The "Lemons" Problem in C2C Markets

Yanbin Tu

University of Connecticut

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The “Lemons” Problem in C2C Markets

Yanbin Tu
School of Business
University of Connecticut
ytu@sba.uconn.edu

ABSTRACT
Asymmetric information and adverse selection widely exist in used product markets. However, current C2C markets have two significant features: dynamic online evaluation system and “smarter” buyers (defined as customers with more prior information). In our primary analysis on the first feature, we find that higher quality used items are available in C2C markets and the size of the markets becomes larger. This suggests that the “lemons” problem is alleviated in current C2C markets. Further research about the impact of “smarter” buyers on C2C markets and empirical testing on the “lemons” problem in C2C markets are underway.

Keywords:
C2C markets, “Lemons” market, online evaluation system, prior information.

INTRODUCTION
Most items in C2C markets are used items such as electronics and books. The quality of used items can vary greatly. The seller has the full information about the used items. By contrast, the buyer has limited information. Obviously, this is an asymmetric information problem in the used product market. However, current C2C markets have two significant features that might alleviate this information asymmetry. (1) Dynamic online evaluation system. The buyer can refer to previous evaluations of the seller before he makes a purchase decision. After the buyer receives the product and has full information of the used item he bought, he will assign an evaluation to the seller to which future buyers can refer. Therefore, unlike the conventional used goods market in which the transaction between the buyer and seller is a “one shot deal”, online C2C markets are a dynamic environment. Under this mechanism, when the seller sells used items in this period, he needs to consider what kind of feedback he will get from the buyer in the next period, and this feedback might affect his future sales. (2) The buyer has multiple channels to get prior information about the used item he intends to purchase. By searching these additional channels, the buyer becomes “smarter” and will more likely make a better purchase decision. Some channels include online product introduction, previous evaluations for the similar items, BBS discussion and communications within virtual community.

Intuitively, both features built into the C2C markets force the buyer to list more accurate information for used items, which might alleviate the asymmetric information problem. The objective of this research is to systematically test whether this intuition holds or not. One important question that has not been answered so far: are current C2C markets still a “lemons” market? This paper focuses on the posted price C2C marketplaces such as Half.com and Amazon.com. It models the dynamic online evaluation system, investigates the behavior of buyers with more prior information and explores how these two features affect the “lemons” problem in C2C markets. Also, we collect market data to measure the extent to which of “lemons” are present in C2C markets. If “lemons” still dominate C2C markets, it means that we need to develop better market mechanisms to enhance the efficiency of C2C markets.

LITERATURE REVIEW
Akerlof (1970) shows that the adverse selection due to asymmetric information between the seller and buyer for used cars, taken to the extreme, can lead to total market failure. Under asymmetric information, the seller has incentive to market poor quality goods instead of high quality goods because the return for high quality accrues to the whole group of goods, not only to the individual seller. Every seller expects other sellers to supply high quality goods, while he would like to offer low quality goods. As a result, the average quality of used-goods and the size of the market shrink. The resulting used-goods
market is full of low quality goods, which are called “lemons”. Wilson (1979, 1980) describe the conditions for used good transactions reached in one-shot markets. Stigliz and Weiss (1981) extends the adverse selection problem into the banking setting. Greenwald (1986) extends the lemons model to the labor market. After the theory of the lemons model market was raised by Akerlof, some economists tried to test whether such lemons markets actually exist. There are two streams of empirical study on this topic. The first stream uses an experimental approach (LMP study in Lynch, Miller, Plott and Porter 1986, Holt and Roger 1990, Plott and Wilde 1982). Generally, these studies support the main points of Akerlof’ s arguments. The second stream of research uses the real data from different markets (Bond 1982, Bond 1984, Genesove 1993, Gibbons and Lawrence 1991). Some real-world lemons market scenarios are Bond (1982 and 1984) for the used pick-up truck market, Genesove (1993) for the wholesale used car market and Gibbons and Lawrence (1991) for the labor market. Dewanand Vernon (2002) find that buyer prices on eBay are 10-15% lower than those in an intermediated market, which suggests there is an adverse selection problem present in the current online auction market.

THE MODEL

I. Dynamic Online Evaluation System

Suppose there are a seller of used goods, and a potential buyer who is interested in the used item. When the seller decides to sell his used item, he knows its quality very well. Generally, better quality should carry a higher price. If the seller sets a higher price with low quality, the buyer will complain and give him a negative feedback. If he sets the price low with high quality, he foregoes some income. The best strategy for the seller is to match price and quality appropriately. In our model, the seller has two periods. In period 1, the seller lists his item for sale. He describes the quality of the item and sets the price.

