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## Abstract

*Building trust is very important because fraud has been on rise in online electronic markets. Trust allows participant in online electronic markets to overcome perceptions of risk and uncertainty and make a deal. This paper proposes a design of a mechanism of building trust in online electronic markets. The interesting aspects of this mechanism is that it not only improves reputation rating measure but also uses both register deposit and trade security deposit in order to induce participant trade truthfully.*

**Keywords:**   Electronic Commerce, Trust, Register Deposit, Trade Security Deposit

## 1. Introduction.

Electronic markets based on the internet have changed the way business done. It makes it possible that people geographically separated world could exchange goods and services without time and space limitation. There are three kinds of online electronic markets: (1) the one which is set up by a buyer such as GE for procurement, (2) the one which is set up by a seller such as Amazon to sell merchandise, and (3) the one which is set up by a third party intermediary. Among them the third party online electronic marketplace has become the most popular venues for conducting business and developed rapidly. But the third party intermediary assumes no responsibility for items listed on its website typically. While it brings people convenience it brings new problem. The anonymity of an online trade creates opportunity for fraud. In the third party electronic marketplace, a seller assumes the responsibility of describing products and explaining the detail of such things as delivery and payment methods. In most transactions, the shipment occurs only after the payment has been received; a 5 to 14 day waiting period is required for checks to clear. Meanwhile, in environments with noisy observations of outcomes, the seller would inflate the true quality of their goods. So the buyer thus assumes a risk when sending a payment. For instance, the seller sends inferior goods which are not as seller declared or the seller may not send the item at all. On the other hand, the buyer may choose not to pay and this definitely would hurt the seller. A 26% increase in Internet fraud complaints in 2002 coupled with an average consumer lost of as much as US$468 is significantly affecting consumers' trust towards online business (Internet Fraud Watch, 2002).

Online feedback aggregation mechanisms are emerging as a promising approach for helping to build trust and inducing cooperation in online trading environments where more established

methods of social control (such as state regulation or the threat of litigation) are often difficult or too costly to implement (Resnick, et al. 2000). Simple online feedback aggregation mechanisms such as "feedback forum" in eBuy allow the participants to leave comments about their trade partners when the transaction is completed. The feedback rating can be 1 , -1 or 0 as the feedback is positive, negative, or neutral. The websites will aggregate past rating as the participant's reputation index according to the feedback as well as summary statistics of his recent ratings available to the entire community. The rationale behind the feedback aggregation mechanisms is that the reputation of a participant is a signal of one's past trading behavior. A bad reputation or low reputation will discourage others from conducting future transactions with the participant. But can trade partner's reputation serve as "hostage"? Most of the electronic exchange marketplace identifies sellers or buyers by email address, which can be easily obtained without monetary cost from multiple sources. Current simple feedback aggregation mechanisms can't prevent participant from identity fraud and product quality fraud because:

1) The reputation under current feedback aggregation mechanism can be easily manipulated for the rating measure is bias. It only reviews trade times, but it is nothing to do with trade amount. So a participant who trade one thousand times goods valued 1$ honestly can aggregate a reputation index one thousand, but a participant who trade one time goods valued $1000 can get a reputation index of 1. It is obviously unreasonable.

2) Online identities are often no more than an email. Reputation is a signal of one's past trading behavior but it can't ensure if the trade keep honestly next time. In the example above, maybe the former is going to make a big "kill" at the next time trade then abandon the identity.

3) In environments with noisy observations of outcomes, the seller would inflate the true quality of their goods. Cripps, Mailath and Samuelson prove that in environments with noisy observations of outcomes, such a mechanism makes it impossible to sustain long-term reputation (Cripps, 2002). So the reputation can't ensure online trade truthfully.

These problems have resulted in two responses. One response has been to place value on reputation. Another response has been to design mechanisms to prevent or detect fraud. There has been recent work on both these responses.

Empirical studies of the relationship between seller reputation and auction outcomes on eBay found that reputation has a small but statistically significant positive effect on price(Lucking,1999, Houser,2000, McDonald et al. 2002, Dewan et al. 2001, Ba et al. 2002 ). The results show that: 1) the reputation effect is much larger for negative feedback than positive feedback, 2) a higher reputation in eBay auctions leads to higher bids, and 3) the number of bids increases with reputation as well.

