

**UNIVERSITÀ CATTOLICA DEL SACRO CUORE**

**DIPARTIMENTO DI ECONOMIA INTERNAZIONALE  
DELLE ISTITUZIONI E DELLO SVILUPPO**

Guido Merzoni

**A theory of trust failure and vertical integration  
in industrial districts**

N. 1001



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## Abstract

*We model the interaction of independent firms within an industrial district as a repeated game of trust, where cooperative outcomes are not due to the cultural attitudes of the players, but the result of non-cooperative behaviour taking place in a stable organizational setting. When the outside option of changing partners is not too attractive, cooperation may arise also without ties between firms; when such attractiveness increases, cooperation may only be guaranteed by making the relationship more stable through a formal commitment, which may lead to a fully-fledged vertical integration. As the efficiency gains of changing partners becomes even larger, stable relationships are no longer optimal and the traditional model of industrial districts breaks down.*

JEL classification: L14, L23, C72

Keywords: trust relationships, industrial districts, vertical integration.



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## 1. Introduction <sup>o</sup>

At least since the seminal work by Putnam et al. (1993) and Becattini (1990), local social capital accounts are among the most successful explanations for industrial districts.<sup>1</sup> According to this view, in such localized systems of production coordination is not the outcome of explicit contractual obligations between the parties, but it stems from generalized expectations of cooperation based on a shared set of values, which constitutes a local identity. While most of the literature, and in particular those studies that had as their main objectives the Italian case, had explained the presence of such social capital as an exogenous endowment of historic origins, some more recent papers have tried to endogenize it as the outcome of strategic interactions. In such frameworks trust emerges as an equilibrium of a repeated game played between either the same agents or randomly matched agents within an environment that guarantees sufficient observability of past behavior of all members of the local community.<sup>2</sup> In particular, Annen (2003) studies the trade-off

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<sup>1</sup> In the same vein see also Harrison (1992) and Lorenz (1992).

<sup>2</sup> The analytical underpinning of such a view of industrial districts can be found in the literature on cooperation in repeated games (Kreps et al. 1982; Bull, 1987; Fudenberg and Maskin, 1986) and in community interactions



between the sustainability of self-enforcement of cooperation and the inclusiveness of the network where the games are played; Farrell and Knight (2003) studies how institutions may affect local social capital in industrial districts.

In recent years, the still ongoing process of increasing integration of markets, chains of production, and, more generally, economic systems has progressively put industrial districts in developed countries under stress. The traditional and informal cooperative arrangements, based on stability of the relationships among individuals and firms, are threatened by the ever more frequent recourse to “flexibility” and de-localization of production to low-cost emerging and developing countries. Foresti et al. (2008) documents some difficulties within Italian industrial districts, starting from the second half of the '90 up until the first half of the present decade, in terms of returns on investment and margins; those difficulties are accompanied by an increasingly profound restructuring of the production chain characterised on the one hand by de-localization and, on the other, by the increase of the average size of the firms. These observations are compatible with an explanation based on a two-fold reaction by the firms belonging to industrial districts: facing the increasingly attractive option of buying intermediate goods and components from producers in low-cost countries some firms internalize some functions strengthening the ties with their suppliers

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(Kandori, 1992; Ghosh and Ray, 1996, Bowles and Gintis, 2002, Greif, 1993).

to sustain cooperation, and in doing so get bigger; others give up their stable relation and in doing so contribute to the disarticulation of the industrial district very fabric.

The present paper tries to provide a theoretical underpinning for an explanation of the current phenomena along those lines by modelling the interaction of independent firms within an industrial district as a repeated game of trust, where cooperative outcomes are not due to the cultural attitudes of the players, but the result of non-cooperative behaviour taking place in a stable organizational setting.<sup>3</sup> When the outside option of changing partners is not too attractive, cooperation may arise also without ties between firms; when such attractiveness increases, cooperation may only be guaranteed by stabilizing the relationship through a formal commitment, leading to vertical integration.

The next section presents the main the model; section 3 discusses the basic trade-off between flexibility and commitment. Section 4 concludes.

