

How Escrow Services Affects Trader Decisions on Online Auction Marketplace

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December 2000

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Research Status

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has been accepted by WISE 2000

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Outline

- ✦ Online Escrow Services for Internet Auctions
- ✦ Agents in Online Escrow Economy
 - ✦ A Rational Online Cheater
 - ✦ Perceived Risk Rate
 - ✦ Risk-neutral Traders
 - ✦ OES Provider's Profit Maximization
- ✦ Dynamic Equilibrium Analysis
- ✦ Conclusions and Further Research

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Online Escrow Service (OES)

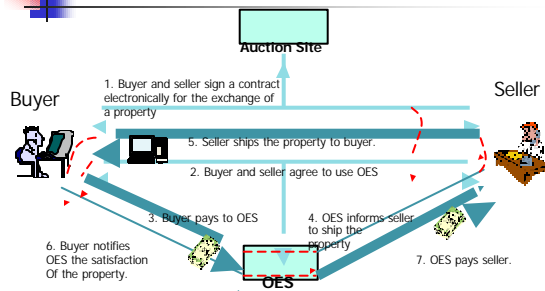
- ✦ An online trust service for Internet auction markets provided by a trusted third party (Ba, Whinston, and Zhang, 1999; Kollock, 1999) to secure:
 - ✦ Payment transactions, and
 - ✦ Property/ownership transfers

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How OES Works



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Why We Need OES

- ✦ Online auction sales remained the number one Internet fraud in 1999 (Internet Fraud Watch, 2000, <http://www.fraud.org>)
 - ✦ 1998 - 68% of the frauds reported to the Internet Fraud Watch
 - ✦ 1999 - 87% of the frauds reported
 - ✦ Average online auction loss: \$293/person
- Internet Fraud Watch 2000
- ✦ OES can secure executions and deliveries in B2C/C2C auctions

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Internet Frauds

- Defined as the consequence of trader's cheating behavior in online trades. E.g.
 - undelivered merchandise,
 - fake check, or
 - fraudulent credit card payments
- Anonymity and lack of interpersonal interactions in the online market encourage Internet frauds.

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Leading OES Providers

- i-Escrow (<http://www.i-escrow.com>), allied to eBay (occupies about 80% market share).
- TradeSafe (<http://www.tradesafe.com>), allied to agauktion.com

i-Escrow service fee varies according to purchase amount:

- \$2.50 service fee when purchase \leq \$100.
- 2% of the purchased amount if paying in cash, or 4% of the purchased amount if paying in credit card, when \$100-\$25,000.
- 1% of the purchased amount if paying in cash, or 4% of the purchased amount if paying in credit card, when \$25,000-\$50,000.
- 1% of the purchased amount up to \$1,000 if paying in cash, and credit card payment is not accepted, when purchase $>$ \$50,000.

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Research Angle at OES

- Two-phase process of online auctions:
 - Online contracting phase - a lot of researches have been done.
 - Property delivery phase - not well explored
- At the second phase trades are substantially completed
- The research is aimed at studying the consequence of the first phase resulted in the second phase.

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Questions

- Why the OES adoption rate is low ($<$ 5%)?
- What are the hurdles discouraging online users to use escrow services?
- Does an optimal pricing rule exist for the escrow services?
- What is the implication of low level of the absolute reported losses (\$3.2 million in 1999 compared to \$3 billion C2C trading alone) (Cnet news, 2000)

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Three Agents in Online Escrow Market

- A rational cheater
- An honest trader
- An OES provider
- Situations:
 - A trade between two honest traders
 - A trade between a cheater and an honest trader
 - A trade between two cheaters

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A Three-Stage Game

- Stage 1: A trader decides to cheat or not
 - If the trader chooses not to cheat s/he is considered an honest trader. Otherwise, s/he is a cheater.
- Stage 2: The trading counterpart decides whether or not to use OES
- Stage 3: The cheater decides if s/he proceeds to cheat or quits from cheating.
 - Even OES is used the cheater may still cheat to maximize the utility.

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Cheating Risks

- 1) Cheating has risks, such as penalties, reputation damage, and membership dismissal
- 2) Cheating is not guaranteed to succeed. OES undermines frauds.

- The success rate of Internet fraud depends on the above two factors.