A mechanism for inducing cooperation in online auction settings with noisy monitoring of quality and adverse selection is proposed by (Dellarocas, 2003). The mechanism combines the ability of electronic markets to solicit feedback from buyers with the more traditional ability to levy listing fees from sellers. Each period the mechanism charges a listing fee contingent on a

seller's announced expected quality. It subsequently pays the seller a reward contingent on both his announced quality and the rating posted for that seller by that period's winning bidder. He shows that, in the presence of a continuum of seller types with different cost functions, imperfect private monitoring of a seller's effort level and a simple "binary" feedback mechanism that asks buyers to rate a transaction as "good" or "bad", it is possible to derive a schedule of fees and rewards that induces all seller types to produce at their respective first-best quality levels and to truthfully announce their intended quality levels to buyers.

A novel feedback management mechanism called "Goodwill Hunting" that succeeds in facilitating efficient transactions in an environment that the same seller sells products of many different qualities, such as marketplaces of used cars and collectibles (Dellarocas,2002). It uses the threat of biased future reporting of quality in order to induce sellers to truthfully declare the quality of their items.

Ba. al et. regard that community can make an anonymous individual's behavior as well as the present social structural setup to secure trust between transacting participants can be obtained using community, the community might be an online community such as The Well or a religious community that influences the ethical values and behaviors of individuals. They give a formal investigation on how to design and implementation of OCSS (Online Community Systems Strategy) that are regarded towards providing C2C trust (Ba.et al. 2003).

The trusted third party (TTP) to serve the online auction communities is proposed as a design of an economic incentive mechanism by (Ba.et al. 2001). The proposed model addresses both the economic and technological aspects of online auction transactions by assigning a digital certificate to each participant. Thus, each participant's identity as well as his or her reputation can be established by other market participants. The analytical results demonstrate that when online transactions take place with the assistance of digital certificates issued by a TTP, the most utilitarian course of action for a market participant is to behave honestly.

GWH and list fee focus on B2C transaction which make sellers announce their intended quality levels truthfully. But they can't avoid problem when the buyer fraud. OCSS must depend on community trust which could not solve the problem that the seller fraud and change their identities. TTP need trust of the authority third party organization and pay for digital identity, obviously, it prevents those participants who transacting one or twice enter into the market for the gain from transaction may less than the fee to be paid. Things become complex when participants' fraud lies in quality announcement and transaction complement in a market with both B2C and C2C transaction.

This paper proposes a novel mechanism RD&TSD(Register Deposit and Trade Security Deposit) under feedback aggregation system to induce cooperation in online trade. It not only improves the reputation rating measure but also makes the trickery not chase away without cost under the feedback system. Meanwhile, the mechanism combines the reputation and trade security deposit with credit amount the participant applying. Each period the mechanism computes how much trade security the participant must pre-deposit according to the participant's reputation and credit amount applying. Then the participant can make a deal with

the limitation that transaction amount is less than their credit amount. This paper provides a normative analysis to illustrate how the RD&TSD can be used to provide online trade trust.

The rest of the paper is structured as follows. Section 2 explains why simple feedback aggregation mechanism fails in trading environment where the participant can enter and chase away without cost. Section 3 gives a brief overview of RD&TSD mechanism. Section 4, a formal analysis of RD&TSD under feedback aggregation mechanism is given that is aimed at promoting trust and ensuring secure online transactions. Section 5 discusses the mechanism's robustness and practical implementation. Section 6 concludes.

## 2. Shortcomings of Simple Feedback Aggregation Mechanism.

The current simple feedback aggregation mechanism of online transaction can be described as follows. A seller and a buyer make a deal $T_t$ (transaction amount) in $t^{th}$ period, $R_t^i$ is the aggregated reputation index of participant, where $i = s, b$, $s$ denotes a seller and $b$ denotes a buyer respectively. $R_t^i = \sum_{j=1}^{t-1} sign \cdot r_j$, where $r_j = 1$, $sign \in \{1, 0, -1\}$. Both participants evaluate partner's behavior after transaction complete. That is if a participant gets positive feedback $sign = 1$ or negative feedback $sign = -1$, otherwise, $sign = 0$. Initially, $R_0^i = 1$. Denote the participant's payoff in each period as $G(T_t, R_t^i)$, for the reputation can affect the participant's payoff in some scope, suppose $G(T_t, R_t^i) < T_t$ for there is transaction cost, and reputation index has positive effect on $G(T_t, R_t^i)$.

