

# TRUST AMONG STRANGERS IN INTERNET TRANSACTIONS: EMPIRICAL ANALYSIS OF eBAY'S REPUTATION SYSTEM

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## ABSTRACT

*One of the earliest and best known Internet reputation systems is run by eBay, which gathers comments from buyers and sellers about each other after each transaction. Examination of a large data set from 1999 reveals several interesting features. First, despite incentives to free ride, feedback was provided more than half the time. Second, well beyond reasonable expectation, it was almost always positive. Third, reputation profiles were predictive of future performance, though eBay's net feedback statistic is far from the best predictor available. Fourth, there was a high correlation between buyer and seller feedback, suggesting that the players reciprocate and retaliate.*

## 1. INTRODUCTION

Reputations in a classic marketplace spread overwhelmingly by word of mouth, on a "retail" basis. The news of a dissatisfied customer at a store, or even a dozen dissatisfied customers, is not likely to reach the ears of most potential customers. There are some coordinated rating agencies in regular markets; one example is Zagats. Even though Cousin Larry may be more reliable than the

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unknown masses who provide ratings to Zagats, the guide has an edge (at least for many diners) because it reports on dozens of opinions on each of hundreds of restaurants. The difference between Zagats in the bookstore and Zagats on the web is also instructive. The book costs money, but most all of the same information is available on the web for free. With the web Zagats, one can instantly get information on restaurants in far-away cities, whereas printed Zagat books on distant locales are harder to come by. While one word-of-mouth review reaches perhaps dozens, Zagats books reach thousands, and Zagats on-line reaches hundreds of thousands. The potential of the last rating system – which capitalizes on the extraordinary reach of the web – has not begun to be met for most goods and services.

By virtually any metric, orders of magnitude more people are connected to each other, and communicate cheaply with each other, than at any time in history. However, many of these communications are among strangers, people who do not know each other before they receive a communication, learn little about each other from the communication, and do not encounter each other again. Where such encounters involve merely mail or chat room messages, such exchanges are not surprising. Risks are small so not much trust is required.

What is surprising is the vast shuttling of both new and second hand goods among distant strangers on the Internet, through such mechanisms as eBay and the Yahoo auction site. Buyers, who must pay before inspecting or receiving their items, must put considerable dollars at risk. This paper seeks to explain why buyers trust unknown sellers in this vast electronic garage sale. For data, we shall be drawing on all the transactions on the eBay auction site from February through June 1999. The scale of these operations is impressive. eBay's site now boasts an average of more than five million active auction listings and though there has been growth over time our complete data set consists of millions of items.<sup>1</sup>

How is trust traditionally created when goods are exchanged? We identify eight factors; readers would add more:

- (1) Most retail transactions are conducted locally, which gives individuals the opportunity to inspect them, as say with fruit in a rural market. If quality is discernible, no trust is needed;
- (2) Retail operations tend to be large relative to their local market, be they vegetable sellers or the local department store. Buyers have frequent interaction with the same seller, and learn whom they can trust;
- (3) Even when one's personal interactions are limited, given that a retailer's sales are concentrated in a locale makes it easy to develop reputations so customers learn about retailers from their peers;

- (4) Retailer reputations are borrowed from other contexts. For example, retailers are likely to be pillars of the church and community, and would be highly reluctant to sacrifice the status that comes from such reputations.<sup>2</sup>
- (5) Reputations are built over many years; at an extreme, witness the reputations of Rothschild and Sons and the Bank of Scotland, leading financial institutions, which have built reputations over hundreds of years;
- (6) Reputations are borrowed from others. Thus celebrities will attest to the quality of products;
- (7) New goods benefit from established brand names, and policing of quality by those who own them. The product, not the retailer, wins the reputation;
- (8) Significant expenditures – e.g. building a fancy store on Manhattan’s Fifth Avenue<sup>3</sup> – indicates that one will be reliable, lest this expenditure be wasted, a form of signaling.

Internet auctions have none of these mechanisms available. Sellers are not met, and little or nothing is known about their characteristics, or even their location beyond their city. Customers rarely repeat, and they do not run into each other. Putting items on the web is a cheap activity. Some goods that are traded are not brand name, and when they are, there is a risk of being counterfeit. Measured in relation to the age of significant retail operations, all of the sellers are new. No one attests about the sellers. Firms like eBay do not stand behind their auctioneers. Yet millions of transactions have taken place.

Cheap collection, distribution, and computation, however, can accomplish a lot. If one has a bad experience in the village, one may tell one’s friends, at a cost of a few minutes for each telling. A bad experience with an Internet seller can be recorded in less than a minute, and spread to millions of potential customers. Each of those potential customers is much less likely to ever encounter the blameworthy seller, but they will have the relevant information on a seller when they need it. Through computational power, vast amounts of even snippets of information can be aggregated to inform buyers about patterns of seller trustworthiness. A reputation system collects, distributes, and aggregates feedback about participants’ past behaviors.

The task of this paper is to determine, as best as is possible with data provided by eBay, how the system is working. Resnick et al. (2000) identify three challenges for a reputation system. It must: (1) provide information that allows buyers to distinguish between trustworthy and non-trustworthy sellers; (2) encourage sellers to be trustworthy; and (3) discourage participation from those who aren’t. In the terminology of asymmetric information, the second and third criteria are that a reputation system must deter moral hazard and

adverse selection on the part of sellers (e.g. Milgrom & Roberts, 1992, Chaps 5 and 6).

The eBay reputation system is applied to buyers as well. However, buyers' reputations matter substantially less, since sellers can hold goods until they are paid. The greatest risk is that they will not get paid, in which case they can turn to the second high bidder. Moreover, even if sellers wished to rely on buyers' reputations it would do little good, since it is not possible to exclude buyers with bad reputations from one's auction.<sup>4</sup>

It is worth noting at the outset that the system need not be theoretically sound in order to work. It may only be necessary that both buyers and sellers believe that the system or some part of the system works. There is little published literature on the effective workings of reputation systems on the Internet, so it seems extremely unlikely that many participants are aware of frequency of feedback, disproportions in feedback among those having positive and negative experiences, etc. What matters therefore, is not how the system works, but how its participants believe it works, or even whether they believe it works even if they have no concern about why. To invoke an analogy drawn from grander considerations, the behavior of man in a world without a God might be fully moral and God-fearing if its denizens believed there was a God who would judge them and possibly punish them in the hereafter.

Let us illustrate how a system might deter moral hazard and adverse selection, even if it did not allow buyers to actually distinguish trustworthy from untrustworthy sellers. Suppose that negative feedback is rarely given even when buyers are dissatisfied, suggesting that the system would not work if this fact were widely known. Say that new sellers have to pay an entry or initiation fee in terms of reduced prices and reduced frequency of sale/item listed. If unreliable sellers know that they will have to pay their dues at the outset, and if they believe that the feedback system is likely to give them poor ratings, they will be deterred from participating. They will not make the investment of entering in the first place.

