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ABSTRACT

Relational Contracts and the Nature of Market Interactions

We provide evidence that long-term relationships between trading parties emerge endogenously in the absence of third party enforcement of contracts and are associated with a fundamental change in the nature of market interactions. Without third party enforcement, the vast majority of trades are initiated with private offers and the parties share the gains from trade equally. Low effort or bad quality is penalized by the termination of the relationship, wielding a powerful effect on contract enforcement. Successful long-term relations exhibit generous rent sharing and high effort (quality) from the very beginning of the relationship. In the absence of third-party enforcement, markets resemble a collection of bilateral trading islands rather than a competitive market. If contracts are third party enforceable, rent sharing and long-term relations are absent and the vast majority of trades are initiated with public offers. Most trades take place in one-shot transactions and the contracting parties are indifferent with regard to the identity of their trading partner.

JEL Classification: D2, D4, C7, C9

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1. INTRODUCTION¹

In many markets, contracts specify traders' obligations imprecisely and trading relations are riddled with informal agreements and unwritten codes of conduct. Neutral third parties often cannot enforce such relational or implicit "contracts" because, typically, outsiders are unable to verify whether contractual obligations have been met. Therefore, the trading parties face important incentive problems (Chevalier and Ellison (1997, 1999), McMillan and Woodruff (1999), Banerjee and Duflo (2000), Hong, Kubik and Solomon (2000)). There has been considerable progress in the theoretical analysis of markets with enforcement problems in the past two decades, with a strong focus on repeated interactions (Gintis (1976), Klein and Leffler (1981), Shapiro and Stiglitz (1984), Bowles (1985), Bull (1987), Hart and Holmström (1987), MacLeod and Malcolmson (1989, 1993, 1998), Baker, Gibbons and Murphy (1994), Dixit (2003), Levin (2003)). However, empirical evidence has been limited in contrast to the progress of theory. While lack of empirical knowledge is always undesirable, it becomes an even more serious problem in our context because there is generally a plethora of equilibria in the presence of repeated interactions (see e.g., Fudenberg and Maskin (1986)). For this reason, theory alone gives us little guidance regarding the likely consequences of enforcement problems for the functioning of markets.

In this paper, we show experimentally that the absence of third party enforcement of contracts causes fundamental changes in the nature of market interactions. Traders are very much concerned about the identity of their trading partners if third party enforcement is ruled out. They prefer to trade exclusively with the same partner for many periods with the consequence that, over time, bilateral relationships thoroughly dominate the market. Efficiency wages (rents) combined with the threat of firing discipline the workers (sellers) in this market. Moreover, competition seems to have little impact on contract terms because the gains from trade are shared equally among the parties and long-term relations are much more profitable than are short-term

ones for both sides of the market. We also show that the seeds for successful long-term relations are planted at the very beginning of a relationship. Successful trading relations are characterized by high wages and high effort which are already prevalent in the first period of the relationship.

This pattern contrasts sharply with what is observed when contracts are third party enforceable. The identity of the trading partner does not matter in this case and the traders are basically indifferent to their trading partners. As a consequence, the vast majority of trades take place in one-shot transactions and most offers in these markets are public offers that any trader on the other side of the market can accept. In addition, competition drives contract terms towards the competitive level and the short side of the market appropriates the lion's share of the gains from trade, i.e., rent sharing is virtually absent.

Our results lend support to the disciplining version of the efficiency wage hypothesis (Gintis (1976), Shapiro and Stiglitz (1984), Bowles (1985)) as well as to the fairness version of the efficiency wage hypothesis (Akerlof (1982), Akerlof and Yellen (1990)). The disciplining version is based on the idea that the payment of rents in combination with the threat of firing constitutes a discipline device for workers and gives rise to involuntary unemployment. MacLeod and Malcomson (1989, 1993, 1998) pointed out in a series of papers that – in the presence of an effort enforcement problem – those equilibria that are associated with rents and involuntary unemployment are only a subset of an infinite number of equilibria and that the Walrasian outcome with no rents and no involuntary unemployment is also an equilibrium. In Malcomson (1999) as well as MacLeod and Malcomson (1998), the authors argued, however, that if fairness concerns affect players' beliefs, Non-Walrasian outcomes will emerge. Our results on the ubiquity of rent sharing indeed show that the market outcome is Non-Walrasian in the absence of third party enforcement. Moreover, the behavioral patterns suggest that this is due to the interaction of fairness preferences with repeated game incentives.

We implemented a finite horizon in all experiments. If all subjects are purely selfish, contract enforcement breaks down in the final period, inducing workers to provide minimal effort levels

and employers to offer them zero rents. Therefore, by backwards induction, contract enforcement also breaks down in all previous periods. However, in the presence of fair-minded workers, who respond to generous offers with a generous effort level, employers have an incentive to offer a rent in the final period. This rent can be used to discipline the selfish workers in the non-final periods by the threat of termination of the relationship. Moreover, due to the existence of fair-minded workers, the employers cannot extract the rents accruing in future interactions up-front because fair workers penalize rent extraction with low effort levels. Thus, the existence of fair-minded workers ensures that employers pay rents, creating a mechanism that disciplines selfish workers.