It is very prevailing in the online electronic setting that buyer shall pay for the goods first then the seller ships the goods after he gets the money. Thus, if the buyer cheats and dose not pay for the goods, he has no pains (loss) and no gains (payoff). Meanwhile, with the goods in hand, the seller won't lose much if the buyer cheats. Denote the loss as $l \cdot G(T_t, R_t^s)$ where $l$ is positive constant coefficient, and $l \cdot G(T_t, R_t^s) < T_t$.

The cheated participant may appeal to the online electronic marketplace. Let $A(T_t) > 0$, $C(T_t) \geq 0$ denote the participant's appeal cost and compensation if a participant finds that he is cheated and appeal. Denote $F(T_t) > 0$ is the fine to the participant who cheats. If the tricker doesn't pay for fine, the one being cheated can't get compensation, in other words, $C(T_t) = 0$. When a participant is engaged in a single exchange, if he cheats and leaves,

it is impossible to charge him any fine.

Research on game theory, especially repeated games, demonstrates how people manage to interact to their mutual advantage without the help of the legal enforcement (Ba.et al. 2003). The theory of repeated games provides a perspective to understanding the role of extralegal mechanisms in online electronic marketplaces.

In this section, we use game theory to analyze online transactions where the individual outcomes for the participant involved depend on the strategies chosen by the other participant. In our analysis, each non-repeated transaction (the stage game) is assumed to be the Prisoners' Dilemma (PD) game described by Table 1. By using the PD model, we demonstrate why the simple feedback aggregation mechanism fails to induce cooperative behaviors.

Suppose that a seller and a buyer are engaged in a single exchange (Scenario 1). Each of them can choose to play one of two strategies: Honest or Cheat. Table 1 presents the payoff structure of the PD game. The first number in each entry indicates the row player (seller)'s payoff and the second is the column player (buyer)'s payoff. In period t, if both the buyer and the seller are honest, they have a payoff of $G(T_t, R_t^s)$ and $G(T_t, R_t^b)$ respectively. If both the buyer

Table 1.　The payoff structure of the stage game

|  |  | Buyer | |
|---|---|---|---|
|  |  | Cheat | Honest |
| Seller | Cheat | 0, 0 | $T_t$, $-T_t$ |
|  | Honest | $-l \cdot G(T_t, E_t^s)$, 0 | $G(T_t, R_t^s)$, $G(T_t, R_t^b)$ |

and the seller cheat, each has a payoff of 0. If the seller decides to cheat while the buyer is honest, then the seller has his highest payoff $T_t$, while the buyer gets his lowest payoff $-T_t$. If buyer decides to cheat while the seller is honest, then the buyer has his payoff 0, while the seller gets his lowest payoff $-l \cdot G(T_t, E_t^s)$. This gives both sides an incentive to cheat, even though honest behavior maximizes the total payoff of the two players. Obviously, if this transaction is conducted only once, it is to each player's separate advantage to play cheat, since that play yields a higher payoff regardless of what the other player does. Accordingly, the only Nash equilibrium of the game is for both players to play cheat. It is, however, worth noting that both agents are worse off than if they could somehow agree to play Honest. This is because the payoff of both playing honest is better than the payoff is only 0 if both plays cheat. The PD game demonstrates the idea that cheating might be profitable in a single transaction.

In reality, transactions are repeated between buyers and sellers (Scenario 2). But they may never have to face the same partner again. For example, when people sell or buy on eBay, repeat transactions between the same seller and buyer are less likely, albeit not impossible. Most often, trading partners change frequently. So the reputation index aggregated by

feedback is used to help people tell who is worth to trust. Can the reputation information do its work under repeated transaction setting?