In period 2, he receives feedback from the buyer. The seller utility in period 1 can be described by the following: $U=(M+sq)n$ subject to: $Y=M+pn$. Substituting $M$ into the objective function, yields: $U=Y+(sq-p)n$, where $U$ is utility, $M$ is the seller’s other consumption goods. $s$ is the parameter for the utility index, and we assume that $s$ is distributed as a continuously differentiable and strictly positive density, $h(s)$. $q$ is the quality of the item for sale. Note that $q$ is assumed to distribute according to a continuously differentiable and strictly positive density, $f(q)$, defined on $[q_0, q_1]$ with $q_0>0$. $n$ is an indicator where $n=1$ means the seller keeps the item, and $n=0$ means the seller sells it. $Y$ is the total income to the seller. The seller’s utility at period 2 can be represented as $U=ae(1-n)$, where $a$ is the parameter for the utility index (This measures the significance to the seller of the buyer’s evaluation.) $e$ is the buyer’s evaluation. Ignoring the discount rate, we can write the seller’s utility in two periods in table 1:

<table>
<thead>
<tr>
<th>Period One</th>
<th>Period Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U=M+sqn$</td>
<td>$U=ae(1-n)$</td>
</tr>
<tr>
<td>s.t.: $Y=M+pn$</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Seller’s Utility In Two Periods

Because when the seller makes a decision on price, he doesn’t know the value of the evaluation, the parameter $e$ is a random variable. We can write the total expected utility in both periods for the seller as follows: $E(U)=Y+(sq-p)n+aE(e)(1-n)$ where $E(e)$ is the expected evaluation from the buyer.

When $n=1$, the seller keeps the item, his expected utility is $E(U)=Y+(sq-p)$. (1)

When $n=0$, the seller sells the item, his expected utility is $E(U)=Y+aE(e)$. (2)

The seller wants to sell the item if and only if (2) > (1):

$Y+aE(e)>Y+(sq-p)$, i.e., $p>sq-aE(e)$. (3)

Under (2), as the seller tries to maximize the expected utility he has incentive to keep $E(e)$ positive and as large as possible. Without the evaluation system, the seller will only care about his utility at period 1. It’s easy to see why he is willing to sell the used item under the condition $p>sq$ (See Wilson 1979, 1980). We have the following proposition.

**Proposition 1:** Under the dynamic online evaluation system in C2C markets, the seller might under-price the used item.

Proof: Under the evaluation system, the sale price defined as $p^i$ should satisfy the condition $p^i>sq-aE(e)$. Without such systems, the sale price defined as $p^t$, should satisfy the condition $p^t>sq$. $p^t$ might be lower than $p^i$ because $sq-aE(e)<sq$ as $a$ and $E(e)$ are positive. QED
The implication of proposition 1 is that since the seller needs to care about the feedback from the buyer, it is possible that he is willing to sell the item at a price that is undervalued relative to its quality.

Similarly, there are two scenarios to the buyer. The first is that no matter what kind of evaluation the buyer gives, he doesn’t get any reward or compensation. The buyer doesn’t include his evaluation in his utility in this case. The second is that the seller gives the evaluator some reward such as a coupon or discount if the buyer says good words about him, or he provides some compensation to the complainer. In this case, the buyer includes the evaluation in his utility in period 2. The utility for the buyer under the two cases is listed in table 2, where \( t \) is the parameter for buyer’s utility index. We assume that \( t \) is distributed according to a continuously differentiable and strictly positive density, \( h(t) \), on \( (t_0, t_1) \). \( E(q) \) is the expected quality in period one. \( n \) is the indicator where \( n=1 \) means the buyer purchases the item and \( n=0 \) means the buyer doesn’t buy the item.

<table>
<thead>
<tr>
<th>Period One</th>
<th>Period Two</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1</strong></td>
<td><strong>N.A.</strong></td>
</tr>
<tr>
<td>( U=M+tq_n )</td>
<td></td>
</tr>
<tr>
<td>( S.T.: Y=M+pn )</td>
<td></td>
</tr>
<tr>
<td><strong>Case 2</strong></td>
<td>( e(q-E(q))n )</td>
</tr>
<tr>
<td>( U=M+tq_m )</td>
<td></td>
</tr>
<tr>
<td>( s.t.: Y=M+pn )</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Buyer’s utility in two periods

In both cases, the buyer derives some utility in period 1. After the buyer determines the real quality of the item, he will assign an evaluation to the seller according to the following rule: If the real quality \( q \) is greater than the expected quality \( E(q) \), he will assign a positive \( e \). If the real quality is less than the expected quality \( E(q) \), he will assign a negative \( e \). We can write the rule in a compact way: \( e(q-E(q))>0 \). In case 2, we use \( e(q-E(q)) \) to represent the buyer’s utility at period 2.

Under the case 1, the total expected utility of the buyer can be written as \( E(U)=Y+(tE(q)-p)n \).