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<sup>3</sup> On the role of stability for cooperation in organizations some general reference are Kreps (1990), Holmstrom-Roberts (1998) and Baker et al. (2002). For specific models on the role of commitment, see also Colombo and Merzoni (2004, 2008).

## **2. The model**

We model the interaction between two firms (an upstream and a downstream) in an industrial district as characterised by both moral hazard and a selection problem. The two sides of the interaction, for simplicity, are assumed to be separable with respect to their effects and presented in the next two sub-sections.

### ***2.1 The trust game***

We represent moral hazard in the simplest way as a two times (potentially) repeated trust game,<sup>4</sup> where an upstream firm (A) decides whether to trust a downstream firm (B) and provide a high level of effort in the production of components used by B in manufacturing a final good to be sold, to simplify matters and abstract from strategic contracting considerations, in a perfectly competitive market.<sup>5</sup> The quality of the components produced increases in the level of effort chosen by the upstream firm.

A's level of effort as well as correlated measures of performance are observable by B but not verifiable, so that fully contingent or any kind of explicit incentive contracts are unavailable. However, B can

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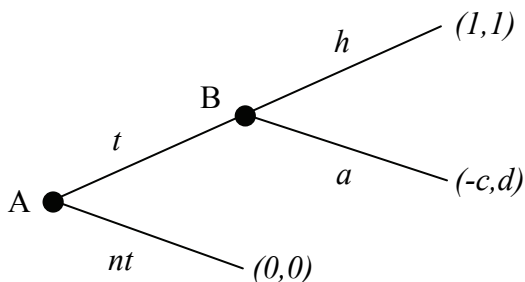
<sup>4</sup> The analysis of the trust game that follows draws heavily from Colombo and Merzoni (2006).

<sup>5</sup> If the downstream product market were not perfectly competitive, the upstream firm could design a delegation contract for the downstream firm to gain a strategic advantage as in the strategic delegation literature (see, for instance, Fershtman-Judd, 1987 and Vickers, 1985, and, on related issues, also Merzoni, 1991, 2000 and 2003).

try to provide incentives to A by promising to reward a high level of effort, for instance by paying a bonus. That promise is not credible if the interaction is one-shot, but it can be made credible within a stable relationship, i.e. within a relational contract between the parties.

If A trust ( $t$ ) B and chooses a high level of effort, B can honour trust ( $h$ ) and reward A or abuse it ( $a$ ). If A does not trust ( $nt$ ) B, no reward is paid and no abuse can take place. If the game is played only once A prefers to trust if trust is honoured and not to trust if trust is abused; B prefers to abuse trust if given the chance of doing so, but it prefers honouring trust to not being trusted. Without loss of generality we can represent the extensive form of the trust game as follows:

*Figure 1 - The trust game*



where  $c > 0$ ,  $d > 1$ .

The unique sub-game perfect equilibrium of the one-shot version of this game is  $(nt, a)$ , which is Pareto-inefficient since in  $(t, h)$  both players are better off.

In order to capture the idea that stability is valuable, we consider a twice repeated version of this game played under incomplete information on A's type. This allows us to obtain a reputation equilibrium *à la* Kreps and Wilson (1982), where trust emerges as a possible equilibrium strategy. We assume that with probability  $p$  B is trustworthy and always honours trust, whereas with probability  $(1-p)$  its payoffs are those reported in Fig. 1.

The probability  $p$  can be thought of as a pure modelling device, useful to obtain “reasonable” results. Alternatively, it can be taken to represent the share of the population which spontaneously adopt reciprocal (cooperative) behaviour. The choice between the two interpretations has important implications on the way we look at the nature of industrial districts: is social capital a source or a consequence of the development of districts?<sup>6</sup> Our interpretation will be that social capital, and so the presence of reciprocal types, is an important pre-requisite for the development of industrial districts, but the degree of stability of the environment, affected by organizational design, does also condition its prospects. Hence, we do not consider  $p$  as a mere modelling device, but as a real feature of the environment, while always implicitly assuming it to be small enough

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<sup>6</sup> Who comes first between the egg and the hen?

not to be sufficient for trust to arise in the one-shot version of the game.

