

The Design of Intermediary Mechanism in E-Commerce Trust-Building and Solutions to Its Realization Condition

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ABSTRACT

Trust risk has become one of the main barriers to online trading, and how to design an effective trust-building mechanism has become the key to the further development of e-commerce. According to e-commerce's character of systematic trust and cause of risk, an online trading stage game model revolving intermediary organization is established, and corresponding optimal behavior chain is constructed; based on this, find solutions to the realization condition of optimal behavior chain, and disclose the relationship between parameters required by an effective intermediary mechanism in e-commerce trust-building. This study shows: the price of digital ID and fine coefficient to the fraud are two key parameters in the operation of intermediary mechanism; the condition for effective operation of intermediary mechanism is that the price of digital ID is less than or equal to the discount value of honest income expectation in each game stage, and the fine coefficient to the fraud is less than or equal to the ratio of expectation present value of honest income in each game stage to the maximum of average social interests.

Keywords: E-commerce, Intermediary organization, Game

1 INTRODUCTION

E-commerce is an important microcosmic base for information society, however, its characters such as anonymity, information asymmetry, and changeability of online identity lead to trust risk that has puzzled e-commerce in a long time, and the trust risk has become main barrier to the further development of e-commerce. According to a study^[1], in United States whose e-commerce is relatively developed, the situation of trust fraud is going more and more serious; take online auction market for example, the average loss per person increased from \$310 in 1999 to \$518 in 2001, and it hit record high again to be \$2033 in 2005. Thus, how to design a set of effective, feasible trust-building mechanism has become the key to the further development of e-commerce, and this paper tries to discuss this from the aspect of trust intermediary.

2. DESIGN OF INTERMEDIARY MECHANISM IN E-COMMERCE TRUST-BUILDING

2.1 Basic Tools for the Design of Intermediary Mechanism

Digital ID is the most basic tool in the operation of intermediary mechanism in e-commerce trust-building. In the process of releasing and managing digital ID by intermediary organizations, characters such as criterion, rigidity, authority and promptitude are the key to the buildup of intermediary mechanism in e-commerce trust-building.

2.1.1 Digital ID

Digital ID is released by e-commerce trust intermediary organizations and is based on public key encryption and digital signature technology. It is a digitalized identity

description and certificate and is used to verify every bargainer's identity in online trading. It is tied to a natural person or entity organization. The main information include: holder's name or title, public key and any other information that can uniquely identify the holder; it is hard for the holder to change his identity in online trading.

2.1.2 Release and Management of Digital ID

By building up trust database, releasing digital ID, trust intermediary organization serves as both information retainer and information disseminator. Digital ID can be only released through rigid certification program, that is, intermediary organization has verified information provided by applicant and traced back his history to make sure he can not change his online identity, or even if he could change, there were record on digital ID. Thus, online bargainer is always tied to a natural person or entity organization in real world, so he can not change easily.

Any person with a valid digital ID can be considered to be an honest bargainer, that means he has never been dishonest in previous e-commerce trading, or even if he had been dishonest, he paid fine judged by intermediary organization. An intermediary organization is not an administrative organization and it can not put teeth in fining, thus, paying fine judged by an intermediary organization is a volunteer behavior. However, if a bargainer had dishonest behavior, say, a person didn't pay fine judged by intermediary organization due to selling dummy or not paying for goods on time, then his digital ID would be declared invalid or cancelled by intermediary organization. That means he is a dishonest online bargainer, and these information will be sent to intermediary organization and online trust database for queries from potential trading partners, thus make him lose lots of potential trading partners and opportunities.

Based on this, a further problem is how online bargainer chooses to change his behavior after intermediary organization engaged in e-commerce exchange. First of all, it revolves the process that intermediary organization engages in e-commerce trading, and the essence is e-commerce stage game revolving intermediary organization.

2.2 E-Commerce Stage Game Revolving Intermediary Organization

2.2.1 Basic Hypothesis

In order to simplify discussion, make following assumptions about e-commerce trade environment revolving intermediary organizations and its relevant parameters:

- (1) There are only two bargainers in e-commerce market, all of online bargainers are rational economic man, and intermediary organization is honest;
- (2) Game between online bargainers is static game;
- (3) Information is complete in game between online bargainers;
- (4) Trust behavior in online trading is discrete, that is, exist two types of behavior choices: honesty and fraud

2.2.2 E-Commerce Trade Stage Game Model Revolving Intermediary Organization

According to previous assumptions, abstract e-commerce trade process revolving intermediary organization as several sequential stages or steps.

