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Social Capital and Informal Contracting: Experimental Evidence

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Abstract

Informal contracting is widely spread, but what makes it work in the absence of institutional enforcement and repetition? According to game-theoretic models of social capital, informal relationships can help agents self-enforce contracts when third-party enforcement is not available, because agents can use network links as a form of "collateral". While recent empirical studies find a link between network proximity and the ability to self-enforce contracts, it is unclear whether this effect is mediated by agents behaving altruistically or whether they are responding to incentives to preserve their network status. Additionally, the endogeneity of natural networks makes econometric identification of these effects challenging. In this study, I estimate a structural decision model in which both mechanisms are present but distinct, using experimental gameplay data from the administration of an Optional Prisoner's Dilemma. The game is framed to mimic a situation of informal exchange. I find the gameplay to be consistent with the "social collateral" channel, but not with the "directed altruism" channel.

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1. INTRODUCTION

Historical and contemporary examples of economic networks that do not rely on either institutional contract enforcement or repetition abound. Even large developed countries are known to harbor vast shadow economies, where one-off agreements that are not legally enforceable routinely occur.

How do agents overcome the commitment problem that arises when engaging in informal contracting? One emerging hypothesis is that, absent third-party enforcement, the social capital (trust) that is embedded in informal networks might be able to facilitate contracting.

This idea has found some empirical support. Chandrasekhar, Kinnan, and Larreguy (2018) found that agents who are more closely connected in a social network are more likely to write contracts and less likely to renege on them when no external enforcement is present.

However, there are two competing mechanisms that can explain this result. One is the so-called "social collateral" model of trust (Karlan et al., 2009). According to this theory, agents derive utility from network links, and these can be removed when an agent breaks a contract. The resulting utility loss provides a disincentive to cheating. Agents that are connected in multiple ways through the network have more "social collateral", and can therefore self-enforce larger contracts when third-party enforcement is not available. Another explanation is offered by "directed altruism" (Leider et al., 2009): that is, agents behave altruistically towards network peers to whom they are more closely-connected.

The aim of this study is to investigate whether social collateral or directed altruism best explain empirical patterns of informal contracting. In other words: do agents that engage in informal contracting behave as "homo economicus" (social collateral) "homo socialis" (directed altruism), or a combination of both?

In order to separately estimate the effect of social collateral and directed altruism, I designed a game that mimics a situation of contracting without commitment and I administered it to a network of high school students from southern Italy. I used gameplay data to estimate a structural model in which the utility penalty from cheating on a connection is represented by two parameters. One captures directed altruism while the other captures social collateral.

2. THE GAME

The game administered in this study is a type of Optional Prisoner's Dilemma (Cardinot et al., 2016), and it simulates a situation of exchange without commitment.

There are two players: Red and Black. Red receives a standard black suit card (i.e. seven of clubs) and a blank (white) card. Black receives a standard red suit card (i.e. jack of diamonds) and a blank card. The cards have a subjective monetary value that determines the payoffs. The red suit card is worth €15 to Black and €30 to Red. The black suit card is worth €15 to Red and €30 to Black. Blank cards are worthless to both players.

Each player can choose to trade their regular card in exchange for the other player's regular card. The trade only occurs if both players agree to it. The players' subjective valuation of the cards implies that there are gains from trade of €15 for each player.

Players have an option to "cheat" on the agreement. They do so by delivering, instead of the regular card, the blank card. I add this "opt-in" stage to the classical prisoner's dilemma in order to clearly frame the game as a situation of exchange without commitment (under a typical prisoner's dilemma, the subjects might behave differently as they would effectively be "forced" to trade).

If either of the two players agrees to the trade and cheats, while the other player agrees to the trade but does not cheat, the cheater realizes a payoff of €45, while the other receives €0. If both players agree to the trade and do not cheat, they both receive €30.

The strategy space available to the players can be represented as follows. A player is said to play *Abstain* (A) if she does not agree to the trade; *Cooperate* (C) if she agrees to the trade and does not cheat; *Defect* (D) if she agrees to the trade and then cheats. The game's monetary payoffs are summarized in Exhibit 1.

