Games and Economic Behavior 124 (2020) 354–368

Contents lists available at ScienceDirect

Games and Economic Behavior

www.elsevier.com/locate/geb

Can intermediaries assure contracts? Experimental evidence ☆

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ARTICLE INFO

Article history:
Received 4 October 2018
Available online 3 September 2020

JEL classification:
C91
D03

Keywords:
Experimental economics
Optional prisoner's dilemma
Pre-commitment
Reputation
Intermediary institutions
Information
Enforcement
Reciprocity

ABSTRACT

We model economic transactions as prisoner's dilemma games with an outside option played by randomly matched pairs drawn from an anonymous population. In this environment, two intermediary institutions are studied who punish their customers for cheating. One institution does so by enforcing payment of a fine, while the other inflicts a bad reputation on the customer. By voluntarily becoming a customer of an intermediary institution, a player can signal her pre-commitment to honest action to the transaction party. The paper reports experimental results, which show that such a pre-commitment practice fosters cooperation and improves efficiency relative to the setting without intermediation. The results show that when the intermediary imposes a fine on customers for cheating, behavior moves towards the social optimum. In contrast, when the intermediary has only a mandate to impose a bad reputation score on cheating customers, efficiency gains are small compared to a situation without any intermediary.

1. Introduction

In (almost) all bilateral economic transactions both trading parties have an opportunity to make a gain at the expense of the other. A seller can cheat on quality; a buyer can cheat on payment. When they fear a loss from fraud, prospective market participants may avoid transactions that would be mutually beneficial. They need contractual assurance promoting both honest play and trust in the transaction. In markets where no law allocates contractual assurance, private intermediation has established as an alternative mode of governance. Intermediary institutions have evolved either in decentralized or in monopolistic structures. Feedback forums on computer platforms in Internet markets (Resnick et al., 2000) and 'gossip networks' in emerging markets (McMillan and Woodruff, 2000) induce a decentralization of intermediation. Monopolistic structures of intermediation dominate, for instance, in the shadow economy (Gambetta, 1993). In India, the non-profit organization Janaagraha established 2010 the website IPaidABribe, where citizens can report actual corrupt acts. Regions obtain a bad reputation when frequent reports of bribes emerge. Local governments face then political pressure to improve

☆ We thank John Hey and Manuel Guerrero Martos for their invaluable support of this research. The comments of two anonymous reviewers and the advisory editor helped to enhance the article as well as the comments of Helga Fehr-Duda, Werner Güth, Stefan Homburg, B.-Andrea Kanteh, Malte Loos, Howard Margolis, Stefan Traub, Ulrich Schmidt, J. Matthias von der Schulenburg, Gerald Seidel, Maros Servatka, Marc Willinger and the seminar participants at Jena, Leuven, Kiel, Amsterdam, Dresden, Tucson, Hannover and Montpellier. Financing of the experiments through the EU-TMR Research Network ENDEAR (FMRX-CT98-0238) and the Fond National de la Recherche Luxembourg (INTER/RCUK/16/11555355 EXPBOTS) is gratefully acknowledged. Michael Mitzkewitz acknowledges research funding by the Fond National de la Recherche Luxembourg (INTER/RCUK/16/11555355 EXPBOTS).
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https://doi.org/10.1016/j.geb.2020.08.004

measures against corruption. Ryvkin et al. (2017) model a comparable information-sharing system and investigate it in the laboratory. Their results suggest that the mere existence of an intermediary institution like IPaidABribe is insufficient to systematically lower bribery. Additional requirements on the quality of information are necessary to improve efficiency. Cason et al. (2016) report on experiments analyzing the impact of social information schemes for achieving compliance. Akin to the results of Ryvkin et al. (2017), Cason et al. (2016) observe frequent misreporting which undermines the efficiency of a feedback institution.

The service intermediary institutions offer to transaction parties consists either in the dissemination of information on past cheating or in enforcement actions.[2] The theoretical literature suggests that information unveiling cheaters and the punishment of cheaters are crucial ingredients to inducing honest play in a population (Dixit, 2003). This paper is inspired by Dixit's model and reports on a laboratory study that investigates the efficiency enhancing effect of two highly stylized intermediary institutions, referred to as INFO and ENFO. **INFO** records and disseminates **info**rmation about past cheating. In contrast, **ENFO** may **enfo**rce a fine on cheaters. Neither INFO nor ENFO have legal mandates to punish cheaters. Individuals become voluntarily customers of an institution or not. The subsequent economic transaction is modeled as a prisoner's dilemma game (PDG) featuring an outside option. This outside option is embedded in the model to control for the influence of the intermediary institutions on the frequencies of transactions and not only on the outcomes of transactions. It accounts for the fact that people cannot usually be forced to agree to a contract and that they have the right to refuse any particular transaction party. A customer of an intermediary institution unilaterally pre-commits to receiving a determined punishment for cheating in the PDG. Therefore, the present study also contributes to the literature on the resolution of the PDG (e.g., Kreps et al., 1982; Kandori, 1992; Ellison, 1994; Nowak and Sigmund, 1998a,b; Dixit, 2003). The pre-commitment option to become a customer of the intermediary institution contrasts with the laboratory institutions of reputation and enforcement available in the literature, which establish participation by default.[3] Only Andreoni's (2005) nonbinding optional satisfaction guarantee treatment may have similar degrees of freedom as our institutions. We propose to study the pre-commitment options as well as the outside option because such options are realistic features of contract assurance.

Feedback reputation systems in person-to-person online auction markets[4] and credit-rating agencies perform a similar contract assurance task as INFO. ENFO involves an economic assurance comparable to contractual liability or collateral which imply accountability in case of contract breach. Treaties involve liabilities to which willing countries agree under international law. Satisfaction guarantees are voluntary liabilities of sellers to enthrall buyers. Collaterals like dead pledge, mortgage or bail are usually compulsory to the contract and requested on a take-it-or-leave-it basis, but the contract taker still accepts them voluntarily. A striking example of collaboration amid voluntary enforcement comes from China before the communist regime, where independent riverboat pullers agreed to hire a monitor to whip them in case of weak effort, as reported in Cheung (1983, p. 8).

We report the experimental results related to five treatments: a baseline treatment without an intermediary institution, and two treatments for ENFO as well as for INFO. The two treatments for the same kind of institution differ in only one parameter value as explained in Section 2. The main results can be summarized as follows. First, both institutions increase the probability of transactions and the number of efficient outcomes compared to the baseline treatment. Second, given the chosen parameter values of our treatments, ENFO's welfare enhancing effect is greater than that of INFO. Third, over time behavior slowly moves towards the social optimum under ENFO, but under INFO behavior slowly moves towards the inefficient non-cooperative solution. Fourth, in the ENFO treatments a larger fine improves efficiency more than a smaller one. These results suggest that privately organized intermediary institutions between potential trading partners could boost welfare, but outcomes are highly sensitive to institutional design and to parameter values. In this respect, our results for a rather general approach resemble the results of both Cason et al. (2016) and Ryvkin et al. (2017) for specific situations.

The paper is organized as follows. Section 2 presents the experimental design and explains the specifications of the INFO institution and the ENFO institution. Section 3 states testable hypotheses based on theoretical considerations and findings of the experimental literature. Results are presented in Section 4. Section 5 concludes, discusses the implementation of intermediary institutions, and proposes directions for further research.

2. Experimental design

The paper reports on five treatments to which we refer hereafter as BASELINE, ENFO(10), ENFO(20), INFO(0) and INFO(.5).[5] The experiments were conducted at the universities of York (UK) and Hannover (Germany). They were computerized using the software package z-Tree (Fischbacher, 2007) and z-tree unleashed (Duch et al., 2020). A total of 240

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[2] In reality, punitive measures against cheaters involve monetary fines, exclusion from transactions by boycott (Greif, 1993; Clay, 1997), blacklisting (Weidenbaum and Hughes, 1996), or ostracism (Hirshleifer and Rasmusen, 1989).

[3] Reputation effects have been studied for example in the PDG (Hauk, 2003; Hauk and Nagel, 2001; Riedl and Ule, 2003; Cassar, 2007), in the image scoring game (Wedekind and Milinski, 2000; Bolton et al., 2005; Seinen and Schram, 2006), in the trust-game (Andreoni, 2005), in a transaction game (Bolton et al., 2004; Dulleck et al., 2011), and in field experiments on the Internet (see the survey of Resnick et al., 2006). Only a few studies have dedicated to the impact of enforcement institutions on cooperation (Bohnet et al., 2001; Gneezy, 2003; Andreoni, 2005).

[4] The Internet auction house eBay, among others, runs a feedback forum that allows sellers and buyers to state their satisfaction or dissatisfaction about the trading partner. Several field studies on eBay have reported that prices and demand for merchandise is greater for sellers with good reputation than for those with bad reputation or without reputation (Resnick et al., 2006).

