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Trust and Reputation in Internet Auctions*

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* This paper is based on a German language version published in the "Kölner Zeitschrift für Soziologie und Sozialpsychologie", Vol. 54:674-693, 2002. Small errors in the data set were corrected. For example, almost new but used phones were deleted to include only homogeneous products. Moreover, in this version more refined statistical methods were applied. All data are from the Swiss auction platform ricardo.ch collected in the time span October 2001 to January 2002. The maximum number of positive ratings was 103 indicating that sellers' businesses were rather new. Therefore, this paper reports effects of the reputation system in the relatively new environment of ricardo.ch's auction platform. This specific feature of the sample might be an advantage compared to the analysis of today's auction data. We assume that the reputation system is of greater importance for newly established auction platforms than for platforms with a longer history. We would like to thank Debra Hevenstone, Andrea Hungerbühler, Wojtek Przepiorka, Thomas Voss, and Andreas Wald for helpful comments and suggestions.

Trust and Reputation in Internet Auctions

Abstract

Exchange between anonymous actors in Internet auctions corresponds to a one-shot prisoner's dilemma-like situation. Therefore, in any given auction the risk is high that seller and buyer will cheat and, as a consequence, that the market will collapse. However, mutual cooperation can be attained by the simple and very efficient institution of a public rating system. By this system, sellers have incentives to invest in reputation in order to enhance future chances of business. Using data from about 200 auctions of mobile phones we empirically explore the effects of the reputation system. In general, the analysis of non-obtrusive data from auctions may help to gain a deeper understanding of basic social processes of exchange, reputation, trust, and cooperation, and of the impact of institutions on the efficiency of markets. In this study we report empirical estimates of effects of reputation on characteristics of transactions such as the probability of a successful deal, the mode of payment, and the selling price (highest bid). In particular, we try to answer the question whether sellers receive a "premium" for reputation. Our results show that buyers are willing to pay higher prices for reputation in order to diminish the risk of exploitation. On the other hand, sellers protect themselves from cheating buyers by the choice of an appropriate payment mode. Therefore, despite the risk of mutual opportunistic behavior, simple institutional settings lead to cooperation, relatively rare events of fraud, and efficient markets.

1. Reputation mechanisms and cooperation

Economic exchange between anonymous actors is risky for all interacting parties. Whether in barter or in sale against cash, in a bilateral exchange situation both actors have to choose between being more or less cooperative or acting fraudulently. A seller, for example, has to decide whether to deliver at all, to deliver good quality, or to deliver bad quality, and a buyer may choose to evade, reduce, or delay the payment. It is well known that such cooperation problems can be solved by repeated interactions if the "shadow of the future", that is, the expectation and valuation of future transactions is sufficiently large (Axelrod 1984; for a survey see Diekmann und Lindenberg 2001). However, no such temporal "embeddedness" (Raub and Weesie 2000) occurs in single transactions. Hence, it is likely that both actors behave uncooperatively. Internet auctions, characterized by anonymity and non-repetition of transaction, closely correspond to this type of interaction. Sellers and buyers may adopt "virtual identities", that is, they may act under fictitious names and fake addresses, and it is evident that a basic trust problem has to be overcome in order to realize mutually satisfactory exchanges.[1] In terms of game theory, an Internet auction with simultaneous transaction corresponds to the ideal type of a single one-shot prisoner's dilemma. If, however, the actors fulfill their obligations sequentially such that the second actor can condition his move on the action of the first, a sequential prisoner's dilemma or a "trust game" is played (see below).

A single exchange between anonymous actors is very precarious situation and gives reason for the prediction that both parties will strongly tend towards fraudulent behavior without intervention by a central authority. Therefore, one would expect cheating in Internet transactions and unstable markets that collapse rapidly or, despite demand, fail to emerge at all.

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[1] Note that, usually, actors have to create an account at the auction platform and leave their postal address before participating in Internet auctions. It is not much of a problem, however, to sidestep this identification procedure using a temporary address.

Contrary to expectation, several Internet auction platforms such as eBay, QXL ricardo, or Amazon have been successful for years. Apparently, these markets do not erode due to lack of mutual trust. Furthermore, cheating in Internet auctions seems to be relatively rare. Kollock (1999) mentions early figures by eBay according to which only 27 cases of fraud have been reported out of two million auctions between May and August 1997. The "National Fraud Information Center/Internet Fraud Watch" (NFIC/IFW), a project of the "National Consumers League" of the United States, is concerned with registering cases of Internet fraud and forwarding them to the appropriate law enforcement agencies. According to the "Internet Fraud Statistics" of the NFIC/IFW, the majority of all registered cases of Internet fraud around the time of our study occurred in Internet auctions.[2] The average monetary loss per Internet auction fraud victim amounted to between $300 and $400. Even if the NFIC/IFW-statistics underestimate the actual crime rate, risk of fraud is relatively low given the millions of transactions handled by auction platforms such as eBay and Ricardo.[3]

The reason for the success of these Internet markets is a simple institutional rule: Both actors participating in a transaction, buyer and seller, are advised to rate each other after the

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[2] 78% or about 6200 cases in 2000, 70% or about 8300 cases in 2001, 90% or about 28000 cases in 2002 (see http://www.fraud.org/internet/intstat.htm, visited 2/18/2004).

[3] Likewise, a further institution, the Internet Fraud Complaint Center (IFCC), reported that the largest share of all complaints about fraudulent behavior came from Internet auctions (43% or about 7200 cases in 2001, 46% or about 22000 cases in 2002; see National White Collar Crime Center 2002, 2003). The IFCC estimated that less than one percent of all transactions on Internet auction sites resulted in fraud (IFCC 2001; according to the same report the most frequent Internet auction fraud items in the observed time period were "Beanies"—soft toys, which are popular among collectors—followed by video consoles/games/tapes, laptop computers, cameras/camcorders, desktop computers, and jewelry). Furthermore, even if added up, the reported total money loss from Internet fraud (NFIC/IFW: $6 million in 2001, $15 million in 2002; IFCC: $18 million in 2001, $54 million in 2002) only amounted to around 0.1 percent of the estimated U.S. e-commerce retail sales ($35.6 billion in 2001, $43.5 billion in 2002; see http://www.census.gov/mrts/www/current.html, visited 2/18/2004).

deal has been completed. That is, the actors may valuate the other party's business conduct by assign "marks" and verbal statements, and these assessments are open to anyone who is interested. Therefore, a potential buyer can browse a seller's list of received ratings from previous transactions before placing a bid. To simplify matters, auction platforms usually also provide summary reputation indices based on the single ratings. In the time we collected our data, ricardo.ch declared the average number of "stars" (transaction partners could be rated with one to five stars) and the number of transactions on which this average measure was based. Additionally, separate statistics for positive (four or five stars), neutral (three stars), and negative (one or two stars) assessments were provided for the most recent transactions (Figure 1). Although the rating process is reciprocal, that is, seller and buyer can both submit a rating in a given transaction, the assessments given to sellers seem to be more important, since bidders may pick sellers by their reputation, but sellers may not choose buyers.

