilibrium point of the evolution system can be obtained from the local stability analysis of the jacobian matrix (denoted by J) [4]. The jacobian matrix by the combination of Eqs. (7) and (8):

$$J = \begin{pmatrix} \frac{\partial \dot{x}}{\partial x} & \frac{\partial \dot{x}}{\partial y} \\ \frac{\partial \dot{y}}{\partial x} & \frac{\partial \dot{y}}{\partial y} \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}, \tag{11}$$

and

$$a_{11} = (1 - 2x) [y(P_1 + P_2) + F - C_1 - P_2 + C_2], \tag{12}$$

$$a_{12} = x(1 - x)(P_1 + P_2), \tag{13}$$

$$a_{21} = y(1 - y)(2V - K), \tag{14}$$

$$a_{22} = (1 - 2y) [x(2V - K) - V]. \tag{15}$$

Thus, we can get the numerical results about a_{11} , a_{12} , a_{21} and a_{22} under the five local equilibrium points, the results are shown in Table 2.

Table 2. The numerical results about a_{11} , a_{12} , a_{21} and a_{22} under the five local equilibrium points.

Equilibrium point	a_{11}	a_{12}	a_{21}	a_{22}
(0, 0)	$F - C_1 - P_2 + C_2$	0	0	$-V$
(1, 0)	$-F + C_1 + P_2 - C_2$	0	0	$V - K$
(0, 1)	$P_1 + F - C_1 + C_2$	0	0	V
(1, 1)	$-P_1 - F + C_1 - C_2$	0	0	$K - V$
(p^*, q^*)	0	A	B	0

And the expressions of A and B respectively are:

$$A = \frac{V}{2V - K} \left(1 - \frac{V}{2V - K}\right) (P_1 + P_2), \tag{16}$$

$$B = \frac{C_1 - F + P_2 - C_2}{P_1 + P_2} \left(1 - \frac{C_1 - F + P_2 - C_2}{P_1 + P_2}\right) (2V - K). \tag{17}$$

When the jacobian matrix satisfies the following conditions of the determinant value (denoted by $\det J$) and trace value (denoted by trJ), the local equilibrium of system is the stability and can be the evolutionary stable strategy (denoted by ESS).

Condition 1:

$$\det J = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11}a_{22} - a_{12}a_{21} > 0, \tag{18}$$

Condition 2:

$$trJ = a_{11} + a_{22} < 0. \tag{19}$$

Obviously, when the local equilibrium of system is (p^*, q^*) , $a_{11} + a_{22} = 0$ do not meet condition 2, so it is not as ESS. The study needs to discuss the possibility that four local equilibrium points become ESS from different situations in the plane of $N = \{x, y | 0 \leq x, y \leq 1\}$.

3.2 Result Discussion

Case 1: When $F > C_1 + P_2 - C_2$ and $V > K$, the stability of four local equilibrium points is as the Table 3 shown. We can get the ESS when $(1, 1)$ satisfies the conditions of $\det J > 0$ and $trJ < 0$.

Table 3. The stability analysis of local equilibrium point when $F > C_1 + P_2 - C_2$ and $V > K$.

Equilibrium point	$\det J$	trJ	Stability
$(0, 0)$	-	Indeterminacy	Saddle point
$(1, 0)$	-	Indeterminacy	Saddle point
$(0, 1)$	+	+	Instability point
$(1, 1)$	+	-	ESS

Case 2: When $F < C_1 + P_2 - C_2$ and $V > K$, the stability of four local equilibrium points is as the Table 4 shown, We can get the ESS when $(0, 0)$ and $(1, 1)$ satisfy the conditions of $\det J > 0$ and $trJ < 0$.

Table 4. The stability analysis of local equilibrium point when $F < C_1 + P_2 - C_2$ and $V > K$.

Equilibrium point	$\det J$	trJ	Stability
$(0, 0)$	+	-	ESS
$(1, 0)$	+	+	Instability point
$(0, 1)$	+	+	Instability point
$(1, 1)$	+	-	ESS

Case 3: When $F > C_1 + P_2 - C_2$ and $V < K$, the stability of four local equilibrium points is as the Table 5 shown, We can get the ESS when $(1, 0)$ satisfy the conditions of $\det J > 0$ and $trJ < 0$.

Case 4: When $F < C_1 + P_2 - C_2$ and $V < K$, the stability of four local equilibrium points is as the Table 6 shown, We can get the ESS when $(1, 0)$ satisfy the conditions of $\det J > 0$ and $trJ < 0$.

Table 5. The stability analysis of local equilibrium point when $F > C_1 + P_2 - C_2$ and $V < K$.

Equilibrium point	$detJ$	trJ	Stability
(0, 0)	–	Indeterminacy	Saddle point
(1, 0)	+	–	ESS
(0, 1)	+	+	Instability point
(1, 1)	–	Indeterminacy	Saddle point

Table 6. The stability analysis of local equilibrium point when $F < C_1 + P_2 - C_2$ and $V < K$.