We begin our analysis with general characteristics of the eBay marketplace and reputation system. Section 2 describes the mechanical workings of the feedback system. Section 3 describes the data sets used in the remainder of the paper. Section 4 presents the distribution of feedback profiles among buyers and sellers and examines the extent of ongoing trading relationships versus single transactions.

In Section 5, we address the provision of feedback. Information about the behavior of others is a public good, and whether the information is bad or good, there is little incentive to provide it. Even keystrokes are costly. To counteract underprovision, small payments could be provided to raters. Avery et al. (1999)

explored alternative mechanisms for organizing such a market for evaluation. However, even without such payments, we found empirically that buyers left feedback for more than half of the transactions.

In Section 6, we examine whether feedback profiles are informative to buyers. Sellers might manipulate their profiles by handling small transactions honestly but cash in their reputations on high value items. Or they might ask friends to help artificially inflate their profiles. eBay's summary statistic, the number of positive feedbacks minus number of negatives, is highly inappropriate in an information theory sense, because it underweights negative feedback, which is quite rare. We find, however, that a seller's prior feedback profile as a whole is somewhat predictive of future performance.

Section 7 turns to incentive effects in deterring moral hazard. We do not consider here whether better reputations are rewarded with price premiums. A number of recent studies have investigated this question through observational studies (e.g. Ba & Pavlou, forthcoming; Bajari & Hortacsu, 2000; Dewan, 2001; Eaton, 2002; Houser & Wooders, 2000; Kalyanam & McIntyre, 2001; Kauffman & Wood, 2000; Lee et al., 2000; Lucking-Reiley et al., 2000; McDonald & Slawson, 2001; Melnik & Alm, forthcoming). Resnick et al. (2002) recently conducted a controlled field experiment, but no clear consensus has yet emerged from these studies about the effect of reputation on seller profits. We do examine one bit of evidence about the incentive effects for sellers, their propensity to monitor their own feedback and respond to negative comments.

Section 8 then returns to questions of feedback provision. Assuming feedback is provided, will it be without bias? The disincentive to provide negative information may be far stronger, with the potential for lawsuits, and for retaliatory negative feedback.<sup>5</sup> Once again, the reality may not matter. Even if there has never been a lawsuit, participants may feel the threat.<sup>6</sup> Beyond these concerns, most people do not like to provide negative feedback. And there may be a bias to the positive side, particularly if the seller goes first, if the feedback process is basically an exchange of courtesies: "You behaved well. You also behaved well."

But why should anyone consider providing feedback at all? Why shouldn't they merely free ride? We suspect that many people do it as part of some quasi-civic duty. It is an encouraged activity, and does not cost much. Others do it as a courtesy. They have had a successful transaction and want to say thanks. Some expect reciprocity. Indeed, numerous sellers communicate with buyers that they always provide feedback for a successful transaction, and they hope the buyer will do so as well. These reasons do not apply, or apply much less forcefully, when an experience was bad. Bad evaluations, theory would

suggest, are much less likely to be given, unless revenge is a strong motivating force.<sup>7</sup> On the other hand, a phenomenon of stoning may emerge, where buyers are much more willing to give negative feedback to sellers who have recently received other negative feedback. In ongoing work with Miller (2002), we are considering how payments tied to the quality of evaluations (as measured by agreement with future evaluations) might overcome these natural distortions in the elicitation of feedback.

## 2. THE eBAY FEEDBACK SYSTEM

Before turning to our actual data, it is worth looking at how the eBay reputation system actually works. Before participating in any auctions, as either buyer or seller, people (henceforth called users, as in users of the auction service) register, providing information to eBay, including name and contact information. The only information that eBay verifies, at least for buyers, is that the email address is valid.<sup>8</sup> Not all of the information provided to eBay is made visible to other users. In particular, as part of the registration process, the user chooses an online pseudonym, or ID. This, rather than the full name provided to eBay, is shown to other users when buying and selling. Some users choose to use their email address as their pseudonym but many others choose other short monikers. Other users can request the email address associated with any pseudonym, but must reveal their own email address in order to do so. eBay does not reveal the real names and physical addresses provided during registration to other users. Since there are many ways to sign up for free email accounts at services like HotMail and Yahoo, this system means that anyone who wants to remain anonymous has the option to do so.

Buyers and sellers can leave comments about each other after transactions, but are not required to do so. Each comment consists of one line of text, plus a numeric rating of +1 (positive), 0 (neutral), or -1 (negative). Initially, any user could leave feedback about any other user. Beginning in February, 1999, all negative feedback had to be tied to a particular transaction. Beginning in February, 2000, all feedback had to be tied to a transaction: i.e. only the seller and winning bidder can leave feedback about each other.

Users have the option of whether to make their feedback visible to other users or not, but this decision must be made about the entire feedback profile, not on a case by case basis. By default, the feedback profile is publicly visible, and we have never encountered a user who had chosen to hide their feedback profile.

When a buyer searches for items, she sees a summary listing of items, with item titles and current prices, but not the sellers' pseudonyms or any indication

of their prior feedback (Fig. 1). After clicking through to the item's full description page, the seller's ID and a summary feedback score are displayed (Fig. 2). The feedback summary statistic is the number of unique (distinct) users who left positive feedback, minus the number of unique users who left negative feedback. If the buyer chooses to click on the summary feedback score, she sees details of the seller's feedback profile (Fig. 3). This includes a breakdown of positives, neutrals, and negatives, and also breakdowns for the most recent week, month, and six-month period. The buyer can then scroll down to view the text of the actual comments, most recent comments first (Fig. 4). It is possible to scroll through any or all of the comments, but eBay does not provide an easy way to search for the negative and neutral comments. After placing a bid on an item, the seller can view the list of bidders and click through to see their feedback profiles. Sellers are permitted to cancel particular bids, but they do not have a way to proactively prohibit future bids from the same bidder, or all bids from bidders having bad feedback profiles. Since many bids arrive in the last few minutes of auctions (as analyzed by Roth and Ockenfels, forthcoming), it is often impossible for a seller to avoid unwanted buyers.<sup>9</sup>

A user can change the pseudonym presented to others at any time, but the previous feedback follows the user. It is possible, however, to get a new email address, and register completely anew, thus leaving behind one's previous feedback. Over time, eBay has taken efforts to make it increasingly difficult to return with a new identity (e.g. when registering with a hotmail.com email address, a user has to provide a credit card number and eBay may notice when the same number is used again). It is not, however, completely impossible to do so.