[5] We use the terms "ENFO" and "INFO" both for treatments and for institutions if no confusion is possible.

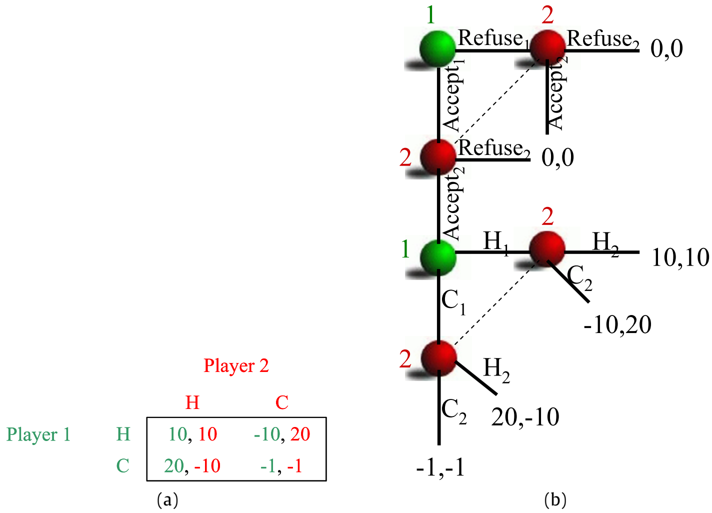


Fig. 1. (a) Prisoner's dilemma game (PDG). (b) BASELINE: Optional prisoner's dilemma game (OPDG).

subjects (5 (treatments) × 6 (cohorts) × 8 (subjects)) participated in the experiment. Subjects interacted in two-person games anonymously for 50 rounds within a cohort of eight participants. Every subject participated only in one cohort under the conditions of one treatment. Within their cohort, subjects were randomly re-matched with another in every round. Each subject was initially endowed with a balance of 600 tokens to which (potentially negative) round payoffs were added after every round. At the end of the experiment, subjects received their final balance paid out in cash. Each token was exchanged for one British Pence Sterling in York and for two Eurocent in Hannover. The average payoff was £7 and €11. The experiment lasted one hour.

BASELINE. This treatment is based on a two-player PDG. Each party i might either 'cheat' C_i (frequently referred to as 'defect') or play 'honest' H_i (i.e., 'cooperate'), $i = 1, 2$. Fig. 1a presents the PDG in normal form including the payoffs in tokens. The design involves a symmetric setting; thus, the index i denotes any of the two players. In the dominant strategy equilibrium of the PDG both players play C_i and lose one token. Conversely, in the cooperative solution both play H_i and win 10 tokens each. Finally, if one plays honest while the other cheats, the cheating [honest] player wins 20 [loses 10] tokens. In each of the 50 rounds an optional prisoner's dilemma (OPDG) is played. In the first stage, each player has the option to refuse or to accept to interact with the other one. Fig. 1b represents the resulting OPDG. The dashed lines in Fig. 1b indicate player 2's information sets. If at least one player chooses Refuse_i, the game ends, and both players receive a zero payoff. Only if both players choose Accept_i, the PDG is played out in the second stage. If the PDG is played, we say that *a transaction takes place*.

ENFO(10) and ENFO(20). In these two treatments, the game extends the OPDG by inclusion of a 'pre-stage' decision to subjects' refusal option, which affects the payoffs. At that first stage of the thus constructed three-stage game, each subject decides whether to become a customer of the intermediary institution ENFO or not (see Fig. 2). A customer of ENFO must pay a fine f if she plays action C_i in the PDG. A non-customer, i.e., a player who chooses *No ENFO*$_i$, faces the (potential) own payoffs identical to BASELINE as presented in Fig. 1b except that the other is informed about this choice. The decision to 'buy' ENFO is independent across rounds. The two treatments ENFO(10) and ENFO(20) impose a fine of $f = 10$ and $f = 20$ on cheating customers, respectively.

INFO(0) and INFO(.5). Analogously to ENFO, players simultaneously decide to 'buy' INFO at the first stage of the three-stage game. The game tree featuring the INFO treatments is represented in Fig. 3. Note that, also analogously to the ENFO treatment, the choice to buy INFO is independent across the rounds of the repeated game; one is a customer of the intermediary INFO only in the round in which one chooses INFO. In contrast to ENFO, the purchase of INFO has implications for the following rounds. The action of INFO's customer is recorded (see details below). The purchase of INFO involves a service cost c regardless of the outcome of the game. The cost to customers of INFO is $c = 1/2$ token in INFO(.5), and is $c = 0$ in INFO(0). A non-customer, i.e., a player who chooses *No INFO*$_i$, faces the same possible consequences in the remaining OPDG as a player in BASELINE, except that the other player is informed about this choice. The information the intermediary has on each customer involves a "bad reputation" record acquired in the past. This record includes five binary entries, which correspond to the five most recent games played by the individual when she was a customer of INFO.[6] At the outset of

[6] If the "cheat score" would involve the whole history, a customer of INFO who erroneously chose C_i in an early round would have a bad reputation throughout the experiment. Hence, we enabled subjects to regain a zero cheat score for repeated well behaving. Reputation scores have already been used in some experimental studies. In the image scoring game, subjects learn their counterpart's action in a limited number of previous periods

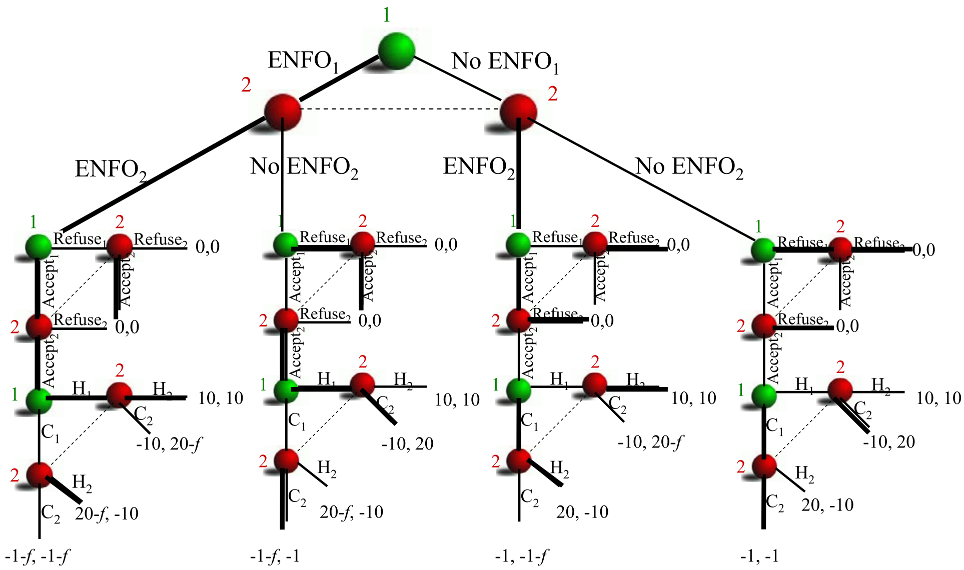
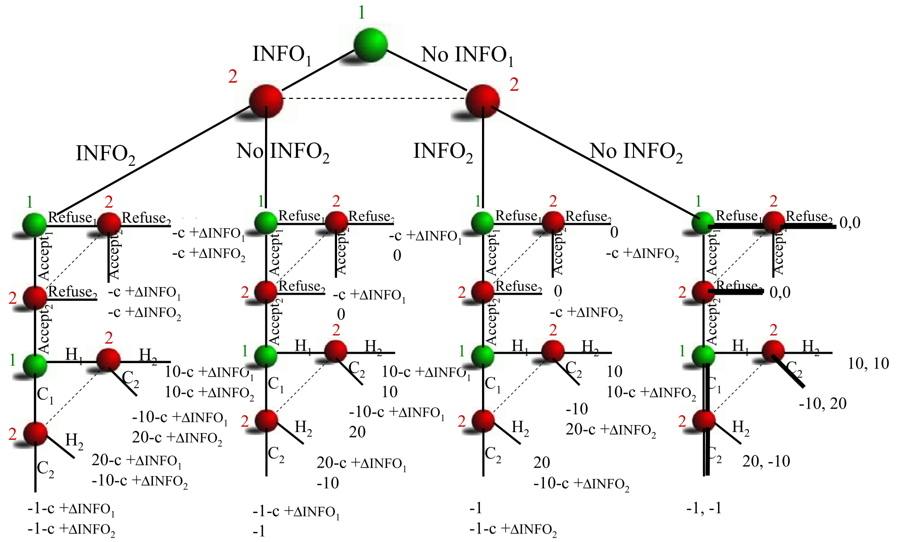


Fig. 2. ENFO: three stage game ($f = 10$ [20] in ENFO(10) [ENFO(20)]).



