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Exchange networks, markets and trust

Jon Reiersen

School of Business, University of South-Eastern Norway, Borre, Norway

ABSTRACT

Network-based transactions are attractive as a system for economic exchange because they give network members greater protection against opportunism and exchange hazards compared to more anonymous market transactions. At the same time, networks restrict the possibilities to exploit economies of scale and other efficiency enhancing properties of markets. When the problem-solving capacity of networks do not make up for the losses generated by not trading with outsiders, trust is important to promote transactions among strangers in the anonymously market. This paper offers an economic analysis of this idea. With the help of a social evolutionary model, it is also demonstrated that mutual trust relations can survive in the anonymous market, even when there is a clear danger of opportunism, and the conventional mechanisms like repetitions and contracts are ruled out.

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1. Introduction

Networks and markets can be viewed as two alternative ways of organising economic exchange. A major benefit of networks is that they greatly protect members against opportunism and exchange hazards than market transactions (e.g., Bowles & Gintis, 2004; Erikson & Samila, 2015; Granovetter, 2017; Jackson, Rogers, & Zenou, 2017; Kollock, 1994; Raub, Buskens, & Frey, 2013). At the same time, large-scale market interactions increase the possibilities of benefiting from economies of scale, specialisation and gains from trade (e.g., Algan & Cahuc, 2010; Bulte, Kontoleon, List, Turley, & Voors, 2017; Dixit, 2004; Frey & Van de Rijt, 2016; Greif, 2006; Smith, 2017 [1776]).

This paper investigates the dilemma that arises when the problem-solving capacity of networks does not make up for the losses generated by not trading with outsiders. We show that trust plays an important role in the decision to trade in networks or markets. When people trust each other, their perception of hazards in market exchanges reduces, and hence promotes transactions among strangers. If the level of generalised trust is low, individuals may prefer to uphold existing ties within

CONTACT Jon Reiersen  jon.reiersen@usn.no

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networks instead of embracing valuable possibilities with new partners. This creates assurance but reduces the possibilities of securing increased gains from trade and other efficiency enhancing properties of markets.

The idea that trust is important in facilitating market transactions is not new. The social psychologist, Toshio Yamagishi, developed the so-called emancipating theory of trust where he highlights the virtues of trust as a mechanism that helps individuals to seek out new possibilities outside committed relationships.¹ The main contribution of this paper is that it offers an economic model that formalises Yamagishi's idea of trust as an emancipator. But the analysis is taken a step further by asking the following question: If conventional mechanisms like repetition and contracts are ruled out, what can secure the continuation of trust-based market exchanges when untrustworthy types exploit the honest behaviours of other players? Dishonesty represents a cost for those who act honest, while dishonest individuals increase their income by cheating others. The question is whether trustworthy individuals will continue being honest in the market when faced with this situation. If dishonest behaviour produces a higher payoff, the norm of honesty is likely to wither while dishonesty blooms. The anonymous market may eventually collapse into a state of deceitful behaviour, leading the players to re-establish networks as the dominant arrangement for economic exchange.

Fortunately, our analysis reveals a more optimistic scenario. By building on the idea of Frank (1988) and Güth and Kliemt (2000), we show that trust-based honest behaviour can be maintained in the anonymous market if the trustworthy types have a costly type detection 'technology' available that makes it possible to discriminate between trustworthy and untrustworthy individuals. If detection of untrustworthy individuals is not too costly, trustworthy behaviour will dominate the anonymous market. Untrustworthy behaviour is not, however, completely eliminated. A stable evolutionary equilibrium emerges in which there is a niche for both trustworthy and untrustworthy types.

The rest of the paper is organised as follows: [Section 2](#) gives a short review of related literature. [Section 3](#) presents a simple model of trust based on the ideas of Yamagishi (2011). The model specifies the costs and benefits of networks and markets, and the role trust plays for the decision to transact in networks or markets. An evolutionary version of the model is formulated in [Section 4](#), addressing the question of how trust-based transactions can be maintained in the anonymous market. [Section 5](#) concludes the paper.

2. Related literature

This paper contributes to the large literature on the impact on trust on economic organisation and performance. The importance of trust has become widely accepted in economics in recent years (Algan & Cahuc, 2014; Fehr, 2009). An important reason for this is that economic exchange often requires that one party, the trustor, acts in a way that leaves himself vulnerable to exploitation by the other party, the trustee (Kreps, 1990; Rousseau, Sitkin, Burt, & Camerer, 1998). If the trustor think that the trustee is untrustworthy, mutually beneficial exchange may be blocked – or the

trustor must rely on complicated legal procedures for securing contracts. This is both time consuming and costly. Trust make things easier – it leads to less control and precautions, decisions can be taken faster, and economic transactions run more efficiently.