Equilibrium point	$detJ$	trJ	Stability
(0, 0)	+	–	ESS
(1, 0)	–	Indeterminacy	Saddle point
(0, 1)	+	+	Instability point
(1, 1)	–	Indeterminacy	Saddle point

4 Netlogo Simulation Modeling and Analysis

The study validates and analyzes the stability of equilibrium points with the aid of Netlogo modeling and simulation in the four situations. Netlogo is developed by the center of connectionist learning and computer modeling in northwestern university. It is based on multi-agent modeling, multi-agent parallel and asynchronous updating, and the whole system is dynamic with time. It can well study the macroscopic patterns of micro-individual interaction, and is especially suitable for modeling and simulating complex systems with time evolution. Based on the analysis of the stability of the equilibrium point in the evolutionary game model, this study sets the payment matrix from four cases and performs simulation verification and analysis. The horizontal axis represents the simulation time and the vertical axis represents the ratio that the number of subjects to the total number of game strategy in the simulation results chart. X_1Rate and Y_1Rate respectively are the cause marketing rate and ethical consumption rate, and the initial ratio is 1/2.

Case 1: From the stability analysis result of the replicated dynamic equation, (1,1) is ESS when $F > C_1 + P_2 - C_2$ and $V > K$. The study substitutes $F = 8$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$ and $K = 1$ into the simulation model, and the simulation result is as shown in Fig. 1.

The simulation results validate the deduction of the replicated dynamic equation. The evolution result is an ideal phenomenon that businesses, consumers and electric business platform are involved in social responsibility behavior. Consumers need to pay additional costs, but the additional utility of social contribution is always greater than the additional costs paid, consumers still choose ethical consumption strategy; cause marketing strategy will increase the cost

of income, but a strong sense of social responsibility and good support and encouragement of electric business platform will increase the business additional benefits, so businesses still prefer to cause marketing strategy. Responsibility behavior of businesses and consumers will enter a good time of continuous interactive development.

Case 2: From the stability analysis result of the replicated dynamic equation, (1,1) and (0,0) are ESS when $F < C_1 + P_2 - C_2$ and $V > K$. The study respectively substitutes $F = 4$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$ and $K = 1$ and $F = 1$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$ and $K = 0.5$ into the simulation model, and the simulation result is as shown in Figs. 2(a) and 3(a).

The simulation results validate that there are two kinds of behavior patterns in the evolution system, namely [cause marketing, ethical consumption] and [non cause marketing, unethical consumption]. When the benefits from a good corporate brand image and self-perception of social contributions and commercial policy benefits make up for the loss of profits due to cause marketing, businesses will still choose cause marketing. Consumers, compensated for the additional cost, will still choose the ethical consumption strategy, so businesses and consumers are in a benign behavioral interaction process. When the additional benefits of cause marketing can not make up for the loss of profits, the system will quickly move toward a vicious direction: businesses will choose non cause marketing strategy, consumers will choose unethical consumption strategy. Social responsibility awareness of businesses and consumers is low and the system fails to achieve the sustainable social interaction due to lack of awareness and support of electric business platform.

Case 3: From the stability analysis result of the replicated dynamic equation, (1,0) is ESS when $F > C_1 + P_2 - C_2$ and $V < K$. The study substitutes $F = 8$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$ and $K = 4$ into the simulation model, and the simulation result is as shown in Fig. 4.

The simulation results validate that businesses will still keen on cause marketing although they can not sell products when the additional effect is greater than the sum of non cause marketing profits and the cause marketing cost. Consumers, as “economic man”, can not pay too much extra expense for ethical consumption, and finally give up ethical consumption. The stability of system is based on policy support of the electric business platform and businesses own economic interests, if the electronic business platform reduce support and the economic benefits can not make up for cause marketing cost, then the system will be rapidly unbalanced.

Case 4: From the stability analysis result of the replicated dynamic equation, (0,0) is ESS when $F < C_1 + P_2 - C_2$ and $V < K$. The study substitutes $F = 1$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$ and $K = 4$ into the simulation model, and the simulation result is as shown in Fig. 5.

The simulation results validate that consumers can not use the extra utility of ethical consumption to make up for the extra cost, so they abandon the ethical consumption, and gradually choose unethical consumption through game learning. Although businesses get a certain income because of cause marketing,

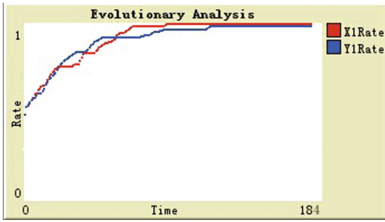


Fig. 1. The simulation result ($F = 8$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$, $K = 1$)

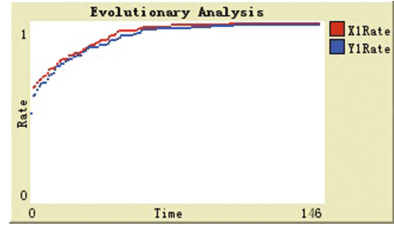


Fig. 2. The simulation result ($F = 4$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$, $K = 1$)