Let $V_t^i = \sum_{j=t+1}^{\infty} \delta^j G(T_j, R_j^i)$ be the total expected payoff of a participant from $t^{th}$ period on,

where $\delta = 1/(1+ir)$ is the time discount rate, and $ir \in (0,1)$ is interest rate. A participant $i$ gets negative feedback if he cheats in $t^{th}$ period, and then his reputation index of $t+1^{th}$ period is $R_{t+1}^i = R_t^i - 1$. $G(T_t, R_t^i) > G(T_t, R_{t+1}^i)$ for reputation has positive effects on $G(T_t, R_t^i)$. So, negative feedback makes a participant's expected payoff less and positive feedback makes a participant's expected payoff more in future.

Denote $V_t^i$ the total expected keeping honest payoff of a participant from $t^{th}$ period on when

he keeps honest strategy in $t^{th}$ period, $V_{t(Cheat)}^i$ the total expected payoff from $t^{th}$ period on when he selects cheat strategy in $t^{th}$ period. Then the following inequation holds.

$$V_{t(Cheat)}^i = \sum_{j=t+1}^{\infty} \delta^j G(T_j, R_j^i) \mid_{R_{t+1}^i = R_t^i - 1} < V_t^i = \sum_{j=t+1}^{\infty} \delta^j G(T_j, R_j^i) \mid_{R_{t+1}^i = R_t^i + 1} \qquad (1)$$

Suppose $V_0^i = \sum_{j=1}^{\infty} \delta^j G(T_j, R_j^i)$ denotes a participant's total expected keeping honest payoff in

infinite times of trade with an identity. Then the following inequation holds,

$$V_0^i = \sum_{j=0}^{\infty} \delta^j G(T_j, R_j^i) = \sum_{j=0}^{t} \delta^j G(T_j, R_j^i) + V_t^i > \sum_{j=0}^{t} \delta^j G(T_j, R_j^i) + V_{t(Cheat)}^i \qquad (2)$$

***Proposition 1:   During long term of repeated game, a seller will select cheat strategy in any period and then register a new identity for next trade so that he avoids the influence of negative feedback, and the cheated buyer will not appeal to the market.***

**[Proof]** If the seller selects cheat strategy in $t^{th}$ period, then his payoff can be as follows:

When the buyer makes an appeal, the seller will

i)   get the payoff if he pays the fine:

$$V_{t(Cheat)}^s + \sum_{j=0}^{t-1} \delta^j G(T_j, R_j^i) + T_t \delta^t - F(T_t) \qquad (3)$$

ii)   get the payoff if he does not pay the fine and registers a new identity:

$$T_t \delta^t + V_0^s \qquad (4)$$

Combining with inequation (2), (4)>(3), That means, it is a strict superior strategy to cheat and register a new identity.

Given the seller will cheat and register a new identity, the buyer can not get compensation from the seller after being cheated and make appeal, which means $C(T_t)=0$. Therefore the buyer will not make an appeal.

***Proposition 2: During long term of repeated game, it is a credible threat for the seller to cheat so the buyer will select cheat strategy and register a new identity to avoid the influence of negative feedback.***

**[Proof]** if the buyer pay the fine after cheating he gets the payoff:

$$V_{t(cheat)}^b - F(T_t)\delta^t \tag{5}$$

if he does not pay the fine and register a new identity he gets the payoff:

$$V_0^b \tag{6}$$

Because (7)>(6), the buyer will register a new identity after cheating. That makes $C(T_t)=0$.

For the seller, he will appeal when $C(T_t)>A(T_t)$ holds, but $C(T_t)=0$ in $t^{\text{th}}$ period, therefore the seller can not get any compensation, so the seller will not make an appeal.

Though the buyer's payoff is 0 when he cheats in this setting, it brings him a way to chase away when he want to retract his bid.

***Theorem 1:    It is a sub-game perfect Nash equilibrium to cheat and register a new identity in long term under simple feedback mechanism.***

**[Proof]** According to proposition 1 and 2, the both participants will select cheat strategy and register a new identity to avoid the influence of negative feedback in long term.

This means that the participant especially the sellers might find that a fly-by-night strategy is payoff maximizing. It is obviously the electronic market will failure for no one would buy under such a mechanism whether in long term or short term.

