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# The Good, The Bad, or the Ugly? An Empirical Investigation of Revoking Behavior on eBay

Shun Ye
*University of Maryland - College Park*, sye@rhsmith.umd.edu

Guodong (Gordon) Gao
*University of Maryland - College Park*, ggao@rhsmith.umd.edu

Siva Viswanathan
*University of Maryland - College Park*, sviswana@rhsmith.umd.edu

# THE GOOD, THE BAD, OR THE UGLY? AN EMPIRICAL INVESTIGATION OF REVOKING BEHAVIOR ON EBAY

*Completed Research Paper*

**Shun Ye**
Decision, Operations and Information Technologies
Robert H. Smith School of Business
University of Maryland, College Park, MD 20742
sye@rhsmith.umd.edu

**Guodong (Gordon) Gao**
Decision, Operations and Information Technologies
Robert H. Smith School of Business
University of Maryland, College Park, MD 20742
ggao@rhsmith.umd.edu

**Siva Viswanathan**
Decision, Operations and Information Technologies
Robert H. Smith School of Business
University of Maryland, College Park, MD 20742
sviswana@rhsmith.umd.edu

## Abstract

*In this paper, we investigate a crucial aspect of the reputation mechanism design in electronic markets – the ability of buyers and sellers to revoke or mutually withdraw negative feedback and ratings. Based on recent changes in eBay feedback mechanism, we find that the two-way reputation system enables certain sellers to behave opportunistically by revoking negative feedbacks they receive. This makes the reputation system less effective in discerning the quality of sellers. We also find that changes in the reputation system have a significant influence on these sellers' behavior. After revoking is not possible on eBay, sellers put more efforts in the transactions. Our findings support the moral hazard assumption regarding seller's strategic behavior. We also discuss the implications of the above findings to reputation mechanism design and practice.*

**Keywords:** mechanism design, reputation mechanisms, revoking, online auctions, moral hazard

## Introduction

As the now classic adage goes, "on the Internet, no one knows you are a dog". Given the issues resulting from significant information asymmetry in online transactions, it has become more important than ever for online markets to adopt mechanisms that help establish and maintain credibility and trust among participants. The most popular and well studied among these is the reputation mechanism in markets such as eBay. On eBay, for instance, a buyer can leave either positive, neutral, or negative ratings to a seller after a transaction. Based on these feedbacks, the seller's reputation is calculated and metrics such as the total number of feedbacks and the percentage of positive ratings are made available to other potential buyers. While eBay's reputation mechanism is arguably the most established and the most scrutinized by the popular press and academics, several other websites including eLance.com, rentacoder.com, and amazon.com among others also adopt similar systems.

Although it has been argued that the reputation system works well for eBay, it is not without drawbacks. One particular problem is the potential for "gaming" the system. Typically, both buyers and sellers on eBay can provide feedback regarding the other party in the transaction and this feedback is available for others in the marketplace. However, it has been suggested that due to the threat of retaliation from sellers, buyers with a bad experience might prefer to remain silent instead of leaving negative ratings (Dellarocas and Wood 2008). The ability of buyers and/or sellers to "game" the reputation mechanism threatens to not only reduce its effectiveness but also exacerbate informational asymmetry.

Despite the increasing awareness of users' strategic gaming behavior of online reputation mechanisms and their potential adverse impacts, there are still significant gaps in our understanding of how users react to reputation systems, and how reputation systems could be appropriately designed (Masclet and Penard 2008). In this paper, we investigate a crucial aspect of the reputation mechanism design – the ability of buyers and sellers to revoke or mutually withdraw their feedback and ratings. While buyers can leave positive, neutral, or negative feedback for sellers, eBay also allowed sellers to rate buyers. A two-way feedback mechanism is often considered to be "fair" to both participants in a transaction; however this also allows sellers to retaliate against buyers who provide them with negative feedback. Interestingly, a feedback (especially a negative one) can be "revoked" if both the seller and the buyer mutually agree to do so. Such revoking may happen if a seller "corrects" his mistake by either replacing a previous low quality product with a better one, or refunds the buyer. Alternatively, a seller could retaliate against a buyer who provides negative feedback and then force the buyer to revoke her negative feedback. While in the former case, the revoking behavior reflects a seller's responsibility and honesty to some extent, in the latter, the ability to revoke negative feedbacks enables bad sellers to disguise their dark pasts and send misleading signals to other potential buyers. In other words, a seller could be an inherently "*good seller*" and revoking could be a sign of a genuine mistake. Alternatively, a seller could be an inherently "*bad seller*" and revoking could be a sign of the seller trying to masquerade as a high quality seller. Either of these characterize a situation with adverse selection where the seller types are a given – good sellers or bad sellers. A third possibility is one of moral hazard: where the seller is able to behave honestly, but chooses not to because of self-interest – the case of the "*ugly seller*". We are particularly interested in understanding which of these behaviors drive revoking behaviors in eBay auctions. More importantly, we are interested in examining the implications of feedback-revoking behaviors on market efficiency and welfare outcomes.

Our study is among the first to examine the implications of feedback-revoking behavior in online markets. Ours is also among the first study to empirically examine if such revoking behavior is due to moral hazard or adverse selection. While it has been difficult to empirically differentiate instances of moral hazard from adverse selection, recent changes in eBay's reputation system provide us a unique opportunity to examine this issue.

Empirically, we take advantage of a recent significant change in eBay's reputation system. On Jan 30th 2008, eBay announced a radically overhaul of its reputation system for the first time in its history. Among other changes, negative feedbacks are no longer allowed to be withdrawn. More importantly, sellers are no longer allowed to leave negative feedbacks for buyers starting May 2008 – in essence, eliminating the possibility of strategic behavior by sellers. Not surprisingly, this caused outrage amongst sellers, and culminated in a week-long strike (Feb 18$^{th}$ -Feb 25$^{th}$) to protest these changes. These changes in eBay's reputation mechanism also allow us to examine the impact of changes in reputation mechanism design on seller behaviors as well as transactional outcomes and market efficiency. Although there have been numerous studies showing that reputation matters to sales in eBay auctions (Dewan and Hsu 2004, Lucking-Reily et al. 2007), we provide the first empirical evidence on sellers' reactions to the changes in reputation system design.