### 3. DATA SETS

Our primary data source consists of transactional data from eBay from February 1 – June 30, 1999, and all feedback data up to June 30, 1999. This data set contained more than 20 gigabytes, or the equivalent of more than 13 million pages of double-spaced text. In order to protect the privacy of users, the data set does not include email addresses, pseudonyms, or any other personally identifying information.<sup>10</sup> In order to protect eBay's commercial interests, we are not able to report data that could be used to infer revenue or profits, such as average number of items sold or average selling price. In order to make the data set manageable, we received only the item titles, and not the more extensive text descriptions of items that appeared on the item detail page (e.g. Fig. 2). A few other data fields are also not available to us, in order to protect privacy interests of eBay users, or commercial interests of the company. For the

120262094	BRILLIANT Cut Crystal Court by HAWKES #2	\$65.00	-	Dec-22 19:10
1202254895	2 APRICOT CUT TO CLEAR WINE GOBLET NR	\$75.00	1	Dec-24 10:25
1203577333	2 Swedish Plates Fortheds	\$9.99	-	Dec-25 22:54
1203323028	Cut Glass 2 Handed 9" Bowl - EXPANDING STAR	\$15.00	1	Dec-27 20:36
1203241845	CUT GLASS - 1 1/2" SHALLOW BOWL - OLD	\$99.95	-	Dec-27 21:18
1203505974	Cut Glass 11 1/2-in. High Shouldered Vase	\$150.00	-	Dec-28 18:39

Fig. 1. The Auction Summaries Listing.



**Pottery & Glass: Glass Cut Glass American Brilliant**

Currently	<b>\$75.00</b>	First bid	<b>\$75.00</b>
Quantity	1	# of bids	1 bid history
Time left	2 days, 0 hour +	Location	CT
Started	Dec-14-00 10:25:53 PST	Country/Region	USA/Hartford
Ends	Dec-24-00 10:25:53 PST		<input type="checkbox"/> mail this auction to a friend
Seller (Rating)	<a href="#">seller01090</a> ☆		<input type="checkbox"/> watch this item
High bid	<a href="#">buyer01079</a> ☆		

[view comments in seller's Feedback Profile](#) | [view seller's other auctions](#) | [ask seller a question](#)

Fig. 2. Detail About One Item, Including Feedback of Seller and Highest Bidder.  
 Note: User Names are Disguised in this and Other Figures to Protect the Privacy of eBay Users.

**Overall profile makeup**

94 positives, 91 are from unique users and count toward the final rating.

4 neutrals, 0 are from users no longer registered.

1 negatives, 1 are from unique users and count toward the final rating.

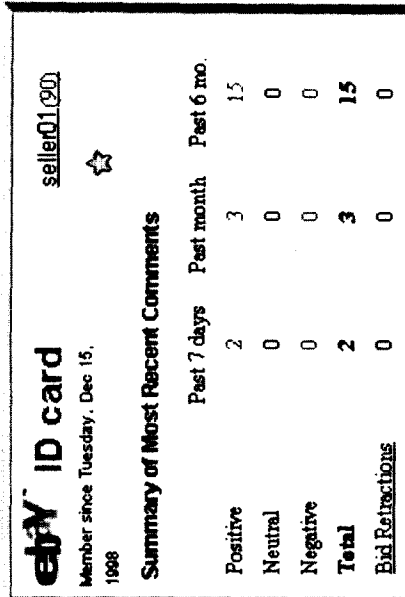


Fig. 3. Feedback Profile of the Seller.

User: **buyer02(82)** ☆ **Date: Mar-21-00 23:16:24 PST**  
Praise: Very good communication. Fast delivery. Great seller. A+++++

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User: **buyer03(739)** ★ **Date: Mar-21-00 14:21:32 PST**  
Praise: FINE MAN, HIGHLY RECOMMEND, VERY FAST PAYMENT, GREAT E-MAILS, THANKS

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User: **buyer4(104)** ★ **Date: Mar-21-00 12:48:00 PST**  
Complaint: ABSOLUTELY NO CONTACT!!!! THIS SELLER IS ONLY WORRIED ABOUT MONEY!!! BEWARE!!!  
Response: \*\*\*\*\*THIS BIDDER BOUNCED CHECK THIS IS JUST CHILD LIKE RETRIBUTION \*\*\*\*\*

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User: **buyer05(22)** ☆ **Date: Mar-20-00 11:53:23 PST**  
Praise: prompt shipment, good packaging, would recommend.....

Fig. 4. Some of the Individual Comments about the Seller.

Note that the seller's response to the one negative feedback alleges that it was retaliatory in nature rather than a real indicator of the seller's performance.

most part, however, we have fairly complete data about items listed, bids placed, and feedback given and received.

Several smaller data extractions form the basis for analyses in this paper. The first we refer to as the listed items data set, LI. It is a sample of single items (eBay also permits Dutch auctions of multiple units of the same item) that were open for public bidding (eBay also permits private sales). 36,233 of these items attracted a bid at least as high as both the starting bid and the reserve price and hence were officially sold (some buyers back out after winning auctions, which is the primary source of seller complaints against buyers). All the selected items were listed on February 20, 1999, but this was not a complete sample of items sold on that day.<sup>11</sup> There were 13,695 distinct sellers who listed items for sale in the LI data set (we refer to them as sellers even if the item did not sell), and 25,103 distinct buyers. This data set was small enough to permit, for each transaction, computation of buyer and seller feedback profiles prior to the transaction and extraction of feedback about the transaction.

The second data extraction, which we refer to as the longitudinal listings data set, LL, contains all the items listed by a sample of 1000 sellers, during the full time period February 1 – June 30, 1999. The LL data set contains 168,680 item sales. It is too large to permit detailed analyses, but is useful for assessing the extent of repeated interactions between particular buyers and sellers.

A third data extraction focuses on negative feedback in particular, and we refer to it as NF. It consists of a random sample of 1,580 negative feedbacks entered on May 1, 1999. For each recipient of this negative feedback, all transactions from February 1- June 30, 1999 were also extracted. This data set is considered in Section 7.

#### **4. GENERAL CHARACTERISTICS**

Before looking more specifically at the provision and effects of feedback, we first examine three characteristics of the eBay marketplace. First, are most transactions really between strangers, or do users develop ongoing trading relationships. Second, what is the distribution of prior feedback for buyers and sellers? Third, do most buyers also tend to sell and vice versa, or are the buying and selling roles distinct?

To assess the frequency of ongoing trading relationships, we examined the trading histories of 1,000 sellers in the LL data set. Overall, these sellers sold 168,680 items during the five-month period from February 1 to June 30, an average of 169 items each. There were 121,564 distinct buyers.