Another reason for the increased interest in trust in economics is that trust, as measured in surveys, correlates strongly with several other variables that are highly attractive for a society.² Countries with more trusting people are likely to have higher economic growth (Algan & Cahuc, 2010; Bjørnskov, 2018; Zak & Knack, 2001), less crime and corruption (Rothstein, 2016; You, 2018), and more developed welfare systems (Bjørnskov & Svendsen, 2013; Kumlin, Stadelmann-Steffen, & Haugsgjerd, 2018; Rothstein, 2009).³

More directly related to this paper is the following observation made by Algan and Cahuc (2010) about the importance of trust: *‘A prerequisite for the successful development of market economies would be to depart from closed group interactions and to enlarge exchanges to anonymous others. In that regard, generalized trust and trustworthiness appear as the keystone for successful economic development.’* (Algan & Cahuc, 2010, p. 2060). According to Algan and Cahuc, trust is important because it enables actors to move out of committed relations and invest their resources in more uncertain but at the same time more profitable projects. If there is a general belief among actors that others will behave trustworthily, mutual beneficial transactions can take place on the anonymous market, even when contracts are highly incomplete or even missing. The main aim of this paper is to formalise this idea and thus to contribute to a better understanding of why trust is important for well-functioning market exchanges.

From a more practical perspective, the theoretical framework developed in this paper provides an insight into the fundamental ups- and downsides of networks. Repeated exchanges in closed networks establish a context that moderate the problem of behavioural risk. Networks give its members strong incentives to act honestly because developing a bad reputation could impede many future exchanges. Hence, networks lower transaction costs and reduce the need for formal contracts. However, since networks provide a high degree of security against opportunism, they run the risk of ‘overembeddedness’ (Lazzarini, Miller, & Zenger, 2008; Uzzi, 1997). Instead of forming relationships with new partners that offers new opportunities and higher returns, actors may prefer to preserve existing ties with familiar partners. Therefore, in many situations those managing firms face a difficult dilemma in deciding how to arrange economic exchange.⁴

The theoretical framework developed in this paper is close in spirit to the analysis of Bowles and Gintis (2004). Our framework shares similar assumption with their model that trade can take place either inside networks or in the anonymous market, and that all trade is governed by incomplete contracts. The major benefit of networks is that they give easy access to information about the reliability of potential exchange partners. Bowles and Gintis (2004) also assume that the anonymous market, in contrast to networks, guarantee an optimal match among exchange parties. The downside of anonymous markets, however, is that it rules out the possibility of informal contract enforcement which arise from interactions inside networks. Bowles and Gintis

(2004) investigate the effect of the costs and benefits of the various forms of trade on the size of local networks and the anonymous market. This is done within a general equilibrium model where both the size of the local network and the anonymous market are determined simultaneously. Our theoretical design differs from this approach in the way that we assume that the costs and benefits of networks and the market are independent of the size of both. This simplifies the analysis and makes it possible to concentrate more fully on the main questions that our model highlight: What are the conditions for players to step out of networks of personalised honest exchange relationships and to enter the anonymous market where there is a clear danger of dishonest behaviour – but where markets also increase the players' possibility to reap increased gains from trade?

Kranton (1996) also views networks and the anonymous market as competing forms of economic organisation. She shares with Bowles and Gintis (2004), the general equilibrium framework of interaction between anonymous market transactions and personal exchanges in networks. According to Kranton (1996), the comparative advantage of markets is in product diversity, but this advantage becomes less when more exchanges take place in networks. Kranton (1996) is concerned with deriving the optimal mix of networks and anonymous market exchanges. She shows that when the decision to trade in networks or in the market is taken by independent actors, it easily creates a situation where networks either become too big or too small when viewed from a social perspective. In a related contribution to that of Kranton (1996), Davis (2006) looks at a situation where informal institutions, defined as a set of conventions regarding behaviour among members of a society, secure contract enforcement and increases division of labour in the anonymous market. At the same time, a large anonymous market undermines the social conventions that division of labour rests on. Since informal institutions are undervalued in private decision making, Davis (2006) shows that decentralised decisions cause the equilibrium degree of specialisation to be too high compared to what is socially optimal. Since the model developed in this paper assumes that the costs and benefits of networks and market are independent of their size, we do not get this conflict between social and private optimality.