We find evidence that sellers do indeed respond to the design of reputation system. In the two-way reputation system (prior to the recent changes), certain sellers exhibit opportunistic behavior by revoking negative feedbacks they receive. This makes the reputation system less effective in discerning the quality of sellers. We further find these sellers are the ones who are more likely to participate in the strike in protest of the recent reputation system change on eBay. Interestingly, change in the reputation system has a significant influence on these sellers' behavior. Most interestingly, we find that after the changes to the reputation system design (banning revoking or mutual withdrawal of feedbacks), sellers who were more likely to revoke feedbacks earlier significantly improve the quality of their transactions as evidenced by the changes to their reputation scores.

The rest of the paper is structured as follows. In the next section, we provide an overview of eBay's reputation system. In section 3 we detail the changes to the reputation system and the strike by sellers. Data are described in section 4, followed by empirical analysis in section 5. We discuss our findings and their implications in section 6. Section 7 concludes.

## Overview of eBay's Reputation System

eBay launched in 1995 has become one of the dominant online marketplaces in the US. Given the substantial information asymmetry faced by buyers and sellers in online markets, a large part of eBay's success is attributable to its effort to build a trustworthy environment for both sellers and buyers. Several factors exacerbate the trust issues on a marketplace like eBay. First, participation is easy. To register, the only thing needed is a valid email address. Second, there is very little information available about the members of eBay. Members can pick up a pseudonym as their IDs and eBay does not reveal the user's real name or address. Third, the eBay marketplace is truly global, and there is no obvious way to refer to institutional or legal systems to resolve disputes in transactions. Although a seller's account could be closed by eBay if significant dishonest behavior is discovered, it is relatively easy for the seller to create a new user ID and renew his participation in eBay.

The primary source of information about a seller or a buyer's trustworthiness is her feedback score. Upon the completion of a transaction, both buyers and sellers have the opportunity to leave a feedback within 90 days of the transaction. The feedback has three different levels of valence: positive, neutral, and negative. In addition, they can also provide detailed comments about each other or regarding the transaction. Once a feedback is given, it cannot be removed unilaterally, unless both the seller and buyer agree to mutually withdraw their feedbacks. eBay displays two summary statistics of the feedbacks that constitute a seller's reputation: the total number of feedbacks a seller receives, and the percentage of positive ratings.

On the face of it, eBay reputation system seems to have been working well. Although economic theories predict that feedbacks, as a public good, should be under-provided, about 50% of the buyers on eBay do leave feedbacks (Resnick and Zeckhauser 2002). Further, over 99% of the feedbacks left on eBay are positive, seemingly suggesting that the degree of satisfaction is very high on eBay (Resnick and Zeckhauser 2002).

Yet, there is evidence of inefficiency in eBay's reputation system. Certain sellers keep selling fraudulent items with misleading descriptions without being caught. For instance, it is estimated that over 80% of the Tiffany jewels sold on eBay are fakes – leading to suspicions about the 99% positive feedbacks on eBay. Further, one would expect an effective reputation system to reward good sellers. However researches have failed to find any consistent evidence of the impact of a seller's reputation on auction price. For instance, Resnick et al. (2006) find that negative feedbacks seem to have no impact on buyers' willingness-to-pay. Cabral and Hortacsu (2004) study laptops, coins and beanie babies on eBay and find that neither positive nor negative feedbacks influence the final auction price. Melnik and Alm (2002) find that even when a seller doubles his ratings, the consumer's willingness to pay for gold coin only increases by 18 cents. Along the same lines, Lucking-Reiley et al. (2007) find that positive ratings have a negligible impact on price - a result is echoed by Eaton (2005) who find that reputation has little or no impact on the actual bid prices.

A closer examination of eBay's feedback mechanism reveals two major problems. The first problem is retaliation. eBay allows sellers and buyers to independently leave feedbacks within 90 days of transaction, and the feedback is available immediately to the other party. This creates incentive for one party to strategically hold back its feedback as a way of retaliation if the other party provides a negative feedback. Resnick and Zeckhauser (2002) find evidence that half of the time sellers hold their feedback to buyers, even the sellers receive payment from buyers before buyers receive the items. Cabral and Hortacsu (2004) also find that if a buyer leaves a negative feedback about a seller, he has a 40% chance of getting a negative feedback from the seller. Consequently, due to fear of retaliation,

buyers with bad transaction experience are much less likely to leave negative feedbacks to the sellers (Dellarocas and Wood 2008). Other studies also reinforce the presence of such reporting bias (Klein et al. 2005; Reichling 2004). These biased reporting of feedback by parties to a transaction has been shown to be one major reason for the overwhelmingly positive feedbacks on eBay---customers with negative experience simply choose not to leave negative feedback for sellers.

The second problem with eBay's feedback mechanism – and one that is the focus of our study - is revoking. eBay's revoking policy states that the two parties of a transaction are allowed to withdraw their feedbacks based on mutual agreement. Although the intention of this policy is to facilitate the reconciliation of any dispute in a transaction and correct errors in ratings, in practice revoking creates a way for sellers to manipulate their reputation. In the vast majority of instances, revoking (mutual withdrawal of feedbacks) is preceded by both parties leaving negative feedbacks for each other. If indeed revoking helps convert negative ratings to nullified ratings, revoking can help bad sellers disguise their dark pasts and send misleading signals to other buyers on the marketplaces. Because negative ratings are very rare (typically less than 1% of total ratings), by revoking negative ratings, a bad seller can effectively manage its reputation to be as good as, or even better, than truly good sellers.

Retaliation and revoking has made eBay reputation system less effective in signaling the quality of sellers. Scholars have suggested different ways to enhance the system. In a theoretical analysis followed by experiments, Masclet and Pénard (2008) suggested that the eBay feedback system could be improved by either constraining partners to leave ratings simultaneously or by predetermining the rating sequence. Some others have also proposed that eBay should allow only the buyer to rate the seller (Chwelos and Dhar 2006), or that eBay should simultaneously reveal both partners' ratings (Reichling 2004).

In an attempt to possibly address these problems inherent in the design of its reputation mechanism eBay announced dramatic changes to its reputation system in January 2008. These changes, detailed in next section, are regarded the first major overhaul of its reputation mechanism since its inception.

