Managing Online Trade by Reputation Circulation: An Agent-Based Approach to the C2C Market

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Abstract

E-commerce faces a problem due to the risks inherent in C2C online trading. The most common worry is how to ensure that the buyer pays for the goods and the seller sends the goods to the buyer. Online trading has the features of anonymity and facility in participation or leaving. Therefore, a system for managing risk in the e-commerce market would very desirable. In this paper, we focus on online trading among consumers. In a traditional market, a law or a third-party service manages risk, but in this case, the traditional systems have limits. Ease of participation, low cost, and time lag when exchanging goods for money are characteristics typical of online trading. In these transactions, one has to worry about “free riders” within a community and lack of cooperation. We propose that the method of addressing these problems is explicit reputation circulation.

1. Introduction

We deal with the problem of how the market should manage the risks of trading without third-party services. An example of online trading among consumers is an auction site on the Internet. In this type of market, the risk is significant for the individuals involved in the trades. Necessarily, no committee within these markets can adequately check participants’ profiles for a history of abuse of the privileges granted to them. Thus, how do present systems for managing risk and fostering trust work in the market?

In this paper, we propose that the reputation of the participants can be used to manage the risk of trade. We describe a reputation management system that distributes "reputation" information to its participants. We discuss general approaches to managing risk in online markets. Then we develop an operational model for simulating online markets and discuss the effectiveness of our reputation management system.

Next, we survey the current reputation management systems that manage online markets and communities. EBay (www.ebay.com) is an enterprise that provides consumers with a means of conducting their own auctions. On eBay, the transaction history of each seller and buyer and the degree of satisfaction are exhibited for every transaction. The reputation of the participant is clearly shown through this mechanism. This system gives an incentive to participants to cooperate and ensure the quality of goods traded. In the economics of information field, economists have argued about the role of reputation. They have regarded a reputation as a quality guarantee in the market where imperfect information exists. However, reputation is not only a quality guarantee but also a driving force for an efficient knowledge market and currency in the pricing mechanism of the knowledge market. Davenport (1997) suggested that being a good knowledge seller makes one a more effective knowledge buyer. It is

necessary to make a participant recognize that supplying questions and replies to a market is useful to oneself. Chienowa.com and K-square have built a knowledge market on the Internet that has introduced an explicit market.

We believe that explicit circulation of reputation is needed to guarantee effective functioning of online trading among consumers.

2. Emergence of Trust in C2C Transactions

We review types of online transactions on Internet to discuss emergence of trust on C2C transactions. Based on the review we discuss the necessity of a reputation management system for online transactions.

There are two types of trust management systems: a top-down type (e.g., a trusted third party) and a bottom-up type (e.g., sharing reputation information). We will discuss them in 2.2 and 2.3, respectively, and argue that the bottom-up type is more effective than the top-down type.

2.1 Online Transactions

In an online transaction, a business organization or firm (B) and a consumer (C) are the main participants. The most successful and popular type of online transaction is between business organizations (B2B), such as the supply chain management (SCM) system. There are few changes of function in B2B transactions on the Internet, except cost, compared to none in transactions used private lines before the Internet era.

A second type of transaction is between a business organization and a consumer (B2C). Popular examples include bank transactions and online ticket shops because they deal in information goods rather than physical goods. Standardized goods (e.g., books and music CDs) are also popular within online transactions. Amazon.com is one of the most successful examples. As the example shows, B2C transactions have been changing due to the Internet. This new type of retailer known as "Click & Mortar," which means an Internet-powered retailer, has emerged.

Distributors have also changed as much as retailers. For example, Dell assembles a computer on demand by a consumer. It is an example of a direct transaction between a maker and a consumer, as well as an example of an intermediated transaction between computer parts suppliers and consumers. This new type of intermediary is known as an infomediary, which means an internet-powered intermediary (Hagel and Singer, 1999).

