Trust and Reputation in Markets

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Abstract

Economic transactions are confronted with problems of trust, which can be solved in a variety of ways: by means of long-term business relations, by institutional rules or by reputational incentives. In the first section, we deal with the trust problem and various ways of its solution. In the second section, we discuss the functioning of the reputation mechanism in markets in historical and contemporary societies. Although similar mechanisms are at work in contemporary societies as in historical societies, the technologies available to communicate information about reputation have changed. This is particularly evident in online markets, in which electronic rating systems have become an essential element. In the third section, we focus on the development, forms and consequences of reputation in online markets. Reputation information promotes cooperation in markets if it is credible. This requires the absence of simple means of deception. We deal with the shady side of reputation systems in the fourth and final section.

Keywords: trust, trustworthiness, asymmetric information, online market, reputation system

1. Economic exchange and the trust problem

Assume you intend to buy a second-hand laptop from a seller on eBay. It has crossed your mind that the laptop may have hidden defects and, even worse, that the seller may keep your money without delivering the laptop. Would you be more likely to send your money to the seller in advance if the laptop was much cheaper than other offers, if the offer was from a registered computer-shop, and if the seller had a large number of positive customer ratings? Or would you prefer to pay extra for your transaction to be handled by an escrow service, which releases your payment to the seller once you confirm receipt of the laptop? Problems of trust hamper mutually beneficial exchanges not only in online markets such as eBay.

Heinrich Popitz (1980) formulated the trust problem in his work on the "normative construction of reality" as follows: "The condition for this reliance on the future behaviour of others is trust. Where trust is lacking, only limited and rudimentary forms of sociality are possible. In the extreme case of total distrust the interactions of the partners must be restricted to a strictly controllable simultaneity of the corresponding actions. The black market situation provides an example. I must hold my goods firmly in my right hand until I have grasped the goods of the other person with my left hand. We both pull at the same time and release the goods at the same time" (Popitz 1980: 78; translated from German by the authors).

If an exchange between A and B is sequential, i.e. if A moves first (e.g., sends money) and B moves second (e.g., delivers merchandise), it becomes possible that B fails to reciprocate A’s advance. In what follows, we call A, the first moving party to the exchange, *truster*, and we call B, the second moving party, *trustee*. A trust problem exists in as far as it is uncertain whether the trustee will return the advance the truster made in expectation of a benefit (Coleman 1990).

A trust problem does not only arise if it is uncertain whether the trustee will deliver at all, but also if the agreed quality and/or quantity of the exchanged good or service is not directly observable. The trustee could deliver goods of inferior quality, whereas the truster might only recognize the quality after the conclusion of the transaction. If the trustee knows the quality of his goods whereas the truster does not until the exchange is completed, the exchange situation is one of *asymmetric information*. The degree of the information asymmetry can vary depending on the good. In the case of *inspection goods*, for example unpacked food, it is relatively easy for the truster to determine the quality before the exchange. In the case of *experience goods* the quality only becomes apparent in the course of use, often after a longer period of time. Second-hand cars, dental crowns or beauty creams are examples of experience goods.

We define the *trust problem* as the uncertainty regarding the trustworthiness and/or competence of the trustee that the truster faces. We define *trustworthiness* as the trustee's intention to meet the truster's advance, and distinguish it from *competence*, the trustee's ability (in terms of skill and knowledge) to meet the truster's advance. Finally, we define *trust* as the truster's belief regarding the trustee's trustworthiness and/or competence based on which the truster decides whether or not to make the advance. That is, by trusting, the truster acts upon the expectation that the trustee will abide by the agreement, for example, that a good will be delivered in a certain quality and quantity, although the trustee has the possibility to deviate from the agreement.

The trust problem arising in social and economic exchange is often described with the trust game known from game theory (Dasgupta 1988; Kreps 1990). In the trust game, if the truster does not trust the trustee, the exchange is refused and neither of the actors gains anything (0). But if the truster agrees to the exchange – thereby placing trust – the trustee then has two possibilities. The trustee can fulfil the agreement and both the truster and the trustee earn the

gains from trade (*R*). However, the trustee can also abuse the truster's trust. The trustee then gains an exploitation profit (*T*) and the truster suffers a loss (*S*). In the latter case, the truster's position is even worse than it would have been without the exchange. In the trust game, the trustee's temptation to exploit the truster (*T*) is larger than the gains from trade (*R*), which is larger than no earnings at all, which, for the truster, is still larger than suffering a loss (*S*) from being exploited by the trustee (i.e. $T > R > 0 > S$). In a one-time-only trust game, a self-regarding trustee who only maximizes his or her private benefit, will always abuse trust. As the truster can anticipate this move he or she will refuse to place trust. In the Nash equilibrium[1] of the trust game, both actors come away empty handed, although both could benefit from the trust-based exchange.