## Recent Changes to eBay's Reputation System

eBay announced a drastic overhaul of its reputation system on Jan 30th, 2008. Among other minor changes, the most significant change involved limiting sellers' strategic gaming behavior. Starting May 2008, sellers are no longer able to leave negative feedbacks to buyers. However they can provide positive or neutral feedbacks. Furthermore, no mutual withdrawal (revoking) of the feedbacks is allowed. Bill Cobb, CEO of eBay, in his public announcement on the reputation system changes, made the following comments:

*"…… the original intent of eBay's public feedback system was to provide an honest, accurate record of member experiences. …… But overall, the current feedback system isn't where it should be. Today, the biggest issue with the system is that buyers are more afraid than ever to leave honest, accurate feedback because of the threat of retaliation. In fact, when buyers have a bad experience on eBay, the final straw for many of them is getting a negative feedback, especially of a retaliatory nature. Now, we realize that feedback has been a two-way street, but our data shows a disturbing trend, which is that sellers leave retaliatory feedback eight times more frequently than buyers do ... and this figure is up dramatically from only a few years ago. So we have to put a stop to this and put trust back into the system."*

This change in essence, eliminates the seller's ability to retaliate against buyers. Not surprisingly, this lead to several claims of the new system being unfair to sellers and leaving them vulnerable to negligent bidders and scammers. As pointed out by one seller:

*"You get bad buyers as often as you get bad sellers. On an expensive transaction, having a buyer cause trouble - by, for example, disputing the transaction and requesting a credit-card chargeback after they've already received their merchandise - can be financially devastating."*

As a result, a proposal to boycott eBay was initiated by sellers[1]. A discussion thread on eBay's own forums with the title "Sign the pledge: no sales Feb 18-25!" had received thousands of posts, many expressing intentions to join the boycott. Facebook and MySpace pages dedicated to the strike began circulating, and YouTube video entitled "Feb

[1] It is pertinent to note that along with the changes to feedback policy, eBay also revised its fees. Given the focus on the changes to the reputation mechanism, our empirical analysis controls for changes to the fee structure.

18-25th 2008: Worldwide eBay Strike" had racked up 16,000 reviews on a single day (Feb 10th). Due to this strike, eBay's number of listings was reported to decrease by more than 13%. Many sellers abandoned eBay and moved to other auction sites like OnlineAuction.com and eCrater.com (USA Today 2008, BusinessShrink 2008).

Undoubtedly the changes to eBay's reputation system and the online strike by infuriated sellers are two significant events. The reputation system change serves as an exogenous event that allows us to investigate how revokers and non-revokers respond to the different reputations systems.

In addition, the online strike initiated by sellers serves as a natural field experiment that separates different types of sellers. We identify three types of sellers: sellers who participate in the online forum; sellers who actually join the strike by boycotting eBay for the week of Feb 18$^{th}$ – Feb 25$^{th}$; and general sellers who neither participate in the forum or the strike. In addition to examining the reputation and behavior of revokers (and non-revokers) under the two reputation regimes, we are also interested in understanding if there are any significant differences in reputation as well as behaviors among the three groups of sellers – strikers, forum participants, and general sellers. Finally, as mentioned earlier we compare the market efficiency before and after the changes to eBay's reputation system.

## Data

The data for this study was collected from April 2008 to February 2009. The strike was initiated by a thread on the seller central section of eBay forum. Strikers expressed their frustration with the proposed changes, signed up, revealed their eBay IDs, and pledged to join the one-week strike. From this thread on eBay's discussion forum, we identified 586 unique strikers. We then constructed our control sample of 3278 general sellers who did not participate in the strike. A stratified random sample based on the product category distribution of the 586 strikers was drawn to control for product categories sold by these eBay members. We further restricted our sample to well-established sellers with total feedbacks of more than 500.

Since the strike was initiated in the eBay forum, one may argue that sellers active in the forum were more likely to strike merely because they knew about it. To control for this potential confound and ensure the robustness of our results, we introduced a second control group—forum sellers who were active in the forum but did not participate in the strike. We also created a stratified random sample of 3083 forum sellers to ensure that they have a similar product category distribution as the strikers in our sample. As mentioned earlier, our first control group - the general sellers on eBay - did not post or participate in eBay's forum.

We collected two types of data: sellers' feedback history and sellers' listing history data. We collected the lifetime feedback histories until January 2009 for all three categories of sellers – the strikers, the forum sellers, and the general sellers. To allow enough time for the new reputation system to have an impact, we define July 2008 to January 2009 as the post-change period and correspondingly July 2007 to January 2008 as the pre-change period[2]. While our primary focus is on the change to eBay's reputation system, eBay also instituted changes to its fee structure: lower listings fees (price charged for each item listed to be sold on eBay) and higher final value fees (a percentage of the closing price extracted by eBay). Based on their own most recent listings, some eBay sellers believed that they would have to pay more because of these changes. Thus, potential financial loss under the new fee structure could have also led some sellers to join the strike. To control for this potential impact of changes in the fee structure, we collected listing histories for all three types of sellers from January 2008 to March 2008 and from January 2009 to March 2009.

Our empirical analysis focuses on sellers who had feedback histories in both periods - before and after the change. This restricts our sample to 431 strikers, 3037 general sellers and 2479 forum sellers (see Table 1). We compared this sample with the left out sample in terms of product category distribution and found no statistical difference.

[2] We collected the feedback history from the beginning of eBay to January 2009 for each seller. This data is available during our data collection period from April 2008 to February 2009 and we chose July 2007 to January 2008 as the pre-change period.

**Table 1. Sample Definition**

| | Definition/brief description | # of observations |
|---|---|---|
| Strikers | Sellers who signed on the strike thread and participated in the strike | 431 |
| General Sellers | Sellers who neither had activities in the forum nor participated in the strike | 3037 |
| Forum Sellers | Sellers who had activities in the forum but not participated in the strike | 2479 |

## Data Analyses

Prior to any analysis, we first confirmed that the validity of our strikers sample. Although sellers signed up on the strike pledge thread, they may not have actually participated in the strike. Economically, each seller has an incentive to free-rider on others' strike efforts especially when it is costless to not join the strike. Moreover, a seller would be benefit from encouraging other sellers to strike as he would actually sell more products during the strike period due to lower competition. This potential problem, however, is not a concern in our study. As shown in Figure 1, the number of listings per seller decreased sharply on the beginning day of the strike and remained at a significantly lower level compared to pre-strike period. We did not observe a similar trend for general sellers and forum sellers. This suggests that the strikers in our sample did participate in the strike and refrained from listing their products. Interestingly, as can be seen from the huge spike prior to the strike, they also seemed to have increased their listings in the pre-strike period.