[Figure 1 about here.]

Trust in exchange situations arises from "learning" from past behavior of the contracting partner and from "control", that is, the possibility to impose sanctions in the case of uncooperative behavior (Buskens and Raub 2004). From the viewpoint of the buyer, both elements, "learning" and "control", are inherent components of the rating procedure. Moreover, a high participation rate in the feedback system and perfect transparency compose a reputation mechanism which generates trust not only on the side of potential bidders, it also makes investments in reputation worthwhile for offerers. For if a positive rating facilitates future business, the actors have a strong incentive to acquire good reputation. However, positive reputation may only be gained through cooperative behavior. Thus, the dynamics of reputation simultaneously launch a dynamic process of cooperation. "Honesty is the best policy" and—at least if willing to stay in business—even the most unscrupulous character is forced by these institutional constraints to invest in reputation and behave cooperatively. The rating mechanism introduces the "future" into single-shot games because the current behavior of an actor will influence future behavior of the market

participants. Hence, the feedback system may be seen as a substitute for repeated interactions.

Reputation systems, nota bene, are not an invention of the Internet era. However, the technical capabilities of the Internet make it possible to implement the reputation principle in a very simple and elegant manner and to establish stable, efficient, and fraud-proof markets. Greif (1989, 1993), in a very informative historical economic study, describes the Maghreb traders in the 11th century who conducted their extensive trading activities in the Mediterranean area through representing agents. A principal-agent problem existed for the traders (principals) because the representatives (agents) had practically uncontrollable opportunities to engage in fraud. Nonetheless, in general, the representatives acted cooperatively. The explanation for the compliance of the agents is that the traders formed a coalition through which they were able to exchange information about the activities of the agents. "Within the coalition an internal information-transmission system served to balance asymmetric information and a reputation mechanism was used to ensure proper conduct" (Greif 1989:881). The result of disingenuous business conduct of an agent was that no trader of the coalition would commission the agent ever again. In addition, agents and traders were often swapping roles and a deceitful agent would no longer have been accepted to join the coalition of traders. In sum, the reputation mechanism set up by the Maghreb traders made a substantial contribution to solving the cooperation problem (also see Homann and Suchanek 2000).

Apart from reputation per se, reliable methods to indicate and verify reputation are also crucial for successful business. This is an aspect that has been emphasized by Max Weber (1920) in his study "The Protestant Sects and the Spirit of Capitalism". Weber describes various personal observations related to the apparent credit-worthiness of members of protestant sects. For example, on a railroad journey during his America travels in 1904, Weber sat next to a traveling salesman whose business was selling iron letters for tombstones. The businessman told him: "'Sir, for my part everybody may believe or not believe as he pleases; but if I saw a farmer or a businessman not belonging to any church at

all, I wouldn't trust him with fifty cents. …'" (Weber 2002:128). A German-born nose-and-throat specialist in Ohio was puzzled by his first patient who emphasized that he was a member of a Baptist Church. The doctor, who later reported the incident to Weber, was informed by an American colleague "that the patient's statement of his church membership was merely to say: 'Don't worry about the fees'" (Weber 2002:129). After attending a baptism ceremony of a Baptist congregation, Weber learned that "'… once being baptized he will get the patronage of the whole region and he will outcompete everybody.' Further questions of 'why' and 'by what means' led to the following conclusion: Admission to the local Baptist congregation follows only upon the most careful 'probation' and after closest inquiries into conduct going back to early childhood (Disorderly conduct? Frequenting taverns? Dance? Theatre? Card Playing? Untimely meeting of liability? Other Frivolities?) The congregation still adhered strictly to the religious tradition. Admission to the congregation is recognized as an absolute guarantee of the moral qualities of a gentleman, especially of those qualities required in business matters. Baptism secures to the individual the deposits of the whole region and unlimited credit without any competition. He is a 'made man'" (Weber 2002:129-130; also see Voss 1998).

Several aspects are crucial for the creation of the reputation. First, the sect chooses its members after careful inquiries and gives them—in Weber's words—"a certificate of moral qualification and especially of business morals" (2002:130). Second, admission of a new member occurs by ballot, that is, by vote of the sect members. Third, the acquisition of reputation is supposed to be forgery-proof, so that impostors have no chance. And fourth, it is advantageous that the reputation can easily be disclosed.

A secular variant of these elements can be found in Internet auctions. The qualification certificate corresponds to the rating outcome, which is generated by "vote", i.e. by the customers' assessments. Furthermore, the mechanism is relatively forgery-proof, since a good reputation can only be achieved by cooperative behavior. As already mentioned, the values of the ratings and especially their frequencies are visible to all interested users. Thus, simple institutional regulations generate (a) reputation, which (b) rests upon the judgments

of many interactive partners, (c) appears to be more or less unforgeable, and (d) is perfectly transparent and, hence, the rules establish ideal conditions for a functioning market.

The relation between reputation and cooperation has been analyzed theoretically in various case studies, as well as in studies using formal modeling (see, e.g., Akerlof 1970, Granovetter 1985, Coleman 1990, Raub and Weesie 1990, Greif 1993, Hägg 1994, Voss 1998, Ziegler 1998, Kollock 1999, Abell and Reyniers 2000). On the other hand, at the time we started our research, relatively few studies existed in which a systematic attempt was made to evaluate the implications of reputation mechanisms on an empirical basis. Internet auctions provide an excellent resource to study the effects of reputation and to test hypotheses about reputation mechanisms. Other types of hypotheses, for example about how the temporal distribution of bids depends on auction rules (e.g. "last-minute bidding") or about the determination of minimum bids, may be tested effectively as well (Roth and Ockenfels 2002, Bajari and Hortaçsu 2003). Unlike population surveys, internet auctions are like field experiments where the researcher observes the results. Contrary to questionnaire data, the auction data are process-produced, non-reactive, and reflect realities without distortion. While some of the available Internet auction studies report on the degree and development of reputation (e.g. Kollock 1999, Brinkmann and Seifert 2001), the focus of this paper lies in the analysis of the effects of the reputation mechanism on auction prices and the choice of payment modes.

The term "investment" in reputation is not just meant figuratively. Reputation really generates its returns. On the one hand it paves the way for future business, on the other hand enhanced auction prices, a sort of a reputation surcharge, can be realized. If reputation is high, the bidder's risk of getting exploited is reduced and a bidder, therefore, will be willing to pay more. In a way, the surcharge is like a premium for risk coverage against being defrauded.