The social dilemma (Kollock 1999) inherent to social and economic exchanges (formally described as a trust game) can, in principle, be solved in three ways: first, by means of repeated exchanges; second, by institutional regulation of the exchanges; and third, by reputational incentives. Combinations of these solutions can also exist. For example, institutions can intentionally or as a side product create opportunities for long-term exchange relations or reputation building.

It is known from game theory (Fudenberg and Maskin 1986), simulation experiments (Axelrod 1984) and behavioural experiments (Rapoport und Chammah 1965; Dal Bó 2005) that in repeated social dilemma situations as well as in repeated trust games cooperation can arise under certain conditions. A central condition is the "shadow of the future" (Axelrod 1984), a figurative expression for the subjective probability that in a series of exchanges a further interaction will take place between the same actors. If this probability exceeds a

[1] A Nash equilibrium is a combination of strategies such that no actor has an incentive to deviate (to switch to an alternative strategy) as long as all other actors stick to their strategies. In other words, a *unilateral* switch does not pay off in a Nash equilibrium.

critical level, cooperation can evolve; put differently, long-term exchange relations are more cooperative.[2]

The importance of repeated exchange relations was already observed by the anthropologist Bronisław Malinowski. In "Crime and Custom in Savage Society", the classic study on the Trobriand peoples, Malinowski (1926: 22) describes how "the inland village supplies the fishermen with vegetables: the coastal community repays with fish." As Malinowski (1926: 25) further explains, exchange dyads emerge in this process: "… every man has his permanent partner in the exchange". The same actors deal repeatedly with one another and can thus develop a lasting cooperative exchange relation. Long-term exchange relations can also provide a solution for the trust problem arising from asymmetric information. Siamwalla (1978) analyses markets for rice and rubber in Thailand. The quality of rice is immediately recognizable by the expert. But in the case of raw rubber the production process plays a decisive part. The quality of raw rubber can only be ascertained after several months in use. Hence, rice can be characterized as an inspection good and rubber as an experience good. The different degrees of information asymmetry lead to different market relationships. In the case of rice a producer deals with changing customers, whereas "rubber-growers generally prefer to trade continuously with one buyer" (Siamwalla 1978; see also Geertz 1979, who observes a similar mechanism in a Moroccan bazaar economy). Simulating the situation on the rice and rubber markets described by Siamwalla (1978), Kollock (1994) shows in a behavioural experiment that different market relationships arise depending on the degree of information asymmetry.

In his experiment Kollock varies the degree of uncertainty about the quality of the goods. In the control condition buyers and sellers are informed about the quality. In the experimental

[2] In terms of game theory, cooperative equilibrium strategies exist in a repeated game, if the probability of meeting one's interaction partner again is sufficiently high (see, for example, Osborne 2009, Ch. 15.).

condition the seller alone is informed and the buyer learns the quality of the goods only after purchasing them. Four subjects in the role of buyers and four subjects in the role of sellers deal with each other over 20 rounds. The sellers can offer goods at the quality and price of their own choosing. In the experimental condition the sellers can advertise the quality of their goods but are not required to be honest. The results show that in the experimental condition (1) buyers more frequently deal with the same seller, (2) the assessment of the trustworthiness of sellers by buyers diverges more strongly, (3) sellers make a greater effort to acquire a good reputation and (4) the quality of the goods traded is on average lower than in the control condition (Kollock 1994).

To the trust problem we have outlined above, institutional solutions exist, such as contract law, which regulate economic exchanges in contemporary societies. But it is of course well known that taking legal action involves costs and uncertainties, so that problems arising between trading partners who are repeatedly engaged in business transactions are usually settled outside the courts (Macauley 1963). It may be therefore useful to distinguish between two types of institutional regulations of markets: (1) exogenous institutions equipped with formal sanctioning powers, such as state authorities, and (2) endogenous, self-organized institutions. Self-organized solutions to the trust problem can, for example, be promoted by means of commitments, such as the payment of a deposit. An example is the rent deposit, which the landlord receives from the tenant and which the tenant receives back from the landlord at the end of the tenancy provided the property is left in good order. The interplay between exogenous and endogenous institutions for the regulation of markets in modern societies is moreover exemplified by the mortgaging process involved in the purchase of property. The property is mortgaged to the bank, but after the entry in the land register conflicts are settled by the legal institutions provided by the state. In the case of property

acquisition, the mortgage interest issued by the bank would be substantially higher if (exogenous) trust-building institutions did not exist.