A third type of online transaction is between a consumer and a consumer (C2C), which had never been seen before the Internet era. Internet-based C2C transactions continue grow because networks have removed the constraints of distance and time and have provided opportunities for consumers to make deals with others (e.g., eBay and Yahoo auction in Japan).

We will discuss C2C online transactions because of the enormous impact of the Internet on this type of transaction. In online transactions, especially C2C transactions, the risk of cheating and fraud are great. Because of its consumers' anonymity, it is easy to enter into and exit from a online market. The characteristics of an online transaction create an incentive to obtain services, goods, or money without any reciprocation. The risk involved in such a situation can be thought of as a kind of prisoners' dilemma.

3. Modeling the C2C Online Market

To analyze and design a C2C online market, we developed a model based on an agent-based approach because its analysis and design require a detailed and dynamic explanation at the individual level in order to exhibit social phenomenon. Axelrod (1997) concluded that the effectiveness of an agent-based approach for analyzing mechanisms in which global phenomena emerge from local interactions between agents. Hence, we use the approach to describe C2C online transactions based on the framework of prisoners' dilemma and to find requisite conditions and market mechanisms for promoting cooperative behavior.

3.1 Prisoners' Dilemma in C2C Online Transactions

A player who participates in an C2C online transaction always has the incentive for non-cooperation (i.e., to cheat others), due to anonymity and the ease of entering and exiting from the transaction. On one hand, a buyer may accept goods from a seller without delivering payment. On the other

hand, a seller may accept payment from a buyer without delivering goods. Hence, the situation created in C2C online transactions is that of prisoners' dilemma.

In the simplest situation of prisoners' dilemma, there are two players (i.e., Player 1 and Player 2). They cannot communicate each other. Each player has two strategies: cooperation (C) and dis-cooperation (D). We can consider a payoff matrix for the situation, as shown in table 1.

Table 1: A payoff matrix for prisoners' dilemma

		Action of Player 2	
		C	D
Action of Player 1	C	S_1, S_2	W_1, B_2
	D	B_1, W_2	T_1, T_2

The necessary condition for prisoners' dilemma follows three inequalities (1):

$$\begin{cases} B_i > S_i > T_i > W_i \quad , i = 1,2 \\ 2S_1 > B_1 + W_1 \\ 2S_2 > B_2 + W_2 \end{cases} \qquad (1)$$

In the prisoners' dilemma of a C2C online transaction, the seller can take two methods of action:. cooperation with the buyer by delivering goods in exchange for payment, or dis-cooperation by accepting payment without delivering goods. The buyer can likewise cooperate or dis-cooperate by paying for goods or by accepting goods without delivering payment.

Under the circumstances, a participant who does not always cooperate could exploit a participant who always cooperates if there is no system to promote cooperation. We propose a reputation information management system for C2C online transactions as a solution.

3.2 Formulation of a Reputation Management System

In our model, an agent composes strategies of transaction, goods to sell, goods wanted, the range of acceptable difference between goods that a buyer wants and a seller has, the focus on reputation, and the length of history taken into account in decision-making. The strategies of transaction consist of cooperative strategy, non-cooperative strategy, tit for tat strategy, and random strategy.

Table 2: Elements of agent

Element	Types or meaning
Strategy of transaction	cooperative strategy, non-cooperative strategy, tit for tat strategy, and random strategy
Goods to sell	bit strings
Goods wanted	bit strings
Acceptable difference of characteristics between goods	Range of acceptable difference between goods that a buyer wants and a seller has
Focus on reputation	Balance between cooperative and non-cooperative actions in history for calculating the level of reputation.
Length of history	Length of history taken into account in decision–making

4. Simulation Experiment

Market flexibility is one of the most important factors in comparing an online transaction with a real-world transaction. In our model, it is described as the number of agents entering and exiting within a time period. The market situations of online transactions and real-world transactions can be described using the low values and high values of the parameter, respectively. The parameters concerning focus on reputation and length of history are characteristics of a reputation management system. Table 3 shows the parameters and their values.