An important part of our model is to study the evolutionary stability of pro-social cooperative behaviour in anonymous market, where players are unconstrained by complete contracts and the possibility of repeated interaction. Here, we build on the work of Güth and Kliemt (1998, 2000). However, while they look at a set-up where the players act within a sequential-move game, we embed our analysis in simultaneous-move game. The next section set out the basic game structure, while the details of the evolutionary variant of the model follow thereafter.

3. The cost and benefits of networks

A well-established result within economics is that there are two key components behind wealth-creation: exchange and specialisation. Already in *The Wealth of Nations*, Adam Smith (2017 [1776]) pointed out that voluntary exchange between individuals creates wealth, but this wealth can be increased if individuals are allowed to specialise in those activities in which they have a comparative advantage. At the

same time, he observed that the market size determines the degree to which people can specialise and thus create wealth. The problems with large anonymous markets, however, is that they increase the problems arising from incomplete contracts and behavioural risk. This gives actors an incentive to embed economic exchanges in closed networks where sharing of reputation information is easier (Granovetter, 1985). It follows from this that exchanges within networks have their pros and cons. Networks produce greater protection against opportunism and exchange hazards, but also restrict the possibilities to reap potential gains generated by larger markets. The model developed below builds on this basic idea.

Consider a society with many players who have the possibility of managing on their own or exchanging goods and services with each other. The former strategy produces the payoff d , while the latter strategy gives a payoff of c . There are gains from trade, which means that $c > d$. All trade is assumed to be governed by incomplete contracts which give room for opportunistic behaviour. Following Yamagishi (2011), we assume that networks provide a solution to this problem. Due to repeated interaction, social control and threat of retaliation against opportunism, networks allow informal agreements on honest behaviour to be self-enforcing.⁵ That is, transactions within a network produce the payoff c with certainty.

Although networks solve problems related to behavioural risk, they may generate problems in other areas. Due to their small size and restricted exchange possibilities, networks restrict the ability to achieve further benefits related to gains from trade in larger markets. This is taken into account by simply assuming that the players can reap the payoff b by trading outside the network, where $b > c$. This is called a market transaction.

Although a market transaction produces a higher payoff if the partner acts trustworthily, a market transaction generates behavioural risk. Players in the market are assumed to be unknown to one another and their interactions are non-repetitive. The formation of self-enforcing agreements on honest behaviour is therefore not possible. This creates the following dilemma: If a player decides to leave a network and jump into a transaction with a stranger in the market, he reaps the payoff b if the stranger is trustworthy. But there is also a chance that the partner is untrustworthy, producing a loss of $-e$. This clearly expresses a typical situation of trust: Trust is important when a person faces a possibility of getting a higher return and a risk of being cheated simultaneously.

Finally, we make the risk of being a target of dishonest behaviour genuine by assuming that dishonesty gives a payoff of a , where $a > b$. We also need to specify the fourth situation that can happen, referred as the situation where both players act dishonest in the anonymous market. This gives both a payoff of 0, where the total payoff ranking is $a > b > c > 0 > -e$. Notation in the game is summarised below.

Notation and explanation of variables:

d_i : Player i 's payoff without trade

Payoffs from trade inside a network:

c_i : Player i 's payoff (comes with certainty, where $c_i > d_i$)

Payoffs from trade in the anonymously market:

b_i : Player i 's payoff from playing honest when partner is honest ($b_i > c_i$)

- a_i : Player i 's payoff from playing dishonest when partner is honest ($a_i > b_i$)
- 0_i : Player i 's payoff from playing dishonest when partner is dishonest
- $-e_i$: Player i 's payoff from playing honest when partner is dishonest

The situation described above is illustrated in [Figure 1](#) and can be interpreted as a market exchange, in which (for example) player 1 is the seller and player 2 is the buyer. Both players can choose between playing 'Honest' (H) and 'Dishonest' (D). If both players play H, this would mean that both players maintain their promises. The seller delivers the promised commodity, and the buyer pays the agreed-upon price. Both receive a payoff of b . If both players play D, neither the seller delivers the commodity nor the buyer pays the price, and both players receive a payoff of zero. If the seller fails to deliver the commodity (plays D) and the buyer nevertheless pays the price (plays H), the seller receives his highest possible payoff, a . The buyer, having paid the price and not receiving the commodity, receives his lowest possible payoff $-e$. In the opposite case, in which the seller delivers the commodity while the buyer does not pay, the seller receives his lowest possible payoff ($-e$), while the buyer receives his highest possible payoff (a).