Whereas the expectation of repeated exchanges creates a "shadow of the future", reputation refers to the "shadow of the past". Reputation carries information about the perceived and rated activities of a person or organization (trustee) with third parties. If the transaction history of a trustee is known, cooperative exchanges can occur between self-regarding and rational actors in analogy to repeated exchange relations, provided that the trustee is interested in maintaining a good reputation. Game theoretic studies show formally that reputational incentives can create the basis for cooperative behaviour even if it is unlikely that the same trading partners meet again in the future. Under certain conditions cooperative strategies of trusters and trustees can arise in a Nash equilibrium (Kreps 1990, Milgrom et al. 1990).

Social capital, social networks and, generally, the social "embeddedness" of market participants, are fundamental concepts in the social sciences in general and in new economic sociology in particular (Granovetter 1992, Coleman 1990, Diekmann 2007, Przepiorka 2014). In the light of these concepts, reputation can be described as a form of social embeddedness, and its causes and consequences can be more precisely grasped with the help of game theory and behavioural experiments. Buskens and Raub (2013) deal with various forms of social embeddedness and how it can promote cooperation by the two mechanisms of "learning" and "control". By learning actors consider information about the past. A trustor’s decision to trust is based on information about past experiences with the trustee. By control actors consider their influence on the future course of action. A trustor’s decision to trust is based on his or her power to inflict negative sanctions on the trustee in case his or her trust is abused. In dyadic embeddedness learning and control apply to the situation in which the same two interaction partners meat repeatedly; trust and cooperation are maintained via direct reciprocity (Axelrod 1984, Gouldner 1960, Trivers 1971). In network embeddedness, learning

and control apply indirectly and trust and cooperation are maintained via indirect reciprocity (Nowak and Sigmund 2005; Milinski 2016). That is, in network embeddedness, learning is based on the information transferred by third parties about a certain trustee, and control is based on the truster's possibility to induce third parties to inflict negative sanctions on a trustee (also see Buskens and Raub 2002).

Long-term exchange relations, self-organized institutional rules and reputational incentives are three forms of organizational assurances which can promote the evolution of cooperation without state intervention and can thus be characterized as promoting "order without law" (Ellickson 1991). Unsurprisingly, examples of the functioning of these mechanisms can also be found in prehistoric and historical societies, in which state authority is weak or entirely absent.

2. Reputation and markets in historical and modern societies

In the evolution of mankind reputation has always played an important part in maintaining the cohesion of societies. In Dunbar's (2003) prehistoric communities, reputation was communicated through language, i.e. spoken information about third parties or "gossip" – very much in the same way as in contemporary informal groups. Language makes it possible to pass on information on the deeds and misdeeds of others. In this way reputation can be built or possibly even destroyed in larger groups – Dunbar speaks of around 150 members of prehistoric communities (see also Milinski 2016). In laboratory experiments, the spread of information about group members' reputations through gossip has been shown to promote cooperative exchanges (Sommerfeld et al. 2007; Feinberg et al. 2014), and does so in a more efficient way than other forms of peer-sanctioning (Grimalda et al. 2016; Guala 2012; Wu et al. 2016).

Economic historians have described institutionalized forms of communicating information about reputation in social and economic exchanges from antiquity to modern times. Temin (2013) deals with the grain market in ancient Rome. A "peer-monitoring system" (Temin 2013: 106) and the documentation of the quantities and prices of business deals reduced merchants' risks of being deceived by their agents in long-distance trade. The *annona*, a kind of authority responsible for the supply of grain, could punish fraudulent agents and exclude them from trade. Apart from the institutional regulations, agents were interested in maintaining their reputations. The unloading of the ships in the harbour of Ostia and the further transportation of the grain to Rome was the task of specialized guilds, which paid careful attention to the reputation of their members.