Table 3: Parameters in experiment

Initial number of agents for each group of strategy	25
Duration	100 periods
Number of characteristics of goods	5 bits
Varieties of each characteristic	5 bits
Acceptable difference of characteristics between goods	10 bits
Focus on reputation	Operational parameter
Length of history	Operational parameter
Number entering and exiting	Operational parameter

To find an effective strategy under each parameter, we observed a population in a group for each strategy. The size of the population measures effectiveness of the strategy under each condition.

Explicit reputation circulation among buyers and sellers is effective in increasing the number of cooperative agents and decreasing the number of non-cooperative agents.

Figure 1 shows the trajectories of population for four groups when the number entering and exiting is low and focus on reputation is negative (α=0). This figure illustrates the effectiveness of cooperative strategy. Figure 2 shows the trajectories of population when the number entering and exiting is high and focus on reputation is negative (α=0). This figure illustrates the effectiveness of non-cooperative strategy. However, a positive reputation system can help cooperative participants. Figure 3 shows the trajectories when the number entering and exiting is high and focus on reputation is positive (α=1).

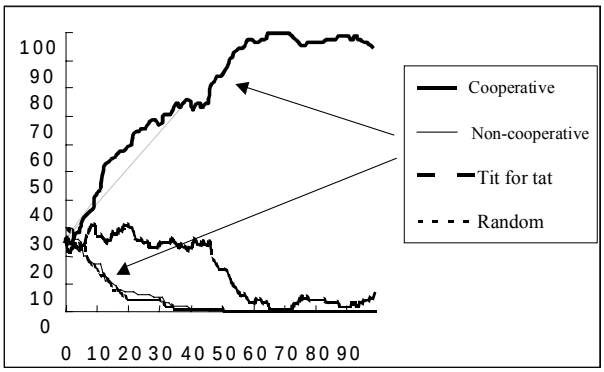

Figure 1: Trajectories of population with slow turnover rate and on negative reputation system

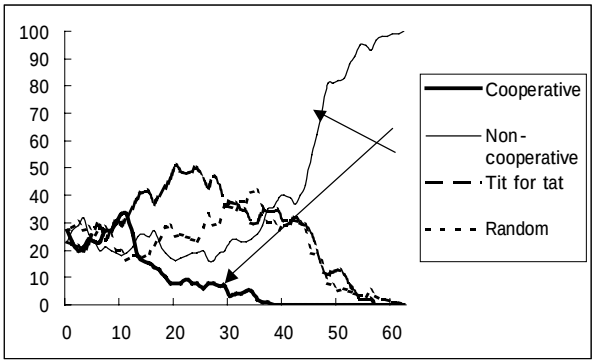

Figure 2: Trajectories of population with high turnover rate and on negative reputation system

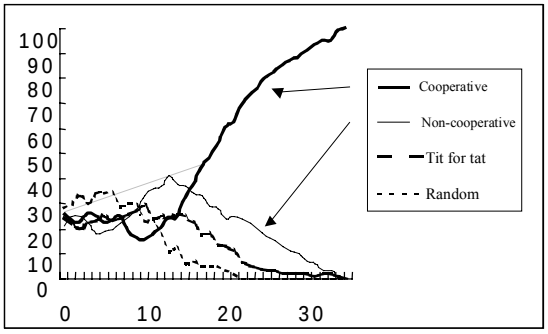

Figure 3: Trajectories of population with high turnover rate and on positive reputation system

5. Conclusion

Using an agent-based model for our logical and virtual experiment, we showed the effectiveness of sharing information concerning the reputation of participants in C2C online transactions to promote cooperative actions. In such a high turnover rate market, a positive reputation system can be more effective than a negative reputation system. This means that we need a new framework to design institutions for the online transaction market, instead of the traditional framework designed to punish criminals. Moreover, it means that branding strategies will become more important in online markets than in traditional markets.

However, a positive reputation system faces the problem that a new participant cannot make deals with others due to lack of reputation information. As a result, we observed the ineffectiveness of a positive reputation system on occasion. We will invent a new method to avoid the problem in future research.

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