There were 138,458 distinct seller-buyer combinations. This indicates that 17.9% of all sales involved a buyer and seller who had done business with each

other before. However, 89.0% of all seller-buyer pairs conducted just one transaction during the time period, and 98.9% conducted no more than four. In the vast majority of cases, multiple transactions between a seller and buyer occurred within a few days of each other (sellers often offer reduced shipping costs to buyers who buy several items that can be shipped together). In most cases, even these multiple transactions are best thought of as a single interaction. Thus, performance in the current transaction will rarely be directly remembered by future buyers who are, after all, different from the current buyer: an explicit reputation system is needed to make current performance visible to other buyers.

Sellers tend to be far more experienced, on average, than buyers. Figure 5 shows histograms of the overall feedback scores (unique positives minus unique negatives) of the two groups for the LI data extraction. The sellers are much more likely to have very high feedback scores. The sellers' median was 33 (the score of the median item was 82, reflecting that high feedback sellers listed more items in the data set). The buyers' median was 8. It's unlikely that many people accumulate scores of 55 ( $\ln[\text{score}]$  of 4) or 148 ( $\ln[\text{score}]$  of 5) selling items from their attics, so eBay must be attracting professional sellers who are deliberately acquiring items from other sources in order to sell them on eBay. On the other hand, about a quarter of items were listed by people with net scores of less than 20, and 18% were listed by sellers with scores of 10 or less. Thus, there is also a large contingent of amateur sellers. Among the buyers, the concentration of low feedback scores is much higher. Overall, then, eBay is not only a c2c (consumer to consumer) marketplace but also a b2c (business to consumer) marketplace.

While some eBay users are traders, most are primarily either sellers or buyers. We traced the selling and buying of all users who listed or bought items in the LI extraction, for the entire period from February 1 through June 30, 1999. For the sellers in the LI extraction, the median number of items sold during the five-month period was 76 but the median number of items bought was just 9. For the buyers in the LI extraction, the median number of items sold was 0 (three quarters sold fewer than 10 items) and the median number of items bought was 28.

## **5. PROVISION OF FEEDBACK AT eBAY**

The first and most basic questions about feedback concern the extent to which it is provided, and its content when provided. Clearly, there are some users with hundreds or even thousands of feedback points, so feedback is given at least some of the time. How often is feedback positive? A brief perusal of the ratings

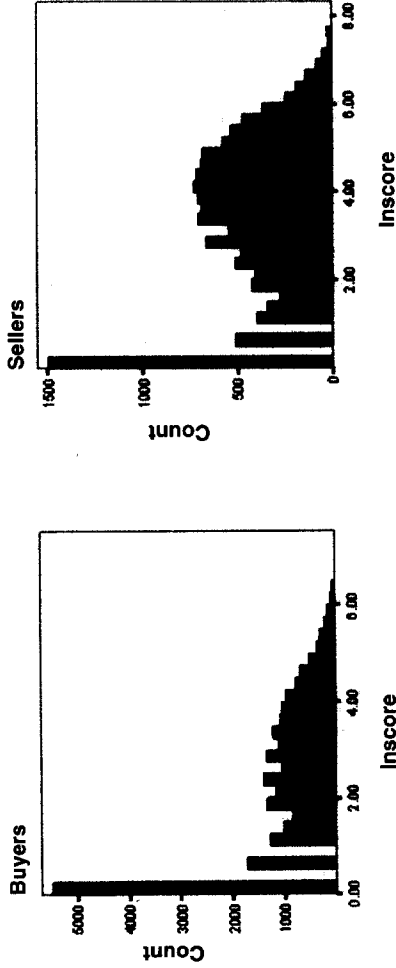


Fig. 5. Histograms of Feedback Profiles for Distinct Buyers and Sellers in the LI Data Set.

Each bar shows the number of buyers and sellers, respectively, with  $\ln(\text{positives-negatives} + 1)$  defining the range of feedback scores grouped in that bar. A  $\ln[\text{score}]$  of 2 corresponds to a score of 7, 4 to 55, and 6 to 403. The sellers group includes all users who listed items, whether or not the items sold.

on ebay or Yahoo suggests that negative feedback is rare, but hardly unknown.<sup>12</sup>

The LI data extraction of 36,233 sold items permits more systematic examination of these questions. During this time period, feedback was sometimes but not always explicitly marked as relating to a particular transaction. Using computerized matching, we were, however, able to find, for each transaction, the first feedback from the buyer about the seller that occurred in the six weeks following the transaction.<sup>13</sup> Table 1 summarizes the descriptive statistics for this data set. Buyers commented on sellers for 52.1% of the items, sellers on buyers 60.6% of the time. Thus sellers – many of whom have quite extensive experience – will have at least some expectation that there will be feedback on their transactions. Of feedback provided by buyers, 0.6% of comments were negative, 0.3% were neutral, and 99.1% were positive. Sellers were slightly less happy (the most common complaint by sellers is that the winning bidder simply doesn't follow through on the transaction). Taken at face value, the overwhelming majority of transactions lead to happy outcomes. A cursory examination of the follow-up comments after negative feedbacks suggests that even these transactions sometimes end with happy buyers.

Analysis of the text comments accompanying the 111 negative and 62 neutral comments revealed many reasons for dissatisfaction, as shown in Table 2. While both neutrals and negatives generally indicate dissatisfaction (except for 8 of the neutrals), they tended to be used for different kinds of complaints. Surprisingly, items that did not match their description were somewhat more likely to receive neutral than negative feedback, perhaps reflecting that buyers may have thought discrepancies were honest mistakes on the part of sellers. Similarly, slow shipment was more likely to lead to a neutral

**Table 1.** The Frequency of Feedback After Transactions in the LI Data Extraction.

	Buyer of Seller		Seller of Buyer	
	Frequency	Percent	Frequency	Percent
negative	111	0.3	353	1.0
neutral	62	0.2	60	0.2
positive	18,569	51.2	21,560	59.5
none	17,491	48.3	14,260	39.4
Total	36,233		36,233	

**Table 2.** Buyers' Most Common Complaints.

	Neutral feedback	Negative feedback
Arrived in poor condition, item not as advertised, replica rather than original	24	17
Backed out of transaction (did not contact or respond to high bidder)	1	30
No item received after sending payment	2	38
Other communication problems	17	18
Slow shipping	13	6
Positive about transaction	8	0
All	62	111

Note that a single comment may be classified in more than one way, if it mentions more than one problem with the transaction.

than negative feedback. Not following through on a sale, or worse, not sending the item after receiving payment, tended to yield negative rather than neutral feedback.