A mixed form of various institutional regulations involving enforceable contracts as well as reputation resulting from recommendations or the membership in guilds reduced the risk of agents deceiving their customers. In the late medieval Hanseatic city of Lübeck, Burkhardt (2010) finds among the "Bergen travelers" (i.e. merchants who traded with the Norwegian city of Bergen) a change in the structure of long-term relations. His analysis of commercial networks reveals the dominance of family relations in the 14th century. But already in the second half of the 15th century, the family networks were disappearing. According to Burkhardt the reason is that institutions such as clubs, guilds and brotherhoods had emerged, which provided alternative solutions to the trust problem by enabling merchants to build a good reputation.

Greif (1989) and Milgrom et al. (1990) analyze various forms of self-organized institutions which promote economic exchange based on reputational incentives. The economic historian Avner Greif has examined the reputation system created by Maghrebian merchants in the 11th century, and Paul Milgrom, Douglas North and Barry Weingast have analyzed the Lex Mercatoria, which regulated trade at the Champagne fairs in the 12th and 13th centuries.

These case studies make apparent the importance of reputation for economic exchange and are highly instructive for game theory argumentation. We will therefore take a closer look at these two studies.

Jewish merchants had settled in North Africa in the 11th century, predominantly in Tunisia. These Maghrebian traders were active in long-distance trade, which was, however, burdened by great uncertainty. The sea voyage from Egypt to Sicily lasted from 13 to 50 days and the price of goods fluctuated widely. The merchants had agents at the destination of the goods who looked after their sale. The agents had information which the merchants at first did not have. This was a situation involving both asymmetric information and exchanges with potentially large returns. Agents could, for example, inform the merchant of a price lower than the price that was actually realized in the sale of the goods and pocket the difference. But the agent had an incentive to act honestly in order to continue working for the merchant in the future, as for acting dishonestly, the merchant would no longer employ him. This mechanism only functioned, however, if the dishonest activities of the agent came to the merchant's knowledge. In fact the Maghrebian merchants formed a coalition, whose members observed the following rules: First, they informed each other about dishonest agents. Second, an agent who cheated not only lost his position with the merchant, but was never again offered employment by any other member of the coalition. The fact that agents and merchants did not belong to different social classes but often switched roles also played a part. A merchant could act as an agent for another merchant. Attempted fraud could not only cost him his wage as an agent but also the profits from his activities as a merchant, as a third rule stated that a fraudulent agent who operated as a merchant could be cheated with impunity by the other merchants of the coalition. An agent thus had a great interest in acting honestly as he would otherwise lose both his future wage as an agent and his profits as a merchant. The double incentive thus ensured honest actions to the benefit of all parties. Maghrebian Mediterranean

trade only came to an end with the expansion of trade of the Italian city states and the conquests of the Bedouins in North Africa at the end of the 11th century (Greif 1989).

Traders in the Champagne fairs (Milgrom et al. 1990) also faced trust problems, as the traded goods were often delivered later and both the quality and the quantity could be subject to dispute. The Champagne fairs were of preeminent importance for trade in Europe of the 12th and 13th centuries. In contrast to the reputation system maintained by the Maghrebian merchants, here the information about traders' reputations was communicated by specialized actors who kept a record of disputed transactions and at the same time administered justice. Merchants or local officials worked as private judges, who received information about disputed transactions and provided information on particular traders upon request and in return for a fee. These private judges could also pass judgment and impose penalties in case of dispute. But they were not able to impose penalties outside of the fairs. Why, then, should a foreign trader accept the judge's verdict and pay a penalty on conviction after he had already returned to his home town? A good reason was the maintenance of his reputation and the prospect of good business, as traders with a bad reputation were excluded from trade or could only participate under worse conditions.

The Lex Mercatoria, which developed out of the merchant law of the Champagne and other trade centres of medieval Europe, was private law. Violations of the rules could not be punished under the sanctioning powers of state officials. Consequently all market participants had a personal interest in observing the rules. The interplay of various individual incentives has been analyzed by Milgrom et al. (1990) in an abstract model comprising the main features of the Lex Mercatoria. Their analysis reveals that a self-organized reputation system must fulfil four conditions to enable cooperation and hence an efficiently functioning market: 1. Norm violators must be punished. 2. Traders must be informed about the behaviour of others in earlier transactions. 3. Traders must provide information on the behavior of their trading

partners after a transaction. 4. Traders must comply with the judges' verdicts. Milgrom et al. (1990) apply game theory to examine the incentive problem in regard to the maintenance of a reputation system and hence of cooperative market transactions between traders. It turns out that observing the rules of the Lex Mercatoria is, under certain conditions, an equilibrium strategy. These conditions include the information costs and the profit from a single act of fraud. If these two factors do not exceed a certain level, the market participants will have a personal interest in playing by the rules.

