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# Contract choice in C2C E-commerce based on game analysis

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## ABSTRACT

With the development of C2C e-commerce, selecting proper contract to govern the transactions becomes particularly important. Although scholars have made considerable theoretical efforts to understand the rationale for various contractual arrangements, few empirical studies are undertaken to analyze contract choice in C2C e-commerce. Usually the interaction of informal and formal contract was analyzed under two-side repeated game framework. By extending the analysis from two-side repeated game framework to multi-side game situation, this paper enables us to discuss the contract implementation in non-frequent transactions. The conclusions are: when contract cost is very high, informal contract is the best choice; when contract cost is relatively high, there is substitution between formal contract and informal contract; when contract cost is low, formal contract complements informal contract.

## KEYWORDS

Formal contract; Informal contract; Game analysis.



## INTRODUCTION

Contracts can be divided into formal contract and informal contract. Formal contracts are written arrangements with detailed provisions made beforehand which can be confirmed afterwards by the third party such as formal courts of law. However, informal contracts are built on the observable ex-post outcomes or the outcomes which can not be described in advance due to high cost and can only rely on the punishment mechanism inflicted by repeated transactions to ensure the cooperative behaviors of parties. And informal contracts are always self-enforcing.

Although formal contracts can be enforced by courts of law or the third party, to save transaction cost people always avoid turning to the third party to deal with conflicts and more depend on norms, customs or reputation to implement contracts. The transactions of C2C e-commerce are always small and flexible, which further convinces the importance of informal contract for C2C e-commerce. Consumer-to-consumer (C2C) e-commerce is an online transaction mode which provides a private, convenient, and efficient platform of price negotiation for consumers to trade. Virtual community and online auction are the typical cases of C2C e-commerce. C2C e-commerce offers an online transacting platform for both buyers and sellers which enables buyers to auction their goods and sellers to buy these goods freely by bargaining. Usually C2C has the same characteristics with e-commerce such as virtualized transaction, low transactional cost, high transactional efficiency and transparency[1-4].

However, all these characteristics of C2C e-commerce increase the uncertainty of online transaction. First of all, because usually participants of transactions are individuals without the status of legal entity and there is no corresponding commercial entity in reality, opportunistic behaviors can easily appear in such anonymous transactions. Furthermore, the current transaction mode of C2C e-commerce has very low qualification requirements for sellers. Only with one identity card number and certain number of goods can a seller transact on the internet. Buyers don't have any information about the authenticity of sellers' personal information and the quality of the goods. Lastly, C2C transactions are always anonymous and non-repeated. Usually buyers pay first and then sellers will deliver the goods. So it is quite possible for sellers not to deliver goods after receiving the payment or to send the goods which are inconsistent with the description. For buyers, they may stop implementing the contract after the deal is reached, which will result in sellers' loss of commissions. All in all, all these possible opportunistic behaviors will bring high risks to online transactions.

Based on above analysis, the importance of choosing proper contract to govern C2C transactions is self-evident. In these transactions, although formal contracts can effectively reduce fraudulent conducts, the high contracting and implementation cost makes the use of informal contract also possible. Therefore, in this sense, the interaction of formal and informal contracts is an interesting topic worthy to be further explored.

## LITERATURE REVIEW

Currently there are three perspectives to analyze the interaction of formal and informal contracts:

The first perspective is built on whether the performance is observed. Suppose the performance can not be observed by the third party and only buyers can precisely observe it. In this sense, the performance is subjective. In this situation, there are two possibilities: (1) the sellers do not follow the informal contract which leads to the breakdown of relationship. Therefore, they have to sign a formal contract; (2) the performance indicators can be used to reduce the possibility of breach of contract. If the former one is more likely to happen, then formal contract will substitute informal contract; for the latter one, formal contract will complement informal contract[5].

The second perspective is based on different conditions for contract choice. If one attribute of a good can not be verified by the third party in advance, sellers and buyers can only reach an informal contract. After the attribute is verified, both sides can sign a formal contract based on the verified

attribute. In another word, if the introduction of formal contract relaxes the condition on the establishment of transactions or enlarge the set of feasible transactions, then the introduction of formal contract complement informal contract[6,7].