EXHIBIT 1. Monetary payoff matrix of the Optional Prisoner's Dilemma

		Red		
		Abstain	Cooperate	Defect
Black	Abstain	15, 15	15, 15	15, 15
	Cooperate	15, 15	30, 30	0, 45
	Defect	15, 15	45, 0	15, 15

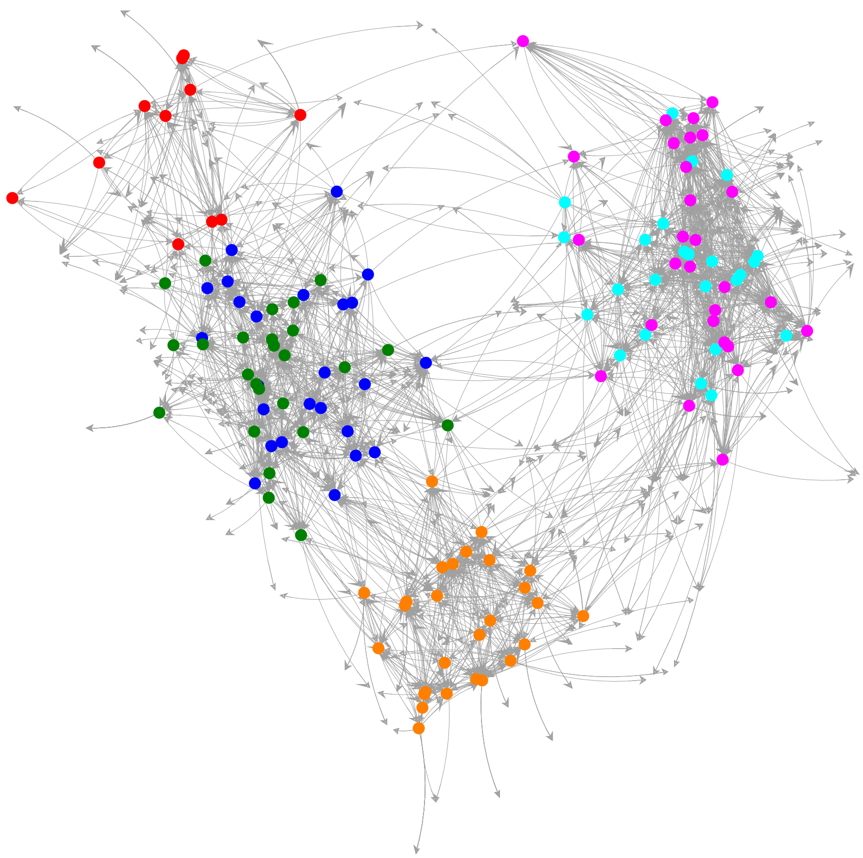
3. EXPERIMENTAL SETUP AND TREATMENTS

I recruited 132 students from six classes of a high school in southern Italy. Ahead of the experiment, I mapped their friendships network using an online survey. Subjects were asked to report their top eight school friends, both within and outside their class. Exhibit 2 shows a map of the network. Each color represents one of the six classes involved in the study. Students that are reported as "friends" but do not belong to the recruited classes are represented by an empty space.

I adopt a double treatment arm design, in order to empirically separate the effect of social collateral from directed altruism, as do Leider et al. (2009): the underlying idea is that social collateral requires observability of a partner's action, while directed altruism does not.

Recruited students played, anonymously, the game described in section 2. They were randomly assigned to one of four possible treatment conditions, along two treatment arms: a *Connectivity*

EXHIBIT 2. Network of friendships among the subjects



arm and a *Visibility* arm. If a subject was assigned to the *Connectivit*y treatment, she would be paired to play with another student, from a different class, with whom she had at least one friend in common. Otherwise, she would play with a student from a different class with whom she had no friends in common. I do not allow the matching of direct friends, in order to control for repeated interaction.

The reason I focus on the presence of a common friend is that the amount of social collateral between node pairs is determined by the number of edge-independent paths (Karlan et al., 2009), and the number of common friends coincides with the number of edge-independent paths of length two. At the same time, the presence of a common friend is a piece of information that can be easily understood by high school students.

Students assigned to the *Visibility* treatment were informed that, by taking part in the experiment, they consented to reveal their identity to their partner at the end of the experiment. *Invisible* pairs were instead explicitly told their identities would remain undisclosed.