These case studies clearly show that the reputation mechanism can promote cooperative market transactions. Moreover, they show that self-organized reputation systems can be maintained without state intervention, as long as it is in all actors own interest to observe certain rules.

As with the Roman professional guilds (Temin 2013) or the Lübeck "Bergen travelers" (Burkhardt 2010) reputation can be acquired through membership of a recognized social group or organization. The membership of a religious community can also confer reputation, particularly when admission to the religious community is accompanied by strict rules and tests and potential business partners know that the members of the community adhere to honest business conduct. The "Amish People" in North America can easily receive credit because the banks know that the credit agreements are virtually always kept. A banker with 15 years of experience with the evangelical community said: "I never lost a dime lending to the Amish" (Kraybill 2001: 257, Diekmann 2007). In his study on "The Protestant Sects and the Spirit of Capitalism" Max Weber ([1920] 2002) reports on various observations which clearly show that membership of a religious group not only fulfils religious needs but also may have the important side effect of attributing business reputation. On a train journey, Weber meets a travelling salesman who assures 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 50 cents'" (Weber [1920] 2002: 128). Weber's observations at the baptism of a new member of a Baptist community are also highly informative:

> *"'… once [he is] 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 [1920] 2002: 129-130, also see Voss 1998).

Three characteristics make a person's reputation in this case credible and effective. First, admission to the community only takes place after careful examination and with the agreement of the members of the community; second, membership cannot be faked and the reputation cannot therefore be falsely acquired, and third, the membership and hence the attestation of the ethical quality of all the business partners is known (see also Diekmann et al. 2009).

In secular societies we hardly any more rely on membership in a religious community when giving credit or choosing business partners. Specialized "reputation firms" such as credit bureaus, aka credit reference agencies (CRAs), collect and provide information on the credit

history and business conduct of a customer or business partner (Djankova et al. 2007). Anyone who, for example, applies for a loan, buys a new mobile phone or car will come across a contract clause which permits the bank, mobile provider or car dealer, respectively, to do a "credit check" by obtaining information from a CRA. CRAs such as Experian operate globally and collect individual consumer information from different sources (e.g., credit payment histories, public records on bankruptcies and court judgements, etc.). Based on this information, CRAs calculate individual credit scores which are increasingly used by borrowers to assess lenders' creditworthiness (Einav et al. 2013). The parallel to the Lex Mercatoria with a system of notaries who keep a register of all known transactions is apparent. The same principles are applied; only the technology of communication has changed. Technological progress has drastically reduced the cost of acquiring and sharing information and has increased the speed by which information can be accessed.

3. Reputation in online markets

In online trade trust problems arise due to the anonymity of market participants, who often interact with each other over large geographic distances and across national borders (also see Przepiorka 2013). Most of their transactions are for one time only, that is, only a small proportion of business deals concluded on platforms such as eBay comprise repeated encounters between the same traders (e.g., Diekmann et al. 2014). According to the Nash equilibrium predictions of the standard trust game, one-time-only exchanges between online traders should not take place – online markets should not exist (Güth and Ockenfels 2003). However, online markets are a growth sector.

To a large part, the popularity and success of online markets can be attributed to the implementation of decentralized reputation systems made possible by the development of

internet technology (Kollock 1999; Resnick et al. 2000). A person who buys something on eBay, for instance, is asked to rate the seller after the transaction. These ratings (positive and negative) make up the interaction history of a seller, which can be accessed online anywhere in the world, at no cost and within seconds. Because it is time consuming and cognitively demanding to read and interpret the entire interaction history of a seller, similar to a credit score calculated by CRAs (see above), a reputation index is calculated which informs potential buyers of the number and the percentage of a seller's positive ratings. The cost of acquiring this information, a central factor in the reputation model of the Lex Mercatoria (Milgrom et al. 1990), is virtually zero. Moreover, in contrast to the Lex Mercatoria and modern credit bureaus, online rating systems are decentralized, whereby the costs of providing information is also reduced (Dellarocas 2003).