Table 1 Strategies and Payoff for e-commerce stage game

		Buyer	
		Honesty	Fraud
Seller	Honesty	π_t, π_t	$-h\pi_t, (1+d)\pi_t$
	Fraud	$(1+d)\pi_t, -h\pi_t$	$0, 0$

Step1: before online bargainer engages in e-commerce trade, he might apply for purchasing a digital ID from intermediary organization, and its price is assumed to be P .

Step2: when online bargainers meet on the net, they are likely to ask each other to provide digital ID released by intermediary organization. Meanwhile, given at no cost, online bargainers might verify validity of trade partners' digital IDs through intermediary organization: trade partner has never lost trust in previous e-commerce trade, or even if he has had fraud, he paid fine judged by intermediary organization.

Step3: online bargainers make decisions about own behaviors through mutual game. Table1 illustrates online bargainers' strategy choices and payoff. The first figures in each column showed in table1 refer to corresponding payoff when online seller chooses behaviors, and the second figures refers to corresponding payoff when online buyer chooses behaviors. h and d are positive constant coefficients, and they are separately defined as symmetrical honesty-benefit coefficient and fraud-benefit coefficient in online trade. Assume π_t is random variable which is independent and in accordance with identical distribution. Common distribution is π , $E[\pi]$ is the expectation of π . Define π_{Max} as its maximum, set $\theta = \pi_{Max} / E[\pi]$, obviously $\theta \geq 1$.

When there is no intermediary organization, it can be easily concluded based on assumptions that Nash equilibrium of this game model is (fraud, fraud), and both parts' benefits are zero.

Step4: in current game stage, if online bargainers have verified the validity of trade partners' digital IDs, when being cheated, online bargainers may input personal cost $A\pi$ to make an appeal to intermediary organization, among it, $A\pi > 0$, define A as appeal coefficient, and is positive constant coefficient.

Step5: when online bargainers appeal to intermediary organization, intermediary organization carries out investigation and makes judgment. If accuser is honest while his trade partner is cheating, and the cheater accepts fine judgment by intermediary organization, then the appellant can get compensation $C\pi$, define C as compensation coefficient, and is positive constant coefficient. Or intermediary organization would not make judgment.

Step6: if intermediary organization makes judgment and the appellant gets compensation $C\pi$, then the defendant is likely to be judged to pay fine $f(C)\pi$, he might reject payment, then personal cost is zero, define f as fine coefficient, it is continuous increasing function, and $f(x) \geq x$, $f(x) - x$ is the compensation for intermediary organization investigation, it can be called compensation coefficient after standardization.

Step7: if the defendant (that is the fraud) doesn't pay fine, intermediary organization will cancel its digital ID. All information about unpaid judgments will be filed into intermediary organization's online trust database.

Previous analysis shows that in the e-commerce stage game revolving intermediary organization, game payoff is uncertain, that is, it is uncertain whether online bargainer for own benefits will take honest behavior, or will voluntarily accept intermediary organization's

judgment and pay fine to make online trade game reach equilibrium. Further study revolves insuring the equilibrium of previous game, essence of which is the optimization of e-commerce stage game model revolving intermediary organization.

2.3 Optimization of E-Commerce Stage Game Model Revolving Intermediary Organization

For easy to discuss, an interrelated behavior chain is constructed which is corresponding to different stages of e-commerce stage game revolving intermediary organization. It is an optimal behavior path for online bargainers, along this path, online trade can achieve equilibrium automatically, and it is optimal, it can be called optimal behavior chain for short.

Behavior1: online bargainers purchase digital ID.

In stage game step1, before online trade, online bargainers have to purchase digital IDs, thus intermediary organization can engage in e-commerce trade, in another word, online bargainers enter intermediary organization system.

Behavior2: online bargainers appeal to intermediary organization to verify trade partners' digital IDs.