Early empirical evidence supporting the hypothesis of a reputation premium is provided by Lucking-Reiley et al. (2000), McDonald and Slawson (2002), and Houser and Wooders

(2001), based on analyses of eBay auctions data. In the latter two studies, auctions of homogeneous goods have been examined (451 auctions of Harley-Davidson Barbie dolls in factory packaging and 94 auctions of Pentium III 500 processors, respectively) so that differences in product characteristics should not play a role (similarly Melnik and Alm 2002). Lucking-Reily et al. (2000) on the other hand estimated the effect of reputation based on a random sample of 461 auctions of U.S. Indian Head pennies that were of varying quality. They found a weak price effect for positive reputation and a strong effect for negative reputation, but no significant effect for the eBay summary reputation index (that takes into account both positive and negative ratings). However, because the varying quality of the traded coins in the analyzed auctions opens the door for confounding effects, this study's results are probably less reliable than the results of the two other studies. Lucking-Reiley et al. (2000) themselves classified their analysis as explorative.[4]

Looking out for sellers with good reputation, a buyer can reduce the risk of becoming a victim of a fraudulent seller. But how can sellers protect themselves against cheating buyers? The buyer's reputation does not give a hold here because, usually, offerers cannot choose buyers. However, sellers have the power to set the payment and delivery mode.

Depending on the payment mode, the risks in business between anonymous actors are divided differently between the actors. (a) In spot transactions, where goods are exchanged against cash simultaneously, the risks are distributed symmetrically. In contrast, the risks are divided unevenly between the interacting partners if (b) payment is due in advance or as cash on mail delivery or (c) on account. In terms of game theory, payment mode (a) corresponds to a prisoner's dilemma, the types (b) and (c) correspond to a sequential prisoner's dilemma, in which the second player gets to know the choice of the first player

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[4] Meanwhile, support for the reputation hypothesis is also provided by a series of other studies (see, e.g., the surveys in Bajari and Hortaçsu 2004, Snijders and Zijdeman 2004, and Resnick et al. 2006).

before making his own decision.[5] The second player has more pull, so to say. For example, imagine a customer who receives the product, inspects it and then decides on whether to pay the bill or not. The two cases named under (b) are asymmetric in favor of the seller (note that the customer cannot inspect the product before paying if cash is due on mail delivery) whereas in case (c) the seller bears the risk of payment (see Figure 2). Which payment modes are chosen in Internet auctions? Since it is risky for a buyer to engage in an asymmetric game in favor of the seller, it may be assumed that a buyer will not be willing to accept "cash on mail delivery" and, in particular, "payment in advance" unless the seller has good reputation.

[Figure 2 about here.]

2. Data

In order to examine comparable transactions we chose a homogeneous good which is traded relatively frequently and is not too inexpensive, so that the threat of being cheated is salient. Mobile phones of a specific make and type ideally fulfill these criteria. In autumn 2001, Nokia released a new cell phone with the type designation "Nokia 8310". The retail price for such a device was approximately 700 Swiss Francs. Between October 2001 and January 2002 we kept track of all auctions on the Swiss e-commerce platform ricardo.ch in which a new and unlocked Nokia 8310 without phone company contract was offered. Over all, our master sample consisted of 204 auctions. However, sellers may draw back an offer as long as no bids have been placed and, in addition, the auction house reserves the right to cancel an auction if irregularities occur, which happened in 10 cases. Furthermore, extensive re-inspection of the data material and the stored screen shots revealed that in six

[5] The sequential prisoner's dilemma is very similar to the trust game. Trust games (Dasgupta 1988, Kreps 1990, Snijders 1996; Gautschi 2002) end after the first player defects, whereas in a sequential prisoner's dilemma the second player may respond to the first player's defection by cooperation or defection. Also see Preisendörfer (1995) on the notion of trust.

cases the offered cell phone was not really new but only "as good as new", in one case the offer also included some older model, and two auctions had been recorded twice. Furthermore, eight auctions turned out to be not comparable to the other auctions because multiple items were offered (the auction rules for multiple offers were as follows: if, say, five cell phones are offered, then the top five bidders each receive one piece). Finally, five cases had to be dropped due to incomplete documentation. This leaves us with a net sample of 172 auctions.[6]

QXL ricardo plc is one of the leading provider of auction platforms in Europe. The vendues proceed in the manner of an "English auction", i.e., the auction is open and the highest bid wins (see, e.g., Lucking-Reiley 2000 for a description of different auction formats). This winning bid equals the net selling price (without shipping and handling) of the auctioned item. Sellers and bidders have to register at ricardo.ch before participating in an internet auction. The confirmation of the registration, which includes the access code for offering and bidding, is sent by ricardo.ch to the specified postal address. If one plans to cheat, one may, of course, set up a temporary address and suspend it after receiving the access code. The nonrecurring registration is valid for all future auctions and, according to our investigations, changes of the postal address are not verified. By the time an auction ends, a legal contract exists between the seller and the buyer, who placed the highest bid. The auction house collects from the seller a fee amounting to small percentage of the selling price (4 percent for deals below 1000 Swiss Francs at the time of our study). Seller and buyer have the possibility to rate each other after the transaction and also submit verbal comments. At the time of our study, one to five stars could be assigned where one and two stars correspond to a negative rating, three stars are neutral, and a positive assessment is

[6] The data (all 204 auctions) and documentation are freely downloadable for re-analyses from http://www.socio.ethz.ch/.

expressed by four or five stars.[7] As mentioned above, the ratings and the verbal comments are accessible by anyone interested.

The seller sets the duration of the auction, a starting bid, and the smallest increment between bids (the minimum selling price is the starting bid plus one minimum bid increment). Furthermore, the seller also specifies the payment mode and indicates the shipping costs to be paid by the buyer in addition to his bid. These characteristics are exogenous, meaning that they do not change during the course of an auction, although there is one important exception. Sometimes, sellers specify a "buy it now" price at which the good can be purchased immediately. A buyer placing a bid in this height wins the auction right away and cannot be outbid anymore. In such cases the duration of the auction is shortened ex post (see Reynolds and Wooders 2003 for some theoretical reflections on buy prices in auctions).

Apart from the above mentioned auction attributes we also recorded the seller's reputation as the average number of stars and the total number of ratings (measured at the beginning of the auction), the verbal description of the offered product, and some characteristics of the auction process. The latter include calendar time, the value of the winning bid (net auction price), and the number of bids.

3. Results

Similar to various other studies (e.g. Kollock 1999, Brinkmann and Seifert 2001) a very high fraction of positive assessments can be observed in our sample: A positive rating seems to be the rule, a negative rating the exception. Therefore, the number of positive ratings seems to be the real signal for reputation, rather than the average degree of the ratings. In what follows we first give an account of the distribution of reputation and then

[7] Since we collected our data, ricardo.ch changed the system. The ratings "positive", "neutral", and "negative" are now available instead of the stars.

estimate the effect of reputation on the minimum price, the likelihood of successful selling, and the selling price. Finally we provide some results concerning payment modes.