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Notations

- U^c – Cheater's expected utility
- a – OES adoption rate
- U_1 – cheater utility if making a fraud
- U_2 – cheater utility in a trade using OES
- V^c – cheater's value of the property
(V^c equals the price if a cheater is a seller, V^c equals cheater's net value of the property if a cheater is a buyer.)
- b - penalty coefficient
- P^c – cheating risk rate to be caught and punished

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Notations (cont'd)

- I – trade set, a trade i ? I
- M_i – the property's price in trade i
- V_i^b – buyer's net value of the property
- V_i^s – seller's net reservation value of the property
- P_i^b – buyer PRR if online escrow is not to be used
- P_i^s – seller PRR online escrow is not to be used
- Q_i^b – buyer PRR if online escrow is to be used
- Q_i^s – seller PRR if online escrow is to be used
- r – the rate of escrow service fee

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Cheater Decision-Making Model

Cheater's utility function:

$$U^c = (1 - a) U_1 + a U_2$$

Its characteristics:

- $U_1 > U_2$, or he/she will not cheat.
- When $U_1 > U_2$ if a ? then U^c ?

Solve a by letting $U^c > 0$, we can obtain the cheating criterion on OES adoption rate a :

$$a < U_1 / (U_1 + U_2)$$

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Proposition 1

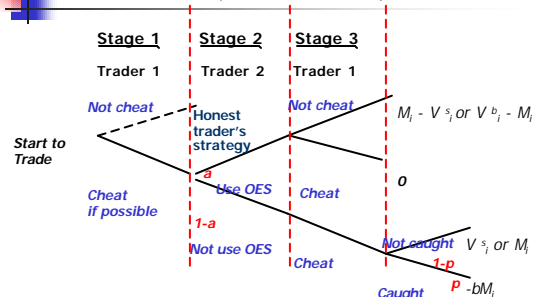
- Even OES has been adopted in a trade, a cheater may still cheat. This is because not cheating may result in lower utility than that from cheating.
- E.g. A cheater in a buying trade may bid at a higher price than the value s/he evaluates because s/he intends not to pay it. Therefore, once OES is adopted by the trading partner, the cheater may lose more when buying the item than simply turning down the deal.

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The Decision Tree for A Cheater (Trader 1)



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Cheater's Utility Analysis (at Stage 3)

- ☞ Cheater's utility when OES is not used:
 $U^c = U_1 = (1 - P^c) V^c - P^c b V^c - C^c$
 where $V^c = M_i$ when seller cheating $V^c = V^{b_i}$ when buyer cheating
- ☞ Cheater's utility when OES is used:
 $U^c = U_2$
 $U_2 = M_i - V^{s_i}$ when a cheater is selling without cheating
 $U_2 = V^{b_i} - M_i$ when a cheater is buying without cheating
 $U_2 = 0$ if cheating
- ☞ So, the cheater will cheat even though OES is used if $M_i - V^{s_i} < 0$ or if $V^{b_i} - M_i < 0$.

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Cheater's Utility Analysis (at Stage 1)

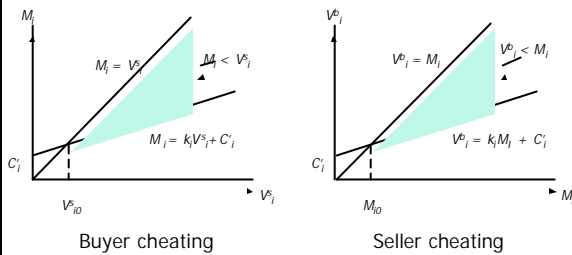
- ☞ A rational cheater knows the above situation. If the cheater stops cheating when OES is used, his/her expected utility is:
 $U^c = (1 - a)[(1 - P^c) V^c - P^c b M_i - C^c] + a(M_i - V^{s_i}) > 0$,
 when selling;
 $U^c = (1 - a)[(1 - P^c) V^c - P^c b M_i - C^c] + a(V^{b_i} - M_i) > 0$,
 when buying.
- ☞ We can convert the above to:
 $M_i > k_i V^{s_i} + C_i$, when selling
 $V^{b_i} > k_i M_i + C_i$, when buying
 where $k_i = a / [(1 - a)(1 - P^c - P^c b) + a] < 1$ when selling
 $k_i = [a + (1 - a) P^c b] / [(1 - a)(1 - P^c) + a] < 1$ when buying

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Cheater's Property Value



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Assumptions

- 1) Cheating may cause losses from honest traders. A **loss**, if any, is completely unrecoverable.
- 2) There exists a subjective risk rate estimated by the trader in a specific trade. We call it **Perceived Risk Rate (PRR)** (Jia et al, 1999). PRR is based on trader's observations and trading experiences.