As can be seen from [Figure 1](#), economic interactions in the anonymous market is basically a traditional social dilemma-game. Everybody is better off if everybody acts honest compared to a situation where everybody acts dishonest. But if everybody acts honest, there is something to gain by being dishonest.

The balance between possible costs and benefits shape the players' decision to transact in networks or markets. This decision is studied more closely by assuming a society composed of a proportion p of trustworthy types and a proportion $(1 - p)$ of untrustworthy types. The trustworthy types always play honest while the untrustworthy types always play dishonest.

In the anonymous market, the players have no prior knowledge of their partner's type, but they have a level of belief about the proportion of trustworthy types in society. This belief is then a measure of trust: If the players perceive the probability that other players act trustworthy is low, they will be more reluctant to take the chance of entering the market. This is particularly true if the payoff from trade in networks (c) is high, the cost of being cheated ($-e$) is high or the gain from trade in markets (b) is relatively low.

To see this more clearly, note that with probability p , a trustworthy type meets another trustworthy type and gets payoff b , and with probability $(1 - p)$, a

		Player 2	
		Honest	Dishonest
Player 1	Honest	b, b	$-e, a$
	Dishonest	$a, -e$	$0, 0$

Figure 1. Payoffs from a market transaction.

trustworthy type meets an untrustworthy type and gets payoff $-e$. Therefore, the expected payoff to a trustworthy type is $pb + (1-p)(-e)$. Similar reasoning shows that the expected payoff for an untrustworthy type is $pa + (1-p)0$. A trustworthy type will enter the market if this expected payoff is greater than the payoff from staying in a network, that is if

$$pb + (1-p)(-e) > c$$

which is satisfied if:

$$p > \frac{c+e}{b+e} \equiv p^* \quad (1)$$

Equation (1) implies that trustworthy types take the risk of leaving their networks if they perceive the probability that the (unknown) counterpart behaves trustworthy, as large enough ($p > p^*$).

Likewise, an untrustworthy type enters the market if his expected income of doing so is greater than the payoff from staying in a network (c). Since an untrustworthy type gets a higher payoff no matter what type he meets in the anonymous market, compared to a trustworthy type, an untrustworthy type will take the risk of entering the market for a lower p than a trustworthy type. It is therefore enough to focus on the condition given in (1), since we know that if the proportion of trustworthy types is large enough for the trustworthy types to enter the market, the untrustworthy types will do the same. That is, if $p > p^*$, both the trustworthy and untrustworthy types will enter the anonymous market.

The condition given in (1) can be seen as a formalisation of Yamagishi's idea that trust plays the role of a 'booster rocket' providing necessary push out of commitment relationships (Yamagishi, 2011 p. 55). We thus obtain the following result:

Proposition 1: A high level of trust allows players to step out of existing networks and establish transactions with strangers in the market.

Equation (1) also shows that the level of trust needed to establish a mutual trust relationship depends on the ratio between the payoffs produced in networks and markets (b , c and e), since these payoffs determine the size of the critical value p^* . As noted, e is the cost of being cheated in the market. It follows from (1) that an increase in e drives up p^* , making it harder to form mutual trust relationships. This is not surprising. If the cost of being cheated is high, players will be reluctant to run the risk of being cheated unless they are sure that other players are trustworthy. We can establish the following result:

Proposition 2: When the cost of being cheated is high, more trust is needed for market transactions to emerge.

Equation (1) also illustrates that the payoffs b and c affect the critical trust value (p^*) in a natural way. b is the payoff from a mutual trust relationship while c is the payoff from staying in a network (where $b > c$). c is received for sure while b comes with a risk of being cheated. The larger c is (all else given), the higher must p^* be, and the more trust must be present for the trustworthy types to take the risk of

entering the market. An increase in b has an opposite effect by lowering the threshold p^* and making possible market transactions for lower levels of trust. This can be summarised in the following result:

Proposition 3: For a given level of trust, the decision to transact in networks or markets depends on the relationship between the gains produced in markets and the safe payoff produced in networks.