Note: ΔINFO$_i$ (change of i's bad reputation record) is a *nonmonetary* payoff. Intermediary cost is $c = 0$ [1/2] in INFO(0) [INFO(.5)].

Fig. 3. INFO: three stage game.

the experiment, all entries in the record equal zero. The record of INFO's customer is updated as follows: the fifth latest entry elapses, the other four entries shift each one position further, and the first entry is set to one if the customer plays C_i, and zero if she plays H_i *or if no transaction takes place*. Thus, the sum of the five entries of a bad reputation record INFO$_i$ changes by $\Delta\text{INFO}_i \in \{+1, 0, -1\}$.[7] For non-customers the record of entries does not change, $\Delta\text{INFO}_i = 0$ (see Fig. 3). If a player becomes a customer of INFO, her cheat score INFO$_i$ is posted to the trading party prior to the OPDG.[8]

(Wedekind and Milinski, 2000 Bolton et al., 2005; Seinen and Schram, 2006). Bolton et al. (2004) give to each player the full transaction record of the counterpart. Different from the literature, our subjects have an option as they decide on revealing information on their cheat score to the counterpart or not.

[7] We use the notation "INFO$_i$" both for individual i's choice to become a customer of the intermediary institution INFO and for individual i's sum of the five entries of his bad reputation records, if no confusion is possible.

[8] Before a subject decided to buy INFO or not her bad reputation cheat score was displayed on her screen and she was reminded that buying INFO implied both: the revelation of her bad reputation cheat score INFO$_i$ to the randomly matched partner and the recording of her action in the PDG.

3. Hypotheses

In this section, we state testable hypotheses for the outcomes of the five treatments. The predictions resulting from the assumption of fully rational behavior are easily obtained by backward induction.

Hypothesis 1. Treatment independently, subjects behave according to subgame perfectness. This means:

a) BASELINE. Individuals choose the refusal option and no transaction takes place.
b) INFO(0) and INFO(.5). Individuals do not buy INFO, choose the refusal option, and no transaction takes place.
c) ENFO(10) and ENFO(20). Individuals buy ENFO, choose Accept$_i$, and play H$_i$ when they are matched with another customer of ENFO. Non-customers are excluded from transaction.[9]

Because subgame perfectness suggests the transaction takes place in ENFO(10) and ENFO(20) but not in BASELINE, INFO(0), and INFO(.5), we also formulate a weaker hypothesis:

Hypothesis 2. The relative frequency of choosing to accept is in ENFO greater than in INFO and in BASELINE.

Subgame perfectness predicts the same decisions for INFO(0) and for INFO(.5) on the one hand (see Hypothesis 1b), and for ENFO(10) and ENFO(20) on the other hand (see Hypothesis 1c). Therefore, Hypotheses 3 and 4 require that the parameter values do not have an influence on the performance of the respective institution.

Hypothesis 3. There are no behavioral differences between INFO(0) and INFO(.5).

Hypothesis 4. There are no behavioral differences between ENFO(10) and ENFO(20).

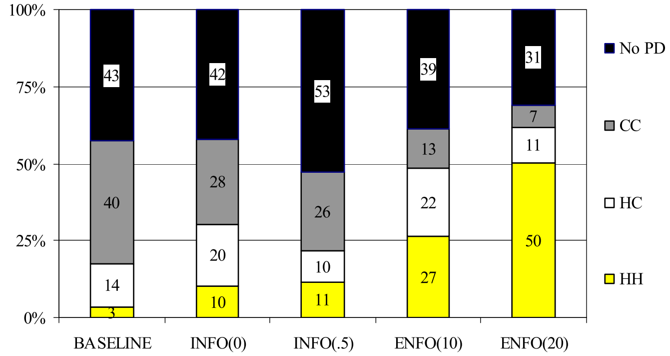
For many games of interest, subgame perfectness is a weak predictor of actual behavior as the experimental literature shows (e.g., Selten and Stoecker, 1986). Therefore, a rejection of Hypotheses 1 or 4 would not be surprising, but it also should not be the end of our story. Some models (e.g., contagious punishment with homogeneous agents; Kandori, 1992; Ellison, 1994) show that cooperation can arise in the PDG with anonymous matching.[10] Experimental evidence suggests that several possible sources for cooperation exist in the OPDG. First, the option to refuse may be used more frequently by non-cooperative subjects because they expect to be cheated by the others, too (Orbell and Dawes, 1993; Hauk, 2003; Hauk and Nagel, 2001). Second, the great surplus of mutual honest play relative to mutual play of cheat (Rapoport and Chammah, 1965) and the negative payoffs for mutual play of cheat have been reported to foster cooperation (Hauk, 2003). Finally, a 'partner' framing is used in the instructions (see the online appendix (section B)). Burnham et al. (2000) show that such a framing may raise cooperation levels. These findings suggest the following hypothesis.

Hypothesis 5. If subjects forego the option to refuse and a transaction takes place, they play honest, independent of the treatment.

Results of laboratory and field experiments suggest that high cooperation levels are possible within frameworks related to INFO. First, in the repeated multiple-players PDG, information feedback on each player's past behavior can induce high cooperation levels (Hauk, 2003; Hauk and Nagel, 2001; Riedl and Ule, 2003; for a literature survey, see Kosfeld, 2004). Subjects who play honest in the past are preferred future partners; they may associate in small subgroups and refuse to play with others who previously cheated. Second, in experiments with the image scoring game where one can either help (being the efficient collective action) or hurt, feedback on past actions significantly increased helping levels (Wedekind and Milinski, 2000 Seinen and Schram, 2006; Bolton et al., 2005). Third, in an experiment with a closely related sequential transaction game in which a buyer submits a payment or opts out and the seller decides to ship or not, Bolton et al. (2004) report a positive effect of reputation feedback on cooperation compared to the benchmark of random matching without reputation. Finally, several field studies on Internet markets also suggest that the goodness of a seller's reputation

[9] For a customer of ENFO(10) [ENFO(20)], playing honest is the weakly [strictly] dominant action in the PDG. Margolis (2007) calls our game involving ENFO the "convertible prisoner's dilemma game". The bold lines in Fig. 2 indicate the *symmetric* subgame perfect equilibrium strategy (ENFO$_i$, (Accept$_i$|ENFO$_j$, Refuse$_i$|No ENFO$_j$), (H$_i$|ENFO$_i$, C$_i$|No ENFO$_i$)), $i, j = 1, 2, i \neq j$, of the one-shot game. This strategy reads as follows: player i plays H$_i$ at the third stage if she is ENFO's customer and C$_i$ if she is a non-customer, she chooses Accept$_i$ at the second stage if the other has chosen ENFO$_j$, $j \neq i$, and Refuse$_i$ if the other has chosen No ENFO$_j$, and she chooses ENFO$_i$ at the first stage. There are other subgame perfect equilibria with only one party refusing.

[10] Duffy and Ochs (2009) present an experimental test of the Kandori-Ellison hypothesis, i.e. that cooperation evolves due to the threat of contagious punishment. However, they observed hardly any cooperation.



'HH' denotes mutual play of honest. 'CC' denotes mutual play of cheat. 'HC' denotes play of honest by one player and cheat by the other. 'No PD' denotes refusal by at least one subject. Game outcomes averaged over all rounds in percent. ENFO(10) [ENFO(20)] represents the ENFO institutional treatment involving a fine of $f = 10$ [20] tokens for playing cheat, C. INFO(.5) [INFO(0)] represents the INFO institutional treatment involving the reputation score and a service cost of $c = 1/2$ [$c = 0$].

Fig. 4. Relative frequency of game outcomes (in percent).

is positively correlated with demand for her goods and the auction prices she earns (see the survey of Resnick et al., 2006). However, Dulleck et al. (2011) find in experimental markets for credence goods little influence on efficiency when sellers can build up reputation.

A customer of INFO can build up reputation on account of her past behavior. If transaction parties only accept customers with good reputation (i.e., zero cheat score), these are better off. We introduce the *honest strategy* as follows: (INFO_i, ($\text{Accept}_i|(\text{INFO}_j = 0)$, $\text{Refuse}_i|(\text{INFO}_j \neq 0)$), ($\text{H}_i|\text{INFO}_i$, $\text{C}_i|\text{No INFO}_i$)), $i, j = 1, 2$, $i \neq j$.[11] The proposal that the honest strategy may evolve through reputation will be referred to as the 'reputation theory'[12] hereafter. The reputation theory could contribute to explain behavior if the following hypothesis is rejected:

Hypothesis 6. Choices in INFO do not depend on a) the goodness of one's own reputation record, and do not depend on b) the goodness of opponent's reputation record.[13]

According to the reputation theory, it may take time until the INFO institution works. This implies that the relative frequencies of choices might change in the course of the experiment. We test the contrary assumption for INFO(0) and INFO(.5), but also for the other three treatments:

Hypothesis 7. For each treatment, relative frequencies of choices do not change with repetition.