Distribution of reputation

In 42 of our 172 auctions the seller appeared as a first-time seller, i.e., no rating was available. In 125 of the remaining 130 auctions (96%), the ratings of the seller were positive on average (four or five stars) and in only five cases did the seller have a negative or neutral reputation (one to three stars). The very high fraction of positive judgments indicates that the reputation mechanism functions well and most of the sellers behave cooperatively. Even though no control group from an Internet auction platform without rating system is available, it seems very unlikely that the cooperation rate would have reached such a high level without the institution of the rating mechanism. In experiments with the one-time prisoner's dilemma game, for example, the cooperation rates are found to reach at most 50% (Rapoport and Chammah 1965; Ledyard 1995).

A positive rating as the rule does not mean, however, that the offerers would be indistinguishable with respect to their reputation. In fact, high variance exists in the number of ratings. With a range from zero to 102, a median of 5 and a mean of 10.8 (neglecting the five cases with non-positive reputation), the distribution is markedly right skewed. Because almost all sellers are either "newcomers" without reputation or have been judged positively on average, the assumption is evident that the number of ratings makes the difference and, therefore, should be considered as the real sign for reputation.

In addition, the number of positive assessments represents a relatively reliable and forgery-proof signal. No doubt it is possible to change identity in the Internet and a fraudulent seller with bad reputation may just change his name. The seller then, however, must start over again with zero reputation. Possibly, one could fake reputation by means of fictitious transaction with stooges. The required effort, however, is considerable and costly, because for each fake rating some percentage of the "transaction volume" has to be paid in real

terms to the auction platform. Of course it would be imaginable that a swindler acquires a high reputation index by means of numerous little sham deals in order to be able to claim advance payment for an expensive good and then, after receiving the money, vanish never to be seen again. Apparently, though, the expenses for such an enterprise seem to be disproportionate to the potential profit, as such cases of fraud occur relatively seldom. If they were to appear more frequently, it would possibly be wise to adjust the reputation index. For example, the single assessments could be weighted by the volume of the associated deal; acquiring fictitious reputation would then be considerably more expensive.

In the analyses that follow, the five cases with non-positive average rating are disregarded. The number of observations is thus reduced to 167 auctions. The definitions of the variables and descriptive statistics of the sample are provided in Table 1. Because we exclude the few cases with non-positive average assessment, the degree of a seller's reputation can be simply measured as the total number of ratings. The reputation index is zero if a seller has not been rated yet.

[Table 1 about here.]

Starting bid

The starting bid is fixed by the seller prior to the start of the auction. Nearly all offerers (158 of 167 or 95%) made use of this option. Sellers with high reputation probably have better chances to get away with a high starting price. Thus, it may be expected, that the number of ratings brings about an increase in the minimum bid. However, the correlation between minimum price and the number of ratings is very low ($r = 0.034$) and not significant. But, as noted, the distribution of the number of ratings is heavily right skewed. It may be assumed that whether a seller has 80 or 90 ratings will not make as much a difference as an increase from 0 to 10 positive assessments. Differences at the beginning of the scale are weighted more strongly if the correlation is calculated between the logarithm of the number of ratings and the minimum price. This yields a moderate, though still

insignificant correlation coefficient of r = 0.158 (p = 0.139).[8] Discrimination between the 42 sellers without rating and the group of 125 offerers who had at least one assessment reveals the following: Offerers without reputation specified a minimum bid of 401 CHF on average (median: 420); for sellers with reputation the statistic is 517 CHF (median: 600). Although quite substantial, the difference is not significant (p = 0.120). Altogether our data only give very weak evidence for a possible association between reputation and the determination of the starting bid.

Successful selling

If no potential customer places a bid in an auction, the product cannot be sold. This happened quite frequently in our data. According to the numbers in Table 1, only 50 percent of the auctions in our sample (85 of 167) resulted in a sale. Obviously, the successful completion of a deal strongly depends on value of the lower price limit. In some auctions, for example, the starting bid was higher than the official retail price of the product. Although some customers seem to be willing to fork out more than the retail price for some reason, a strong negative effect of the minimum price on the success of an auction must be assumed. Reputation, in contrast, should increase the chances of a sale. Table 2 displays the estimation results of logistic regression models.

[Table 2 about here.]

As expected, the probability of sale is strongly influenced by the minimum price and also calendar time has a considerable effect. Evidently, the Nokia 8310 has rapidly lost attractiveness during the four month of our observation window.[9] The duration of the

[8] The data in our sample are clustered on sellers (the 167 auctions are from 75 unique sellers). Thus, we report test statistics and p-values which have been derived from cluster-correlation consistent variance estimators (see Rogers 1993, Williams 2000, White 1980).

[9] One could also assume a decreasing effect of calendar time and, hence, include a quadratic term in the logistic regression equation. However, the parabolic model did not prove to be superior.

auction, the minimum bid increment and the number of supplementary accessories do not seem to have any effect. The variable "number of ratings" shows the expected sign; however, a two-sided test with an error probability of 0.05 reveals that the coefficient is not significant ($p = 0.122$ in Model 1). The effect of the logarithm of the number of ratings, which may be used as alternative measure for reputation, is also not significant (or only slightly significant in a one-sided test; Model 3). Note, however, that the estimation of alternative specifications with the gross minimum price (starting bid plus minimum bid increment plus shipping costs) as an explanatory variable yield significant results for "reputation" ($p = 0.007$ in Model 2 and $p = 0.046$ in Model 4). In sum, the data give slight support to the hypothesis that the reputation of the seller promotes the chances of a successful sale.

Price premium for reputation

What is the effect of the seller's reputation on the selling price of the mobile phones? We estimate the reputation effect using linear regression on the basis of the 84 completed transactions.[10] Controls in the regression equation are the shipping costs, the minimum price, the minimum bid increment, the duration of the auction, the number of bids, the number of supplementary accessories, and calendar time (parabolic). Theoretically, the shipping costs should have a coefficient of minus one: higher shipping costs would be compensated by a corresponding reduction of the highest bid and the gross price paid by the buyer would remain unchanged. In practice, however, it is possible that the shipping costs are psychologically underrated or overvalued, even though they are known. For the minimum price, the minimum bid increment, the duration of the auction, the number of bids, and the number of supplementary accessories we expect all positive effects, that is,

[10] The dependent variable is the net auction price in Swiss Francs. Alternatively, one might consider using the logarithm of the selling price as the dependent variable and, therefore, estimate constant (semi-) elasticity models (as in, e.g., Berger and Schmitt 2005). Apart from entailing rather odd interpretations for the effects of several of our covariates, the logarithmic models did not prove to outperform the linear models. We therefore report the results from the linear specifications.

these variables should likely increase the selling price. In the course of calendar time, on the other hand, prices should fall with declining rates. The regression estimates are displayed in Table 3 (Model 1).

[Table 3 about here.]