The third perspective is about comparing the contract conditions only employed by informal dealings with that of joint use of informal and formal contract. If the joint use (that is, signing a formal contract which contains the provisions for informal contract) relaxes the conditions on the establishment of transactions, there is complementality of formal and informal contracts; conversely, there exists substitution relationship[8].

The first two perspectives are dynamic. But the third perspective is more static. Apart from that, some other economists also made studies on the relationship between formal arrangement and informal arrangement.

Corts & Singh indirectly tested the substitution relationship of informal and formal contract: the increase of frequency of transaction reduced the use of formal contract[9]. Ryall & Sampson found that repeated transactions would promote enterprises to sign a more detailed and formal contract based on a sample data of enterprises[10]. According to the investigation data of information service industry, Poppo & Zenger tested the complementarity relationship of informal and formal contract: the increase of complexity of contract would make sellers as well buyers more depend on informal governance mechanism and vice versa. Furthermore, they found informal contract and formal contract were complementary in explaining transaction performance[11].

Usually the interaction of informal and formal contract was analyzed under two-side repeated game framework[6,7,12,13]. They found the folk theorem in the standard repeated game model is only applicable for analyzing the relationship of one seller and one buyer. The folk theorem was extended to random matching game to analyze the trades in non-frequent transaction environment[14-19]. Their findings showed that although information can not be freely and completely transferred among sellers and buyers, the equilibrium can still be reached. Some other literatures also illustrated this[20-22].

However, in analyzing the interactions of informal and formal contracts many scholars ignored the contract cost and implementation cost. Based on the studies of Schmidt & Schnitzer and Lazzarini, this paper applies random matching game theory to model how contract cost influences the interaction of formal and informal contract and considers the influence of contract cost on contract choices. In this way this paper extends the analysis of interaction of informal and formal contract from two-side repeated game framework to multi-side random matching game environment. It enables us to analyze the contract implementation in non-frequent transactions.

## MODEL CONSTRUCTION

### Variable description

Suppose the costs of different goods are the same for sellers. And buyers have the same evaluation on goods. Suppose the good transacted is comprised of a pair of attributes $(a_1, a_2)$, assumed to take either a low (L) or high (H) level. The two attributes are not related. Therefore, there are four possible combinations: (H, H); (H, L); (L, H); (L, L).

We make C denote the cost of the seller and suppose $C_{HH} > C_{HL} > C_{LH} > C_{LL}, C_{LL} = 0$.

We make U denote the value the buyer can obtain, and $U_{HH} > U_{HL} > U_{LL}, U_{HH} > U_{LH} > U_{LL}$.

Then U-C denotes the payoff of the buyer and $U_{HH} - C_{HH} > U_{HL} - C_{HL} > U_{LL} - C_{LL}$, $U_{HH} - C_{HH} > U_{LH} - C_{LH} > U_{LL} - C_{LL}$.

Suppose $\delta$ is discount factor. The higher the value of $\delta$ is, the more the buyer or seller trust each other.

To make the analysis simple, we suppose the buyer will pay the seller in advance before the seller delivery goods. That indicates only the seller may act opportunistically to provide goods with low attributes.

To analyze the interaction of formal and informal contract, in the following model first of all we suppose both the two attributes of good ($a_1, a_2$) are not verifiable. Therefore, the buyer and the seller will not sign a formal contract and will only depend on informal contract to implement the transaction. Then we suppose the first attribute ($a_1$) becomes verifiable. So there is possibility for the seller and the buyer to sign a formal contract based on the attribute. Of course, to save transaction cost, both sides may intentionally make the contract incomplete and use informal contract to maintain the transaction. Lastly this paper will analyze the choice of formal and informal contract and the influence of the introduction of formal contract on informal contract.

The informal contract in the circumstances that both attributes can not be verified

When the two attributes of good can not be verified, the buyer has two possible actions: (1) to pay for the good in advance without contract; (2) to exit the relationship. If the buyer does not exit, he or she proposes a price $p$. The seller observes the buyer's proposal and takes four possible actions, corresponding to the four combinations of attributes, plus an exit option. Because the buyer can perfectly observes the action taken by the seller, the buyer's offer is essentially a "take-it-or-leave-it". If either the seller or buyer exits, they both earn zero as a payoff.