We conjecture this hypothesis for each treatment 7a) BASELINE, 7b) INFO(0), 7c) INFO(.5), 7d) ENFO(10), 7e) ENFO(20).

4. Experimental results

Table 1 surveys the average round payoffs (in tokens), the relative frequencies of average behavior for all treatments, and the corresponding independent group observations. The relative frequencies of the resulting game outcomes for the five treatments are illustrated in Fig. 4.[14]

To test Hypotheses 1 to 5, we first perform 32 OLS dummy-regressions across session averages using the following dummy variables:

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[11] The honest strategy reads: "buy INFO; accept the PDG given the other is a customer with a zero bad reputation cheat score, otherwise refuse; as a customer, play H_i at the third stage, as a non-customer, play C_i."

[12] In contrast to the reputation theory, the reciprocity theory (Nowak and Sigmund, 1998a,b) proposes a social tit-for-tat strategy: the society rewards honest players for their exemplary behavior in the past and sanctions cheaters by exclusion. Therefore, opportunists mimic the tit-for-tat type in the economy. Note that indirect reciprocity and reputation theory suggest playing the honest strategy based on a different rationale. While in the reputation theory agents refuse to play the PDG with a non-customer or a past cheater to protect herself against abuse, the social tit-for-tat type chooses Refuse_i to punish past cheaters.

[13] The goodness of reputation records is ordered as follows, $\text{INFO}_i = \{0, 1, >1, \text{No INFO}_i\}$. Non-customers are considered of having the worst reputation. More than one, one and zero revealed records are better, still better and best, respectively.

[14] Figures A1-A3 in the online appendix (section A) present the evolution of these frequencies for the treatments plotted over time in intervals of ten rounds. Likewise we illustrate in A4 the evolution of the INFO reputation scores. The raw data are provided in the appendix (section C) of the supplementary online material.

Table 1
Relative frequencies of behavior and round payoffs.

	(1) Session	(2) Relative frequency for choosing the intermediary institution in %	(3) Relative frequency to accept (i.e., choose to play PD) in %	(4) Conditional relative frequency to accept if partner has chosen institution in %	(5) Relative frequency for PD being played in %	(6) Relative frequency for H in %	(7) Conditional relative frequency for H in PD in %	(8) Round payoff in tokens
BASELINE	1	–	80.00	–	63.00	9.00	14.29	0.44
	2	–	73.75	–	56.00	6.00	10.71	0.16
	3	–	71.75	–	52.00	2.50	4.81	−0.22
	4	–	69.75	–	49.00	7.25	14.8	0.37
	5	–	68.00	–	48.00	7.00	14.58	0.35
	6	–	87.25	–	77.00	30.50	39.61	2.73
	mean	–	**75.08**	–	**57.50**	**10.38**	**16.47**	**0.64**
	(st.dev.)	–	**(7.26)**	–	**(11.00)**	**(10.09)**	**(11.96)**	**(1.05)**
INFO(0)	7	57.25	81.75	89.96	65.00	29.25	45.00	2.71
	8	53.50	82.00	86.92	66.00	17.75	26.89	1.42
	9	71.75	73.50	80.49	51.50	13.25	25.73	1.04
	10	65.25	64.25	68.97	39.00	5.75	14.74	0.29
	11	53.50	79.50	87.85	60.00	15.50	14.58	1.21
	12	56.75	82.25	95.59	65.00	39.75	61.15	3.81
	mean	**59.67**	**77.21**	**84.96**	**57.75**	**20.21**	**31.35**	**1.75**
	(st.dev.)	**(7.32)**	**(7.15)**	**(9.23)**	**(10.67)**	**(12.24)**	**(18.35)**	**(1.28)**
INFO(.5)	13	12.25	65.50	73.47	46.00	3.75	8.15	−0.08
	14	55.50	70.50	83.78	49.50	22.75	45.96	1.79
	15	61.25	75.75	95.51	52.50	34.50	65.71	3.00
	16	36.50	68.00	91.78	43.00	9.50	22.09	0.48
	17	47.50	67.00	87.37	40.00	16.00	40.00	1.17
	18	30.25	74.75	94.21	53.50	12.50	23.36	0.77
	mean	**40.54**	**70.25**	**87.69**	**47.42**	**16.50**	**34.21**	**1.19**
	(st.dev.)	**(18.02)**	**(4.21)**	**(8.22)**	**(5.36)**	**(10.87)**	**(20.53)**	**(1.09)**
ENFO(10)	19	67.75	73.75	92.25	53.00	27.50	51.89	0.94
	20	70.00	89.75	99.29	80.00	43.50	54.38	2.23
	21	59.25	72.75	97.89	48.50	28.50	58.76	1.93
	22	73.25	84.75	99.66	69.50	54.50	78.42	4.92
	23	68.25	82.25	99.27	65.00	38.25	58.85	2.19
	24	62.00	72.25	91.53	51.00	32.25	63.24	2.05
	mean	**66.75**	**79.25**	**96.65**	**61.17**	**37.42**	**60.92**	**2.38**
	(st.dev.)	**(5.19)**	**(7.36)**	**(3.74)**	**(12.40)**	**(10.34)**	**(9.43)**	**(1.33)**
ENFO(20)	25	76.00	86.25	100.00	72.50	64.25	88.62	6.24
	26	55.25	80.75	99.55	61.50	37.25	60.57	2.59
	27	50.75	75.75	99.51	52.00	37.50	72.12	3.55
	28	71.50	85.25	98.60	71.00	57.00	80.28	4.93
	29	88.50	94.75	99.72	90.00	86.50	96.11	8.55
	30	64.25	81.75	98.05	66.00	53.75	81.44	5.20
	mean	**67.71**	**84.08**	**99.24**	**68.83**	**56.04**	**79.86**	**5.18**
	(st.dev.)	**(13.93)**	**(6.42)**	**(0.75)**	**(12.74)**	**(18.43)**	**(12.45)**	**(2.09)**

$$INFO_k = 1, \text{ if session } k \text{ belongs to treatment INFO(0) or INFO(.5), zero otherwise.}$$

$$ENFO_k = 1, \text{ if session } k \text{ belongs to treatment ENFO(10) or ENFO(20), zero otherwise.}$$

$$INFO(.5)_k = 1, \text{ if session } k \text{ belongs to treatment INFO(.5), zero otherwise.}$$

$$ENFO(20)_k = 1, \text{ if session } k \text{ belongs to treatment ENFO(20), zero otherwise.}$$

Let Y_k be session k's outcome for a specific variable. The regression equations are:

$$Y_k = \beta_0 + \beta_1 INFO_k + \beta_2 ENFO_k + \beta_3 INFO(.5)_k + \beta_2 ENFO(20)_k + \varepsilon_k$$

If the regression contains all 30 sessions (6 observations $\times$ 5 treatments), we include two or four dummy variables. If the regression contains the 24 sessions with intermediary institutions we consider either one or three dummy variables. Finally, if the regression includes 12 sessions of the INFO [ENFO] treatments, we consider one dummy variable for the differential treatment effect. The variables of columns (2), (3), (4), (6), (7), and (8) of Table 1 represent the dependent regression variables, Y_k. We report the regression results in Table 2, numbered from 1 to 32. In view of the Hypotheses 1 to 5, we summarize the outcomes of the regressions in the following Results 1 to 5, respectively.

Result 1. a) In all treatments, subjects choose to accept (i.e., choose to enter the PDG) more frequently than refuse. Hypothesis 1a) must be rejected (see regressions 5 and 6).

b) Subjects tend to become customers of the existing intermediary institutions INFO and ENFO. Hypothesis 1b) must be rejected (see regressions 1-3 and 5-9).

c) Subjects in ENFO *tend to* behave in line with subgame perfectness. Hypothesis 1c) is *weakly* supported (see regressions 1, 2, 4-8, and 10), but not strictly.[15]

Result 2. In ENFO the relative frequency of choosing to accept is significantly greater than in BASELINE (see regression 5) and in INFO. Hypothesis 2 cannot be rejected (see regression 7).

Result 3. The relative frequencies for choosing the intermediary INFO (see regression 3) and to accept the PDG (see regression 9) are significantly smaller in INFO(.5) than in INFO(0). The first effect indicates how a small monetary cost can decrease the willingness to adopt the intermediary institution; the second effect is apparently the consequence of the first one. For the other four variables under consideration, there is no significant difference between INFO(0) and INFO(.5) (see regressions 13, 19, 25, and 31). Hence, Hypothesis 3 must be partly rejected. See also Result 3' below.