## 6. DOES PRIOR FEEDBACK PREDICT FUTURE PERFORMANCE?

What is the information content of a seller's reputation? In particular, does a seller's feedback profile predict future performance? As suggested in the introduction, the feedback system may be useful even if it is not predictive of future performance, so long as people believe it is. There are also game theoretic models in which buyers should punish sellers for prior negative feedback (or punish newcomers for lack of prior positive feedback) even if prior feedback does not indicate future performance. Still, it is interesting to investigate whether prior feedback is predictive.

Table 2 indicated that neutral comments are typically used for slightly problematic transactions (delays, poor communication) while negative comments are used for very problematic transactions (never shipped, broken, counterfeit, etc.). Since both are rare, we have grouped them together as problematic transactions.

Negative feedback appears to be less frequently directed to experienced sellers than to those who are less experienced. Again considering the buyers and sellers involved in the transactions from the LI data extraction, Table 3 shows the percentage of negative feedbacks among users with varying amounts



**Table 3.** The Percentages of Prior Problematic Feedback for Buyers and Sellers with Different Experience Levels.

Group	<i>N</i> (Sellers)	Percent neutral and negative (Sellers)	<i>N</i> (Buyers)	Percent neutral and negative (Buyers)
0–9 positive	4,018	2.83%	13,306	1.99%
10–49 positive	3,932	1.25%	7,366	1.09%
50–199 positive	3,728	0.95%	3,678	0.76%
200–999 positive	1,895	0.79%	738	0.60%
1000+	122	1.18%	15	0.92%
All	13,695	0.93%	25,103	0.83%

of positive feedback. Among sellers with fewer than 10 positive feedbacks, 2.83% of all feedbacks were neutral or negative. This figure steadily declines as sellers get more experienced, until the group with more than 1,000 positives.<sup>14</sup> Removing one outlier – with 180 negatives, 125 neutrals and 3,681 positives – reduces the ratio of problematic transactions to 1.04%, still a lot higher than the 200–999 group and somewhat higher than the 50–199 group.<sup>15</sup>

The feedback profiles of buyers follow a similar pattern, although they have somewhat less problematic feedback overall than sellers. One possible explanation is that those who were buyers in the transactions in our sample had much more of their prior feedback from purchases than did our sellers. Since buyers offer a standard good (money) and offer it first, one might expect buyers to receive less negative feedback overall than sellers.

We next turn to the question of whether prior feedback could be used to help buyers avoid problematic transactions, again using the LI data extraction. The overall probability of a neutral or negative feedback was 0.46% (0.89% of evaluations given). This may be an underestimate of the true percentage of problematic transactions, because problems may be resolved before users contribute feedback and even if the problem is not resolved, some buyers may not leave negative feedback. It could be a substantial underestimate if participants are hesitant to give negative feedback for fear of retaliation.

We model the feedback the buyer provides about the transaction as a function of the seller's previous feedback profile. It is not obvious exactly what features of the feedback profile should be most diagnostic of performance. The analysis above suggests that more experienced sellers are better, up to a point. We compute the log of the number of positive feedbacks, adding 1 to avoid the possibility of taking the log of 0.<sup>16</sup> To measure previous seller problems, we

combined the neutral and negative feedbacks as an indicator of problematic transactions, added one and computed the log. A logistic regression the following coefficient estimates<sup>17</sup>: The coefficients are all highly significant.

$$\ln \left( \frac{\text{Pr}(\text{problematic})}{1 - \text{Pr}(\text{problematic})} \right) \\ = -3.9404 + 0.7712^8 \ln(\text{PROBLEMS} + 1) - 0.5137^* \ln(\text{POS} + 1)$$

Thus, for a newcomer with no previous feedback, this estimates the probability of a problematic transaction at 1.91%. A veteran with 100 positive and no negative feedbacks would have an estimated probability of a problematic transaction of 0.18%. 100 positives and three negatives would yield an estimate of 0.53%. It is worth noting here that since negative feedback is rare, for experienced buyers the positive feedback score is almost the same as the net score of positives minus negatives. Thus, predicting performance based only on the net score that eBay computes would treat the sellers with 100 positives and 0 or 3 negatives as almost the same, while this model suggests that the risk of problematic transactions is quite different for the two profiles.

The model accounts for only a small part of the variability in which transactions are problematic, but it does provide some value, as summarized in Fig. 6 and Table 4.<sup>18</sup> For example, someone using this model who was willing to forego bidding on about half of the items could avoid more than four-fifths of transactions that were reported as problematic. This would cut the probability of a problematic transaction by almost two-thirds (from 0.48% to 0.18%).

## **7. INCENTIVE EFFECTS: DO SELLERS PAY ATTENTION TO THEIR FEEDBACK PROFILES?**

A necessary (though not sufficient) condition for feedback to have an incentive effect, i.e. to encourage better behavior from sellers, is for them to care about their feedback profiles. Anecdotally, we hear that sellers do indeed care, subtly or not so subtly encouraging buyers to provide positive feedback at the end of successful transactions, and going to great lengths to make buyers happy in order to avoid negative feedback. But perhaps these stories reflect only a small minority of sellers.

To assess this question more systematically, we examine the propensity of sellers to respond to negative feedback. Starting in February 1999, eBay offered users the opportunity to respond to feedback. When feedback comments are displayed, the text of any response is displayed right below the

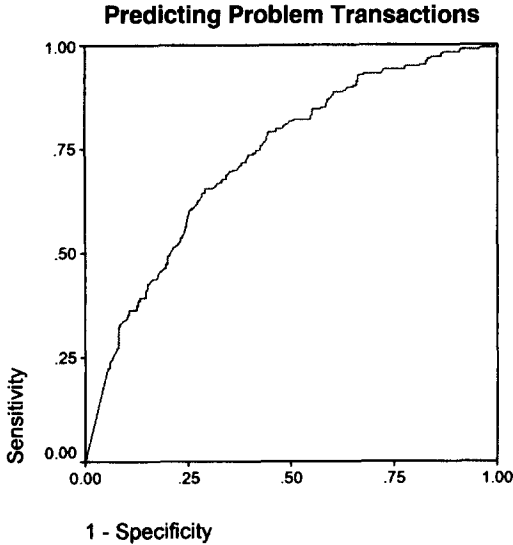


Fig. 6. The Tradeoff Between Sensitivity and Specificity for Predicting Problematic Transactions Based on Previous Feedback of Seller Listing the Item.

Table 4. Some Particular Values for the Tradeoff Between Reducing the Danger of Problematic Transactions and the Percentage of Unproblematic Transactions That Would Be Rejected.