It is straightforward to show that if  $p > \frac{c}{c+1}$  A's equilibrium strategy would be to trust B also when the game is played only once. This would amount to have such a high concentration of reciprocal types in the population, that trust always prevails, also in one-shot interactions; henceforth, we rule out this case and concentrate on  $p \leq \frac{c}{c+1}$ , so that trust will require reputation building.

When the game is repeated, A's beliefs on the actual type of B evolves following Bayes' rule. Hence, at the beginning of the second period the probability that A attaches to the event of facing a trustworthy B is the following

$$p_2 = \begin{cases} p & \text{if in period 1 A did not trust B} \\ \frac{p}{p + (1-p)y_1} & \text{if in period 1 A gave trust and trust was honoured} \\ 0 & \text{if in period 1 A gave trust, but trust was abused} \end{cases}$$

where  $y_t$  is the probability that the untrustworthy B honours trust in period  $t$ .

If we call  $z_t$  the probability that A trust B in period  $t$ , as shown in Colombo and Merzoni (2006)<sup>7</sup> the unique sequential equilibrium of a twice repeated trust game with incomplete information is the following

$$\begin{aligned} \text{if } \left(\frac{c}{c+1}\right)^2 \leq p \leq \frac{c}{c+1} & \quad \text{then } z_1 = 1, y_1 = \frac{p}{(1-p)c}, z_2 = \frac{d-1}{d} \text{ and } y_2 = 0 \\ \text{if } p < \left(\frac{c}{c+1}\right)^2 & \quad \text{then } z_1 = 0, y_1 = \frac{p}{(1-p)c}, z_2 = 0 \text{ and } y_2 = 0 \end{aligned}$$

The equilibrium expected payoffs for A and B for the one-shot ( $\pi_A(1)$  and  $\pi_B(1)$ ) and the twice repeated trust game ( $\pi_A(2)$  and  $\pi_B(2)$ ) are:

$$\begin{aligned} \pi_A(1) = 0 \quad \text{and} \quad \pi_B(1) = 0; \quad \pi_A(2) = p \left( \frac{(c+1)^2}{c} \right) - c \quad \text{and} \quad \pi_B(2) = d \\ \text{if } \left(\frac{c}{c+1}\right)^2 \leq p \leq \frac{c}{c+1} \\ \pi_A(1) = 0 \quad \text{and} \quad \pi_B(1) = 0; \quad \pi_A(2) = 0 \quad \text{and} \quad \pi_B(2) = 0 \\ \text{if } p < \left(\frac{c}{c+1}\right)^2 \end{aligned}$$

Therefore, if the game is played twice, i.e. the moral hazard problem is set within a durable relationship between the two firms, even an

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<sup>7</sup> See Result 2.2 and its proof in Appendix A.

untrustworthy firm B would honour trust with positive probability  $\left(y_1 = \frac{p}{(1-p)c}\right)$  in order to build a reputation for trustworthiness, provided that the share of trustworthy (reciprocal) firms in the population,  $p$ , is large enough. Untrustworthy firm B would honour trust more frequently as that share increases. In such equilibrium both firms are better off with respect to the one-shot version of the game, where, in an equilibrium without trust, they both get nothing.<sup>8</sup>

## ***2.2 The selection problem***

Besides moral hazard and the connected trust-building issue, we assume that the relationship between the two firms is characterised by a selection problem. The quality of components to be used by firm B depends not only on the effort provided by the supplier, but also on some intrinsic feature of the inputs used,  $I$ , divided by the cost of the input,  $c$ :

$$i = \frac{I}{c} .$$

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<sup>8</sup> Indeed it is straightforward to see that

if  $p \geq \left(\frac{c}{c+1}\right)^2$  then  $\pi_A(2) = p \left(\frac{(c+1)^2}{c}\right) - c \geq 2\pi_A(1) = 0$  , while  $\pi_B(2) = d > 2\pi_B(1) = 0$  always.



For simplicity we assume that the two dimensions of quality enter separately in firm B's payoff function, so that the overall payoff for B is just the sum of the payoff obtained from the trust game above and of the measure of quality of the inputs per unit of expense  $i$ :

$$\Pi_B = \pi_B + i$$

We assume that with respect to the quality of inputs all upstream firms within the district are homogeneous and we let  $I_d$  be such quality level,  $c_d$  the corresponding cost and  $i_d$  the quality per unit of expense, all known to everybody.