In stage game step2, if online bargainer has a valid digital ID for his own, he will appeal to intermediary organization to verify partner's digital ID, otherwise he won't appeal for verifying.

Behavior3: online bargainers take honest behaviors

In stage game step3, the premise for online bargainers taking honest behaviors is that each part has a valid digital ID, and has already appealed to intermediary organization to verify partner's digital ID.

Behavior4: online bargainers appeal to intermediary organization

In stage game step4, if partner has been verified to have a valid digital ID, online bargainer's digital ID has been verified in step2, and partner took dishonest behaviors in step3, then the fool will appeal to intermediary organization, otherwise, he won't ask for help.

Behavior5: dishonest online bargainer pay fine

In stage game step5, if online bargainer has chosen dishonest behavior, he has to pay fine $f(C)\pi$ after intermediary organization's judgment.

However, in process of real e-commerce trade, online bargainer does not necessarily comply with these behavior requirements and orientation, because taking actions based on optimal behavior chain needs some conditions for maximizing online bargainer's own utility. It might as well been called realization condition of intermediary mechanism in e-commerce trust-building.

3. SOLUTION TO REALIZATION CONDITION OF INTERMEDIARY MECHANISM IN ELECTRONIC TRUST-BUILDING

3.1 Defining and Describing Relevant Parameters

In previous discussion, part relevant parameters have been defined and described, and some parameters used in getting realization condition of intermediary mechanism in e-commerce trust-building will be defined here. Assume game is an infinite repeating stage game, define δ as discount factor, and $\delta = 1/(1+i)$, $\delta \in (0,1)$, i is average social interest rate, suppose \bar{r} as average income acquired by online bargainers during the whole game period, according to microeconomics theories^[3], then

$$\bar{r} = (1-\delta)R \quad (1)$$

$$\text{Here } R = \sum_{t=0}^{\infty} \delta^t r_t \quad (2)$$

3.2 Solutions to Realization Condition for Optimal Behavior

It is found according to previous analysis of optimal behavior chain: optimal behavior is at the end of the game, that is, the "end" of optimal behavior chain, so the realization condition of optimal behavior chain "end" can be got at first.

(1) Solution to Realization Condition of Behavior5

After online bargainer's appealing, if it is verified that the defendant has dishonest behavior, then based on basic compensation $C\pi_0$ for accuser, intermediary organization asks fraud to pay fine $f(C)\pi_0$, defendant has two choices here: paying or protesting.

If the fraud pays fine, he can keep on retaining his digital ID, thus, in future game, he will still be considered as an honesty by others and be traded with honestly. Here, according to table1, in each period in future, his trade income will be $\pi_t (t=1,2,\dots)$. Thus, after paying fine, his average income is

$$\bar{r} = -(1-\delta)f(C)\pi_0 + (1-\delta)E[\pi_1\delta + \pi_2\delta^2 + \pi_3\delta^3 + \dots]$$

If the fraud protests paying, he can not keep on retaining his or her digital ID, thus, in future game, he will be considered as a fraud by others and be traded with dishonestly. Here, according to table1, in each period in future, his trade income will be zero, $\bar{r} = 0$. Thus, realization condition of behavior5 is

$$\bar{r} = -(1-\delta)f(C)\pi_0 + (1-\delta)E[\pi_1\delta + \pi_2\delta^2 + \dots + \pi_3\delta^3 + \dots] > 0 \quad (3)$$

According to the definition and description of relevant parameters in formulas (1) and (2), in the premise of not

influencing conclusion, an equivalent deduction can be done as follows

$$\begin{aligned}\bar{r} &= -(1-\delta)f(C)\pi_0 + (1-\delta)E[\pi_1\delta + \pi_2\delta^2 + \pi_3\delta^3 + \dots] > 0 \\ \Leftrightarrow & -(1-\delta)f(C)\pi_{Max} + (1-\delta)E[\pi_1\delta + \pi_2\delta^2 + \pi_3\delta^3 + \dots] > 0 \\ \Leftrightarrow & -(1-\delta)f(C)\theta E[\pi] + E[\pi]\delta > 0 \\ \Leftrightarrow & -(1-\delta)f(C)\theta + \delta > 0\end{aligned}\quad (4)$$