## 3.  The Register Deposit and Trade Security Deposit under Feedback Mechanism.

This section provides such a mechanism to enforce participant cooperative. Let $B,E,T$ be vectors denoting the participant's trade security, credit amount the participant applying and transaction amount. $B<E$, $T<E$. $B$ is the function of $R$ and $E$.

To participant $i$, $B_t^i(R_t^i, E_t^i)$, $i=\{s,b\}$ is his trade security deposit in $t^{\text{th}}$ period. $R_t^i$ and $E_t^i$ represent participant $i$'s reputation index and the credit amount he applying in $t^{\text{th}}$ period, respectively. $E_t^i>1$，that is the credit amount the participant applying must more than 1.

$R_0^i = 1$ means that participant $i$ will have a positive reputation index 1 after he registers and pays the register deposit.

Suppose that $T$ follows $N(\mu, \sigma^2)$ school. $\mu$ and $\sigma$ are trade amount mean and deviation of transactions in the whole online electronic marketplace, respectively. The increment or decrement of reputation index $r_t$, satisfies that $r_t = P\{T < \dfrac{T_t - \mu}{\sigma}\} \cdot 100$, which is relative to the level of each transaction amount in the whole market. And $R_t^i = \sum\limits_{j=0}^{t-1} sign \cdot r_j$, in which $i = s, b$ and $sign \in \{1, 0, -1\}$. $sign = 1$ if a participant gets positive feedback due to his honesty or else $sign = -1$. Because the third party online electronic market charges according to sale amount, the participant should get more reputation index when his transaction amount is more in the same condition in order to encourage more transaction amount. Here, it is assumed that the participant's feedback information is true.

Define $B_t^i$ as follows.

$$
B_t^i = \begin{cases} 0, & \text{if } E_t^i \delta^t \le C_0 \\ \min(E_t^i, E_t^{i \max(\frac{E_t^i}{R_t^i}, \frac{\ln\frac{1}{\delta^t} + \ln\delta^t \cdot E_t^i - C_0}{\ln E_t^i})}), & \text{if } E_t^i \delta^t > C_0 \end{cases}
\qquad (7)
$$

If $\dfrac{E_t^i}{R_t^i} \ge 1$, let $B_t^i = E_t^i$, that is, participant $i$ shall deposit 100 percent of the trade amount to make the trade security. If $\dfrac{E_t^i}{R_t^i} < 1$, let $B_t^i = E_t^{i \max(\frac{E_t^i}{R_t^i}, \frac{\ln\frac{1}{\delta^t} + \ln\delta^t \cdot E_t^i - C_0}{\ln E_t^i})}$.

The detail description of the mechanism is divided into seven steps.

**Step 1**: A participant registers in the electronic market and pays the register deposit $C_0$, which will be sent back to him with its interest when he retreats from the market. The time discount rate is $\delta$.

**Step 2**: A seller pays trade security deposit, $B_t^s$, in nominated account of bank before trade. The seller can sell goods with the bargain transaction amount no more than $E_t^s$.

**Step 3:** A buyer pays trade security deposit, $B_t^b$, in nominated account of bank before trade. The buyer can make bids or buy goods, but the transaction amount must be no more than $E_t^b$.

**Step 4:** After bargain the buyer and seller make a deal $T_t$, satisfies that $T_t \leq \min(E_t^b, E_t^s)$.

**Step 5:** Complete a business transaction.

There are three cases according to the strategy both participant selects as shows in the figure1.
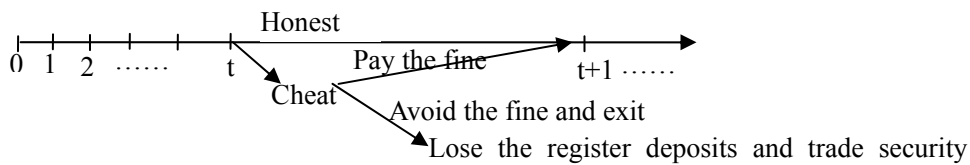


Figure1    the participant's choices in $t^{th}$ periord

**Case 1.** Both participants keep honest strategy and they both get an increment of $r_t$ in reputation index. Suppose that the payoff of each participant satisfies $G(T_t, R_t^s) > 0$, $G(T_t, R_t^b) > 0$, or else they will not trade.