At the beginning of the second period firm B may decide to switch to another foreign supplier. The quality of the input produced by the foreign supplier is assumed to be uncertain and non-verifiable, and its expected value  $\hat{I}$  will in general be lower than the quality of the input produced within the district, i.e.  $\hat{I} < I_d$ . However, the cost of the foreign input is assumed to be much lower, so that the expected quality per unit of expense  $\hat{i}$ , is larger than that obtained within the district

$$\hat{i} = qi_h + (1 - q)i_l > i_d.$$

Hence, in this respect firm B always find it profitable to switch to a foreign supplier and not to be stuck in a long-term relationship with A.

### **3. Flexibility or commitment?**

The analysis of the previous section has shown that there are two distinctive features of the interactions between upstream and downstream firms within a district having opposite implications on the desirability of long-term relationships between them. Stability fosters trust and cooperation, but it also implies a renounce to use flexibility and replace the current partner with a better (less costly) one.

In this section we address this trade-off and endogenize the stability of the relationship between firms, by letting the downstream firm B choose the length of its association with firm A. The choice of a (two periods) long-term relationship is modelled as having a commitment value: once that decision has been taken A cannot be replaced and so it will be the supplier of B for both periods. Hence the choice of a long-term relationship amounts to a move towards a more direct integration of the firms, which, for simplicity, we assume to correspond to a vertical integration of the two firms, with B acquiring A.

On the other hand, if B chooses a (one period) short-term relationship the firms are kept separate and maintain full autonomy and independence: A can be replaced by B with an alternative supplier, when profitable. Of course, also in that case nothing prevents firm B from extending its relationship with firm A;

however, this only takes place when it is profitable since there is no commitment to a long-term relationship

In some circumstances (for some values of the parameters) trust emerges without the need of commitment, because the parties recognise from the beginning that A will not be replaced; however, in other circumstances commitment is needed for trust, because without it the firms do not cooperate (B abuses trust if trust is given and A does not trust B) in anticipation that their relationship will last just one period. The condition for the occurrence of the two regimes is stated in the following lemma.

***Lemma 1.*** *Commitment is not needed for trust if and only if*  
 $\hat{i} - i_d \leq 1$ .

*Proof.* Given Bayesian updating a untrustworthy firm B is only able to build a reputation for trustworthiness if the equilibrium in period 1 requires B to play a mixed strategy and honour trust with positive probability but not with certainty, i.e. if and only if  $0 < y_1 < 1$ . That only occurs if, when given the move in the first period, B is indifferent between honouring or abusing trust. When the parties are not committed to a two periods relationship, B is indifferent if its continuation payoff from honouring trust and not replacing A is equal to its continuation payoff from abusing trust and replacing A, i.e. if  $dz_2 + 1 = d + \hat{i} - i_d$ , which can be re-written as

$z_2 = \frac{d - 1 + \hat{i} - i_d}{d}$ . Given that  $z_2$  is the equilibrium probability that

A trust B in the second period, it cannot be greater than 1. Hence,  $\frac{d-1+\hat{i}-i_d}{d} \leq 1$  and so  $\hat{i}-i_d \leq 1$ . On the other hand, if  $\hat{i}-i_d > 1$  there is no reputation-building equilibrium where firm A could be replaced but it is not, since that would require  $z_2 > 1$ . (Q.E.D.)

When commitment is not needed for trust, firm B will always choose not to acquire A, since reputation concerns allow to solve moral hazard problems while keeping the firms independent. When instead commitment is needed for trust, B has to choose between acquiring A and renounce to the ability to replace it with a foreign supplier or maintaining the firms independent to exercise the option of replacing the inefficient local partner, but giving up the benefits of cooperation. The following proposition summarises all the possible equilibria.