My design also attempts to control for two topological features that are likely to apply to this network: 1) *community structure*, which occurs when nodes are clustered and edges are more likely to form within clusters than across clusters (Girvan and Newman, 2002); 2) *homophily*, which is the tendency of nodes to link to other nodes which are similar across a given attribute space

EXHIBIT 3. Utility payoff matrix of the Optional Prisoner's Dilemma

		Red		
		Abstain	Cooperate	Defect
Black	Abstain	$u(15), u(15)$	$u(15), u(15)$	$u(15), u(15)$
	Cooperate	$u(15), u(15)$	$u(30), u(30)$	$0, [u(45) - u(\theta)x_{ij} - u(V)x_{ij}z_{ij}]$
	Defect	$u(15), u(15)$	$[u(45) - u(\theta)x_{ij} - u(V)x_{ij}z_{ij}], 0$	$u(15), u(15)$

(McPherson, Smith-Lovin, and Cook, 2001). When we vary the relative position of contracting pairs, we are also likely varying community membership and node similarity, both of which are generally not observed and can act as confounder.

As can be seen in Exhibit 2, the community structure of the network of friendships is well approximated by class membership. By only pairing students that are not classmates I control for community structure in the friendships network. Through anonymity, I control for potential homophily.

4. STRUCTURAL MODEL

The following structural model is used to analyze the gameplay data. Let y_i be the monetary payoff to player i, who is matched to player j; let $S_i \in \{A, C, D\}$ be player i's strategy, and define

$$\pi_{ij} \triangleq \mathbb{P}_i\left(S_j = D \middle| S_j \in \{C, D\}\right) \tag{1}$$

player i's subjective probability of her partner j defecting, conditional on j accepting the trade. i's utility (as a function of the strategy), conditional on j accepting the trade, is therefore

$$\begin{aligned} U_i(A) &= u(15) \\ U_i(C) &= u(30)\left(1 - \pi_{ij}\right) \\ U_i(D) &= u(15)\pi_{ij} + \left[u(45) - u(\theta)x_{ij} - u(V)x_{ij}z_{ij}\right]\left(1 - \pi_{ij}\right) \end{aligned} \tag{2}$$

where x_{ij} is a dummy variable that evaluates to one if the (i, j) pair receives connectivity treatment (i.e. i and j have at least one friend in common) and z_{ij} is a dummy variable that evaluates to one if the (i, j) pair receives the visibility treatment; $u(\cdot)$ is the players' utility for money.

To model the players' valuation of the punishment that they receive for defecting, I use the parameters θ and V. The "directed altruism" parameter θ measures, in Euros, i's disutility from cheating when i and j receive the connectivity treatment, regardless of whether they also receive the visibility treatment. The "social collateral" parameter V measures, in Euros, i's disutility from cheating when i and j receive the connectivity treatment as well as the visibility treatment.

The model above assumes that the players are "punished" for defecting only when the other player cooperates. The reason I assume that the disutility from defecting does not apply in the Defect-Abstain strategy profile is that, in a real-life exchange scenario, the abstaining player does not usually get to observe the other player's strategy. The reason I assume that the disutility from defecting does not apply in the Defect-Defect strategy profile is because of the potential for collusion: suppose there was a punishment applied to both players for defecting; then, the defecting players would have an incentive to collude and *not* punish each others' defection through the network. It is important to note that this operationalization of the *directed altruism* and *social collateral* channels is specific to the game I use and that an alternative definition might be more suitable for a different game or framing.

I posit a multinomial logit model for individual i's gameplay; the probability of i playing strategy $S \in \{A, C, D\}$ is given by:

$$\mathbb{P}(S_i = S) = \frac{\exp\left[\frac{1}{\sigma} U_i(S)\right]}{\exp\left[\frac{1}{\sigma} U_i(A)\right] + \exp\left[\frac{1}{\sigma} U_i(C)\right] + \exp\left[\frac{1}{\sigma} U_i(D)\right]} \tag{3}$$

The parameter σ controls the amount of individual-level "randomness" in the model.