**Case 2.** Both participants select cheat strategy and they both get 0 payoff. Neither will feedback information.

**Case 3.** One of the participants selects to cheat. If only the seller selects cheat strategy, he gets $T_t$ payoff and the buyer loses $T_t$. If only the buyer selects cheat strategy, he gets 0 and the seller loses $l \cdot G(T_t, E_t^s)$. No matter which participant selects cheat strategy, the cheated participant will feedback negative and the cheater's reputation index will decrease by $r_t$. If a cheated participant appeals to the market, he shall cost $A(T_t)$ and then gets compensation of $C(T_t)$, and the cheater is expected to pay a fine of $F(T_t)$. If the cheater will not pay for fine $F(T_t)$ his identity will be frozen and his trade security deposit in the dominated account will be used for compensate the cheated participant.

**Step 6:** Transaction is over. When the online electronic marketplace gets both participants'

feedback information which shows that the transaction is implemented, the participants' trade security deposits are thawed.

***Step* 7**: Participants exit online electronic marketplace. A participant can get back his deposit for registered account, $C_0$, and its interest if he is honest in transaction. A cheater will not get back his deposit for registered account and trade if he does not pay the fine.

## 4. Analysis of the Register Deposit and Trade Security Deposit Mechanism.

***Proposition 3:*** **In the RD&TSD under feedback aggregation mechanism if $V_0^i > 0$, where**

$i = \{s, b\}$, **both participants will pay register deposit and enter the online electronic marketplace to trade.**

**[Proof]** The participant can get back their register deposits with interest if they exit the market normally. For example, the deposit for register is $C_0$, then the interest in $t^{\text{th}}$ period is

$C_0 \cdot \dfrac{1}{\delta^t}$. Here, it is simple interest.

If a participant exits the EC market normally, his payoff is $-C_0 + V_0^i + \delta^t C_0 \cdot \dfrac{1}{\delta^t} = V_0^i$. Only

when $V_0^i > 0$, the participant will enter the online electronic marketplace to trade.

***Proposition 4:*** **In RD&TSD mechanism, $\exists F(T_t)$ so that**

$$T_t^s \delta^t - V_t^s - G(T_t, R_t^s)\delta^t < F(T_t)\delta^t < C_0 + B_t^s \delta^t + V_{t(Cheat)}^s.$$

**[Proof]** There are two cases.

Case 1. $E_t^i \delta^t \le C_0, B_t^s = 0$. $T_t^s \le E_t^s \Rightarrow$

$$T_t \delta^t - G(T_t, R_t^s)\delta^t - V_t^s - V_{t(Cheat)}^s - C_0 < E_t \delta^t - G(T_t, R_t^s)\delta^t - V_t^s - V_{t(Cheat)}^s - C_0 < 0 = B_t^s$$

$\Rightarrow T_t^s \delta^t - V_t^s - G(T_t, R_t^s)\delta^t < C_0 + B_t^s \delta^t + V_{t(Cheat)}^s$, so Proposition 4 hold.

Case 2. $E_t^i \delta^t > C_0$, $B_t^s = \min(E_t^s, E_t^{s \max(\frac{E_t^s}{R_t^s}, \frac{\ln\frac{1}{\delta^t} + \ln \delta^t \cdot E_t^s - C_0}{\ln E_t^s})})$. And,

$$T_t^s \delta^t - V_t^s - G(T_t, R_t^s)\delta^t < C_0 + B_t^s \delta^t + V_{t(Cheat)}^s$$

$$\Leftrightarrow B_t^s \delta^t > T_t^s \delta^t - V_t^s - G(T_t, R_t^s)\delta^t - C_0 - V_{t(Cheat)}^s$$

$$\Leftarrow B_t^s \delta^t > T_t^s \delta^t - C_0 \quad (\because G(T_t, R_t^s) > 0, V_t^s > V_{Cheat}^s > 0) \tag{8}$$

If $\dfrac{E_t^s}{R_t^s} \geq 1$, $B_t^s = E_t^s$ and $T_t^s \leq E_t^s$. Thus, inequation (8) holds.