It follows from propositions 1–3 that, it is harder to profit from trade in markets in societies where players feel the need to safeguard their interests in established networks. b may be seen as the opportunity cost of networks, defined as the forgone opportunities for getting a better outcome outside the network. A main point emphasised by Yamagishi (2011) is that the opportunity cost of networks is steadily increasing due to more integrated and larger markets. This leads to the following result:

Proposition 4: When the problem-solving capacity of networks is offset by losses incurred by not trading with outsiders, networks become a constraint rather than an asset.

4. The evolutionary stability of trust

The situation analysed above illustrates the close relationship between trust and risk. Trust may generate economic gains, but it also creates room for dishonesty and exploitation. Hence, trust does not remove or reduce risk, rather it creates risk. Trustworthy types entering the anonymous market to deal with strangers that are unconstrained by explicit or implicit promises of future rewards or punishments put themselves in a vulnerable position. While two trustworthy types together produce a good result, conversely, trustworthy types suffer a loss when they encounter an untrustworthy type. Untrustworthy types never suffer this loss since they never act honest.

The untrustworthy types always fare better than the trustworthy types in the anonymous market since they receive a higher payoff no matter the type they encounter. The question then is whether the trustworthy types will continue to perform honest when faced with this situation. Since dishonest behaviour gives a higher payoff such behaviour may spread, leaving the anonymous market in a state of deceitful behaviour. To analyse this issue further, we allow the players to change their type and behaviour over time.

4.1. Evolutionary dynamics

We start where the analysis in section 3 ended and assume that Equation (1) is satisfied. All players have left their local networks and deal with each other in the anonymous market. The trustworthy types are honest, while the untrustworthy types are never honest. However, we now open up for the possibility that the two types need not necessarily hold on to their original type and behaviour. We do this by

embedding the framework developed above into a model of social evolution in which the trustworthy types ‘compete’ with untrustworthy types. The two types compete in the sense that the players copy the behaviour that is perceived as successful in the population, where the population is made up of trustworthy and untrustworthy types. The role of the evolutionary process is to determine the proportion of the two types in the anonymous market.

The structure of the social evolutionary process builds on the following simplifying assumptions: We start out with a given distribution of the two types, and the players are randomly matched in the anonymous market. Each player simultaneously implements the strategy dictated by their type which produces a payoff to each. The payoff structure is as before and illustrated in [Figure 1](#). b is the payoff for mutual honest behaviour, 0 is the payoff for mutual dishonest behaviour, a is the payoff for being dishonest when meeting a honest player, while $-e$ is the cost of being honest when meeting a dishonest player, where $a > b > 0 > -e$.

The players play the game independently of their memory of the past, or their expectations of future interactions with either the same or other players. After each round of play, the population distribution changes according to the relative success of the trustworthy and untrustworthy types. Players know the distribution of types in the population, but do not at the onset have any information about their partner type. Equilibrium is defined as stationary of the distribution of the two types.

As before, p is the fraction of trustworthy types (T -types) in the anonymous market, while the remaining $(1 - p)$ are untrustworthy types (U -types). At any given time, the growth rate of the proportion of trustworthy types in the population changes according to the following *monotonic evolutionary rule*, which includes the much-studied *replicator dynamics* as a special case (Weibull, 1995)⁶

$$\dot{p} = \frac{dp}{dt} \begin{cases} > 0 & V^T > V^U \\ = 0 & \text{as } V^T = V^U \\ < 0 & V^T < V^U \end{cases} \quad (2)$$

where V^T and V^U are expected payoffs of types T and U , respectively. Hence (2) states that the growth rate of the proportion of trustworthy types in the population is positive or negative depending on whether the expected payoff of trustworthy types is higher or lower than the expected payoff of the untrustworthy types. The population distribution p will be unchanging (reaching an equilibrium) if the expected payoffs for the two types are equal ($V^T = V^U$).⁷

4.2. Market transactions with incomplete type information

Let us briefly recapture the situation mentioned above, that is, the case where all players have left their networks and deal with each other in the anonymous market (condition (1) is satisfied). With probability p , a trustworthy type meets another trustworthy type and gets payoff b and with probability $(1 - p)$, a trustworthy type meets an untrustworthy type and gets payoff $-e$. Two trustworthy types together produce a good result (b), but when a trustworthy type encounter an untrustworthy type, he suffers a loss ($-e$). The expected payoff to a trustworthy type is $V^T =$