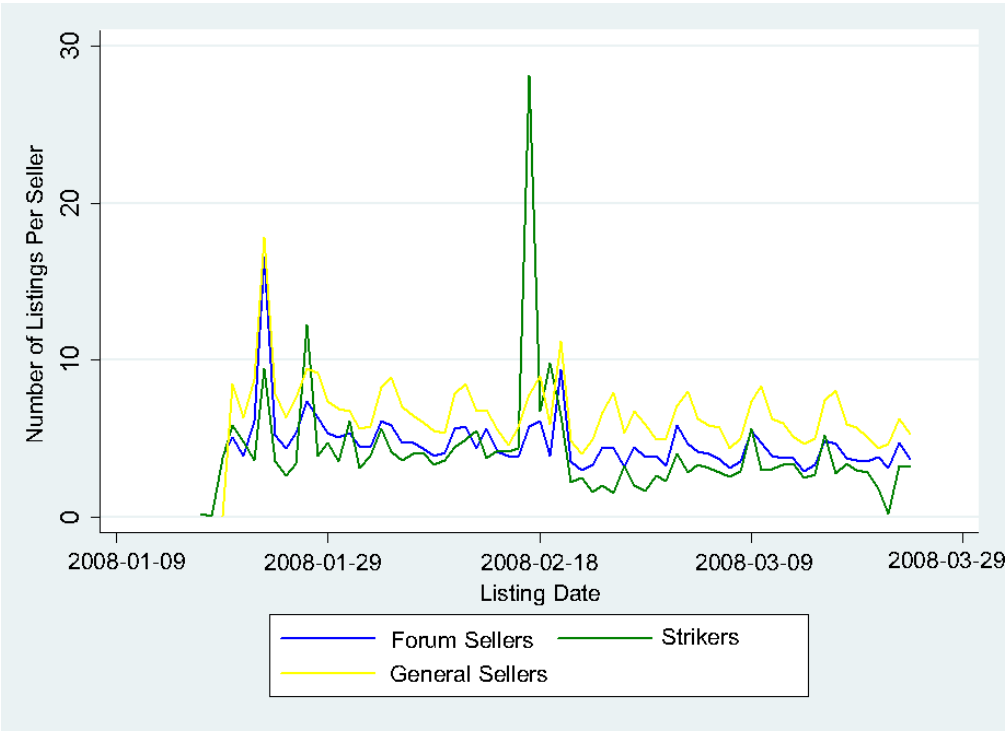


**Figure 1. Sellers' Listing Trends**

### *Can Strategic Revoking Behavior Explain the Strike?*

Theoretically, sellers with bad reputation are more likely to strike because they can no longer "retaliate" against buyers who leave negative feedbacks and "protect" their reputation. Because in general the percentage of negative feedbacks is very low, one additional negative feedback will not change the overall feedback very much for a seller with already enough number of positive feedbacks. To address this problem when measuring reputation, we only counted in feedbacks in the pre-change period (i.e., from July 2007 to January 2008), namely, every seller's reputation is treated as 0 on July 1st 2007. Reputation score is measured as the number of unique positive feedbacks subtracted by the number of unique negative feedbacks.

Table 2 presents the reputation profile for the three categories of sellers. Compared with other sellers, strikers have a lower reputation score. If we only count the positive and negative feedbacks as eBay does[3], strikers are similar to general sellers and forum sellers. Merely looking at positive feedbacks and negative feedbacks does not reveal much information about whether strikers were worse than general sellers or not. However, a close inspection of all types of feedbacks reveals that strikers have a lower positive feedback percentage and much higher revoked feedback percentage than both general sellers and forum sellers. These revoked feedbacks are originally negative ones. They get nullified when both sellers and buyers mutually agree to do so through negotiation. Considering the original negative value of revoked feedbacks, we find that strikers actually have significantly more negative feedbacks (0.21%+0.66%=0.87%) than both general sellers (0.31%+0.13%=0.44%) and forum sellers (0.22%+0.11%=0.33%). This implies that strikers have strategically negotiated with buyers to revoke negative feedbacks so that they are similar to other sellers[4].

While seller and buyers can mutually agree to withdraw their feedbacks, some feedbacks are also withdrawn by eBay. A negative feedback is usually withdrawn by eBay if the buyer fails to respond to an "unpaid item notification". In other words, these negative feedbacks are generated when bad buyers who do not pay try to blame the sellers. We find that sellers are not different in their eBay-withdrawn feedbacks, indicating that all sellers have a similar probability of facing bad buyers. Therefore, the differences in seller feedbacks in our sample are primarily due to different seller behaviors rather than due to differences in their probability of encountering bad buyers.

**Table 2. Pre-Change Reputation Profile Comparison for All Feedbacks**

| | | **Distribution Displayed** | | **Hidden Detailed Distribution** | | | | |
|---|---|---|---|---|---|---|---|---|
| | Score | Positive | Negative | Positive | Negative | Neutral | Revoked | eBay-Withdrawn |
| Strikers | 267.11 | 99.78% | 0.22% | 98.72% | 0.21% | 0.35% | 0.66% | 0.06% |
| General Sellers | 436.03 | 99.65% | 0.35% | 98.96% | 0.31% | 0.51% | 0.13% | 0.09% |
| (Forum Sellers) | (341.49) | (99.78%) | (0.22%) | (99.22%) | (0.22%) | (0.38%) | (0.11%) | (0.07%) |
| T-test | -3.41*** | 1.40 | -1.40 | -2.00* | -2.38* | -3.97*** | 8.37*** | -0.67 |
| | (-1.45) | (0.25) | (-0.25) | (-6.40***) | (-0.22) | (-0.82) | (12.24***) | (1.10) |

*p<0.05, **p<0.01, ***p<0.001

[3] eBay only considers unique positive feedbacks and unique negative feedbacks when displaying the percentage of positive feedbacks. Therefore, we do not present neutral feedbacks in the "distribution displayed" section. Due to space limitation, we do not show the number of positive feedbacks and the number of negative feedbacks in the table. The data is available upon request.