Else if $\dfrac{R_t^s}{E_t^s} < 1$, $B_t^s = E_t^{i \max\left(\frac{E_t^s}{R_t^s}, \frac{\ln\frac{1}{\delta^t} + \ln \delta^t \cdot E_t^s - C_0}{\ln E_t^s}\right)}$. There are two cases.

i) $\dfrac{E_t^s}{R_t^s} > \dfrac{\ln\dfrac{1}{\delta^t} + \ln(\delta^t \cdot E_t^s - C_0)}{\ln E_t^s} \Leftrightarrow \ln(E_t^s)^{\frac{E_t^s}{R_t^s}} > \ln \dfrac{(\delta^t \cdot E_t^s - C_0)}{\delta^t}$

$\Leftrightarrow (E_t^s)^{\frac{E_t^s}{R_t^s}} > E_t^s - \dfrac{C_0}{\delta^t}$

According to equation (7), $(E_t^s)^{\frac{E_t^s}{R_t^s}} = B_t^s$, then $B_t^s > E_t^s - \dfrac{C_0}{\delta^t} > T_t^s - \dfrac{C_0}{\delta^t}$ $(\because E_t^s \geq T_t^s)$.

$\Rightarrow B_t^s \delta^t > T_t^s \delta^t - C_0$, so inequation (8) holds.

ii) if $\dfrac{E_t^s}{R_t^s} \leq \dfrac{\ln\dfrac{1}{\delta^t} + \ln(\delta^t \cdot E_t^s - C_0)}{\ln E_t^s}$, $B_t^s = (E_t^s)^{\frac{\ln\frac{1}{\delta^t} + \ln \delta^t \cdot E_t^s - C_0}{\ln E_t^s}}$.

$\Leftrightarrow \ln B_t^s = \ln(E_t^s)^{\frac{\ln\frac{1}{\delta^t} + \ln \delta^t \cdot E_t^s - C_0}{\ln E_t^s}}$.

$\Leftrightarrow \ln B_t^s = \ln \dfrac{(\delta^t \cdot E_t^s - C_0)}{\delta^t} = \ln(E_t^s - \dfrac{C_0}{\delta^t})$.

$\Rightarrow B_t^s = E_t^s - \dfrac{C_0}{\delta^t} > T_t^s - \dfrac{C_0}{\delta^t}$ , Therefore, inequation (8) holds.

According to the above analysis, it is concluded proposition 4 holds. By the way, the inequation in proposition 4 is equals to the following inequation:

$$T_t^s \delta^t - C_0 - B_t^s \delta^t < T_t^s \delta^t - F(T_t) \delta^t + V_{t(Cheat)}^s < V_t^s + G(T_t, R_t^s) \delta^t \tag{9}$$

It means that a seller gets payoff more if he keeps honest strategy than that if he cheats and pays the fine, and he gets payoff more if he pays the fine after cheat than that if he does not pay.

***Proposition 5:*** ***In RD&TSD mechanism, if*** $\min\{C_0/\delta^t + B_t^s, C(T_t)\} > A(T_t)$***, a seller would keep honest* strategy.**

**[Proof]** If the cheated buyer select to appeal his payoff will be:

$$\min\{C_0/\delta^t + B_t^{\ s}, C(T_t)\} - T_t - A(T_t) \qquad (10)$$

When he selects not to appeal his payoff will be:

$$-T_t \qquad (11)$$

Formula (10)> (11)So the cheated buyer will appeal.

Combining with proposition 4, the seller will pay for fine if he is fined for his register deposit and trade security deposit are more than transaction amount, so the seller is better payoff if he keeps honest strategy. In other words, the seller will not deviate from honest trade.