When both the attributes can not be verified, the buyer and the seller can only depend on informal contract to transact. This paper supposes the buyer will take the trigger strategy: the buyer offers a price schedule $P \geq C_{HH}$. If the seller chooses a combination of attributes other than (H, H), the buyer exits afterward as a punishment. In C2C transactions, because there is small possibility for repeated transactions, the punishment for the opportunistic behaviors of the seller is always small. However, if information can be transferred efficiently, the deceptive strategy will harm the seller's reputation and other buyers will enforce collective punishment on the seller. To simplify the analysis, we suppose the collective punishment will last forever. If

$$\frac{P - C_{HH}}{1 - \delta} \geq P - C_{LL} \quad \textbf{(1)}$$

Then the informal contract is self-enforcing. The reputation mechanism can force the seller to choose the combination of attributes of high quality. The left-hand side of the equation (1) denotes the long term payoff the seller can obtain when choosing act honestly; the right-hand side of the equation denotes the current payoff the seller can obtain when choosing deceptive action. Because other buyers will implement collective punishment on the deceptive seller, his or her long term payoff is zero.

The interaction of formal and informal contract when contract cost is high

When the first attribute $a_1$ can be verified by the third party, in the contract the buyer can require $a_1$ must reach certain standards in advance. And the second attribute $a_2$ can not be verified by the third party and the buyer can only observe this attribute afterwards. In this case, the buyer can not require attribute $a_2$ must reach certain standards and can only adopt informal contract to motivate the seller to provide the good whose second attribute is high. To motivate the seller to choose the combination of (H, H), the buyer can sign a formal contract containing informal provisions: the buyer offers $P \geq C_{HH}$ and requires the seller to provide the combination of (H, H); If the seller choose to provide the good whose first attribute is low, the seller must return certain amount of money $d(0 \leq d \leq P)$ to the buyer.

Comparing with the first situation of which both $a_1$ and $a_2$ can not be verified, the above contract is more complete. Signing formal contract may bring contract cost. The contract cost usually includes the cost paid in advance, which is the technological input invested to ensure the contract can be verified by the third party. We suppose the contract cost $x$ to be borne by the buyer in each transaction but costs nothing to the seller. Then the buyer has three possible actions: (1) to pay for the good without formal contract; (2) to propose a formal contract based on the measurable attribute ($a_1$) which is required to meet certain criterion; (3) to exit the relationship. If the buyer does not exit, he or she proposes a price $p$. The seller observes the buyer's proposal and takes four possible actions, correspondingly to the four combinations of attributes, plus an exit option. The high contract cost ($x > U_{HL} - C_{HL}$) implies the buyer won't sign a formal contract to implement the second-best combination (H, L). Therefore, in the single stage game, the seller has the motives to provide low quality good. And the transaction will stop.

**The informal contract in the circumstances that attributes can be partly verified**

When one of the attributes can be verified, the buyer can transact with the seller by the informal contract or by a formal contract containing informal provisions. In the circumstances of not signing formal contract, if equation (1) is satisfied, then the informal contract is self-enforcing. The reputation mechanism can ensure the seller to choose the combination of attributes with high quality.

In the circumstances of not signing formal contract, the payoff of the transaction is $(U_{HH} - C_{HH}) - \max[0, (U_{HL} - C_{HL} - x)]$, This paper supposes that the buyer and the seller can bargain on the surplus of transaction. And the proportion the seller can get is $\alpha$ and $1-\alpha$ is what the buyer can get. Therefore, the price $P_h^i$ the buyer may pay is:

$$P_h^i = C_{HH} + \alpha(U_{HH} - C_{HH}) \quad \textbf{(2)}$$

From equation (1) and equation (2), we can get:

$$\delta \geq \frac{C_{HH} - C_{LL}}{P - C_{LL}} \quad \textbf{(3)}$$

From equation (3) we can see, when contract cost is high ($x > U_{HL} - C_{HL}$), both sides won't sign formal contract and mainly depend on informal contract to transact. $h$ denotes high contract cost, $i$ denotes informal contract, $f$ denotes formal contract. And at this time $\delta^i = \delta_h^f$.