Result 4. The relative frequency of honest play (see regression 20), the conditional frequency for honest play given that the PDG is played (see regression 26), and the subjects' payoff (see regression 32) are significantly greater in ENFO(20) than in ENFO(10). For the other three variables under consideration, there is no significant difference between ENFO(10) and ENFO(20). Hypothesis 4 must be partly rejected (see regressions 4, 10, and 14). See also Result 4' below.

Result 5. In ENFO the relative frequency of honest play in the PDG is significantly greater than in BASELINE (see regression 21) and in INFO (see regression 23). Furthermore, this relative frequency is also significantly greater in INFO than in BASELINE. Hypothesis 5 must be rejected (see regression 21).

To test Hypothesis 6 (i.e., the conjecture that reputation plays no role in INFO), we draw on the conditional frequencies of decisions when matched with a customer or a non-customer of INFO. We consider four *reputation conditions* for each subject (non-customer, customer with zero, one, or more than one bad reputation records) and the 16 possible combinations of these reputation conditions. Fig. 5 presents for INFO(0) and INFO(.5) these 16 different combinations, the number on top of the bar indicating their relative frequencies. The conditional frequencies of choosing H_i, C_i, Refuse_i or (Accept_i and) Refuse_j in these reputation conditions are represented for INFO(0) (left diagrams) and INFO(.5) (right diagrams), respectively.

Before constructing the test of Hypothesis 6, we revisit Hypothesis 3. For each of the 64 conditional relative frequencies presented in Fig. 5 (16 bars × 4 segments) we conduct pairwise tests between INFO(0) and INFO(.5). Most differences across these treatments are not significant, but some significant differences exist, thus, elucidating the Result 3 that Hypothesis 3 must partly be rejected.

Result 3'. The main behavioral difference between the treatments INFO(0) and INFO(.5) arises from situations where at most one player chooses the intermediary institution.[16]

We test Hypothesis 6 for the conditional likelihood of the H_i choice both treatments against the alternative hypothesis $\mathrm{Prob}(\mathrm{H}_i \mid \mathrm{No\ INFO}_j) \leq \mathrm{Prob}(\mathrm{H}_i \mid \mathrm{INFO}_j > 1) \leq \mathrm{Prob}(\mathrm{H}_i \mid \mathrm{INFO}_j = 1) \leq \mathrm{Prob}(\mathrm{H}_i \mid \mathrm{INFO}_j = 0)$ with at least one inequality being strict. In Table 3, we write $\Delta\mathrm{Prob}(\mathrm{H}_i \mid \mathrm{INFO}_j)/\Delta\mathrm{INFO}_j < 0$ to indicate this chain of ordered alternatives. The null hypothesis suggests equalities instead. Here, $\mathrm{INFO}_j = \{0, 1, >1, \mathrm{No\ INFO}_j\}$ represents the revealed sum of bad reputations of player j. We test for $i = j$ (Hypothesis 6a)) and for $i \neq j = -i$ (Hypothesis 6b)). For the test of the conditional likelihood of the Accept_i choice (Accept_i replaces H_i in the chain of ordered alternatives), the inequality signs remain the same for $i \neq j$, but are reversed for $i = j$. The four Page tests of ordered alternatives all reject the null hypotheses in favor of the alternative hypotheses. We report the test results in Table 3 for both treatments INFO(0) and INFO(.5). Therefore, we obtain the following:

Result 6. In both INFO treatments, subjects' choices depend on the goodness of one's own reputation score and the reputation score of the opponent. Hypotheses 6a) and 6b) must be rejected.

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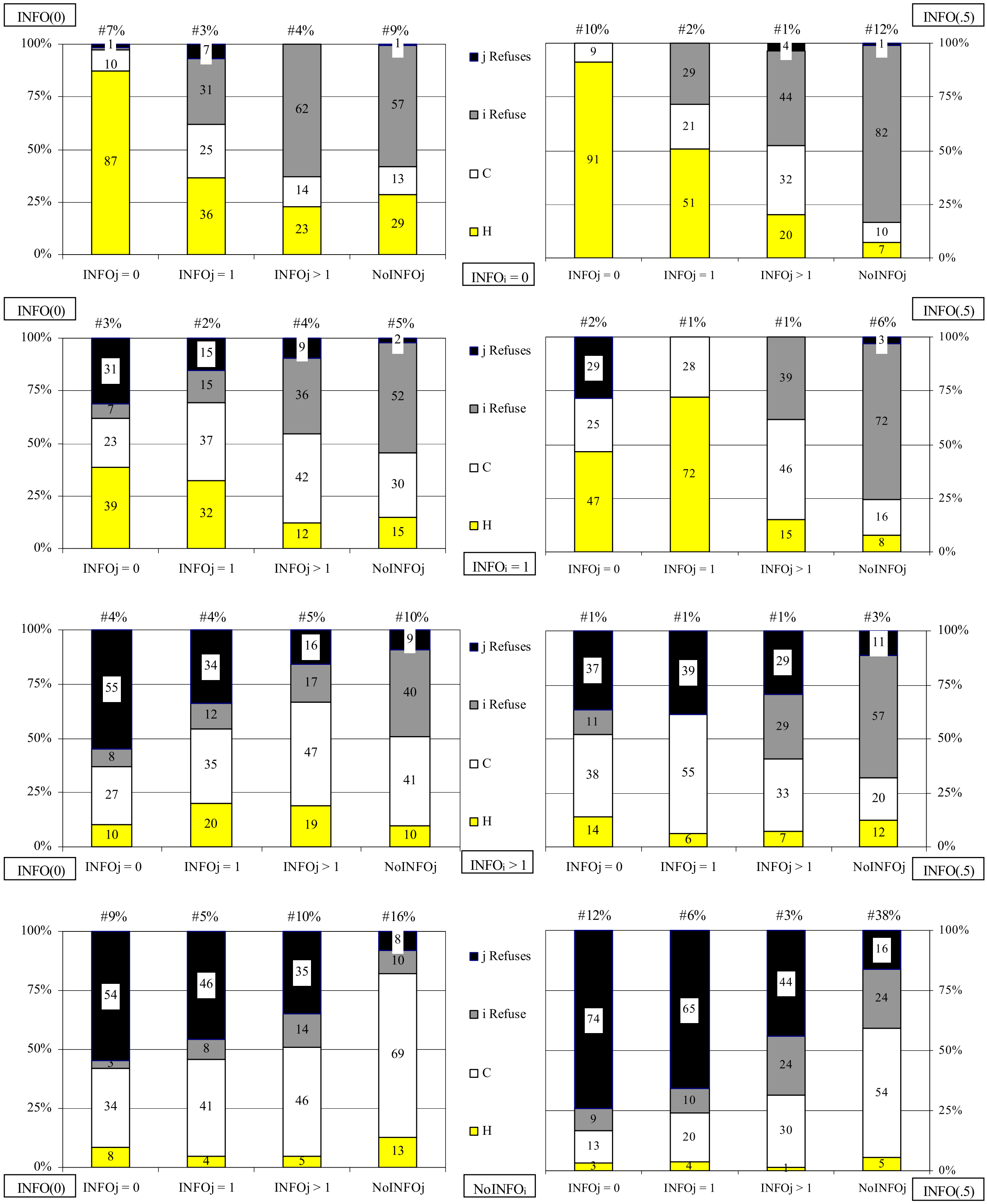
[15] In regressions 5-8 and 10, the relative frequency of accepting is not only significantly different from 0%, but also from 100% at the 1%-level.

[16] Conditionally on the other player choosing No INFO_j, more subjects in INFO(.5) choose to refuse the PDG than in INFO(0), ($p = .037$, $n_1 = n_2 = 6$, Mann-Whitney test). One other interesting difference between the two treatments can be anticipated from Fig. 5; when the revealed INFO record is $INFO_i = 1$ and the opponent one's is $INFO_j = 0$, subject i refuses in 7% of cases ($p = .022$, $n_1 = n_2 = 6$, Mann-Whitney test) in INFO(0), whereas in INFO(.5) it never happens. The intermediary institution is probably valued higher in INFO(.5).

Table 2
Treatment effects: OLS dummy regression.