In anonymous online markets with a reputation system, buyers will trust and pay sellers with a good reputation more; in the case of sellers with a poor reputation buyers will demand a discount (i.e. they will bid lower amounts in auctions) to compensate for the risk they take when dealing with "unknown" sellers. Using econometric methods, Diekmann et al. (2014) have estimated the price increase in the case of positive ratings and the price reduction in the case of negative ratings based on more than 13,000 auctions of mobile phones and 180,000 auctions of DVDs. A significant effect on the selling price is revealed, whereby positive ratings have a smaller effect on price increases than negative ratings have on price reductions. This outcome is consistent with a large number of empirical studies (e.g. Kollock 1999; Diekmann et al. 2009; Dellarocas 2003; Resnick et al. 2006) and shows that sellers have a financial incentive to invest in a good reputation. They are, in particular, interested in avoiding negative ratings. Since this can mainly be achieved by means of honest transactions, fraudulent sellers have a reduced incentive to participate in online trade in the first place.

Todays' online market platforms offer great opportunities to study the functioning of reputation systems unobtrusively at a large scale. However, process data obtained from online markets only reflects traders' behaviour and, as such, does not reveal much about these traders' motives and beliefs. The functioning of reputation systems is therefore also studied in laboratory experiments (e.g., Abraham et al. 2016; Bohnet et al. 2005; Kuwabara 2015). Bolton et al. (2004), for example, compare three market structures: a market with one-off transactions and changing partners (stranger market), a market with repeated transactions with the same partner (partner market) and a stranger market in which transaction partners are informed about each other's decisions in previous transactions (rating market). Trust and cooperation were higher in the rating market than in the stranger market, but the highest level of cooperation was achieved in the partner market. A reason for the difference between the partner market and the rating market was that subjects are mistrustful when they interact with a partner who does not yet have an interaction history. This result also shows that for market entrants establishing a good reputation may pose a problem. However, building a good online reputation must be costly in order to deter fraudulent traders from entering the market or re-entering under a new pseudonym after a fraudulent transaction (Friedman and Resnick 2001). Market entrants with honest intentions must thus accept lower prices to build their reputation; once they have built a good reputation they will be compensated for their initial investment by the higher prices they can charge for their goods (Shapiro 1983).

Buyers can protect themselves against fraud by taking into account sellers' reputations and choose the sellers they want to buy from. Sellers, however, do not generally have the option to choose buyers. How, then, can sellers protect themselves against buyers with poor payment morale? The solution is simple. Sellers determine the mode of payment such that they make the "second move" and deliver the goods only after having received buyers' payment. Payment modalities can be ordered in regard to the degree to which they favour the seller. The

rank order with decreasing seller power is: payment in advance > cash on mail delivery > cash on pick up > cash on delivery (in person) > mail delivery on account. In a study by Diekmann et al. (2009) on mobile phone auctions in the Swiss online market Ricardo.ch, 25% of the transactions were carried out by cash in advance and 70% by cash on delivery. It also turned out that the reputation of the seller correlated with seller power. The better a seller's reputation the more likely was the seller to determine a payment mode in his or her favour. This effect is also shown in (secondary) online markets for game cards. Kollock (1999) reports an example of such a market, in which the norm developed that the exchange partner with the poorer reputation had to initiate the exchange by sending his or her card to the exchange partner first.

However, the functioning of decentralized reputation systems crucially depends on traders rating each other after finished transactions. Although the submission of a rating, for example by a buyer after receipt of the merchandise, costs very little effort, it is by no means a matter of course that ratings are made to a large extent. The sum of all ratings constitutes the collective good "reputation" that is subject to a free rider problem (Bolton et al. 2004). If traders spared themselves the trouble and provided no feedback, the rating system would deteriorate and with it the entire market. However, a little bit of reciprocity and altruism beyond the self-interest of the homo oeconomicus can get an anonymous online market with a reputation system up and running (Bolton et al. 2013; Diekmann et al. 2014). Reciprocity is one reason for giving positive feedback to a seller with whom one is highly satisfied because of the high quality of the goods or the rapid processing of the transaction. Correspondingly, many buyers are inclined to punish a seller who delivers poor quality goods with a negative rating (Resnick et al. 2000). In the case of two-sided rating systems, there are also strategic motives for leaving feedback (Dellarocas et al. 2004). If the seller and the buyer can rate each other, one gladly gives a positive rating in order to receive the same from the other. At the same time, traders will be more cautious with negative ratings as the trading partner has the