Contrary to our expectations, the minimum price and the number of bids have no significant effects on the selling price and the duration of the auction is even negatively related to the auction outcome. The other variables—including reputation, in particular—have significant effects in the anticipated direction. Shipping costs, however, seem to be slightly overweighted. Each extra franc demanded for shipping costs results in an average reduction of the net auction price by almost two Swiss francs. Excessive shipping costs seem to harm the seller and, paradoxically, favor the buyer. Sellers seem therefore well advised to charge relatively low shipping costs whereas buyers should place their bids in auctions in which high fees are appointed for shipment.[11]

Also the minimum bid increment stipulated by the seller has a clear price effect. If the required increment between bids is enlarged by one franc, the selling price raises by approximately two and a half francs on average. Buyers should thus be cautious if the minimum bid increment is rather large and they are about to decide whether to outbid an amount near their personal "threshold of pain" (reservation price).[12]

Note that our regression results may be inappropriate for two reasons. First, we only considered the (possibly selective) sub-sample of successful auctions since a selling price does not exist for the other cases. Second, we neglected the fact that in some auctions there

[11] Note, however, that in Model 1 the coefficient for shipping costs does not significantly defer from minus one ($p = 0.180$, two-sided). It does, however, if the logarithm of the number of ratings is used as indicator for reputation (model 3; $p = 0.028$, two-sided).

[12] Again, however, only in the logarithmic model the coefficient is significantly different from one. The two sided p-values are 0.081 and 0.039 for Model 1 and Model 3, respectively.

is an upper bound for the highest bid (the "buy it now" price). The first issue introduces left censoring (censoring "from below") as illustrated in Panel (a) in Figure 3. No data points are possible in the shaded area of the plot because the selling price has to exceed the starting bid. Unsuccessful auctions may be treated as left-censored at the value of the minimum price (which is equal to the starting bid plus one minimum bid increment). There are 83 such cases, indicated by crosses in the plot.

[Figure 3 about here.]

The second issue, the "buy it now" price, introduces right censoring (censoring "from above") since no bid will exceed this upper limit (Panel b in Figure 3). A "buy it now" price was specified in 103 auctions and was reached in 25 cases (indicated by triangles). Both censoring mechanisms can cause standard regression estimates to be biased. We, therefore, replicate our analysis using a censored-normal regression model (a generalized tobit model) with known but varying lower and upper bounds (cf. Maddala 1983, Amemiya 1985:360ff, Breen 1996).[13] The results of the tobit regressions (Models 2 and 4 in Table 3) are quite similar to the results of the standard models except that the strong effect of the minimum bid increment collapses to a insignificant level[14] and the effect of the duration of the auction is more pronounced.[15]

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[13] Note that the results of such a model critically depend on normality and homoskedasticity of the errors. Inspection of the data did not reveal any evidence for a strong departure from these assumptions.

[14] Outlier diagnostics (Belsey, Kuh and Welch 1980, Fox 1991) for the standard model indicate that the effect is quite unstable anyhow. It drops to around 1 to 1.5 francs if outliers are excluded (the high effect of the minimum bid increment can be traced back, in essence, to one observation with a high minimum increment of 50 francs and a phenomenal selling price of 800 Swiss francs; the observation is easy identifiable in figure 3). The same results are obtained from the application of robust regression procedures (Berk 1990, Hamilton 1991).

[15] The strong negative effect of the duration of the auction is quite puzzling. We believe that the effect is an artifact emanating from two mechanisms. First, the market value of the offered cell phones decreases in the course of an auction because of the general devaluation over calendar time. The shorter the duration of the auction, the smaller is the decrease in value. Thus, higher prices should be achieved in short auctions. Second,

Let us now get back to our main question: Does reputation positively influence the selling price? The results shown in Table 3 clearly support the existence of such a relationship. In the model with the absolute number of ratings as well as in the model where the logarithm of ratings is used, a positive and significant reputation effect can be observed. Similar and even slightly more pronounced results are obtained if the censoring of the dependent variable is taken into account. Sellers with higher reputation get higher prices; customers seem to be willing to reward sellers who have a good record. This is not necessarily so because customers appreciate a seller's virtuousness, it is because cooperative behavior in the past signals that a seller will most likely not act opportunistically in order to keep his good reputation intact and turn it into hard cash also in future transactions.

Modes of payment

According to the auction rules, the highest bid determines the winner of the auction and the final selling price. But, of course, also buyers can act opportunistically. In the case of delivery on account, for example, the seller makes a one-sided leap of faith, which can be exploited by the buyer by refraining from payment. However, a seller can protect himself against cheating buyers by setting the payment mode. He can decide whether the transaction should be symmetric, asymmetric with the seller as the first player (the "trustor"), or asymmetric with the buyer as trustor (see Figure 2). So how does the empirical distribution of the various payment modes look like?

Naturally, sellers try to opt for an asymmetric game in their own favor with only few exceptions. In our data "payment in advance" or "cash on mail delivery" are chosen in 95 percent of all cases (Table 4). The other extreme, a sequential prisoner's dilemma with the

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the duration of an auction is endogenous if the auction is prematurely terminated by a "buy it now" price. Taken together, these two aspects seem to produce the strong negative effect of the duration. At least, the effect disappears (i.e. is substantially smaller and not significant) if the 25 right-censored cases are discarded and calendar time is measured at the end of the auctions instead of the beginning.

seller in the weak position of the trustor and the buyer in the strong position of the trustee only appears in one out of 167 cases.

[Table 4 about here.]

Taken on its own, the power to set the rules of the game is not yet an explanation for the distribution seen in Table 4. Buyers could "go on strike" or choose sellers with better payment conditions, so that a seller could benefit from offering transaction modes in favor of the buyer. The reason why the sellers are so uncompromising in their choice of the payment mode is that, while buyers can choose sellers according to reputation, sellers cannot choose buyers. Regardless of a buyer's reputation the sellers is committed to accept the highest bid and complete the transaction with that buyer. The power to choose the business partner, an asymmetry in favor of the buyer, is counteracted by the power to set the payment conditions, an asymmetry in favor of the seller. Buyers overcome the trust problem by choosing sellers according to reputation; sellers solve the trust problem by choosing an adequate payment mode.

Good reputation probably also helps a seller to enforce a payment mode in his own interest. As is shown in Table 4, the average value of reputation corresponds to the ranking of the chosen payment mode with respect to the asymmetry in favor of the seller. To analyze the relation between reputation and choice of payment mode in more detail, we additionally report logistic regression estimates in which we discriminate "payment in advance", the mode favoring the seller most, against any of the other modes.

[Table 5 about here.]