[4] Revoked feedbacks might also be caused by a seller's correcting his/her genuine mistake. We randomly chose 100 revoked feedbacks and found that the cases of genuine mistakes are pretty rare.

The similarity between strikers and forum sellers indicates that a seller joined the strike not just because he/she was active on the forum and knew about it. On eBay, a seller may sell a few times but buy most times. In this case, he/she might not care much about strategic revoking. As a robustness check on this, we also separate these two and compare feedbacks received as a seller for the three categories of sellers (see Table 3). All major results still hold.

**Table 3. Pre-Change Reputation Profile Comparison for Feedbacks Received as a Seller**

| | Score | Positive | Negative | Neutral | Revoked | eBay-withdrawn |
|---|---|---|---|---|---|---|
| Strikers | 245.51 | 98.65% | 0.21% | 0.41% | 0.67% | 0.06% |
| General Sellers | 415.24 | 98.86% | 0.34% | 0.57% | 0.13% | 0.10% |
| (Forum Sellers) | (322.46) | (99.14%) | (0.23%) | (0.42%) | (0.12%) | (0.09%) |
| T-test | -3.41*** | -1.59 | -2.69** | -3.02** | 8.45*** | -0.73 |
| | (-1.50) | (-5.26***) | (-0.75) | (-0.20) | (12.04***) | (-0.19) |

*p<0.05, **p<0.01, ***p<0.001

The above summary statistics consistently indicates that the elimination of the revoking feedback mechanism may be a major reason for the strike. However there are confounding factors. As we have discussed, potential financial loss under the new fee policy may also lead sellers to strike. To measure potential financial loss, we first calculated, for each listing, the difference between fees actually charged by eBay under the old fee structure and fees charged by eBay if it were under the new fee structure. We collected detailed information about each listing, including product category, auction style, start price, final price and usage of features such as gallery pictures and subtitles. This allowed us to calculate the exact fee charged by eBay based on the fee structure. We then aggregated the differences to the seller level. Because the strike started on Feb 18th, 2008, we only considered listings one month prior to the strike, i.e., from January 18th 2008 to February 17th 2008.

Table 4 presents the sales profile comparison between sellers. As can be seen, strikers are not different from general sellers and forum sellers in terms of sales. Interestingly, all three types of sellers would benefit (save money) under the new fee policy. However, strikers benefit less. This implies that the change in the fee structure seems to be one major reason for the strike.

**Table 4. Sales Profile Comparison**

| | No. of Listings | Overall Sales ($) | Fee Difference ($) |
|---|---|---|---|
| Strikers | 186.11 | 2563.67 | -8.06 |
| General Sellers | 222.68 | 3875.30 | -24.01 |
| (Forum Sellers) | (216.04) | (3106.88) | (-18.55) |
| T-test | -2.01* | -1.90 | 3.52*** |
| | (-1.63) | (-1.22) | (2.38*) |

*p<0.05, **p<0.01, ***p<0.001

To control the confounding factors, we employ a logit regression model to predict the propensity for strike:

$$\text{Logit(strike)}=\alpha+\beta_1*\text{Listings\_Number}+\beta_2*\text{Powerseller\_Status}+\beta_3*\text{Months\_on\_eBay}$$
$$+\beta_4*\text{Fee\_Difference}+\beta_5*\text{Reputation\_Score}+\beta_6*\text{Revoked\_Percentage}$$

In the above model, we included several other control variables that could potentially influence participation in the strike. Sellers with a larger volume of sales will suffer more financially if they join the strike, and hence are less likely to participate. Powersellers are also less likely to join the strike because they would enjoy significant final value fee discounts under the new fee structure. Further, the longer a seller has stayed with eBay, the higher his/her switching cost (ex: loyal customer base). These sellers should care more about the long-term interest and thus have stronger reaction to the reduction of seller power in the new reputation system. Therefore we included number of months on eBay as another control variable.

The descriptive statistics and correlation matrix of the variables in the regression are provided in Table 5 and Table 6. The results of the logit regression model are shown in Table 7. Model I is the baseline model. The coefficient of fee difference is significantly positive, suggesting that sellers who lose more (or save less) are more likely to strike. The coefficient of reputation score is negative and significant, indicating that sellers with lower reputation have a higher propensity to join the strike. Consistent with our prediction, sellers with a longer tenure on eBay are found to have a higher likelihood to strike for their benefits. Powerseller status and the volume of listings do not have a significant effect on a seller's propensity to strike.

In Model II we included the revoked feedback percentage in the regression. We find that pseudo $R^2$ increases by nearly 300%, supporting that a seller's revoking behavior has significant explanatory power on their strike participation. The coefficient of the percentage of revoked feedbacks is positive and significant at $p<0.001$ level, suggesting that sellers who used to strategically revoke negative feedbacks were more inclined to strike. A 0.1% increase in revoked feedback percentage leads to 4.57 percent increase in the odds of joining the strike and a 1% increase in revoked feedback percentage leads to 56.35 percent increase in the odds of joining the strike.

**Table 5. Summary Statistics**

| Variable | Number of observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| # of Listings | 5947 | 217.26 | 333.54 | 0.00 | 9848.00 |
| Powerseller Status (Dummy) | 5947 | 0.42 | 0.49 | 0.00 | 1.00 |
| # of months on eBay | 5946 | 77.17 | 20.68 | 2.87 | 145.83 |
| Fee Difference ($) | 5947 | -20.58 | 88.02 | -699.02 | 1715.68 |
| Reputation Score | 5947 | 384.38 | 1001.60 | 0.00 | 35800.00 |
| Revoked Feedback Percentage | 5947 | 0.16% | 0.99% | 0.00% | 55.56% |
| Strike (Dummy) | 5947 | 0.07 | 0.26 | 0.00 | 1.00 |

Note: there is one missing value for # of months on eBay.