**The formal contract containing informal provisions**

If the buyer provides the following incentive-compatible formal contract which contains informal provisions: the buyer offers the price schedule $P > C_{HH}$ to the seller and requires the seller to provide the combination of attributes (H, H); If the seller chooses the attribute $a_1$ of low, then the seller must return $d$ ($d \geq C_{HL}$) to the buyer.

In this contract, the largest short-term payoffs the seller can get when choosing the attribute $a_1$ of low is $P - d - C_{LL}$, which is less than the short-term payoffs $P - C_{HL}$ when choosing the combination of attributes (H, L). Therefore, with the above formal contract provided by the buyer, if the seller chooses

to breach the contract, he or she will choose the combination of attributes (H, L) other than (L, L). This indicates that when signing a formal contract, if

$$\frac{P - C_{HH}}{1-\delta} \geq P - C_{HL} \quad \textbf{(4)}$$

Then (H, H) will be self-enforcing. If the seller chooses the combination of attributes (H, L), he or she can get the payoff of $U_{HL} - C_{HL}$. If the seller chooses the combination of attributes (H, H), he or she can get the payoff of $U_{HH} - C_{HH}$. Because $(U_{HH} - C_{HH}) > (U_{HL} - C_{HL})$, the seller will choose the combination of (H, H). At this time, the overall payoffs of both sides will be $U_{HH} - C_{HH} - x$. If the proportion the seller can obtain is $\alpha$, the price the buyer should pay will be

$$P = C_{HH} + \alpha(U_{HH} - C_{HH} - x) \quad \textbf{(5)}$$

Comparing with not signing formal contract, the price is lower. And the explanation is that formal contract reduces the payoffs the seller can obtain from choosing a combination of attributes other than (H, H). From equation (5) and equation (4), we can get the deal condition:

$$\delta \geq \frac{C_{HH} - C_{HL}}{(C_{HH} - C_{HL}) + \alpha(U_{HH} - C_{HH} - x)} \quad \textbf{(6)}$$

At this time, $\delta^i > \delta_h^f$.

**Contract choices**

When both formal contract and informal contract are alternatives for transaction, if $(U_{HH} - P_H^i) > (U_{HH} - P_H^f - x)$ which indicates the payoffs the buyer can obtain from the informal contract is larger than the payoffs the buyer can obtain from the formal contract, the buyer will choose to reach an informal contract with the seller. When contract cost is high ($x > U_{HL} - C_{HL}$), $(U_{HH} - P_H^i) > (U_{HH} - P_H^f - x)$. Therefore, when both informal contract and formal contract are feasible, the buyer will choose the informal contract. However, when $(U_{HH} - C_{HH})C_{HL} / C_{HH} < x \leq U_{HH} - C_{HH}$ and $\delta_h^f < \delta \leq \delta_h^i$, only informal contract is feasible; when $U_{HL} - C_{HL} < x \leq (U_{HH} - C_{HH})C_{HL} / C_{HH}$ and $\delta_h^i < \delta \leq \delta_h^f$, only formal contract is feasible.

The interaction of formal and informal contract when contract cost is low

In two-side repeated game, if contract cost is smaller than the overall surplus brought by the second-best formal contract, once the relationship breaks down, both sides will sign a formal contract to get the second-best outcome-the combination of attributes (H, L). However, in the random matching game, although contract cost is smaller than the overall payoffs of the second-best action, the buyer won't sign a formal contract to implement the combination of attributes (H, L). He or she will refuse to transact with the seller and try to find other sellers who don't have the "stain". Therefore, in random matching game, the buyer and the seller won't be locked as in the two-side repeated game. The payoff the seller can get is still the current $p$.

**The informal contract in the circumstances that attributes can be partly verified**

If not signing formal contract, the expected payoff is $(U_{HH} - C_{HH}) - \max[0, (U_{HL} - C_{HL} - x)]$. The seller has the proportion of $\alpha$. Then the price paid by the buyer is

$$P_L^i = C_{HH} + \alpha[(U_{HH} - C_{HH}) - (U_{HL} - C_{HL} - x)] \quad \textbf{(7)}$$

From equation (1) and equation (7) we can get:

$$\delta \geq \frac{C_{HH}}{C_{HH} + \alpha[(U_{HH} - C_{HH}) - (U_{HL} - C_{HL} - x)]} \quad \textbf{(8)}$$

Comparing with equation (6), we can know the condition on self-enforcing informal contract when contract cost is high is stricter than that when contract cost is low.