$pb + (1 - p)(-e)$. An untrustworthy type is in a much better position. He never suffers the loss of $-e$ since he never acts honest. On the anonymous market an untrustworthy type meets a trustworthy type with probability p , and gets the highest possible payoff a . With probability $(1 - p)$, an untrustworthy type meets another untrustworthy type and gets payoff zero. The expected payoff for an untrustworthy type is $V^U = pa + (1 - p)0$. By comparing V^T and V^U we see that untrustworthy types always fare better than trustworthy types in the anonymous market since they receive a higher payoff no matter the type they encounter. This means that $V^T < V^U$ for all $p \in (0, 1)$. Since untrustworthy types get a higher expected payoff, trustworthy types start to turn into dishonest untrustworthy types. According to (2), the fraction of trustworthy types in the population (p) starts to decrease, and this process continues until $p = p^*$, where p^* follows from (1). When $p = p^*$ the players redraw from the anonymously market and start to form networks, where they are protected from dishonest behaviour. Everybody earns a secure payoff of c . We can establish the following result:

Proposition 5: When players are randomly matched in the anonymous market and lack information about their partner's type, there is no room for mutual trust relationships in the long run.

4.3. Market transactions with costly type information

The driving force behind the above result is that the trustworthy types are unable to protect themselves from the dishonest behaviour of the untrustworthy types. In reality it is, however, rarely the case that a player is left completely in the dark with respect to information about the reliability of a possible trading partner – even in a large anonymous market. By performing credit checks, investigating criminal records, seeking information about the partner's reputation, and the likes, it is possible to form an idea about the partner's reliability. Can such an opportunity for inspection or information gathering stabilise a situation of trust-based transactions in the anonymous market?

In order to study this question in more details, we build on the ideas of Frank (1988) and Güth and Kliemt (2000) that the trustworthy types can obtain information about their partner type through active inspection – and that such inspection reveals the partner type with certainty. Since inspection generally requires time and effort, we assume also that this imposes a cost of K on the trustworthy types. We denote K as the cost of investing in information.

By investing in information, trade on the anonymous market gives the trustworthy types a payoff of $b - K$, otherwise they get $pb + (1 - p)(-e)$.⁸ This shows that the trustworthy types have more to gain from investing in information the smaller p is, since this increases the chance of being cheated. If $p = 1$ (everybody plays 'honest') it never pays to invest in information. At the same time, the gain from investing in information is greater when K is lower. The relationship between the size of p and K , and the decisions to invest in information, can be seen more clearly by noting that the trustworthy types will invest in information if $b - K > pb - (1 - p)e$, or if

$$K < (1 - p)(b + e) \quad (3)$$

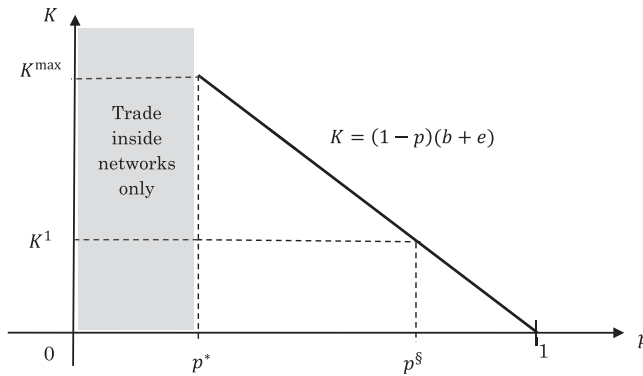


Figure 2. The relationship between p and K .

From section 3 (Equation (1)) we know that the minimum value of p required for trade on the anonymous market to take place is $p^* = \frac{c+e}{b+e}$. By inserting this into (3) we find that the maximum value K can take for the trustworthy types to still be willing to invest in information is given as:

$$K^{\max} = b - c \tag{4}$$

Equation (4) shows that the maximum K which the trustworthy types are willing to pay for information is determined by the difference between the uncertain payoff from trading on the anonymous market (b) and the certain payoff from staying in a network (c).

Figure 2 illustrates how the decision to invest in information depends on the size of p and K . It shows that the trustworthy types are more willing to pay for information with the smaller p . $K = K^{\max}$ is the maximum value K can take for the trustworthy types to still be willing to invest in information. When p increases, the chance of being cheated decreases. The trustworthy types are therefore less willing to pay for information.

Figure 2 also shows that for a given $K = K^1$, the expected gain from investing in information exceeds its cost for $p < p^s$, where

$$p^s = \frac{b + e - K^1}{b + e} \tag{5}$$

If $p > p^s$, the proportion of trustworthy types on the market is so high that it is not worthwhile to invest in information to identify the partner’s type. It is better to be unconditionally honest. When $p < p^s$, the opposite holds. The trustworthy types invest in information since the expected gain from information exceeds its cost. It is best to be conditionally honest.