**Table 6. Correlation Matrix**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| # of Listings (1) | 1 | | | | | | |
| Powerseller Status (Dummy) (2) | 0.37* | 1 | | | | | |
| # of months on eBay (3) | -0.06* | -0.09* | 1 | | | | |
| Fee Difference (4) | -0.37* | -0.16* | 0.07* | 1 | | | |
| Reputation Score (5) | 0.37* | 0.23* | -0.06* | -0.15* | 1 | | |
| Revoked Feedback Percentage (6) | 0.11* | 0.07* | -0.03* | -0.02 | 0.05* | 1 | |
| Strike (Dummy) (7) | -0.03* | -0.01 | 0.06* | 0.04* | -0.03* | 0.14* | 1 |

Note: Pair-wise Spearman correlation is reported. * indicates $p<0.05$.

**Table 7. Logit Regression Analyses**

| | Model I | | Model II | |
|---|---|---|---|---|
| | coefficient | p-value | coefficient | p-value |
| Intercept | -2.980*** | 0.000 | -3.059*** | 0.000 |
| # of Listings | 1.770-e05 | 0.919 | -2.202-e04 | 0.192 |
| Powerseller Status | 0.083 | 0.459 | 0.055 | 0.631 |
| # of Months on eBay | 0.007*** | 0.000 | 0.007*** | 0.000 |
| Fee Difference | 0.001* | 0.012 | 0.001* | 0.018 |
| Reputation Score | -3.506-e04* | 0.027 | -4.085-e04* | 0.016 |
| Revoked Feedback Percentage | | | 44.695*** | 0.000 |
| # of observations | 5946 | | 5946 | |
| Pseudo $R^2$ | 0.0116 | | 0.0443 | |
| *p<0.05, **p<0.01, ***p<0.001 | | | | |

From our reputation profile comparison and logit regression analyses, we find that strikers were indeed sellers with lower reputation scores and higher negative feedbacks – sellers who strategically nullified their negative feedbacks using eBay's revoking mechanism and successfully masqueraded as sellers with higher reputation scores. We next examine if these strikers were just "bad sellers" (a case of adverse selection) or "ugly sellers" (a case of moral hazard) by examining their behaviors and reputation scores after the changes to eBay's reputation mechanism.

### *Changes in Seller Behavior: The Ugly Seller*

In this section we explore any potential changes in seller behavior under the new reputation system in an attempt to shed light on the nature of seller behavior. If the strikers are indeed "bad sellers" (i.e., a case of adverse selection), we should expect to see the new reputation system more effectively reveal these "bad sellers". On the other hand, if sellers were indeed "ugly sellers" (i.e., a case of moral hazard) they should be able to improve their quality and improve their reputation under the new reputation system.

**Table 8. Post-Change Reputation Profile Comparison: Strikers vs. Non-Strikers**

| | Score | Positive | Negative | Neutral | eBay-withdrawn |
|---|---|---|---|---|---|
| Strikers | 204.25 | 98.87% | 0.90% | 0.17% | 0.06% |
| General Sellers | 402.03 | 98.88% | 0.69% | 0.34% | 0.09% |
| (Forum Sellers) | (283.24) | (99.18%) | (0.59%) | (0.15%) | (0.08%) |
| T-test | -3.32*** | -0.05 | 1.04 | -3.56*** | -0.67 |
| | (-1.68) | (-1.26) | (1.27) | (0.25) | (-0.67) |
| *p<0.05, **p<0.01, ***p<0.001 | | | | | |

Table 8 presents the reputation profiles for sellers under the new reputation system. Comparing Table 8 with Table 2, we find that the negative feedback percentage increases for all three types of sellers (0.88% to 0.90% for strikers, 0.44% to 0.69% for general sellers, and 0.33% to 0.59% for forum sellers). This is consistent with our prediction: since sellers are no longer able to prevent buyers from leaving negative feedbacks by retaliation and revoke negative feedbacks, they are expected to receive more negative feedbacks under the new reputation system.

In contrast with the finding that strikers actually had a higher negative feedback percentage under the old reputation system, there is no difference in negative feedback percentage between strikers and other two types of sellers after the ban on revoking. Also, the absolute increase or the percentage increase in negative feedback percentage for strikers is much smaller than the increase for general sellers and forum sellers. If moral hazard prevails on eBay, after revoking is banned, all sellers who are good by nature are supposed to behave honestly, and consequently, there should be no difference between strikers and other sellers in terms of negative feedback percentage. On the contrary, under the pure adverse selection scenario, strikers who are "bad sellers" will reveal themselves by their higher negative feedback percentage on losing their "protection". The smaller increase in negative feedbacks for strikers and the similar negative feedback percentage between strikers and other sellers supports the moral hazard postulates of seller behavior. In other words, sellers (i.e. the strikers in our sample) are the "ugly sellers" - inherently good sellers who strategically choose to behave dishonestly.

### *Robustness check*

Strikers are those sellers who responded strongly to the reputation change. However, they might not be representative of sellers who use revoking to strategically improve their reputation scores. To examine this, we combined all three categories of sellers and partitioned the combined sample into two groups, based on their revoking behavior. We then defined "revokers" as sellers who initially received more than 4 negative feedbacks and then revoked at least 40% of these negative feedbacks. "Non-revokers" are sellers who never revoked negative feedbacks. This resulted in 249 revokers and 2786 non-revokers.

Table 9 presents the reputation profile comparison between revokers and non-revokers for both before and after the change. Revokers have a higher negative feedback percentage than non-revokers. However, the increase in negative feedback percentage for revokers is only 0.07% (from 1.27%+0.53%=1.80% to 1.87% whereas it is 0.24% (from 0.26% to 0.50%) for non-strikers. This implies that compared with non-revokers, revokers have changed their behavior in a positive way to mitigate the increase in negative feedbacks caused by the reputation system change. This further supports the moral hazard assumption about seller behavior.

As an additional robustness check, we restricted or relaxed the definition criteria for revokers. We find that the moral hazard assumption is still supported. Defining revokers as the top 5% or 10% sellers in terms of their revoked feedback percentage produced similar results.