**The formal contract containing informal provisions**

The buyer can provide an incentive-compatible formal contract which contains informal provisions to the seller: the buyer offers a price schedule $P \geq C_{HH}$ and requires the seller to provide the combination of attributes (H, H). If the seller chooses a combination of attributes ($a_1 = L, a_2$), the seller must return $d$ ($d \geq C_{HL}$) to the buyer. Therefore, the short-term payoffs the seller can get from choosing the combination of attributes ($a_1 = L, a_2$) is $P - d$. It is less than the short-term payoffs ($P - C_{HL}$) the seller can get by choosing the combination of attributes (H, L).

Therefore, if the buyer provides the formal contract described above, (H, L) will be the best action the seller will choose when breaching the contract. Similarly, in random matching game, if the seller chooses a combination of attributes other than (H, H), he or she can only get the current payoff of $P - C_{HL}$. In the following periods, all buyers will not sign a formal contract which implements the second-best choice (H, L) with the seller. This indicates that for the formal contract containing the informal provisions, if equation (4) is satisfied, the formal contract containing informal provisions is self-enforcing. Therefore,

$$P_L^f = C_{HH} + \alpha[(U_{HH} - C_{HH}) - (U_{HL} - C_{HL})] \quad \textbf{(9)}$$

From equation (4) and equation (9), we can get:

$$\delta_L^f \geq \frac{C_{HH} - C_{HL}}{(C_{HH} - C_{HL}) + \alpha[(U_{HH} - C_{HH}) - (U_{HL} - C_{HL}))]} \quad \textbf{(10)}$$

**Contract choices**

Next we analyze the contract choices of both sides. When both formal and informal contract are feasible, if

$$U_{HH} - P_L^i > U_{HH} - P_L^f - x \quad \textbf{(11)}$$

which indicates the payoff the buyer can get from informal contract is larger than the payoff of formal contract, the buyer will choose to reach an informal contract. When $x < U_{HL} - C_{HL}$, equation (11) is satisfied. Therefore, when contract cost is low, if both formal and informal contract are feasible, the

buyer will choose informal contract to implement the transaction. But when $\delta_L^i < \delta \le \delta_L^f$, only formal contract is feasible.

Contract choices and the interaction of formal and informal contracts

This paper mainly applies the second and third perspectives mentioned in the literature review to analyze the relationship between formal contract and informal contract. When the attributes can not be verified, both sides will depend on the informal contract to transact. The condition on feasible informal contract is $\delta \ge \delta^i$. From four conditions this paper further analyzes the influence of introduction of formal contract on informal contract.

*Condition 1:* when $x > U_{HH} - C_{HH}$ (that is, the contract cost is higher than the payoff of the best action) and the attributes can not be verified, both sides will choose informal contract to transact. When the attributes become partly verified, both sides will only choose informal contract because of $\delta^i = \delta_H^i$. According to the second perspective which judges the interaction of informal and formal contract, when the attributes become partly verified, the introduction of formal contract doesn't influence the use of informal contract.

*Condition 2:* when $(U_{HH} - C_{HH})C_{HL} / C_{HH} < x \le U_{HH} - C_{HH}$ (that is, contract cost is high), if $\delta \ge \delta_H^i$, both informal contract and formal contract are feasible. But if $\delta_H^i < \delta \le \delta_H^f$, only informal contract is feasible. Next we further analyze the satisfying condition of each contract before and after the attributes are verified. From above analysis we can know that the set of feasible transactions adopting informal contract with the attributes not being verified are quite the same with that whose attributes can be partly verified ($\delta^i = \delta_H^i$). But the set of feasible transactions adopting formal contract with the attributes being partly verified is smaller than that whose attributes can not be verified ($\delta^i < \delta_H^f$).