The results shown in Table 5 reveal that reputation, at least in the logarithmic form, has a significant effect on the choice of the payment mode. The higher the reputation, the more likely a seller requests payment in advance. Apparently, offerers with high reputation can afford to stipulate payment conditions, which are strongly in their own interest, and buyers

seem to be more likely to accept the risk associated with an unfavorable payment mode if the risk is counterbalanced by a good seller reputation. Hence, good reputation does not only give sellers a competitive edge in terms of selling price, but also with regard to payment modes. This is yet another incentive for offerers to invest in reputation.[16]

4. Summary and Discussion

The empirical evidence in this study clearly supports the hypothesis that, in single exchange situations between unknown and anonymously operating actors, reputation may cause a high degree of cooperation and promotes a well-running market. By rewarding cooperative behavior in the long run, reputation creates order. Whereas Axelrod's (1984) simulations suggest that the evolution of cooperation can succeed under the conditions of the repeated prisoner's dilemma, it is shown here that social order is also possible under the condition of reputation, without the need for sanctioning interventions by an external authority. Reputation is a very effective substitute for the lack of repeated interactions between the same actors. A simple institutional setting, i.e. the assessment of the sellers by the buyers and the absolute transparency of the results, creates incentives for cooperative behavior, as is demonstrated by the empirical findings on the effects of reputation. To summarize, the empirical results are:

- A predominant share of the transactions is rated positively. Negative reputation is the exception and positive reputation is the rule.[17] At the same time a high degree of cooperation and, therefore, a smooth functioning of the market is observable.

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[16] An alternative explanation for the relation between reputation and the choice of payment mode could be that there are some learning effects. Sellers with a high reputation score are also sellers that have a lot of experience in the market and maybe it is just their experience that makes them opt for the more secure payment modes.

[17] Note that, most likely, the ratings are positively biased to some degree. Since both the buyer and the seller can submit a rating, a buyer may fear retaliation and submit, say, a neutral instead of a negative rating. Also see Diekmann et al. (2007) who provide detailed analyses of the feedback process in Internet auctions.

- Sellers have incentives to invest in reputation. Customers interpret reputation as a signal for a reduced transaction risk and are willing to pay a fee for it, similar to an insurance premium. According to the regression estimates, reputation has a positive effect on the selling price. In line with many other studies, a reputation premium is empirically detectable.

- Furthermore, reputation seems to influence the determination of the starting price and the success of an auction, and has an effect on the choice of the payment mode. On average, offerers with high reputation seem to set higher starting bids, are more likely to successfully sell their goods, and can afford to request payment conditions that are strongly in their own favor.

- Sellers and buyers are in a situation characterized by information asymmetry. Buyers can address the trust problem by choosing a seller with better reputation, but must pay a premium for it. Sellers cannot use buyer reputation to solve the trust problem because they cannot choose buyers. Yet, they have free choice of the rules of the game as far as the payment mode is concerned. The empirical finding is unambiguous: offerers almost exclusively choose asymmetric payment modes in their own favor to reduce the risk of being exploited. The risk is shifted to the customers who, however, can secure themselves by selecting sellers according to the criterion of reputation.

Since the reputation system proves to be of value in Internet auctions, it seems reasonable to ask whether it could be transferred to other exchange situations outside the Internet. The fact that more or less elaborate reputation mechanisms can exist in various settings is not only demonstrated by the introductory historical examples cited from Greif (1989, 1993) and Weber (1920), but also becomes clear to any bank customer who applies for a loan and whose "reputation" is checked in the credit reports. Problems of trust with asymmetric information (Akerlof 1970) also exist in numerous other social situations, for example when buying "credence goods" (Emons 1997), in recruitment of university professors,

when choosing dentists, lawyers, garages, courses of further education, plumbers, offerers of holiday apartments, second-hand car dealers, or marriage partners. Wouldn't it be sensible in these situations as well to introduce the institution of an open reputation system according to the archetype of the Internet auctions? And how does this system compare to approaches such as Eco-Audit or product tests by consumer organizations, brand names, the rating of the credit-worthiness of enterprises, reputation systems in science (Gerhards 2002), or the evaluation of teaching and the ranking of universities?

Apparently there are miscellaneous, more or less institutionalized systems of reputation. Following a preliminary categorization, we can differentiate the following five types: (1) Informal reputation in social networks. For example, person A is recommended for a new job by person B. In this case, person B bestows reputation upon A. Also gossip in social networks can be seen as an informal reputation system. (2) More institutionalized forms of consumer ratings. Buyers and users assess products. Usually, the evaluators are a highly self-selective group. Here, too, institutionalized forms exist in the Internet, e.g., the platforms ciao.com and dooyoo.de, which encourage buyers to evaluate products and financially reward test reports. Similar, but without financial incentives, at Amazon: readers review books. A typical element of these systems is that also the evaluators' reports get rated (readers can assign marks to the test reports and reviews), i.e. there is a second layer of reputation on the meta level (also see Dworschak 2000). The assessments in these systems are transparent because they are accessible to anyone by a single click, but they are not forgery-proof. Involved parties, such as, say, the originator of a product can submit an evaluation guided by self-interest (e.g., using a pseudonym, authors can review their own books at Amazon). (3) Institutionalized expert ratings such as "Eco-Audit" or product tests by consumer organizations. (4) Reputation based on brand names. Producers create distinctive products that are legally protected against imitation and are provided everywhere in the same quality. (5) The institutionalized and highly systematic reputation system in Internet auctions, as described and analyzed in this study.

This last reputation system, which was the subject of our analysis, is highly effective in producing cooperation. However, it is also tied to narrowly defined conditions. It requires that (a) sellers trade repeatedly (usually with changing partners) and that (b) a buyer is able to quickly assess the seller's business conduct in an objective and reproducible manner. (c) All or most transactions should be systematically rated. This requires that either there are incentives to provide ratings or that the costs are minimal. (d) Finally, the ratings should be easily accessible by anyone interested. With respect to (c) and (d), ubiquitous rating and transparency, the Internet provides ideal conditions.

The reputation system, however, will function less well if one or more of the mentioned conditions are violated. "Cooperation" of dentists is often not immediately discernible to the customer. If causally attributable at all, the botch is possibly discovered not before years, when the expensive crown or filling has turned out to be more fugacious than expected. Similarly, toxic substances in edibles normally stay hidden to the consumer. This does not necessarily disqualify an increasing adoption of consumer ratings, because why shouldn't also doctors, dentists, lawyers, or university professors be evaluated by their "customers"? Furthermore, because transparency can be established easily and cost-efficiently in the Internet, such reputation systems could develop well. Additionally, if the quality of the cooperation, the good, or the service cannot be easily judged by the customer, e.g. as in the case of the toxic load of nourishments, reputation systems based on expert ratings should be helpful. Under which conditions and institutional regulations an effective cooperation-promoting reputation system emerges is a question that cannot be answered without a theory of reputation systems. Empirical analyses of existing reputation systems may contribute to that development.

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Tables

Table 1: Descriptive statistics

Variable	minimum	maximum	mean	standard deviation	number of cases
Reputation (number of ratings)	0	102	10.84	19.80	167
Starting bid	0	756	487.53	221.22	167
Starting bid > 0	0.5	756	515.30	193.24	158
Buy-it-now price	450	800	621.46	89.07	103
Shipping costs	0	28	16.78	5.77	167
Minimum bid increment	0.5	50	6.30	7.48	167
Number of supplementary accessories [a]	0	3	0.13	0.47	167
Calendar time at the start of the auction (in days; centered)	-61.32	56.33	0.00	31.65	167
Duration of the auction in days	0	15	5.76	4.49	167
Number of bids	0	65	5.99	11.53	167
Successful selling (0/1)	0	1	0.50		167
Net auction price	450	800	531.08	59.55	84
Gross auction price (incl. shipping costs)	460	800	545.53	58.14	84

Note: Currency is Swiss francs (CHF).