1-specificity (% of unproblematic transactions rejected)	Sensitivity (% of problematic transactions rejected)	Cutoff predicted probability	% of accepted transactions that are problematic
75 %	94.2%	0.20%	0.11%
50 %	81.5%	0.31%	0.18%
25%	57.2%	0.54%	0.27%
10 %	32.4%	1.09%	0.36%
0 %	0 %	Accept all	0.48%

The third column gives the cutoff: if the model predicts a probability less than this cutoff, then the transaction would be accepted. Since some of the accepted transactions have predicted probabilities far less than the cutoff, the figures in the right column tend to be somewhat lower.

text of the feedback. (The original issuer of feedback has the further opportunity to respond to the response, but the dialog ends there.) If sellers were concerned about how negative feedback would affect their reputations, we might expect them to provide explanations in response to negative feedback.

Since the opportunity to respond was introduced during the month of February, 1999, we selected a sample of 1,580 negative feedback events from May 1 to generate the NF data extraction, well after the feature was introduced, so that participants could have learned how to play. Of these, the recipient entered explanatory text in 457 cases, 29% of the time.

In future work, we plan to analyze whether sellers tend to alter their behavior in any detectable way after receiving a negative. For example, they might tend to buy a few items or sell lower-priced items in order to cause the negative feedback to no longer appear at the top of their feedback profile, or simply wait a week or a month, so that it no longer appears as recent feedback. We also plan to analyze whether negative feedback is correlated with decisions to stop participating altogether.

## 8. EQUILIBRIUM CONSIDERATIONS

Economists are used to studying interactive situations, setting up the game, and describing the equilibrium or equilibria that result. Strangers buying and selling on the Internet do not have the luxury of having a keen game theorist on hand. Many will not understand the game they are playing. Others would understand, but do not have the information to draw appropriate conclusions. No doubt, different people – based in part on presuppositions and part on personal experience – believe the games are quite different. Bearing these qualifications in mind, our empirical evidence tells a great deal about the nature of the game being played. We turn now to a discussion of considerations that likely inform the perceptions of the players and the performance of the feedback market.

### *High Courtesy Equilibrium*

There are two surprising facts about the feedback game on eBay: (1) the high rate of providing evaluations; and (2) the extreme rarity of neutral or negative evaluations. The first suggests that free riding is overcome, the second that buyers are grading generously, or saying nothing after bad experiences.

We think of this as a High Courtesy Equilibrium. Manners frequently lead people to make small cost efforts, even when dealing with strangers that one will never again encounter, that promote general welfare and a sense of comity (Martin, 1985). Such behaviors, say waving a car ahead of you at an

intersection, can be self-reinforcing if people take satisfaction in doing the right thing, or experience discomfort from violating a possible norm. If buyers think it is the courteous or right thing to do to provide feedback, that is what they will do, if it is not too expensive.

The frequency of positive feedback can also be a result of High Courtesy. As children we have been told that: "If you can't say something nice about someone say nothing at all." If it appears that everyone, or near everyone, on eBay is behaving this way, then it is natural that we should as well. Etiquette is the art of getting people to coordinate on social conventions, and the convention of being positive in casual encounters is well known.

eBay itself has done what it could to create an environment where people will be strongly positive. For example, in computing an overall score, eBay merely subtracts the number of negatives from the number of positives, despite the former being much rarer and hence presumably more informative. eBay does not provide a facility for searching for a seller's negative feedback comments, leaving potential buyers with the task of scrolling through all the other feedback to find the rare but informative complaints. Finally, eBay encourages buyers to contact sellers to try to resolve problems and leave negative feedback only as a last resort.

Indeed, eBay may produce additional inducement of positive feedback through its policy of allowing sellers to provide feedback on buyers as well as the reverse. If a seller provides positive feedback, it may create a reciprocal obligation to provide positive feedback in return.<sup>19</sup> There may also be a fear of retaliation for negative feedback.<sup>20</sup> Table 5 shows the distribution when both parties provided feedback. As before, we lump negative and neutral into the "problematic" category.

There are two striking features about the table. First, there is a noticeable correlation in the propensity to provide feedback at all. Second, there is a very strong correlation of buyer and seller feedback when both provide feedback.

**Table 5.** Patterns of Reciprocation.

Buyer feedback about seller	Seller feedback about buyer		
	Problematic	Positive	None
Problematic	54	35	84
Positive	17	15,122	3,430
None	342	6,403	10,746

The seller is positive 99.8% of the time when the buyer is positive but only 39.3% of the time when the buyer is neutral or negative. Similarly, the buyer is positive 99.7% of the time when the seller is, but only 23.9% of the time when the seller is neutral or negative. This overwhelming correlation is presumably due to two factors: (1) Some transactions just work out poorly – say a shipment that gets delayed and elicits complaints, and both parties get upset. (2) Even when one side of the transaction has been without blame, there is retaliation.

Why do these features emerge? We might expect sellers to provide more feedback. First, since they engage in many more transactions, and they have more to do for each transaction, we would expect them to be more automated. Second, reputations count much more for them. If there is some degree of reciprocity, providing positive feedback early could be a good seller strategy (although retaining the threat of giving negative feedback would be a reason for sellers to delay giving feedback). Cutting in the opposite direction, buyers have much more to provide feedback about, promptness of shipment, adequacy of wrapping, and whether the product was as described, including sins of omission.

In fact, sellers do provide feedback more often, 60.6% as opposed to 51.7% for buyers. To address the other questions, we provide more disaggregated data, including information about whether the buyer or seller first provided feedback, in Table 6.

We might expect that in most cases sellers would provide feedback first, since the buyer's responsibilities – namely payment – are completed first, and reputations are much more important to sellers, who therefore might provide early positive feedback to elicit reciprocity. Overall, buyers are the first provider of feedback 37.6% of the time, sellers are first 32.8% of the time, and neither provides feedback 29.7% of the time. Surprisingly, when both provide feedback, buyers actually go first about twice as often as sellers.

Can an early positive feedback by a seller strongly discourage a negative rating of the seller? When a satisfied seller provided feedback first, buyers gave them only 8 problematic (negative or neutral) feedbacks, a rate of 0.07%. By contrast, when the seller was satisfied but waited (either providing no feedback or positive feedback after the buyer evaluated) there were 111 problematic feedbacks, a rate of 0.81%, or 11 times as high. Of course, providing early feedback may simply be a covariate with some other cause of buyer satisfaction (e.g. good communication skill on the part of the seller). Still, the numbers suggest that early positive feedback may discourage negatives from buyers, even if they are dissatisfied.