When \( n=1 \), the buyer buys the item, \( E(U)=Y+(tE(q)-p) \) (4)

When \( n=0 \), the buyer doesn’t buy the item, \( U=Y \) (5)

The buyer decides to buy the item if and only if (4)> (5):

\[ Y+(tE(q)-p)>Y, \] that is, \( p<tE(q) \) (6)

So, the necessary condition to reach a transaction is that the price should satisfy (3) and (6) simultaneously, that is, \( sq-aE(e)<p<tE(q) \). This implies that \( sq=tE(q)+aE(e). \) (7)

Under case 2, the total expected utility of the buyer can be written as \( E(U)=Y+(tE(q)-p)n+e(q-E(q))n \).

When \( n=1 \), the buyer buys the item, his utility is \( E(U)=Y+(tE(q)-p)+e(q-E(q)) \) (8)

When \( n=0 \), the buyer doesn’t buy the item, his utility is \( E(U)=Y \) (9)

Obviously, he decides to buy the item if and only if (8)> (9):

\[ Y+(tE(q)-p)+e(q-E(q))>Y, \] that is, \( p<tE(q)+e(q-E(q)). \) (10)

Therefore, the necessary condition to reach a transaction in case 2 is that the price should satisfy conditions (3) and (10) simultaneously: \( sq-aE(e)<p<tE(q)+e(q-E(q)) \) which implies \( sq<tE(q)+aE(e)+e(q-E(q)). \) (11)

It’s clear that without the dynamic evaluation system, the condition to reach a transaction is \( sq<p<tE(q) \) (See Wilson 1979, 1980). From the above analysis, we get the following propositions.

**Proposition 2:** If the buyer has some utility in period 2 due to his evaluation, he is willing to accept a higher price for the same used item.

**Proof:** Under case 2, the price condition for a transaction is \( sq-aE(e)<p<tE(q)+e(q-E(q)) \). Since \( e(q-E(q))>0 \), a higher price \( p \) might be acceptable to the buyer.

**QED**

**Proposition 3:** Under the current C2C markets mechanism, the adverse selection problem is mitigated.

**Proof:** From Wilson (1979,1980), we know the items for sale satisfies the condition \( sq<tE(q) \). Under case 1 and case 2, from the equations (7) and (11), we get \( sq=tE(q)+aE(e) \) and \( sq<tE(q)+aE(e)+e(q-E(q)) \) respectively, which means there are items
with higher quality available in the market. If we compare case 2 with case 1, we find case 2 will bring some used items with even higher quality.

**Proposition 4:** The market size under the current C2C markets mechanism is larger than the size under the one-shot market.

Proof: From Wilson (1979, 1980), we know the Walrasian supply at price \( p \), \( S^p(p) \) is equal to the number of items for which

\[
q \leq p/t: \quad S^p(p) = \begin{cases} 
\int_{q_0}^{p/t} f(q) dq, & \text{for } p > t q_0 \\
0, & \text{otherwise}
\end{cases}
\]

The Walrasian demand at price \( p \), \( D^p(p) \) is

\[
D^p(p) = \begin{cases} 
\int_{p/E(q(p))}^t h(t) dt, & \text{for } p < t E(q(p)) \\
0, & \text{otherwise}
\end{cases}
\]

Under case 1 and case 2, the Walrasian supplies, \( S^1(p) \) and \( S^2(p) \) are:

\[
S^1(p) = S^2(p) = \begin{cases} 
\int_{q_0}^{p+aE(e)/t} f(q) dq, & \text{for } p > (t q_0 - a E(e)) \\
0, & \text{otherwise}
\end{cases}
\]

The corresponding Walrasian demands in case 1 and case 2 are

\[
D^1(p) = \begin{cases} 
\int_{p/E(q(p))}^t h(t) dt, & \text{for } p < t E(q(p)) \\
0, & \text{otherwise}
\end{cases}
\]

\[
D^2(p) = \begin{cases} 
\int_{p-E(q(p))/E(q(p))}^{p-aE(e)/t} h(t) dt, & \text{for } p < t E(q(p)) + a E(e) \\
0, & \text{otherwise}
\end{cases}
\]

Obviously, \( S^1(p) \) and \( S^2(p) \) are greater than \( S^p(p) \), and \( D^1(p) \) is greater than \( D^p(p) \). This indicates that under the dynamic online evaluation system in C2C markets, more suppliers and more consumers enter the market. QED

**SUMMARY AND FUTURE STUDY**

From our primary analysis, we find that higher quality used items are available in C2C markets, and the size of the markets becomes larger, due to the dynamic online evaluation system. This suggests that the “lemons” problem is alleviated in C2C markets.

Our next step for the study includes two parts. In the first part, we will analyze the impact of “smarter” buyers (defined as customers with more prior information) on the market efficiency. We will use Bayesian analysis to model this problem. In the second part, we will test the “lemons” problem in C2C markets by using real market data. Currently, we are designing the computer program to collect data from Half.com and Amazon.com. If these tests show that the “lemons” problem is still significant, it suggests that we need to propose a better market mechanism to enhance the efficiency of C2C markets.

**REFERENCES**