***Proposition 6: In RD&TSD* mechanism, *a buyer would keep honest strategy.***

**[Proof]** There are three cases:

Case 1: If a buyer selects cheat strategy, and the cheated seller does appeal
   i) When the buyer pays the fine, his payoff is:

$$V_{t(Cheat)}^b - F(T_t)\delta^t , \qquad (12)$$

   ii ) When the buyer doesn't pay the fine, his payoff is:

$$0 - C_0 - B_t^{\ b}(R_t^b, E_t^b)\delta^t . \qquad (13)$$

Case 2: If a buyer selects cheat strategy, and the cheated seller doesn't appeal
   The buyer's payoff is:

$$V_{t(Cheat)}^b \qquad (14)$$

Case 3: The payoff when the buyer keeps honest strategy also is:

$$V_t^b + G(T_t, R_t^b)\delta^t \qquad (15)$$

Formula (15)>(14)>(12)>(13), so the buyer can maximize his payoff if he always keeps honest strategy in trades.

**Theorem2: *In register and trade deposits under feedback aggregation mechanism, if*** $\min\{C_0/\delta^t + B_t^{\ s}, C(T_t)\} > A(T_t)$ ***and*** $V_0^i > 0$***, (honest, honest) is a perfect sub-game Nash equilibrium in long term.***

**[Proof]**   According to proposition 5 and 6, neither the buyer nor the seller will select cheat strategy. They both will keep honest in long term transaction.

## 5. Robustness and implementation considerations.

An important consideration in mechanism design is the robustness of a mechanism to the assumed features of the underlying environment. The sheer number and heterogeneity of participants in large-scale electronic markets makes such robustness considerations

particularly important.

**Easy change name**. An attractive property of the mechanism presented in this paper is that it induces cooperation and achieves efficiency. This is a particularly desirable property in online electronic markets where the relative ease with which players can change online identities reduces the efficiency of mechanisms that rely on repeated interaction.

**Fly-by-night strategy**. Some participant enters an electronic market with the explicit intention to cheat, i.e. advertise products, receive money but never send anything back to buyers, for as long as he can. Given the relative ease with which players can anonymously enter (and exit) most online markets, fly-by-night strategies are plausible and mechanisms ought to be robust to their existence. Under RD&TSD mechanism those who take fly-by-night strategy will not enter the online electronic market.

**Manipulate reputation**. The reputation index aggregated by trade one hundred times goods valued 1\$ honestly is no more than that aggregated by trade goods valued \$100 once. The participant can not manipulate reputation easily under our mechanism. For example, let $\mu$=50 and $\sigma$=20, if $T_t^i = 1$, $100\,r_t^i$=0.71 and when $T_t^i = 100$, $r_t^i$=100. Meanwhile, in practice there are thousands transaction accomplished every day in the electronic market, the $\mu$ will change as time goes by, so $r_t^i$ is different as time goes by, and it is hardly to be manipulated.

**Make a big kill**. Under RD&TSD mechanism the participant may find it is not profitable to make big kill and chase away no matter his reputation index is high or low, because his register deposit and trusted security deposit is more than that "big" kill.

**Implementation considerations**. The mechanism is straightforward to implement in electronic marketplaces provided that (1) the transaction follows normal school. (2) the transaction amount mean and deviation can be estimated. (3) there exists a suitable fine amount $F(T_t)$ satisfy proposition 4. Under the above assumptions, the basic idea of the mechanism applies to all open electronic marketplaces which participant trade with anonymous identity.

## 6. Conclusions.

Online feedback aggregation mechanisms are emerging as a promising alternative to more traditional trust building mechanisms in online electronic markets. The appeal of reputation mechanisms is that, when they work, they facilitate cooperation without the need of additional costly enforcement institutions. But there are many problems for the sample feedback aggregation mechanism such as fraud.

This paper proposes a novel mechanism RD &TSD for inducing cooperation in online trade. The RD &TSD mechanism takes a more active stance than most current feedback aggregation mechanisms, in that it combines the reputation and trade security with credit amount, and provides participants with incentives to trade honestly.

The initial results reported in this paper can be extended in a number of directions. For example, first, this paper assumes the transaction amount follows normal school. These need to be tested when using the mechanism in real electronic markets. Second, we have supposed that the feedback information is true, but there may be retaliation in the feedback information, how to erase such noise? While these issues are important to the success of RD &TSD mechanism, we believe that the work presented in this paper is a necessary essential step towards inducing participants to trade honestly.

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