**Table 6.** Timing of Reciprocation.

Buyer feedback about seller	Seller feedback about buyer										
	Seller first (or only)			Buyer first (or only)			No feedback				
	neg	neut	plus	neg	neut	plus	neg	neut	plus	none	none
none	300	42	6,403								10,746
neg	20	1	3	18	0	11				58	
neut	2	4	5	5	4	16				26	
plus	0	6	5,091	8	3	10,031				3,430	

Similarly, does the threat of retaliatory negative feedback from sellers discourage a negative rating of sellers? Sellers are far more likely to provide negative feedback after a buyer negative or neutral (19.4%) than they are overall (1.2%). Again, however, the evidence is not conclusive, since a botched transaction (e.g. lost in the mail) is likely to leave both parties unsatisfied. In such cases, reciprocal feedback may reflect misplaced blame by both buyer and seller, rather than retaliation.<sup>21</sup>

*Skunk at the Garden Party, A Few Bad Apples*

Assume that our High Courtesy equilibrium is in effect. Might not a few disreputable sellers seek to capitalize on the situation – e.g. negative feedback unlikely – and begin a process akin to Akerlof’s (1970) lemons model that ruins the market for all? Suppose, for example that there were two types of people, good and bad apples, with two types of sales, satisfactory and unsatisfactory. Suppose good apples produced an unsatisfactory sale 10% of the time due to chance variation. Bad apples are totally strategic. They behave like goods when it is desirable to do so. But they strategically exploit the system and reap profits from unsatisfactory sales, say from excessively generous descriptions of items.

If there were an infinite supply of bad apples, it would seem, and if the vast majority of buyers were willing to forego bad evaluations despite an unsatisfactory sale, then a bad apple could cruise along for a while before being detected. Consider a world filled with goods. With only 0.3% bad evaluations, this suggests that a negative evaluation conditional on an unsatisfactory sale is only about 3% as likely as a positive evaluation after a satisfactory sale (based on our assumption of 10% of sales being unsatisfactory and the observed levels of negative feedback at eBay). Thus, a bad apple could imitate goods half the time, presumably on cheaper items, and build up a reputation of 30 positives on average before receiving his first negative. Understanding this, more and more bad apples will come into the market, bad evaluations will increase in frequency, buyers will become less satisfied with the distribution, and presumably the whole process could spiral downward.

However, we do not observe such a downward spiral. We identify two phenomena that may help maintain the High Courtesy equilibrium while deterring bad apples: paying initiation dues and stoning bad behavior.<sup>22</sup>

*Paying Initiation Dues*

Many organizations have initiation dues to be paid before one can become a member, and this may well be the case on eBay, even though eBay does not



charge an entry fee. For example, a new seller may find it difficult to make a sale, or may get a significantly lower price until his reputation is built. That is, buyers may consider the extent of a seller's record before deciding whether to do business with him, and what price to offer. If this is so, it may be worthwhile for goods to enter the market and pay the initiation dues. Their long-term returns from such dues may be greater than the amount the bad apples can get from exploiting the system for a short period of time. It may also be cheaper for them to engage in good behavior. An honest dealer will find it cheaper to sell lithographs, for example, than will a bad apple whose principal profits come from selling forgeries.

Initiation dues in effect are a way of creating trust. Such dues are to sales on the Internet the equivalent of what a massive advertising campaign is for a new retail brand, or a fancy new store is to a retailer. They show the seller is willing to invest a lot of money, which suggests that he has a high quality product that he knows will sell well in the future.

In fact, Friedman and Resnick (Friedman & Resnick, 2001) found that in environments where players can assume new identities and thus shed previous reputations, some form of initiation dues is inevitable if trust among veteran players is to be maintained. It has to be more valuable for veterans to maintain good behavior than to defect and then start afresh. The dues may be monetary. Or they may come in the form of worse treatment for newcomers, as we found with the lower probability of sale for newcomers.

### *Stoning Bad Behavior*

Initiation dues, by themselves, may not be sufficient to deter bad apples, assuming that they had the ability to get away with their unsatisfactory behavior on a probabilistic basis. It is possible, however, that there is a contagion effect in reaping negative feedbacks. Once one has a black mark by one's name, others may be much more willing, indeed eager, to cast stones. Given the same level of service, they might become far more critical. Thus, the 3% number we mentioned above ( $P(\text{neg}|\text{unsat})/P(\text{pos}|\text{sat})$ ) might rise to 20%, going still higher after a second or third negative. If one seeks to exploit on a sustained basis, one will almost certainly get eliminated from the market.

If there is stoning, a bad apple might expect that he would have a very limited run of positive-profit exploitation after his introductory era of paying his dues and before getting stoned out of the market.<sup>23</sup>

Future empirical work will examine the frequency of negative feedback after a range of feedback profiles, and the likelihood of being driven quickly from the market. It will also examine differences in the contagion effects for different types of feedback. Some unsatisfactory experiences might be viewed

as likely stemming from bad luck, say a delayed shipment. But others might indicate a difference in types, e.g. bad apple behavior of inflating the description of an item.

If the goal is to deter bad apples from playing in this market, it would be desirable if stoning were reserved for behaviors that are deliberate rather than merely careless, and where the perpetrator benefits significantly from the action that led to an unsatisfactory transaction.

## 9. CONCLUSION

The Internet, despite its vast scale and intense use, is still in its infancy. Moreover, its form emerged from hundreds of thousands of private decisions, much as a city develops, rather than being designed by some central coordinator (see Johnson, 2001). It seems likely that many aspects of reputation systems for the web have yet to develop. Still, it is worth examining empirically the functioning of the most prominent system deployed to date.

Despite the lack of incentives to provide feedback, especially negative feedback, the system appears to work reasonably well. We consider two explanations: (1) The system may still work, even if it is unreliable or unsound, if its participants think it is working. Thus, if sellers believe poor behavior will elicit negative feedback, and that buyers depend strongly on reputations, then sellers will behave well and bad sellers will be deterred. It is the perception of how the system operates, not the facts, that matters. We suspect that few participants have conducted even cursory versions of the types of analyses conducted here. (2) Even though the system may not work well in the statistical tabulation sense, it may function successfully if it swiftly turns against undesirable sellers, a process we call stoning; and if it imposes costs for a seller to get established, what we label initiation dues.

We also suspect that norms drawn from elsewhere in society help enable Internet reputation systems to work. To illustrate, we mention merely the norm of reciprocity: The frequency of feedback from little-to-gain buyers on auction sites may derive from the positive but low value feedback to them by sellers. They reciprocate a low value favor with the only favor they have available. On the other hand, sellers gave feedback first only about half the time at eBay, despite the fact that they received the buyer's money before the buyer received the goods, suggesting that such seller-initiated reciprocity can not be the only reason that buyers provide feedback.