**Table 9. Reputation Profile Comparison: Revokers vs. Non-Revokers**

| | **Pre-Change** | | | | | **Post-Change** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Positive | Negative | Neutral | Revoked | eBay-withdrawn | Positive | Negative | Neutral | eBay-withdrawn |
| Revokers | 97.08% | 0.53% | 1.02% | 1.27% | 0.10% | 97.35% | 1.87% | 0.68% | 0.10% |
| Non-Revokers | 99.26% | 0.26% | 0.42% | 0.00% | 0.06% | 99.15% | 0.50% | 0.29% | 0.09% |
| T-test | -16.08*** | 4.74*** | 12.03*** | 18.57*** | 0.78 | -7.98*** | 6.52*** | 6.38*** | 0.78 |

*p<0.05, **p<0.01, ***p<0.001

We also find additional evidence on revokers' changing their selling strategies. On eBay, when an item fails to sell to the winning bidder or when the reserve price is not met or if the seller has duplicates items for sale, the seller can make a second-chance offer (SCO) to other bidders. A seller can offer to the item multiple "losing bidders" and in many cases the seller has to choose one of the "losing bidders" and request to cancel the transactions with other "losing bidders" who also accept the second-chance offer. However, this could make the buyers (especially inexperienced buyers) suspect the transaction. As noted by a buyer: *"…I've never done or accepted a SCO, got burned really bad when I first started here…"*. However, instead of using second-chance offers, a seller could relist the item again to avoid any potential misunderstanding, notwithstanding the additional effort and expense. As shown

in Table 10, we find that both revokers and non-revokers have reduced the percentage of second-chance offers, suggesting that sellers now deliberately seek to reduce any misunderstanding. Interestingly, the magnitude is much greater for revokers (1.64%-0.97%=0.67%) compared with non-revokers (1.04%-0.83%=0.21%). The greater reduction in second-chance offers further suggests that "revokers" have changed their behavior for the better.

**Table 10. Selling Behavior Comparison: Revokers vs. Non-Revokers**[5]

| | Second-Chance Offers | | Store Inventory Listings | |
|---|---|---|---|---|
| | Revokers | Non-Revokers | Revokers | Non-Revokers |
| 2008 Jan - 2008 Mar | 1.64% | 1.04% | 8.78% | 9.91% |
| 2009 Jan - 2009 Mar | 0.97% | 0.83% | 12.61% | 10.50% |
| T-test | 3.28* | 2.23* | -1.99* | -1.46 |
| *p<0.05, **p<0.01, ***p<0.001 | | | | |

In addition, compared with non-revokers, revokers have significantly increased the percentage of store inventory listings. Store inventory items are sold on the seller's eBay store at a set price. They have less visibility in regular eBay search and browse results than auction-style and fixed price listings. Yet typically from the eBay store page, a buyer gets more information about the seller as well as all the products sold by the seller. As a result, the transaction is more likely to be positively evaluated. Indeed, we find that store inventory listings have a 0.38% higher possibility of receiving positive feedbacks than auction-style and fixed price listings based on the listing data from January 2008 to March 2008. An increase in store item listings reflects revokers' efforts to provide more quality information despite the reduced visibility of listings.

It should be noted that eBay's change in the basic fee structure only applies to auction-style listings and fixed price listings. Revokers save less money than non-revokers ($16.90 for revokers and $21.63 for non-revokers). Since in general sellers save money under the new fee policy, sellers should have an incentive to increase the percentage of auction-style listings and fixed price listings rather than store inventory listings. Thus, the increase in store inventory listings is unlikely to be driven by the change in fee structure and more likely by changes in seller behavior. Also, because revokers save less money, they have fewer incentives to increase the percentage of auction-style listings and fixed price listings. Therefore, the decrease in second-chance offers should be smaller for revokers if only considering the change in fee structure. The observed greater decrease in second-chance offers implies that it is not driven by the change in fee structure but by changes in their behavior.

## Discussions and Implications

In this paper, we study the strategic gaming behavior resulting from the ability of sellers to revoke their feedback on eBay. We find evidence that certain sellers strategically utilize revoking to "improve" their reputation. Compared with general sellers, strikers had a much higher revoked feedback percentage. We find that the changes to the reputation mechanism instituted by eBay, has had a significant influence on these sellers' behavior. We find evidence that they put in more effort into their transactions and receive the same level of negative ratings as other sellers.

These findings make significant contributions to the literature of online reputation system design (ex: Dellarocus 2005; Fan, Tan and Whinston 2005; Qu, Zhang and Li 2008; Zhou, Dresner, and Windle 2008). A reputation system should facilitate market transactions by separating good players (either seller or buyer) from bad ones and inducing honest behavior. We provide the first empirical evidence that sellers do respond to the design of the reputation system. Allowing revoking in feedback mechanism will lead to sellers' strategic gaming behavior. After

[5] Here, we focused on sellers who had listings in both periods. The analysis is based on the sample of 104 revokers and 2010 non-revokers.

revoking is disabled, the more opportunistic sellers increase their efforts to behave better. The above findings also provide empirical evidence for a fundamental assumption in the theory work of reputation system: whether sellers should be modeled as intrinsically bad or not.

This paper is also related to the growing literature of gaming behavior in online marketplace. Kauffman and Wood (2005) study the shilling behavior of sellers to artificially raise bidding prices. Cabral and Hortacsu (2004) find that about one third of sellers build up their reputations by being a buyer first. Jin and Kato (2006) find that some eBay sellers make non-credible claims of quality and mislead buyers. We contribute to the above literature by introducing a new way of studying seller's strategic behavior. Our work is also related to how consumers should interpret sellers' reputation. Zhang (2006) finds that reputation as seller and buyer has different impact on closing price. We suggest that consumers should take into account the revoked feedback to better differentiate seller quality.

Managerially, this study has two implications. First, the finding that revoking elicits strategic behavior of sellers suggests that online market makers should adopt other measures to reveal more quality information to buyers when revoking is available to sellers. One potential way is to take into account revoked feedbacks when calculating overall reputation and display the percentage of revoked feedbacks to buyers. Currently there is no easy and straightforward way of getting this information from eBay or other similar markets. Second, the finding that seller behavior is more of moral hazard than of adverse selection suggests that online market makers should focus on soliciting truthful behavior through the design of their reputation systems rather than driving out bad sellers.