4.4. Evolutionary stability

Having specified the evolutionary process and established the relationship between the cost of information, the population’s composition and the decision to invest in

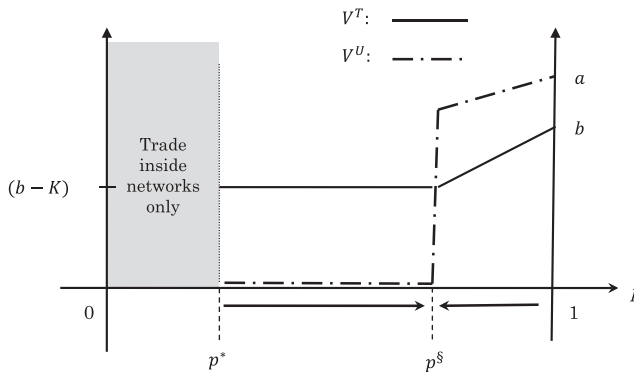


Figure 3. Expected payoff for trustworthy and untrustworthy types.

information, we are in a position to say something more about the problem of evolutionary stability.

Figure 3 shows the expected payoff of the two types for a given cost of information, where the solid line illustrates the payoff for the trustworthy types and the broken line illustrates the payoff for the untrustworthy types.

In the interval $p^* < p < p^S$, the trustworthy types invest in information and act honest only with other trustworthy types. The untrustworthy types receive a payoff of zero, while the trustworthy types, by acting honest and paying for information, receive a payoff of $b - K$. Since the trustworthy types receive a higher payoff ($V^T > V^U$), untrustworthy types start to turn into honest trustworthy types. According to (2), the fraction of trustworthy types in the population (p) increase, and this process continues until $p = p^S$.

In the interval $p^S < p < 1$, the proportion of trustworthy types in the population is so high that the trustworthy types do not find it worthwhile to invest in information. Instead they act unconditionally honest. The untrustworthy types take advantage of this indiscriminate honest behaviour and earn the highest possible payoff (a) when they encounter a trustworthy type (which happens with probability p). The expected payoff for the untrustworthy types is $V^U = pa$. The expected payoff for the trustworthy types is $V^T = pb + (1-p)(-e)$. Since the untrustworthy types receive a higher payoff ($V^T < V^U$), trustworthy types start to turn into dishonest untrustworthy types. According to (2), the fraction of trustworthy types in the population (p) decrease, and this process continues until $p = p^S$.

To sum up: If the proportion of trustworthy types is less than p^S , their number increases. If the proportion of trustworthy types is greater than p^S , their number decreases. p^S is, in other words, a stable interior evolutionary equilibrium. Small deviations away from p^S result in a convergence back to p^S . This stable equilibrium constitutes a mixed society with a proportion p^S of trustworthy types and a proportion $(1-p^S)$ of untrustworthy types. The trustworthy types invest in information and behave honest when they encounter another trustworthy type. The untrustworthy types are never honest. This gives the following result:

Proposition 6: Mutual trust relationships can emerge and survive in the anonymous market if there exists a possibility to obtain information about the ‘type’ of the possible exchange partner, and this information is not too costly to gather.

It should be noted, however, that the evolutionary equilibrium p^s can be close to 1 depending on the cost of information (K). From (5) it follows that $p^s \rightarrow 1$ as $K \rightarrow 0$. Hence, the less it costs to obtain information about who is trustworthy, the less room there is for the untrustworthy types. However, as long as $K > 0$, untrustworthy behaviour is not completely eliminated. Honesty dominates the anonymous market, but there is still some element of dishonesty. In other words, trustworthy and untrustworthy types ‘live’ together in a stable evolutionary equilibrium.

5. Concluding remarks

Networks have properties that make them attractive as a system for economic exchange. Among these properties is the capacity of networks to secure prosocial behaviour and give network members assurance against opportunism. These capacities allow networks to persist in a market economy despite their relative inability to exploit gains from trade and other efficiency enhancing properties of markets (Bowles & Gintis, 2002).

As discussed further by Yamagishi (2011), when the problem-solving capacity of networks is offset by losses incurred by not trading with outsiders, networks easily become a constraint rather than an asset. In such a situation trust is important. According to Yamagishi, the main function of trust is that it acts as a ‘booster rocket’ that enables people to take off from the secure ground of committed relations. This paper offers a simple economic model to analyse this idea more closely.