**Proposition 1.** *When  $\hat{i}-i_d \leq 1$  commitment is not needed for trust, firms A and B stay independent and the equilibrium strategies in the repeated trust game are*

$$z_1 = 1, y_1 = \frac{p}{(1-p)c}, z_2 = \frac{d-1+\hat{i}-i_d}{d},$$

*$y_2 = 0$ ; when  $1 \leq \hat{i}-i_d \leq d$  commitment is needed for trust and used, firm B acquire firm A and the equilibrium strategies in the trust game are*

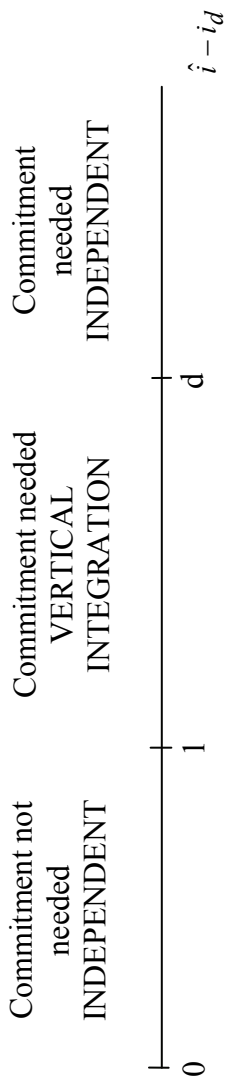
$$z_1 = 1, y_1 = \frac{p}{(1-p)c}, z_2 = \frac{d-1}{d} \text{ and } y_2 = 0; \quad \text{when}$$

*$d < \hat{i} - i_d$  commitment is needed for trust but it is not used, firms A and B stay independent and the equilibrium strategies in the trust game are  $z_1 = 0, y_1 = 0, z_2 = 0, y_2 = 0$ .*

When fostering trust does not require to commit to a long-term relationship the two firms stay independent; when commitment is needed for trust the downstream firm decides to vertically integrate with the upstream firm when the gains from changing supplier are relatively small, while it stays independent aiming at replacing the domestic supplier with a foreign, more efficient one otherwise.

Fig. 2 shows how the optimal choice by the downstream firm changes as the expected gains from switching to a foreign supplier  $\hat{i} - i_d$  increases.

*Figure 2 - Comparative statics on the gains from changing*



When the gains are small the downstream firm is able to build its reputation for trustworthiness, while keeping suppliers independent: it is the golden age of the industrial district, which maintains its cohesion and its traditional organizational equilibrium. As the gains from changing increase, the temptation of a change of supplier increasingly hinders the ability of the downstream firm to build a reputation for trustworthiness while staying independent and the downstream firm has to trade-off flexibility for cooperation by vertically integrating with the local supplier: the defensive reaction of the main firms of the district is able to succeed in maintaining their competitiveness by consolidating their strategic advantage in term of quality produced through cooperation; yet the industrial district partially change its organizational setting and the average size of the firms belonging to it increases. Finally, when the gains from changing supplier are very large, because cost competition from foreign suppliers overcomes the local ones, a complete organizational breakdown of the district may occur.

In the face of the process of increasing integration of markets at international level, the three scenarios just described might be thought of as stages of an irreversible sequential process, where the organizational setting of industrial districts is increasingly suffering from competition of low cost suppliers and, after a period of resistance characterised by a defensive concentration process, is bound to succumb. However, the second and third scenario might also be considered as alternative possible outcomes: the breakdown

of the system is a possibility, but vertical integration and the rise of the average size may foster a rise in efficiency and quality that neutralizes harsh cost competition from abroad.

#### **4. Conclusion**

Cooperative behaviour in the interactions between firms seems to be a basic ingredient for the success of industrial districts, allowing them to preserve the high quality standard of their productions. A rational choice account of the emergence of such cooperative attitudes highlights the importance of stability and long-term relationships to foster them.

However, in an increasingly internationally integrated input market long-term relationships between final firms and suppliers of intermediate goods are difficult to sustain without some form of commitment, binding the parties to each other. Hence, final firms are forced to trade-off the flexibility of being able to change partners at will for the ability to foster cooperation. That amounts to a shift from informal understandings to binding agreements or even fully-fledged vertical integration and it is a first step towards a change in the nature of the organisational setting that prevails within the district.

When the competition of suppliers external to the district, usually based on costs, becomes too strong and the firms belonging to the district are not able to respond by increasing products quality, furtherly taking advantage of cooperative attitudes, the organisational setting of the district may reach a complete breakdown.



The present paper try to substantiate the above account through a simple theoretical model.

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