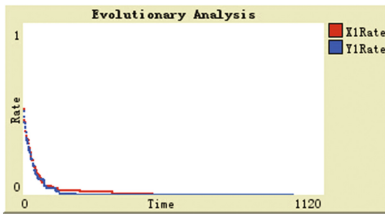


Fig. 3. The simulation result ($F = 1$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$, $K = 0.5$)

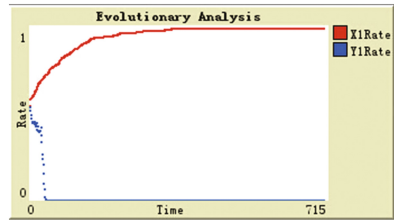


Fig. 4. The simulation result ($F = 8$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$, $K = 4$)

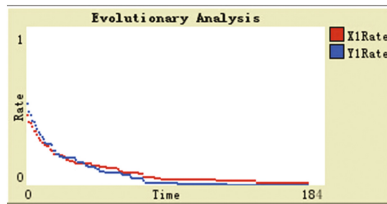


Fig. 5. The simulation result ($F = 1$, $C_1 = 4$, $P_2 = 5$, $C_2 = 2$, $V = 3$, $K = 4$)

businesses finally take non cause marketing strategy in order to sell products for profit without ethical consumption support, so the system will evolve to a vicious direction, and will be rapidly unbalanced.

5 Conclusion and Suggestion

From the perspective of evolutionary game, this paper uses replication dynamic evolutionary game method and Netlogo numerical simulation to analyze the sustainable interaction mechanism between cause marketing and ethical consumption, and obtains the positive and sustainable interaction conditions of cause marketing and ethical consumption.

- (1) Ethical consumption is a prerequisite for the sustainable development of cause marketing. It's the safeguard for the sustainable development of cause marketing that consumers are willing to ethical consumption. Consumer cost affects choices of consumer behavior, low level of social responsibility awareness will directly increase the support burden of electric business platform to cause marketing, can not guarantee the product sales and achieve the good interaction of cause marketing and ethical consumption. Therefore, electronic business platform and businesses should implement the cause marketing, increase the cause marketing publicity to enhance consumer awareness of social responsibility, while reducing the time cost that consumer understand the specific content of cause marketing.
- (2) Reducing cost is the key to promote sustainable development of cause marketing. Cause marketing cost is directly related to the sustainable interactive development of cause marketing and ethical consumption. Businesses should work from two aspects: First, reduce the cause marketing cost. The price of cause marketing product is not necessarily the same as the price of non cause marketing product, but it can not exceed the maximum afforded range of ethical consumption. The price should be combined with consumer's sense of social responsibility, at the same time, businesses should use other ways to reduce cause marketing cost. Second, businesses should indirectly reduce consumer ethical consumption cost. Businesses should accurately analyze consumer behavior, so as to accurately put cause marketing for advertising, really more convenient for consumers to understand the specific content of cause marketing, thereby reducing consumer spending on the time and other additional costs, better to achieve sustainable interaction of cause marketing and ethical consumption.
- (3) Electronic business platform should vigorously promote the sense of social responsibility and promote the platform policy support. Businesses, as "economic man", always want their own additional endogenous utility and electric platform support for cause marketing to make up for opportunity cost and accounting cost. The platform should guide businesses to enhance the sense of social responsibility, so that the maximum expectation of policy support defined in the reasonable range of C1-C2. The specific work can be implement from two aspects: First, increase social responsibility propaganda. Only relying on the platform support policy is unable to maintain the sustainable development of cause marketing. Its important to increase the effectiveness of business and consumer social responsibility that improve the social responsibility sense in the electric business platform. Electric business platform should actively promote social responsibility concept to improve social responsibility awareness of businesses and consumers in order to increase the effectiveness of social responsibility. Second, improve the social responsibility incentive mechanism. Cause marketing will increase the cost of investment, electric business platform should speed up the development of policy incentives and other business incentives, to a certain extent make up the cost burden of business social responsibility, to better promote the sustainable development of cause marketing.

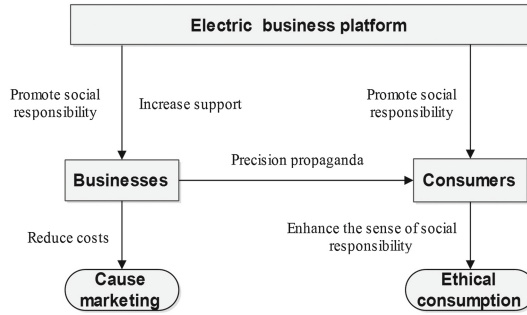


Fig. 6. The theoretical framework for the realization of benign and sustainable interaction.

Based on the above conclusions, this paper constructs a theoretical framework for the realization of benign and sustainable interaction between cause marketing and ethical consumption, as shown in Fig. 6:

Acknowledgements. This paper is supported by the General Project of the National Natural Science Foundation of China “The Mechanism of Effect of Corporate Social Responsibility Behavior on the Image of Scandal Brand and Strategy Research” (No. 71372189).

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