Variable	Regression #	Intercept	$INFO_k$	$ENFO_k$	$INFO(.5)_k$	$ENFO(20)_k$	#obs.	R^2
Relative frequency for choosing the intermediary institution in %	1	50.10*** [.000]	¤	17.13*** [.005]	–	–	24	.300
	2	59.67*** [.000]	¤	7.08 [.328]	−19.13** [.014]	0.96 [.893]	24	.488
	3	59.67*** [.000]	¤	–	−19.13** [.037]	–	12	.367
	4	66.75*** [.000]	–	¤	–	0.96 [.878]	12	.002
Relative frequency to accept (i.e., choose to play PD) in %	5	75.08*** [.000]	−1.35 [.699]	6.58* [.069]	–	–	30	.240
	6	75.08*** [.000]	2.13 [.581]	4.17 [.284]	−6.96* [.079]	4.83 [.216]	30	.366
	7	73.73*** [.000]	¤	7.94*** [.010]	–	–	24	.267
	8	77.21*** [.000]	¤	2.04 [.587]	−6.96* [.075]	4.83 [.206]	24	.419
	9	77.21*** [.000]	¤	–	−6.96* [.067]	–	12	.296
	10	79.25*** [.000]	–	¤	–	4.83 [.253]	12	.128
Conditional relative frequency to accept if partner has chosen institution in %	11	86.33*** [.000]	¤	11.62*** [.000]	–	–	24	.480
	12	84.96*** [.000]	¤	11.69*** [.005]	2.72 [.474]	2.59 [.496]	24	.505
	13	84.96*** [.000]	¤	–	2.72 [.601]	–	12	.028
	14	96.65*** [.000]	–	¤	–	2.59 [.127]	12	.217
Relative frequency of H in %	15	10.38* [.077]	7.98 [.259]	36.35*** [.000]	–	–	30	.582
	16	10.38* [.058]	9.83 [.195]	27.04*** [.001]	−3.71 [.620]	18.63** [.018]	30	.670
	17	18.35*** [.000]	¤	28.38*** [.000]	–	–	24	.509
	18	20.21*** [.001]	¤	17.21** [.037]	−3.71 [.636]	18.63** [.026]	24	.623
	19	20.21*** [.002]	¤	–	−3.71 [.591]	–	12	.030
	20	37.42*** [.000]	–	¤	–	18.63* [.056]	12	.318
Conditional relative frequency of H in PD in %	21	16.47** [.017]	16.31** [.050]	53.92*** [.000]	–	–	30	.678
	22	16.47** [.013]	14.88 [.101]	44.46*** [.000]	2.86 [.746]	18.93** [.040]	30	.730
	23	32.78*** [.000]	¤	37.61*** [.000]	–	–	24	.581
	24	31.35*** [.000]	¤	29.58*** [.004]	2.86 [.746]	18.93* [.051]	24	.657
	25	31.35*** [.003]	¤	–	2.86 [.804]	–	12	.006
	26	60.92*** [.000]	–	¤	–	18.93** [.014]	12	.468
Round payoff in tokens	27	.638 [.356]	.829 [.328]	3.138*** [.001]	–	–	30	.404
	28	.638 [.282]	1.108 [.189]	1.738** [.044]	−.558 [.502]	2.800*** [.002]	30	.599
	29	1.468*** [.009]	¤	2.309*** [.004]	–	–	24	.316
	30	1.747** [.010]	¤	.630 [.475]	−.558 [.526]	2.800*** [.004]	24	.557
	31	1.747*** [.005]	¤	–	−.558 [.435]	–	12	.006
	32	2.377*** [.008]	–	¤	–	2.800** [.020]	12	.433

*** p < .01, ** p < .05, * p < .1, [p values in brackets]; ¤ benchmark category (BASELINE, where not indicated).



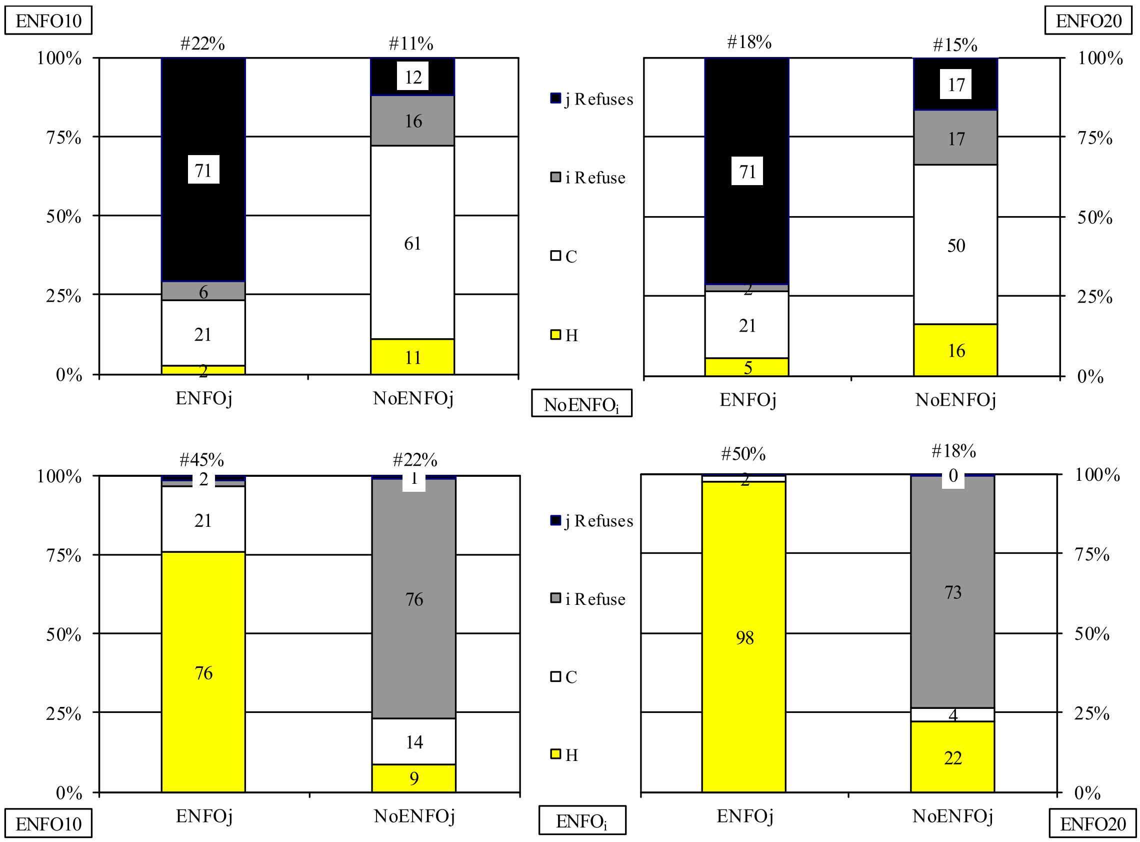
Top to bottom panel and left to right bar: Bar charts are ordered according to the INFO record of player i and opponent j, i.e., $INFO_i = \{0, 1, > 1, NoINFO_i\}$, $j \neq i$. # indicates relative frequency of matching. Left: INFO(0); Right: INFO(.5). The bar charts show the relative frequencies (in percent) of outcomes: H-honest; C-cheat; i/j Refuse-second stage refusal, where *i Refuse* includes the cases when both players refuse to play (e.g., ($NoINFO_i$, $INFO_j = 0$) occurred in #9% of observations in INFO(0). The bottom row indicates 54% of conditional choices of *j Refuses* and the mirror image observation ($INFO_i = 0$, $NoINFO_j$) in the top row shows 57% of *i Refuse*. Hence, in 3% (= 57% − 54%) of occasions both players chose to refuse the PDG).

Fig. 5. INFO institution: conditional relative frequencies for (non-)customers (in percent).

Table 3
Reputation dependent choices: p values of Page test of ordered alternatives.

[a]Alternative hypothesis	INFO(0)	INFO(.5)
ΔProb(H_i | $INFO_{-i}$)/$\Delta INFO_{-i}$ < 0	.007***	.002***
ΔProb(H_i | $INFO_i$)/$\Delta INFO_i$ < 0	.000***	.002***
ΔProb(C_i | $INFO_{-i}$)/$\Delta INFO_{-i}$ > 0	.066*	.000***
ΔProb(C_i | $INFO_i$)/$\Delta INFO_i$ > 0	.001***	.005***
ΔProb($Accept_i$ | $INFO_{-i}$)/$\Delta INFO_{-i}$ < 0	.000***	.000***
ΔProb($Accept_i$ | $INFO_i$)/$\Delta INFO_i$ < 0	.003***	.005***

[a] We test the null hypothesis $\Delta Prob(X_i|INFO_j)/\Delta INFO_j = 0$ against the alternative hypothesis, where $INFO_j = \{0, 1, > 1, NoINFO_j\}$ and $X_i = \{Accept_i, C_i, H_i\}$.
*** p < .01, ** p < .05, * p < .1; $j = -i$ denotes the other player $j \neq i$.