## Conclusion and Future Work

Reputation systems are vital to the success of online marketplaces such as eBay. Taking advantage of the exogenous change in eBay reputation system and the resulting online strike, we explore, for the first time, sellers' strategic gaming behavior related with revoking. Our findings shed light on fundamental assumptions about seller behavior. We find support that seller behavior is more of moral hazard than a case of adverse selection, which has important implications for the design of online reputation systems.

This study has two limitations. First, we only focus on sellers with lifetime total feedbacks of 500 or higher because we want to focus on active sellers and most eBay transactions are conducted by these sellers. Adding sellers with lower lifetime feedbacks to our sample might change the result of our study. Second, eBay also made some other changes in October 2008, such as no checks or money order as payment methods. These changes, although not related with the reputation system, might also influence sellers' behavior. We did not directly control for this potential influence. However, it should not bias our result too much because most eBay sellers are concerned about the change in fee structure and feedback system.

The study can be extended in two major ways. First, we are working on a more detailed analysis of how revoking happens based on both sellers' and buyers' detailed feedback behavior. Second, the changes in reputation system should have influence on market efficiency, like sell-through rate and price dispersion. A comparison of final auction prices between strikers and general sellers can be done to further evaluate the impact of revoking feedback mechanism on market efficiency. This is also part of our ongoing investigation.

Finally, it will be interesting to see whether banning revoking in the new system benefits eBay or not. First, since now only buyers can leave negative feedback, the balance seems to have shifted in favor of the buyers. This might induce buyers to behave opportunistically hurting sellers. Second, the increase in negative ratings from buyers might destroy the perception that eBay is a safe place for transactions. Future research is needed on the costs and benefits of adopting a one-way reputation mechanism and the resulting impact on the electronic markets.

## References

Bolton, G., Katok, E., and Ockenfels, A. "How Effective Are Electronic Reputation Mechanisms? An Experimental Investigation", *Management Science* (50:11), 2004, pp. 1587-1602.

BusinessShrink. "*Ebay Sellers Boycott Gains Traction; Competing Sites Grow*," Febuary 19, 2008 (available at: http://businessshrink.biz/psychologyofbusiness/2008/02/19/ebay-sellers-boycott-gains-traction-competing-sites-grow/)

Cabral, L.M.B., and Hortacsu, A. "The Dynamics of Seller Reputation: Theory and Evidence from eBay", *CEPR Discussion Paper No. 4345*, April 2004.

Chwelos, P., and Dhar, T. "Caveat Emptor: Differences in Online Reputation Mechanisms," *Working Paper*, Sauder School of Business, University of British Columbia, 2006.

Dellarocas C. "The Digitization of Word-of-Mouth: Promise and Challenges of Online Feedback Mechanisms", *Management Science* (49:10), 2003, pp. 1404-1427.

Dellarocas, C. "Reputation Mechanism Design in Online Trading Environments with Pure Moral Hazard," *Information Systems Research* (16:2), 2005, pp.209-230.

Dellarocas, C., and Wood, C.A. "The Sound of Silence in Online Feedback: Estimating Trading Risks in the Presence of Reporting Bias," *Management Science* (54:3), 2008, pp. 460-476.

Dewan, S., and Hsu, V. "Adverse Selection in Reputations-Based Electronic Markets: Evidence from Online Stamp Auctions," *Journal of Industrial Economics* (52:4), 2004, pp. 497-516.

Eaton, D.H. "Reputation Effects in Online Auction Markets," *Working Paper*, Department of Economics and Finance, Murray State University, 2005.

Fan, M.,Tan, Y., and Whinston, A. "Evaluation and Design of online cooperative feedback mechanisms for reputation management," *IEEE Transactions on Knowledge and Data Engineering*, 17 (2) (2005) 244–254.

Houser, D. and Wooders, J. "Reputation in Auctions: Theory and Evidence from eBay," *Journal of Economics and Management Strategy (15)*, 2006, pp. 353-369.

Jin, G.Z., and Kato, A. "Price, Quality, and Reputation: Evidence from an Online Field Experiment," *Rand Journal of Economics* (37:4), 2006, pp. 983-1004.

Kauffman, R.J., and Wood, C.A., "The Effects of Shilling on Final Bid Prices in Online Auctions," *Electronic Commerce Research and Applications* (4:2), Spring 2005, pp. 21-34.

Klein, T. J., Lambertz, C., Spagnolo, G. and Stahl K. O. "Last Minute Feedback," *SFB/TR 15 Discussion Paper*, September 29, 2005.

Lucking-Reiley, D., Bryan, D., Prasad, N., and Reeves, D. "Pennies from eBay: the Determinants of Price in Online Auctions," *The Journal of Industrial Economics* (2), June 2007, pp. 223-233.

Masclet, D., and Pénard, T. "Is the eBay Feedback System Really Efficient? An Experimental Study," *Working Paper*, University of Caen, 2008.

Melnik, M.I., and Alm, J. "Does a Seller's eCommerce Reputation Matter? Evidence from eBay Auctions," *The Journal of Industrial Economics* (3), 2002, pp. 337-349.

Qu, Z., Zhang, H., Li, H., "Determinants of online merchant rating: Content analysis of consumer comments about Yahoo merchants," *Decision Support Systems* (46:1), December 2008, pp. 440-449.

Reichling, F. "Effects of Reputation Mechanisms on Fraud Prevention in eBay Auction," *Working Paper*, Stanford University, 2004.

Resnick, P., Zeckhauser, R., Swanson, J., and Lockwood, K. "The Value of Reputation on eBay: A Controlled Experiment," *Experimental Economics* (9), 2006, pp. 79-101.

Resnick, P., and Zeckhauser, R. "Trust Among Strangers in Internet Transactions: Empirical Analysis of eBay's Reputation System," *The Economics of the Internet and E-Commerce*, Elsevier Science, 2002, pp. 127-157.

USA Today. "*Online auction listings down 13% in boycott of eBay*," February 24, 2008 (available online at: http://www.usatoday.com/tech/techinvestor/corporatenews/2008-02-24-ebay-strike_N.htm)

Zhang, J. "The Roles of Players and Reputation: Evidence from eBay Online Auctions," *Decision Support Systems* (42:3), 2006, pp. 1800-1818.

Zhou, M., Dresner, M., and Windle, R.J. "Online reputation systems: Design and strategic practices," *Decision support systems* (44), 2008, pp. 785-797.