A simplified realization condition of behavior5 can be got:

$$f(C) < \frac{\delta}{(1-\delta)\theta} = \frac{E[\pi]}{i\pi_{Max}} \quad (5)$$

(2) Solution to Realization Condition of Behavior4

If one part in online trade is cheated, as rational economic person, he has to weigh own benefits and costs when making decision about whether appeal to intermediary organization. A cost $A\pi_0$ will be paid when appealing, but compensation $C\pi_0$ can be received. If and only if the fool's compensation is bigger than or equal to appeal cost, then he just appeals to intermediary organization. Thus, the realization condition of behavior4 is

$$C\pi_0 \geq A\pi_0 \text{ or } C \geq A \quad (6)$$

(3) Solution to Realization Condition of Behavior3

According to table1 in step3, when an online bargainer chooses to be honest, his current income is π_0 , if he takes dishonest behavior, his current income is $(1+d)\pi_0$. In addition, in the constraint of inequation

(6), he will pay a fine $f(C)\pi_0$, here, his net income is $(1+d)\pi_0 - f(C)\pi_0$. In the constraint of inequation (6), condition for online bargainer choosing to be honest is

$$\pi_0 \geq (1+d)\pi_0 - f(C)\pi_0 \text{ or } f(C) \geq d \quad (7)$$

Obviously, only if an online bargainer's fine coefficient is not less than his fraud-benefit coefficient, online bargainer might just be honest. This economic meaning is inoculated with real e-commerce trade. Linking inequation (5), the sufficient and necessary condition for online bargainer choosing to be honest can be got

$$d \leq f(C) < \frac{\delta}{(1-\delta)\theta} = \frac{E[\pi]}{i\pi_{Max}} \quad (8)$$

(4) Solution to Realization Condition of Behavior2

According to table1 in step3, if an online bargainer with valid digital ID appeals to intermediary organization to verify partner's digital ID, the income expectation of current period will be π_0 , and the income expectation of each later period is $E[\pi]$; otherwise, his income expectation is zero. Therefore, in order to get more

income, online bargainer will consult intermediary organization to verify validity of his partner's digital ID.

(5) Solution to Realization Condition of Behavior1

When an online bargainer inputs P for purchasing digital ID, takes actions according to optimal behavior chain, then the average income expectation of the whole game duration is

$$\begin{aligned}\bar{r} &= -(1-\delta)P + (1-\delta)E[\pi_0 + \pi_1\delta + \pi_2\delta^2 + \pi_3\delta^3 + \dots] \\ &= -(1-\delta)P + (1-\delta)E[\pi] \sum_{i=0}^{\infty} \delta^i \\ &= -(1-\delta)P + E[\pi]\end{aligned}\quad \dots\dots\dots (9)$$

If an online bargainer doesn't apply for digital ID, then he doesn't have to pay P. Here intermediary organization doesn't engage in trading, according to table1 in step3, (fraud, fraud) is the only Nash equilibrium, both parts choose to be dishonest, the income is zero, that is, $\bar{r} = 0$. For those online bargainers who are willing to purchase digital IDs, at least $\bar{r} \geq 0$, substitute in (9), then the realization condition of behavior1 is

$$\begin{aligned}& -(1-\delta)P + E[\pi] \geq 0 \\ \Rightarrow & P \leq E[\pi]/(1-\delta) = \frac{(1+i)}{i} E[\pi] \dots\dots\dots (10)\end{aligned}$$

As above solutions, realization conditions of optimal behavior chain are got including (5)、(6)、(8) and (10) .

4. CONCLUSION

This paper designs intermediary mechanism in e-commerce trust-building, by introducing intermediary organization who releases digital ID and disciplines dishonest behavior, online bargainer can get partner's history information, digital ID can be tied to the real identity of online bargainer, and identity stability can be insured, thus, digital ID is not only a simple verifying tool, but also represents the holder's credit. This makes up for similar mechanism (such as eBay's feedback forum) in which past trading history can not be completely reflected because identity can be changed easily. In addition, because publicizing information should be verified by intermediary organization at first, trust information reflected by digital ID is more reliable and not easily manipulated by individuals.

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