Top: non-customers (No ENFO$_i$); Bottom: customers (ENFO$_i$). # indicates relative frequency of matching. Left: ENFO(10); Right: ENFO(20). The bar charts show the relative frequencies (in %) of outcomes: H-honest; C-cheat; i/j Refuse-second stage refusal, where *i Refuse* includes the cases when both players refuse to play. As shown in the top row for ENFO(10), non-customers i were matched with non-customers j in #11% of all cases. In these occasions, non-customers played H_i in 11% and C_i in 61% of times. In 28% of these occasions the PDG was not reached; in 24% (= 2 × 12%) one non-customer (either i or j) refused and in 4% (= 16% − 12%) both non-customers refused.

Fig. 6. Conditional relative frequencies (in percent) for customers and non-customers of ENFO.

For the ENFO institution, we report in Fig. 6 the conditional decisions of customers (bottom diagrams) and non-customers (top diagrams) when matched with a customer (left bar) or a non-customer (right bar). The recorded numbers represent the conditional relative frequencies (in %) for the 'row player' i given that the other player j is a customer or a non-customer. The left diagrams record these frequencies for ENFO(10) and the right ones for ENFO(20), respectively. On top of each bar the relative frequency of the corresponding matches is displayed.

Most differences across these treatments are not significant, but some significant differences exist, thus, elucidating the Result 4 that Hypothesis 4 must partly be rejected.

Table 4
Evolution of behavior: OLS regression with robust standard errors.

	Dependent variable	Intercept (in %)	Period (slope in %)	#clusters	#observations	R^2
BASELINE	$Accept_i$	93.48*** [.000]	−.72*** [.003]	6	300	.391
	H_i	25.58** [.048]	−.60** [.045]	6	300	.235
	C_i	59.45*** [.000]	−.48 [.121]	6	300	.103
INFO(0)	No $INFO_i$, $Accept_i$	47.87*** [.001]	−.44** [.047]	6	300	.160
	$INFO_i$, $Accept_i$	40.43*** [.001]	.00 [.984]	6	300	.000
	H_i	29.06*** [.003]	−.35*** [.003]	6	300	.082
	C_i	47.79*** [.000]	−.40*** [.006]	6	300	.076
INFO(.5)	No $INFO_i$, $Accept_i$	74.72*** [.001]	−1.01** [.027]	6	300	.274
	$INFO_i$, $Accept_i$	16.53*** [.000]	.24 [.355]	6	300	.029
	H_i	16.38*** [.001]	.00 [.984]	6	300	.000
	C_i	49.12*** [.001]	−.71** [.019]	6	300	.179
ENFO10	No $ENFO_i$, $Accept_i$	47.54*** [.000]	−.68*** [.004]	6	300	.403
	$ENFO_i$, $Accept_i$	31.93*** [.001]	.67** [.014]	6	300	.192
	H_i	26.59*** [.000]	.42* [.073]	6	300	.094
	C_i	32.66*** [.002]	−.35** [.042]	6	300	.000
ENFO20	No $ENFO_i$, $Accept_i$	53.54*** [.000]	−.95*** [.004]	6	300	.395
	$ENFO_i$, $Accept_i$	28.62** [.019]	1.02*** [.008]	6	300	.258
	H_i	34.53*** [.007]	.84*** [.005]	6	300	.183
	C_i	30.29*** [.002]	−.69*** [.003]	6	300	.296

*** $p < .01$, ** $p < .05$, * $p < .1$, [p values in brackets]; C_i, H_i, customer, $Accept_i$ as (non-)customer refer to relative frequencies per period.

Result 4'. Customers of ENFO(10) play cheat more frequently than customers of ENFO(20) when matched with a non-customer *and* when matched with a customer.[17] Hence, Hypothesis 4 must partly be rejected.

Other conditional frequencies as represented in Fig. 6 are not significantly different at the 10% level between the two ENFO treatments.

To test Hypothesis 7 (i.e., no repetition effect), we conduct OLS regressions on the time trend with robust standard errors. As before, the dependent regression variables are the relative frequencies of playing H_i and C_i (all treatments), $Accept_i$ (BASELINE treatment), $Accept_i$ when being a customer (INFO or ENFO treatments), and $Accept_i$ when being no customer within the respective round. Table 4 shows the results for all five treatments. Hence, we report the following result:

Result 7. a) In BASELINE, the relative frequencies of $Accept_i$ and of H_i are significantly decreasing and the relative frequency of C_i is significantly increasing with repetition. - Hypothesis 7a) must be rejected.

b) In INFO(0), the relative frequencies of $Accept_i$, No $INFO_i$ and of H_i are significantly decreasing and the relative frequency of C_i is significantly increasing with repetition. - Hypothesis 7b) must be rejected.

c) In INFO(.5), the relative frequency of $Accept_i$, No $INFO_i$ are significantly decreasing and the relative frequency of C_i is significantly increasing with repetition. - Hypothesis 7c) must be rejected.

17 Given a customer chooses $Accept_i$, she plays honest more frequently in ENFO(20) than in ENFO(10). This observation is supported by the two-tailed Mann-Whitney test; p-values are $p = .010$ when matched with customers and $p = .025$ when matched with non-customers ($n_1 = n_2 = 6$).

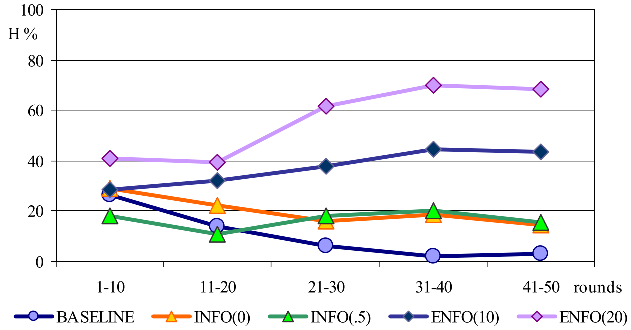


Fig. 7. Relative frequency of honest play (in percent) in the experiment (averaged over 10 rounds).

d) In ENFO(10), the relative frequencies of Accept$_i$, No ENFO$_i$ are significantly decreasing and the relative frequency of becoming a customer is significantly increasing with repetition. - Hypothesis 7d) must be rejected.

e) In ENFO(20), the relative frequency of Accept$_i$, No ENFO$_i$ are significantly decreasing and the relative frequencies of becoming a customer and of H$_i$ are significantly increasing with repetition. - Hypothesis 7e) must be rejected.

Fig. 7 shows the relative frequency of honest play over the course of the experiment. It shows especially the striking success of ENFO(20) as reported in Result 7. It also shows that honest play in INFO(.5) converges from below on INFO(0) after 20 periods; that's when subjects with a good reputation score buy INFO despite the cost.

5. Discussion and conclusion

The paper reports experimental evidence for the impact of contractual assurance through intermediation on behavior in the PDG with random matching involving the option to refuse. The data show that efficiency increases relative to the situation without any intermediary institution. Two different intermediary institutions were investigated. The ENFO institution collects fines from cheaters among its customers, whereas the INFO institution earmarks bad behavior of its customers but also enables them to build up good reputation. The ENFO treatments produced higher payoffs and cooperation levels than the INFO treatments. Subjects in the ENFO institution used the option to refuse significantly less frequently than the subjects in the INFO institution. Customers of ENFO were evidently more trusted by transaction parties than customers of INFO. This trust is clearly based on observed actions; subjects in ENFO choose honest play more frequently and thus earn a higher payoff than those in INFO. These differences between the treatments favor ENFO over INFO from the viewpoint of contractual assurance.

However, the considered institutions ENFO and INFO could not completely resolve the prisoner's dilemma in the laboratory. The outcomes with ENFO only moved slowly towards the cooperative outcome, and the outcomes with INFO moved towards the non-cooperative outcome rather than to the cooperative one. At first glance, this discrepancy seems to correspond to the conjecture that people learn to behave according to the rationality of backward induction. Due to our parameter choices, cooperation is the result of the subgame perfect equilibrium with ENFO, but with INFO no transaction takes place in equilibrium. But a closer look at some subgames shows that backward-induction rationality is often violated.

In order to work out sharper results it seems necessary to conduct further experiments with different parameters. First, in the OPDG a kind of "gambling" is very tempting. If the costs c to become a customer of INFO is small like in our experiments, the bet of winning sometimes $20 - c$ and losing sometimes $1 + c$ is very attractive in comparison with repeated zero. A few "gamblers" undermine the trust into the emerging institution INFO. Higher losses for mutual cheating may favor the exercise of the option to refuse. Second, to become a customer of ENFO is no longer a dominant strategy if for the fine $f < 10$ holds. To change the parameters in both indicated directions is more level playing field for a comparison of the impacts of ENFO and INFO.