[a] Re-inspection of the raw data material (analyses of the product descriptions, in particular) revealed that the traded goods were not always purely homogeneous. In some few cases the offer included accessories which were not part of the original Nokia 8310 distribution (namely: one or more additional covers, an additional battery, a leather sheath, an additional standard charger, a desktop stand and/or a vehicle charger).

Table 2: Reputation and successful selling

	Models with absolute number of ratings		Models with log number of ratings	
	Model 1	Model 2	Model 3	Model 4
Reputation (number of ratings)	0.022	0.033**	0.546+	0.668*
	(1.55)	(2.68)	(1.69)	(2.00)
Starting bid	-0.069**		-0.074**	
	(-4.15)		(-4.03)	
Minimum bid increment	0.064		0.061	
	(0.82)		(0.74)	
Shipping costs	-0.234+		-0.278*	
	(-1.80)		(-2.07)	
Gross minimum price (starting bid + minimum bid increment + shipping costs)		-0.056**		-0.054**
		-(3.77)		(-4.53)
Duration of auction in days	-0.068	-0.085	-0.058	-0.078
	(-0.63)	(-0.66)	(-0.54)	(-0.58)
Number of supplementary accessories	0.006	0.862	0.081	0.508
	(0.00)	(0.94)	(0.05)	(0.55)
Calendar time	-0.074**	-0.055*	-0.070*	-0.042*
	(-2.59)	(-2.32)	(-2.34)	(-1.96)
Constant	40.12**	31.24**	42.62**	29.87**
	(3.94)	(3.56)	(3.76)	(4.22)
McFadden R^2	0.853	0.836	0.855	0.834
Number of cases	167	167	167	167

Notes: Logistic regression of whether the good has been successfully sold (= 1) or not (maximum likelihood estimation of the effects on the log-odds). z-statistics in parentheses (adjusted for clustering on sellers; see footnote 8). Models with log number of ratings: Reputation = ln(number of ratings + 1).
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$ (two-sided)

Table 3: Reputation effect on auction price

	Models with absolute number of ratings		Models with log number of ratings	
	Model 1	Model 2	Model 3	Model 4
Reputation (number of ratings)	0.455**	0.667**	9.132**	11.961**
	(3.26)	(4.81)	(3.35)	(3.69)
Starting bid	0.035	-0.022	0.038	-0.017
	(1.09)	(-0.62)	(1.26)	(-0.46)
Minimum bid increment	2.441**	1.732+	2.672**	1.967*
	(3.01)	(1.96)	(3.39)	(2.33)
Shipping costs	-1.883**	-1.839*	-2.604**	-2.723**
	(-2.90)	(-2.29)	(-3.68)	(-3.43)
Duration of auction in days	-2.409*	-4.159**	-2.594**	-4.355**
	(-2.51)	(-4.58)	(-2.84)	(-4.75)
Number of bids	0.729	0.127	0.873	0.274
	(1.11)	(0.22)	(1.38)	(0.47)
Number of supplementary accessories	27.486**	22.409**	27.046**	21.914**
	(3.32)	(2.65)	(3.39)	(2.63)
Calendar time	-0.858**	-0.736**	-0.827**	-0.700**
	(-6.25)	(-5.64)	(-6.25)	(-5.21)
Calendar time squared	0.011**	0.011*	0.011**	0.011*
	(3.21)	(2.29)	(3.42)	(2.35)
Constant	513.77**	564.15**	511.99**	562.80**
	(32.53)	(26.97)	(31.15)	(25.53)
R^2 / McFadden R^2	0.679	0.099	0.689	0.102
Number of cases	84	167	84	167

Notes: OLS regression (Models 1 and 3) and censored-normal regression (Models 2 and 4) of net auction price (excluding shipping costs). t/z-statistics in parentheses (adjusted for clustering on sellers; see footnote 8). Models with log number of ratings: Reputation = ln(number of ratings + 1).
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$ (two-sided)

Table 4: Modes of payment

Mode of payment	Count	Percent	Symmetry / asymmetry	Ranking of asymmetry in favor of seller	Mean (median) reputation
Payment in advance	42	25.1	asymmetric in favor of seller	4	22.12 (6.0)
Cash on mail delivery	116	69.4	asymmetric in favor of seller	3	7.25 (5.0)
Cash on pickup	6	3.6	symmetric	2	1.67 (0.0)
Cash on delivery in person	2	1.2	symmetric	1	–
Mail delivery on account	1	0.6	asymmetric in favor of buyer	0	–
Credit card	0	0.0	–	–	–
Total	167	100.0			

Table 5: Reputation effect on "payment in advance"

	Model with absolute number of ratings	Model with log number of ratings
Reputation (number of ratings)	0.038	0.556*
	(1.54)	(2.38)
Starting bid	-0.001	-0.002
	(-0.81)	(-1.12)
Minimum bid increment	0.031	0.038
	(0.81)	(0.91)
Shipping costs	-0.253**	-0.290**
	(-3.84)	(-4.24)
Duration of auction in days	-0.074	-0.084
	(-1.26)	(-1.43)
Number of supplementary accessories	-1.269	-1.336
	(-1.64)	(-1.59)
Calendar time	-0.003	-0.002
	(-0.30)	(-0.26)
Constant	3.333**	3.558**
	(3.00)	(3.04)
McFadden R^2	0.325	0.325
Number of cases	167	167

Notes: Logistic regression of "payment in advance" (= 1) (maximum likelihood estimation of the effects on the log-odds). z-statistics in parentheses (adjusted for clustering on sellers; see footnote 8). Model with log number of ratings: Reputation = ln(number of ratings + 1). $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$ (two-sided)

Figures

Figure 1: Rating of Internet auctions (Source: ricardo.ch, 2001/2002; translations by the authors)

General profile (104)

Member since Saturday, December 2, 2000.

89 positive comments from **80** user(s).

5 neutral comments from **5** user(s).

10 negative comments from **10** user(s).