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Perceived Risk Rate

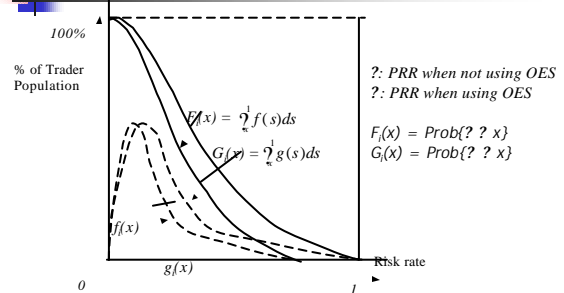
- ☞ PRR is a random variable over trader pool.
- ☞ PRR directly affects a trader's purchase/sell decision in a specific trade and the trader's decision in adopting OES.
- ☞ If a trader agrees to use OES, another trader's PRR will be lowered.
- ☞ However, the trader to pay the fee fully does not feel safer because another trader may choose to cheat without any cost.

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PRR Distribution



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Risk-neutral Traders' Decision Model

The necessary condition for a pair of traders to reach a property transfer agreement is $V_i^b \geq M_i \geq V_i^s$, (1) meaning traders always try to make non-negative benefits.

The necessary condition that the two honest traders agree to use the escrow service is: $V_i^b - V_i^s \geq r M_i$ (2)

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A Normal Form Game for Trader 1 (at Stage 2)

Strategies For Trader 1		Strategies for Trader 2			
		A Cheater		Not A Cheater	
		Cheat	Not Cheat	Cheat	Not Cheat
Use OES	0.1, 0	0.9, x	-0.1, 0	0.9, x	
	-1, 2	1, x	-1, 2	1, x	

Trader 1' faces the situation:

- 1) Trader 2's benefit x when not cheating is unknown.
- 2) If trader 2 is a cheater and $x > 0$, trader 2 may choose cheating.
- 3) If trader 2 is honest, s/he trades only when $x > 0$.

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Risk-neutral Traders' Decision Model (cont'd)

1) Case N-Pay: Traders do not use OES

$$\text{Buyer: } U_{i0}^b = (1 - P_i^b) (V_i^b - M_i) - P_i^b M_i \quad (3a)$$

$$\text{Seller: } U_{i0}^s = (1 - P_i^s) (M_i - V_i^s) - P_i^s V_i^s \quad (3b)$$

2) Case B-Pay: The buyer pays OES fee

$$\text{Buyer: } U_{i1}^b = (1 - P_i^b) (V_i^b - M_i - r M_i) - P_i^b r M_i \quad (4a)$$

$$\text{Seller: } U_{i0}^s = (1 - P_i^s) (M_i - V_i^s) \quad (4b)$$

3) Case S-Pay: The seller pays OES fee

$$\text{Buyer: } U_{i0}^b = (1 - Q_i^b) (V_i^b - M_i) \quad (5a)$$

$$\text{Seller: } U_{i1}^s = (1 - P_i^s) (M_i - V_i^s - r M_i) - P_i^s r M_i \quad (5b)$$

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Risk-neutral Traders' Decision Model (Cont'd)

- When a trader pays OES fee, he/she is unlikely to be a cheater. Knowing this, another trader's PRR $Q_i < P_i$. However, (4b) and (5a) do not contain a deduction from frauds, implying that the trader not paying the fee may cheat without any cost. Realizing the situation, the trader paying OES fee maintains the same PRR as used in Case N-Pay.

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Risk-neutral Traders' Decision Model (Cont'd)

Solving (3) and (4) with $U_{i1}^b \geq U_{i0}^b$ and $U_{i1}^b \geq 0$, we obtain the criterion for Case B-Pay:

$$P_i^b \geq r \quad (6a)$$

Solving (3) and (5) with $U_{i0}^s \geq U_{i1}^s$ and $U_{i0}^s \geq 0$, we obtain the criterion for Case S-Pay:

$$P_i^s V_i^s / M_i \geq r \quad (6b)$$

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Proposition 2

- The probability that a buyer pays OES fee alone is greater than a seller does so, providing they have the same PRR distribution.