The height of the fine is fundamental when the ENFO institution is about to be implemented in practice. The levels $f = 10$ and $f = 20$ evidently disciplined the customers of ENFO in the experiment and increased cooperation. One may ask the question; is a higher fine always a better one? The relevant problem to the practical implementation is that the required deposit binds liquidity and may deter many potential entrants from participation. How many customers an Internet auction house such as eBay would attract if the customers had to deposit a significant amount of money beforehand? Certainly, one could try to implement the ENFO institution without a deposit. But if the potential fine is not deposited in advance it is likely that the cheater does not submit the fine when caught cheating. An example of non-compliance with an enforcement institution comes from the European Union. Its Stability and Growth Pact (SGP) requires the deposit of a fine for violating the conventions. France and Germany violated the SGP, but they refused to pay the fine. Finally, they were freed.

Since INFO requires no deposits, it is less capital demanding and thus rather feasible, e.g. for a start-up business. This issue may account for the fact that information intermediary institutions develop frequently in emerging markets. With a glance at our results, the question arises: How can these markets exist based on information intermediation? To answer this question, one must contemplate the differences between the empirical markets and our experimental design. In the latter, punishment on cheaters was decentralized by refusal from individuals in the population. In contrast, information institutions in empirical markets usually involve a centralized punishment by expulsion. For instance, the Internet company eBay dismisses customers who have a certain number of bad reputation records. The institution involves thus both, inexpensive information and a credible threat of punishment. It is possible that private information intermediation needs centralized punishment rather than a decentralized one to support cooperation.[18]

Another important point is the reliability of provided information. The experimental results of Cason et al. (2016) and Ryvkin et al. (2017) show that widespread misreporting can undermine the functioning of an INFO-like institution. In our experiment, information conveyed is completely safe, but it turns out that this is insufficient to ensure a good performance of INFO. A different sequential game structure (see Clark and Sefton, 2001) may help to foster cooperation in the INFO institution. Possibly a full record of past play might affect a more serious concern for reputation on the side of cheaters, too. In the presented design the small number of possible reputation records enabled a quick recovery of an impeccable reputation at any time. Another idea to improve the performance of INFO is a design in which the costs to become a customer are only incurred if and only if a transaction takes place.

The focus of this paper has been on cooperation and efficiency. The considered intermediary institutions were precise, unbiased and incorrupt. Private institutions may not necessarily match this picture but rather be interested in maximizing their own profits. Thus, one question of concern is: to what extent can a profit maximizing intermediary extract the benefits from the players of the game?[19] In light of our data, it seems that the intermediary institution may indeed extract some welfare if the fee is small but also deter some customers. For INFO we observed an apparent trade-off between the service cost and the number of customers and for ENFO between the height of the fine and honest play; an increase of ENFO's fine induced lower earnings of the intermediary and a significant increase of honest play. This trade-off between the intermediary's income and welfare poses another interesting direction for future research.

Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.geb.2020.08.004.

References

Andreoni, J., 2005. Trust, reciprocity, and contract enforcement: Experiments on satisfaction guaranteed. Mimeo. University of Wisconsin.
Bohnet, I., Frey, B.S., Huck, St., 2001. More order with less law: on contract enforcement, trust, and crowding. Am. Polit. Sci. Rev. 95, 131–144.
Bolton, G.E., Katok, E., Ockenfels, A., 2004. How effective are electronic reputation mechanisms? An experimental investigation. Manag. Sci. 50, 1587–1602.
Bolton, G.E., Katok, E., Ockenfels, A., 2005. Cooperation among strangers with limited information about reputation. J. Public Econ. 89, 1457–1468.
Burnham, T., McCabe, K., Smith, V.L., 2000. Friend-or-foe intentionality priming in an extensive form trust game. J. Econ. Behav. Organ. 43, 57–73.
Cason, T.N., Friesen, L., Gangadharan, L., 2016. Regulatory performance of audit tournaments and compliance observability. Eur. Econ. Rev. 85, 288–306.
Cassar, A., 2007. Coordination and cooperation in local, random and small world networks: experimental evidence. Games Econ. Behav. 58 (2), 209–230.
Cheung, S.N.S., 1983. The contractual nature of the firm. J. Law Econ. 26, 1–21.
Clark, K., Sefton, M., 2001. The sequential prisoner's dilemma: evidence on reciprocation. Econ. J. 111 (468), 51–68.
Clay, K.B., 1997. Trade without law: private-order institutions in Mexican California. J. Law Econ. Organ. 13, 202–231.
Dixit, A., 2003. On modes of economic governance. Econometrica 71, 449–481.
Duch, M.L., Grossmann, M.R.P., Lauer, T., 2020. z-Tree unleashed: a novel client-integrating architecture for conducting z-Tree experiments over the Internet. Working Paper Series in Economics No. 99. University of Cologne.
Duffy, J., Ochs, J., 2009. Cooperative behavior and the frequency of social interaction. Games Econ. Behav. 66 (2), 785–812.
Dulleck, U., Kerschbamer, R., Sutter, M., 2011. The economics of credence goods: an experiment on the role of liability, verifiability, reputation, and competition. Am. Econ. Rev. 101 (2), 526–555.
Ellison, G., 1994. Cooperation in the prisoner's dilemma with anonymous random matching. Rev. Econ. Stud. 61, 567–588.
Fehr, E., Gächter, S., 2000. Cooperation and punishment in public goods experiments. Am. Econ. Rev. 90, 980–994.
Fischbacher, U., 2007. Z-tree: Zurich toolbox for readymade economic experiments. Exp. Econ. 10 (2), 171–178.
Gambetta, D., 1993. The Sicilian Mafia: The Business of Protection. Harvard University Press, Cambridge.
Gneezy, U., 2003. The W Effect of Incentives. Mimeo. University of Chicago.
Greif, A., 1993. Contract enforceability and economic institutions in early trade: the Maghribi traders' coalition. Am. Econ. Rev. 83, 525–548.
Hauk, E., 2003. Multiple prisoner's dilemma games with(out) an outside option: an experimental study. Theory Decis. 54, 207–229.
Hauk, E., Nagel, R., 2001. Choice of partners in multiple two-person prisoner's dilemma games: an experimental study. J. Confl. Resolut. 45, 770–793.
Hirshleifer, D., Rasmusen, E., 1989. Cooperation in a repeated prisoners' dilemma with ostracism. J. Econ. Behav. Organ. 12, 87–106.
Kandori, M., 1992. Social norms and community enforcement. Rev. Econ. Stud. 59, 63–80.
Kosfeld, M., 2004. Economic networks in the laboratory: a survey. Rev. Network Econom. 3, 20–42.
Kreps, D., Milgrom, P., Roberts, J., Wilson, R., 1982. Rational cooperation in the finitely repeated PD. J. Econ. Theory 27, 245–252.
Margolis, H., 2007. Cognition and Extended Rational Choice. Routledge, New York.
McMillan, J., Woodruff, C., 2000. Private order under dysfunctional public order. Mich. Law Rev. 98, 2421–2458.
Nowak, M.A., Sigmund, K., 1998a. Evolution of indirect reciprocity by image scoring. Nature 393, 56–68.
Nowak, M.A., Sigmund, K., 1998b. The dynamics of indirect reciprocity. J. Theor. Biol. 194, 561–574.
Orbell, J.M., Dawes, R.M., 1993. Social welfare, cooperators' advantage, and the option of not playing the game. Am. Sociol. Rev. 58, 787–800.

[18] Nevertheless, findings in the literature on punishment in experimental public goods games suggest that high cooperation levels can also be achieved through decentralized punishment (e.g., Fehr and Gächter, 2000).

[19] Dixit (2003) addresses this question in a theoretical study.

Rapoport, A., Chammah, A.M., 1965. Prisoner's Dilemma: A Study in Conflict and Cooperation. University of Michigan Press, Ann Arbor.
Resnick, P., Zeckhauser, R., Friedman, E., Kuwabara, K., 2000. Reputation systems. Commun. ACM 43, 45–48.
Resnick, P., Zeckhauser, R., Swanson, J., Lockwood, K., 2006. The value of reputation on eBay: a controlled experiment. Exp. Econ. 9, 79–101.
Riedl, A., Ule, A., 2003. Exclusion and cooperation in social network experiments. Mimeo. University of Amsterdam..
Ryvkin, D., Serra, D., Tremewan, J., 2017. I paid a bribe: an experiment on information sharing and extortionary corruption. Eur. Econ. J. 94, 1–22.
Seinen, I., Schram, A., 2006. Social status and group norms: indirect reciprocity in a repeated helping experiment. Eur. Econ. Rev. 50, 581–602.
Selten, R., Stoecker, R., 1986. End behavior in sequences of finite prisoner's dilemma supergames. J. Econ. Behav. Organ. 7, 47–70.
Wedekind, C., Milinski, M., 2000. Cooperation through image scoring in humans. Science 288 (5467), 850–852.
Weidenbaum, M., Hughes, S., 1996. Inside the Bamboo Network. How Expatriate Chinese Entrepreneurs Are Creating a New Economic Superpower in Asia. Free Press, New York.