The model developed produces three major findings. Firstly, the model demonstrates the need to distinguish between *trust* and *assurance*, a distinction highlighted by Yamagishi (2011) but not clearly noticed in past research on trust. The notion of trust that we worked with in this paper is as follows: Trust is an expectation (that might be wrong) about other people’s disposition to act trustworthy. According to this definition, trust is important in situations characterised by social uncertainty, where the players have incentives to act dishonestly and where the consequences of being the target of dishonesty are costly. Networks typically remove the incentives to act dishonestly. Through various mechanisms like repeated interaction, informal sanctioning and easy access to information, actors within networks have nothing (or at least very little) to gain by acting untrustworthy. Networks are in other words characterised by little social uncertainty. Hence, actors within stable groups or networks generally feel safe with insiders. In such situations it makes little sense to talk of trust. It is more meaningful to say that networks create assurance, where assurance refers to expectations of honest behaviour based on the knowledge of the social structure surrounding the relationship. Trust becomes important when actors step out of networks to deal with strangers that are unconstrained by explicit or implicit promises of future rewards or punishments.

Secondly, the model developed shows how alternative forms of economic organisation produce different types of costs and benefits. By dealing with familiar partners within an existing network, economic actors may miss opportunities of a better outcome offered by alternative partners. But dealing with alternative partners also means less assurance against opportunism and a need to safeguard oneself against such behaviour. Hence, networks reduce transaction costs on the one hand, but generate opportunity costs on the other hand (Yamagishi, 2011). How economic actors handle this tradeoff depends, among other things, on the level of generalised trust in the society.

Finally, the paper sheds light on the problem of evolutionary stability of trustworthy behaviour in anonymous market transactions. Those who act honest in the anonymous market, where players are unconstrained by complete contracts and the possibility of repeated interaction, put themselves in a vulnerable position. Dishonest players may deceive them, and this may in the long-run crowd out trust-based market transactions. But if trustworthy types can get information about the partner type, and this information is not too costly to collect, trustworthy behaviour can survive in the anonymous market. A proportion of untrustworthy types will also be present, but this proportion is lower with lower cost of information. As such, the model reflects the fact that we do not live in a perfect, honest world in which dishonesty is unknown. Nevertheless, most of the time trust and honesty seem to find its reward.

Notes

1. This idea was first discussed in Yamagishi and Yamagishi (1994). See also Yamagishi (2011), Yamagishi, Cook, and Watabe (1998) and Yamagishi, Kikuchi, and Kosugi (1999).
2. Trust varies widely across countries (Holmberg & Rothstein, 2017). In the Nordic countries, and the Netherlands about 60–70 percent of people believe most other people can be trusted, whereas in countries like Romania and Brazil less than 10 percent trust others.
3. Trust correlates with a lot of variables that are desirable for a society. But the issue of causality is of course a different question from that of statistical correlation. See e.g. Algan and Cahuc (2014) for a discussion.
4. There is a huge empirical literature that study this dilemma in more detail. See e.g. Levesque, Calhoun, Bell, and Johnson (2017), Gausdal, Svare, and Möllering (2016), Mitsuhashi and Min (2016); Willem and Lucidarme (2014) for recent contributions. De Campos, Resende, and Pontes (2017), Appio, Martini, Massa, and Testa (2016) and Durugbo (2016) offer a more systematic overview of the literature.
5. See e.g. Fudenberg and Maskin (1986), Taylor (1987), and Gibbons (2001) for a more formal analysis of how repeated interaction allows informal agreements on cooperation to be self-enforcing. There are also several empirical and experimental studies that support the hypothesis that networks promote pro-social behavior (e.g. Bulte et al., 2017; Chuang & Schechter, 2015; Frey, Buskens, & Corten, 2019; Simpson, Harrell, Melamed, Heiserman, & Negraia, 2018; Sircar, Turley, van der Windt, & Voors, 2018). Buskens and Raub (2013) survey the literature on conditions under which networks facilitates cooperation in social dilemmas.
6. See Bowles (2004, p. 71–75) for a more detailed account and for a discussion of social evolutionary models in general.

7. We do not need a more complicated or detailed structure of the evolutionary process in order to work out the results found in this paper.
8. The untrustworthy types never invest in information since they have ‘dishonest’ as a dominant strategy.

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