EXHIBIT 4. Summary gameplay data

	Treatment Groups			
	Disconnected Invisible	Disconnected Visible	Connected Invisible	Connected Visible
Abstain	0.118 (0.055)	0.125 (0.058)	0.086 (0.047)	0.188 (0.069)
Cooperate	0.303 (0.080)	0.344 (0.084)	0.286 (0.076)	0.313 (0.082)
Defect	0.606 (0.085)	0.531 (0.088)	0.629 (0.082)	0.500 (0.088)
π_{ij} (predicted)	0.689 (0.034)	0.626 (0.038)	0.657 (0.037)	0.643 (0.038)
π_{ij} (realized)	0.667 (0.086)	0.607 (0.092)	0.688 (0.082)	0.615 (0.095)
N	33	32	35	32

Standard errors in parentheses

5. FINDINGS

Exhibit 4 summarizes gameplay data, by treatment group.[1] *Defect* was the most common strategy; this can easily be reconciled with the fact that it is a dominant strategy in monetary payoffs. Yet, there were high percentages of subjects playing *Cooperate* and (less frequently) *Abstain*. The Connected/Visible group stands out as the one with the lowest propensity to *Defect* and the highest propensity to *Abstain*.

The subjects' predicted probability that their partner cheated, conditional on trade occurring $\left(\pi_{ij}\right)$, was elicited in a follow-up survey. This is a key input in the structural model; as it can be seen, it closely approximates the actual realized probability of cheating.

In Exhibit 5, I present Maximum Likelihood parameter estimates for the decision model of Section 4. This is a non-standard multinomial logit model, in that the probabilities of choosing each strategy are non-linear in the parameters. It was estimated using the `mlexp` routine in STATA, and standard errors were clustered at the class level.

Each column presents estimates for a different functional form of the money utility, namely: Constant Relative Risk Aversion (CRRA)

$$u^{CRRA}\left(y_i\right) = \begin{cases} \frac{y_i^{1-\phi}-1}{1-\phi} & if\ \phi \neq 1 \\ \log\left(y_i\right) & if\ \phi = 1 \end{cases} \tag{4}$$

Constant Absolute Risk Aversion (CARA)

$$u^{CARA}\left(y_i\right) = \begin{cases} \frac{1-\exp(-\phi y_i)}{\phi} & if\ \phi \neq 0 \\ y_i & if\ \phi = 0 \end{cases} \tag{5}$$

and a special case of Hyperbolic Absolute Risk Aversion (HARA),

$$u^{HARA}\left(y_i\right) = \begin{cases} \frac{(1+y_i)^{1-\phi}-1}{1-\phi} & if\ \phi \neq 1 \\ \log\left(1+y_i\right) & if\ \phi = 1 \end{cases} \tag{6}$$

In order to ensure that the money utility is well defined, θ and V are constrained to be non-negative. Hence, significance tests for these parameters are one-sided (H_0 : parameter $= 0$; H_1 : parameter $>$ 0). The test for ϕ is two-sided, and the null hypothesis is risk-neutrality.

In all three specifications, I estimate a social collateral parameter V that is positive and statistically different from zero. All estimates of V are within 30 cents of €26.50, which is sufficiently large to deter a significant percentage of the players from cheating.

[1] Some treatment groups might have an odd number of players, due to the fact that randomization was done within classes and some classes had an odd number of students. Students that were left without a match were matched to a fictitious counterpart that played "Cooperate" and compensated accordingly.

EXHIBIT 5. Structural model parameter estimates

	Dependent Variable:	Strategy $\in$ {Abstain, Cooperate, Defect}		
ϕ	Risk Aversion	-0.682** (0.255)	-0.034* (0.014)	-0.756** (0.265)
θ	Directed Altruism (€)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
V	Social Collateral (€)	26.580** (7.368)	26.298** (9.570)	26.756** (7.435)
N	Observations	132	132	132
$u(\cdot)$	Money Utility	CRRA	CARA	HARA

Cluster-robust standard errors in parentheses; $^{*}p < .05$, $^{**}p < .01$

Directed altruism does not appear to play a role: the estimate of θ is statistically indistinguishable from zero in all three specifications. The money concavity parameter ϕ is negative and statistically significant, indicating that risk neutrality is rejected in favor of risk-loving behavior.

These findings provide evidence in support of the hypothesis that social capital can facilitate informal contracting by opportunely acting as a form of collateral. Because the sample size is modest, these experimental results should be interpreted as preliminary.

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