Proof:

$$\text{B-Pay: } \text{Prob}\{P_i \geq r\} = F_i(r)$$

$$\text{S-Pay: } \text{Prob}\{P_i r M_i / V_i^s\} = F_i(r M_i / V_i^s)$$

$$M_i > V_i^s \text{ implies } \text{Prob}\{P_i \geq r\} > \text{Prob}\{P_i r M_i / V_i^s\}$$

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OES Adoption Rate

- The probability that traders adopt online escrow can be expressed as:

$$S_i(r) = \text{Prob}\{B\text{-Pay? } S\text{-Pay}\} \\ = \text{Prob}\{S\text{-Pay}\} + \text{Prob}\{B\text{-Pay? Not}(S\text{-Pay})\} \\ = 2F_i(r) - F_i(r)^2$$

- The OES adoption rate $A(r)$ in regard to OES fee rate r can be expressed as:

$$A(r) = \sum_i S_i(r)$$

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Monopolist OES Provider

- An OESP is willing to provide escrow service to trade i only if $r M_i - C^e \geq 0$, i.e. the transaction amount $M_i \geq C^e / r$, where C^e is the service cost.

- The monopolist OESP's objective function can be expressed in an expected profit function:

$$\pi(r) = \max_r \sum_i \pi_i(r) = \max_r \sum_i [(r M_i - C^e) S_i(r)]$$

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Optimizing OES Fee Rate

- FOC:

$$\sum_i [M_i S_i(r) + (r M_i - C) dS_i/dr] = 0, \quad \forall i$$

- If PRR is iid in I and C^e is negligible, we can solve the above and obtain:

$$r S_i(r^*) = r [2F_i(r^*) - F_i(r^*)^2] = A$$

where A is a constant.

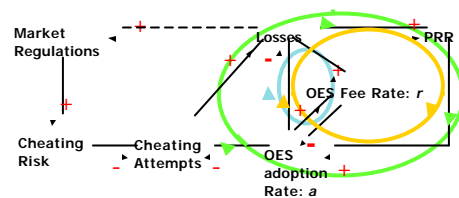
- This is an implicit function of r^* .

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Dynamics of the OES Economy



Three key monetary loops:

- 1) Escrow service adoption loop (Trader's loop): $\text{Loss} - \text{PRR} - a - \text{Loss}$
- 2) Escrow service rate loop (OESP's loop): $\text{Loss} - r - a - \text{Loss}$
- 3) Fraud suppression loop (Cheater's loop): $\text{Loss} - \text{PRR} - a - \text{Fraud} - \text{Loss}$

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Dynamics of the OES Economy

- Loss and OES adoption rate are two important nodes. All three loops go through them.
- PRR is the node affecting two loops.
- The three loops will finally lead to a dynamic equilibrium of OES economy.

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Proposition 3

- OES' functions in preventing Internet frauds is limited: 1) It is impossible that traders adopt OES in every trade; therefore, 2) Loss is inevitable even if OES is available.

Preventing the loss is the incentive for traders to use OES. If adoption rate $a = 100\%$, all trades can be protected. This will cause PRR lowering to zero. Then OES adoption rate will not be maintained at high level because of low PRR.

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OES Fee Rate

- OES fee rate is an exogenous variable in the system without necessary to bind to other variables.
 - A monopolist OESP may choose a optimum r to maximize its profit.
 - A social planner may also adopt a lower OES fee rate to encourage OES adoption, therefore to reduce the losses cause by Internet frauds.

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Improving OES Effectiveness

- Provide OES of social planner type
- Introduce competition into OES market

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Further Research

- Theoretical study on the dynamics of OES economy
- A simulation system will be developed to verify the equilibrium of OES dynamics
- Human subjects will be recruited to work with computer system to study the equilibrium.
- Analyses between the outcomes from the computer simulation and the human-based experient will be carried out.

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Acknowledgement

- Snigdha Chaudhuri, Haijun Zhao, and Jayaraj Parmeswaran researched OES literature in Fall 2000 during their independent study.

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