It is interesting to speculate about whether eBay would be better off with a system where mildly dissatisfied buyers recorded their dissatisfaction more than they do now. It would help buyers to differentiate among sellers,<sup>24</sup> perhaps

creating greater faith in the effectiveness of the feedback system. On the other hand, making dissatisfaction more visible might destroy people's overall faith in eBay as a generally safe marketplace.

Strangers encounter each other regularly on the hyperactive crossroads of the Internet. In some encounters – e.g. discussing books in a chat room – trust is natural, since neither party has much to gain by dissembling. With auctions of objects, however, sellers have strong incentives to exaggerate the quality of or misrepresent the authenticity of their items. Yet judging by the volume of transactions, sellers successfully build reputations of trust. This analysis provided some data on how seller reputations are created, and sketched some mechanisms that are turning such reputations into trust.

## NOTES

1. We are not permitted to reveal the exact number of transactions per day in our data set.

2. In recent years, a literature on social capital has documented the many positive effects of civic activities and informal social ties, including their effects on trust building. Robert Putnam (2000) reviews this literature and also documents declining social capital in the United States from the 1960s to the mid-nineties.

3. Recently, H&M, a Swedish retailer of high quality but little known in the United States, had round the block lines at the opening of such a store.

4. In fact buyers' reputations are slightly better than sellers' reputations overall, as discussed in Section 6.

5. A concern about retaliation for negative feedback is prominent in eBay's discussion forums and eBay has publicly acknowledged the concern, although their only remedy thus far is to exhort users to provide honest feedback despite the risk of retaliation. For example, founder Pierre Omidyar posted a public letter to that effect on June 9, 1998.

6. Note the willingness of credit card companies to cover losses when one's card is stolen or used inappropriately. Presumably the expected cost is low. But assuring customers on this score would be far less effective than merely providing coverage and charging a bit more for the card. The advantage is not due to customer risk aversion, but rather that credit card companies could never assure customers that the level of risk is really low.

7. Personal experience suggests that the threat of providing negative feedback may be employed when seeking to rectify a transaction (a counterfeit watch), but such threats do not always work, and the person issuing the threat (RJZ) does not always follow through.

8. As part of the registration process, eBay sends an email to the user, which authenticates that the email contact information is a working email account that the person registering has access to. eBay does not require buyers to provide a credit card number. Beginning October 22, 1999, eBay required sellers to provide a credit card number or go through an alternative identity verification process.

9. On the online forum that eBay runs, sellers complain about their inability to avoid problem bidders, especially those who do not pay after winning auctions. For example, see the discussion in Appendix B.

10. In our data set, users are identified with numeric identifiers, enabling tracking of user activity over time without revealing who the users are. eBay has lookup tables to match the numeric identifiers with the registration information for users, but this information was not provided to us.

11. Given the possible concern that the selection procedure may have been incompletely random or that Feb. 20 may have been unusual, we repeated the analysis of Sections 4, 5, and 6 for all listings on Feb. 19. The results were quite consistent, although particular numbers varied somewhat.

12. Informal surveys of economists, all of whom knew about eBay but only a small fraction had purchased from it, suggests that theory alone provides little indication to the answers to these questions. There was considerable variation in answer to the questions of: How frequently is feedback given, and how often is it negative? None of our respondents got close to the actual frequency of negative feedback.

13. It is possible that such a feedback could be about a different transaction, if the buyer and seller engaged in multiple transactions during the time period. Thus, the data reported here probably slightly overestimates the percentage of transactions that get positive, neutral, and negative feedback.

14. There are many possible explanations for the experience/frequency of feedback relationships. For example, experience may make someone a better seller. Only sellers with stellar reputations will stay long-term on the system; with a bad record one comes back with a new identity. Buyers may be hesitant to give negative feedback to a long/strong record, perhaps doubting their own judgment.

15. In future work, we hope to explore the decline in performance once an extremely large number of positives has been received. Initial hypotheses include that it becomes too expensive to leave the system once one has acquired so many evaluations, sellers are counting on many buyers not looking beneath the aggregate score, or that sellers become "worse" because they capitalize or ride on their established reputations.

16. We also included the square of  $\ln(\text{pos})$  as a variable, to possibly account for the fact that performance declines with very high feedback, but its coefficient was not significant and was of the same sign as  $\ln(\text{pos})$ , so we have omitted it from the results reported here.

17. We considered other models, including variants on the fraction of negative feedback, but the coefficient on this variable was never significant. We speculated that the value of the transaction may be correlated with the probability it will be problematic, since sellers can profit more from cheating on a high-priced item and the cost of a negative is independent of the price. But the effect of price was tiny and not statistically significant in models either with or without the prior feedback as covariates.

18. More sophisticated models might do even better at predicting future performance. For example, Zaccaria et al. (2000) have analyzed adaptive scoring functions that weight more recent activity more heavily. Dellarocas (2000) has examined models that might discount the effects of a few ratings that were entered in a deliberate effort to manipulate reputations. The results from the simple model in this paper merely demonstrate that there is enough information to do predictions and should motivate further development of prediction functions.

19. Robert B. Cialdini explores the norm of reciprocation in his book *Influence: Science and Practice* (Cialdini, 1993, pp. 19–49). At eBay, some sellers stimulate the reciprocity norm by emailing their buyers and assuring that they themselves always provide feedback. In other venues, shrewd marketers take advantage of reciprocation norms. For example, charities mail out address labels or holiday seals, hoping that respondents will find a need to reciprocate with a contribution.

20. The fear of retaliation for negative feedback is mentioned frequently on eBay message boards. The situation is apparently serious enough that eBay founder Pierre Omidyar posted a message on June 9, 1998 exhorting users to give negative feedback when it was warranted, in spite of such fears.

21. One of our students, Ko Kuwabara, is conducting further theoretical and empirical analysis of the patterns of reciprocity and retaliation.

22. Thomas Schelling (1978) addresses these possibilities. If good sellers can still make a profit despite the suspicion raised by the presence of bads, and if bads hurt bads more than goods, there may be a stable equilibrium with goods and bads together in a stable mix. An increase in the number of bads might also make buyers attend more to details of reputations, e.g. the nature of negative feedback, which would help goods.

23. In situations where initiation does vary by player type (some types find it more difficult to carry out honest sales in order to establish good reputations) and players can trade names and hence reputations, stoning might be especially important. It could deter bad apples from acquiring and spending down good reputations: reputations would be spent down too quickly. Tadelis (1999, forthcoming) analyzes models of name trading, finding that reputations can still convey some information to buyers, but does not explicitly consider the effects of stoning.

24. Dellarocas (2001) analyzes a model in which, so long as harshness in interpretation of feedback is appropriately tied with leniency in giving feedback, leniency has some advantages in deterring seller opportunism even though information about particular mildly unsatisfactory events is not shared.

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