Summary of recent comments			
	Past 7 days	Past month	Past 6 month
Positive	1	2	43
Neutral	0	0	3
Negative	0	0	5
Total	**1**	**2**	**51**

Examples for positive comments

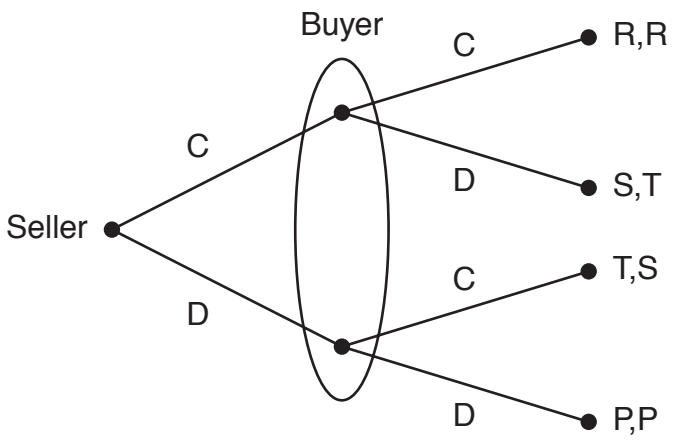
From	Rating	Comment
Inscher		Everything went normal and the item is okay
Manu01		honest business partner with fair prices would buy again at any time
Webshuttle		Since falsified tickets were circulating and the action was stopped, soundgard refunded the money without discussion. Very friendly and good consulting.
Haemmi		Fast and trouble-free :)

Examples for negative comments

Pdf		Slow delivery, wrong accessories kit sent, correct accessories kit not sent until 2 reclamations, hang up on me.
Xanimalex		did not receive the tickets
Drago7		Did not receive any reply to my mails, unfortunately, nor have I ever found the product in the letter box.
Rspm		It has not been delivered completely until reclamation at Ricardo. Did not respond to my e-mails.

Figure 2: Modes of payment

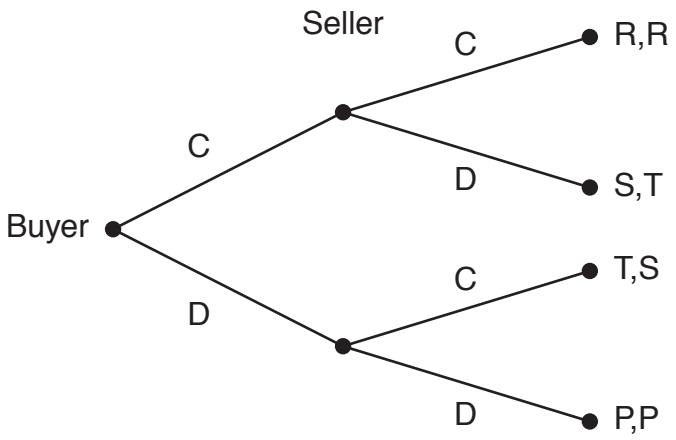
a) symmetric game ("goods against money")



C = Cooperation. The seller delivers good quality; the buyer makes the payment promptly.
D = Defection. The seller delivers poor quality; the buyer does not make the payment, diminishes or delays it.

Payoffs: T > R > P > S (e.g. T = 5, R = 3, P = 1, S = 0; only the order of the utility values matters). The oval marks the information set. The buyer has to make his own choice without knowing the decision of the seller. This game corresponds to the symmetric prisoner's dilemma.

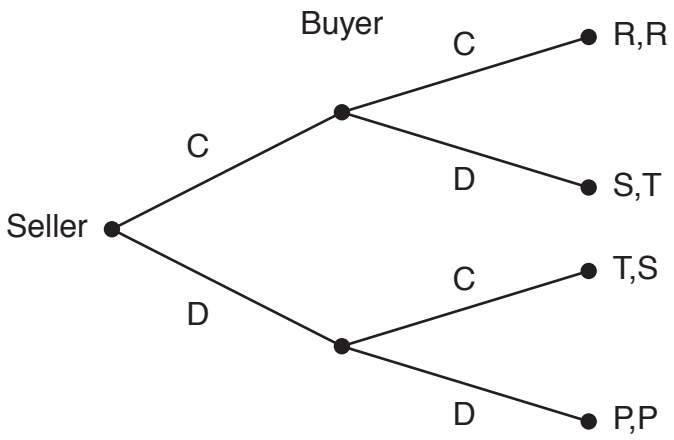
b) asymmetric game in favor of the seller (payment in advance or cash on mail delivery)



C = The buyer makes the pre-payment; the seller delivers good quality.
D = The buyer does not make the agreed payment; the seller delivers poor quality or does not deliver at all.

This game is a sequential prisoner's dilemma. If the game ends with payoff (P,P) after the buyer played D it corresponds to the trust game (Dasgupta 1988, Kreps 1990).

c) asymmetric game in favor of the buyer (e.g. delivery on account)



C = The seller delivers good quality; the buyer endeavors to pay the bill promptly.

D = The seller does not deliver or delivers poor quality; the buyer does not make the payment, diminishes or delays it.

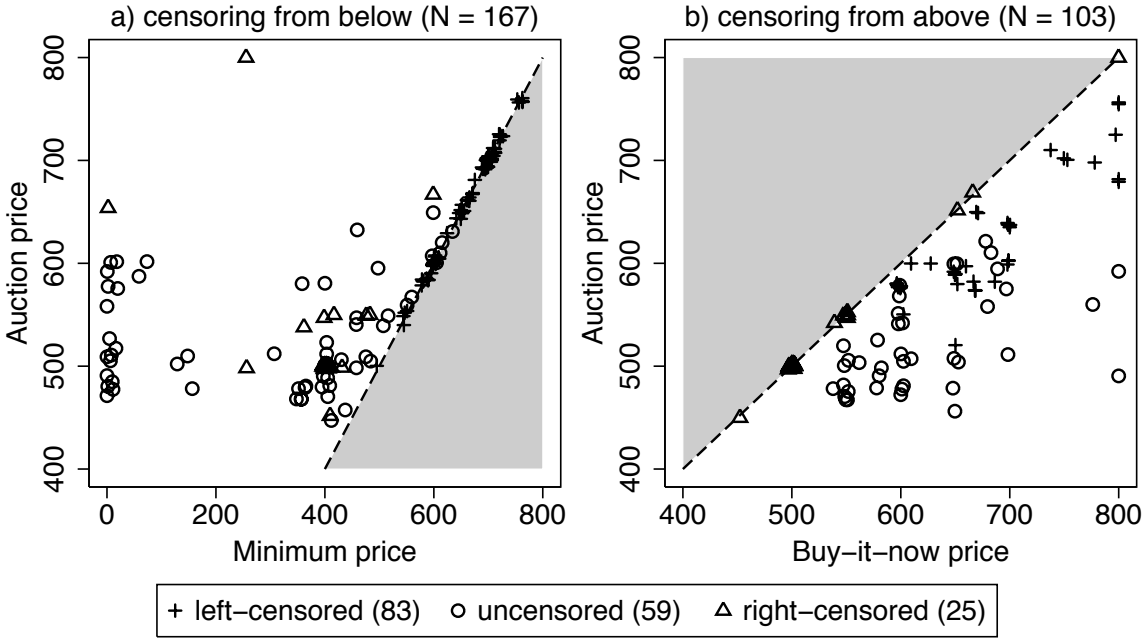



Figure 3: Left- and right-censoring of the selling price