possibility to retaliate. Hence, a side effect of the two-sided rating system is the inflation of positive ratings. In other words, although the reciprocal rating system of eBay may have helped to overcome the free rider problem in feedback provision, it boosted the amount of positive ratings possibly leading to biased evaluations (Dellarocas and Wood 2008). However, it was possible to overcome this problem by means of a change in the rating system. In 2007 eBay essentially shifted to a one-sided system of buyer ratings, and even after the system change the proportion of rated transactions remained at a very high level (Bolton et al. 2013). This outcome supports the hypothesis that a majority of buyers are not only motivated by strategic considerations. "Strong reciprocity" (Gintis 2000), i.e. the tendency to respond to positive actions positively and to negative actions negatively, even when these responses involve a cost, seems to be strong enough in online traders to guarantee a sufficient proportion of ratings.[3]

Note that in their analysis of the Lex Mercatoria, Milgrom et al. (1990) do not assume the existence of any altruism or norms of honorable traders. The rise of the "honorable merchant" could be a consequence of, but it is not a necessary precondition for the proper functioning of a market with a reputation system. In the analysis by Milgrom et al. (1990), the assumption of self-interest suffices, as all actors have an incentive to play by the rules. But this is not the case with online markets. There are no material incentives to provide ratings. If all online traders corresponded to the image of the homo oeconomicus, online markets would not emerge. Online markets can only function if a certain proportion of traders employ reciprocal behaviour. Only if a certain proportion of traders are motivated by *strong reciprocity*, and

[3] Based on a theory driven analysis of hundreds of thousands of rating events obtained from eBay, Diekmann et al. (2014) show that strong reciprocity, but also altruism (Becker 1976) and strategic motives (Dellarocas et al. 2004), are important drivers of online traders' leaving feedback after finished transactions. Other motives such as "warm glow" altruism (Andreoni 1990) or indirect reciprocity (Nowak and Sigmund 2005) may also play a role in leaving feedback but turned out to be difficult to identify with observational data (Diekmann et al. 2014).

possibly other types of other-regarding preferences, can reputation systems function without additional incentives.

Thus far we have been primarily concerned with three elements which promote cooperation among anonymous traders in online markets: 1. the reputation system, 2. the payment mode and 3. the notion of reciprocity. As a fourth element institutional rules must be added to this list. Many online markets offer an escrow service, particularly when larger sums of money are involved. Whereas the power of the seller is strengthened by payment in advance, the availability of an escrow service shifts power back to the buyer. Finally, and as a fifth element, we should call to mind that all transactions are subject to contract law. It is possible to take a fraudulent trading partner to court, although this costs time, money and effort.

It is, however, remarkable that the four elements of *self-organized cooperation* alone are sufficient to enable economic transactions. This is demonstrated by the functioning of numerous cryptomarkets, markets for illegal goods in the so-called dark web (Bradbury 2014). The dark web is only accessible by means of encryption software that obliterates all traces of the actors. In cryptomarkets such as Silk Road, AlphaBay or Evolution, trade with hacked user accounts, forged passports, illegal drugs, weapons etc. is carried out in total anonymity (Barratt and Aldridge 2016; Bartlett 2014; Christin 2012). As with eBay, finished transactions are rated by the customers and to this extent provide information on honest dealers.[4] Although none of the traders in cryptomarkets for illegal goods could ever take legal action to uphold their rights before a state court, trade in cryptomarkets nonetheless flourishes (Soska and Christin 2015).

[4] However, the dark web also helps civil rights activists and journalists living in dictatorial regimes to communicate freely.

Recent findings corroborate that a good seller reputation is at least as important for business success in cryptomarkets as it is in surface web markets such as eBay. Using data of illegal drug transactions in the cryptomarket Silk Road 1.0 (Christin 2012), Przepiorka et al. (2017) analyze the effect of buyer ratings on sellers' business success. They find that sellers with a better rating history charge higher prices and sell their merchandise faster than sellers with no or a bad rating history (see also Hardy and Norgaard 2016). Anonymous traders in cryptomarkets do not, however, rely solely on ratings. There is also an escrow service which protects buyers by releasing the payment to the seller only upon confirmation of receipt of the merchandise by the buyer. The combination of reputational incentives and institutional precautions literally promotes "order without law" (Ellickson 1991).