However, when the attributes become partly verified, the buyer will choose informal contract instead of formal contract. Therefore, based on the second perspective, we can draw the conclusion that when the attributes become partly verified, potential formal contract will substitute informal contract.

*Condition 3:* when $U_{HL} - C_{HL} < x \le (U_{HH} - C_{HH})C_{HL} / C_{HH}$, the set of feasible transactions using informal contract with the attributes not being verified are the same with that with the attributes being partly verified ($\delta^i = \delta_H^i$). But the set of feasible transactions using formal contract with the attributes being partly verified is larger than that whose attributes can not be verified ($\delta^i > \delta_H^f$). Therefore, we can draw the conclusion that when the attributes become partly verified, formal contract partly complements informal contract. Or according to the third perspectives we can know the two contracts complement each other: comparing with only using informal contract, joint use of formal and informal contract enlarges the set of feasible transactions.

*Condition 4:* when contract cost is low ($x \le U_{HL} - C_{HL}$), $\delta_L^f < \delta_L^i < \delta^i$. After the first attribute is verified, if $\delta > \delta_L^i$, both sides will choose informal contract; if $\delta_L^f < \delta \le \delta_L^i$, both sides will choose formal contract. When the attributes can partly be verified, both informal contract and formal contract can enlarge the set of feasible transactions. Therefore, formal contract complements informal contract. Or according to the third perspective, the set of feasible transactions using formal contract is larger than that using informal contract. And we can draw the same conclusion.

Summary: When contract cost is very high, the introduction of formal contract does not influence the choice of informal contract; when contract cost is relatively high, formal contract substitutes informal contract; when contract cost is low, the introduction of formal contract complements informal contract. Therefore, it is meaningless to generally discuss the interaction of formal and informal contract. What is more, this paper analyzes the relationship between formal and informal contract in non-frequent

transactions. Comparing with the study of Lazzarini, this paper also discusses the contract choice and interaction of formal and informal contract in the circumstance when contract cost is low (that is, $x \le U_{HL} - C_{HL}$). From the results, we can see the models established in this paper can better explain the interaction of formal and informal contract.

## CONCLUSIONS

For C2C e-commerce, before the appearance of the third party enforcers, contract cost is high. C2C transactions mainly depend on informal contract to implement. With the development of C2C e-commerce, both the legislative organizations and the third party enforcers are involved in the transactions. This makes contracts become verifiable. Because the involvement of third party can reduce contract cost, when there is a dispute, the buyers may turn to the third party for arbitration apart from the collective punishment mechanism on the seller.

For goods whose attributes are difficult to be verified, the contract cost is high. Sellers and buyers will choose informal contract to transact. For example, the qualities of many goods on www.taobao.com are hard to be verified such as jade articles. www.taobao.com and business alliance don't have the special technology to test their qualities and therefore it is hard for them to arbitrate the disputes arising from these transactions. The contract cost of jade articles is always high, which indicates sellers and buyers can only depend on informal contract to transact. For goods whose attributes are easy to be verified, the contract cost is low. Sellers and buyers intend to choose formal contract to transact. Because there is economies of scale for the third party to deal with disputes, usually the more valuable the goods are, the lower the contract cost is. For example, the electronic appliance sellers purchased the value-added service of consumer assurance plan provided by www.taobao.com. If there is any dispute, as the third party enforcer, www.taobao.com will directly return payment to the buyer first. But for goods with less values, maybe both sides won't purchase the consumer assurance plan.

This paper has extended the study of interaction of formal and informal contract from two-side repeated game to random matching game and has established a model to analyze the interaction in non-frequent transactions with the influence of contract cost. Therefore, this paper to some degree has extended the contract theory. The conclusions are: when contract cost is very high, only informal contract is feasible. When contract cost is relatively high, formal contract and informal contract substitutes for each other. When contract cost is low, formal contract complements informal contract. And the practices of C2C e-commerce illustrate the contract choice.

The limitation of this paper is that we only theoretically analyze the interaction of formal and informal contract and provide several cases of C2C e-commerce to illustrate the model. Whether quantitative analysis supports our analysis? The future research can focus on applying the data of C2C e-commerce to further explore the relationship between formal and informal contract.

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