Reputation contributes decisively to the relatively smooth processing of billions of transactions in online markets, even in markets for illegal goods in the so-called dark web. Without a reputation system online markets in which anonymous actors do business over large geographic distances would fail on account of the problem of asymmetric information (Akerlof 1970). Unsurprisingly, reputation systems have spread rapidly in the internet, in particular in online markets, but also in the form of review platforms of services, hotels, car sharing agencies, hospitals, universities etc.

4. The shady side of reputation systems

Reputation systems can promote cooperation in illegal activities as much as in (legal) online markets. In the same way as Mafia structures are strengthened by strict cooperation norms (e.g. the obligation to secrecy, the omerta), reputation systems also help markets for illegal goods to achieve a high degree of successful transactions (Hardy and Norgaard 2016; Przepiorka et al. 2017).

Reputation is always based on perception and perception can be deceptive. This is true for gossip and title-tattle and equally so for online reputation indices. In particular, a good reputation can also be faked to a certain extent. This used to be called swindling but is nowadays termed reputation management. For example, companies or authors of books sold by Amazon may pay for services praising their products (Arthur 2013; Flood 2012). There is also the possibility to hire reviewers to give negative ratings to competing products. Examples of such services can be found on the online platform Fiverr.com. Recently, Amazon sued fake reviewers on this platform (Kirchner and Beyer 2016). By now, specially programmed algorithms or “bots” are able to generate “like” clicks on social media such as Facebook or Youtube (Clark 2015). In certain domains it may be even simpler to fabricate favourable evaluations. Who knows whether hotel ratings really come from guests or whether they have been commissioned by the hotel owners. Rating agencies which decide on the quality of securities are paid by the issuers, with the result that questionable "collaterized debt obligations" are awarded a "Triple A", the highest possible rating. Finance experts put at least a part of the blame for the recent financial crisis on these agencies. Not only is fraudulently acquired reputation a problem, but also the destruction of honestly acquired reputation. This can take the shape of mobbing among schoolchildren or the destruction of the reputation of a competing product on the market. Thus, in general, for reputation systems the reliability of the information and the rating procedures are core issues.

However, in online markets the construction of a bogus reputation involves costs, as fees are charged for every transaction. A trader can pursue a policy of building up a reputation with a number of small business transactions ("whitewashing") and then act fraudulently in a big transaction. The strategy can pay off if the profit from the fraud exceeds the cost of building up the reputation. Counter measures are, however, available. In the case of big transactions, customers are well advised to make use of the escrow service. Moreover, a seller makes him-

or herself suspicious if, to exaggerate a bit, he or she makes a hundred deals with the sale of chewing gum and then offers a Ferrari for sale with payment in advance. It is important that potential customers are not only informed about the evaluation of a transaction but also about the size of a concluded deal.

Apart from the question of fraudulent reputation building there is a further problem in connection with decentralized reputation systems. In the case of experience goods it can happen that deficiencies can, if at all, only be recognized by consumers after some time. If, for example, a toy bought in an online auction releases toxic chemicals which the buyer cannot notice, this serious deficiency will not of course be reflected in the buyer's rating of the seller. Deficiencies which can only be established by means of special tests and materials analysis require expert evaluation by institutions such as food inspection or consumer safety agencies. In these cases, decentralized ratings alone are, therefore, by no means sufficient and must be supplemented by the evaluations of experts.

In spite of all the reservations and the problems they give rise to, decentralized rating systems are evidently successful. They have spread rapidly in online markets and not only in the internet. The concept of a "reputation society" is perhaps rather exaggerated, but it makes clear that more and more corners of our society are being pervaded by quantifying reputation systems. Reputation is also being increasingly quantified in the field of science. A large number of digital archives exist alongside the Web of Science. Google Scholar, Repec, Research Gate, Academia.edu etc. all publish indices and attribute reputations. Citations, the impact factor of journals, the h-index and other indices increasingly decide about the careers of researchers, who accordingly adapt their behaviour to the requirements of these indices. Reputation can create social order and promote cooperative behaviour but can also lead to false incentives. Whether and to what degree reputation systems promote the welfare of society depends on the quality of the information measured with the individual indicators.

More systematic research into the working of reputation systems, their interaction with individuals' preferences and constraints as well as the consequences of reputation systems for society at large is necessary. The analysis of reputation systems in past and present societies does show that in markets for goods and services, whether online or offline, reputation can help to solve problems of asymmetric information and in this way promote cooperative and mutually beneficial trade.

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