Our findings on the bilateralization of markets can also be viewed as an example of what Williamson (1985) coined the “fundamental transformation”. Williamson forcefully argued that – in the presence of relation-specific investments – trading relations that are subject to outside competition ex-ante become insulated from outside competition ex-post. The parties can create higher gains from trade due to relation-specific investments if they stay together than if they separate, inducing a bilateralization of the relation and a weakening of the impact of outside competition on the terms of trade. In our experiment, workers invest in their reputation as trustworthy trading partners. This reputation has value only in the worker’s current trading relation because his firm alone knows his effort. Thus, a worker’s reputation as a trustworthy person can be viewed as a relation-specific asset. Since the firm can never be completely sure whether an alternative worker will be equally trustworthy, it has an incentive to retain the same worker if he has performed well in the past.

Several aspects of our data suggest that relation-specific reputational assets foster long-term relations. For instance, the longer the relationship between the worker and the firm has already lasted, the higher the effort level which the firm expects from its workers. In addition, the worker's actual effort is indeed higher in a relationship that has already lasted longer. This indicates that the value of an employment relation increases with its length. Therefore, if firms

are aware of this, we should also observe that firms are – *ceteris paribus* – more reluctant to fire workers with whom they transacted more often in the past. It turns out that this is indeed the case.

There are several experimental studies on the role of reputation as an incentive device. Camerer and Weigelt (1988) examined reputation formation in lender-borrower relations where there is a positive probability of (experimenter-induced) honest borrowers. Andreoni and Miller (1993) conducted prisoners' dilemma experiments where human players faced cooperating computerized opponents with positive probability and Jung, Kagel and Levin (1994) report the results of predatory pricing experiments where a long-term player (the monopolist) faces a series of short-term players (the potential entrants) for a finite number of periods. Both Camerer and Weigelt (1988) and Jung, Kagel and Levine (1994) find persuasive evidence in favor of reputation formation and Andreoni and Miller (1993) report that human players become more likely to cooperate as the probability of facing a cooperating computerized opponent increases. Our design differs from these studies in several important ways. Most importantly, long-term relationships arise endogenously in our setting, i.e., they are the result of the subjects' decisions, whereas the experimenter exogenously matched the subjects in the papers mentioned above. This enables us, e. g., to study how long-run relations are initiated and the incentive properties of contract termination threats. Second, trading between the parties is initiated in a competitive experimental market in our study. This enables us to examine how competition affects contract terms when reputation building and long-term relations are important. Third, we conducted control experiments where contracts were third party enforceable. Thus, by comparing markets with and without third party enforceable contracts we can investigate the market consequences of the absence of third party enforcement. Fourth, we conducted control experiments in which long-term relations were ruled out and effort was not third party enforceable. These control experiments were similar to the gift exchange experiments by Fehr, Kirchsteiger and Riedl (1993) and Fehr and Falk (1999) because contracts could only be enforced through the gift

exchange mechanism. The comparison of markets with and without the opportunity to form long-term relations enables us to isolate the contract enforcement power as well as the market consequences of endogenous long-term relations.

The experiments by Miller and Plott (1985) examined the problem of quality signaling in a competitive market setting. However, the formation of long-term relations was ruled out in their experiments. Kollock (1994) modified this design by allowing the traders to do business repeatedly with the same partner. In his experiments, the sellers fixed the actual quality of the good before the start of a trading period but they were free to make false claims about this quality. Kollock (1994) observes that quality uncertainty contributes to the formation of long-term relationships. The most important difference between Kollock's work and ours is that we examine how the absence of third party enforcement affects contract terms and whether this leads to involuntary unemployment, how the contract terms are related to the firms' enforcement strategies, and to what extent the possibility of forming long-term relations enhances effort. These features are absent in Kollock (1994).²

Several econometric studies in recent years have supported the view that career concerns and long-term relations have important incentive effects. Chevalier and Ellison (1999) identify implicit incentives arising from the fact that contract terminations are sensitive to performance. They show that young mutual fund managers have an incentive to avoid unsystematic risk and to hold more conventional portfolios than managers that are more senior. Moreover, they also show that the managers' behavior is consistent with these incentives. Similar results are reported by Hong, Kubik and Solomon (2000) and Hong and Kubik (2003). Hong, Kubik and Solomon (2000) document, for example, that inexperienced security analysts are more likely to be terminated for inaccurate earnings forecasts and for bold forecasts that deviate from the average opinion. As a consequence, they deviate less from consensus forecasts. Our paper complements these studies by showing the existence of a very steep positively sloped relation between a worker's effort and the probability of contract renewal. In addition, since we rule out the renewal

of contracts in one of our control conditions, we can isolate the incentive effects of contingent contract renewal.

The rest of our paper is structured as follows: we present the experimental design in the next section. In Section 3, we discuss the theoretical predictions. In Section 4, we present and interpret our results and Section 5 concludes the paper.

2. AN EXPERIMENTAL APPROACH FOR THE STUDY OF MARKETS WITHOUT THIRD PARTY ENFORCEMENT OF CONTRACTS

The ideal data set for studying the effects of the absence of third party enforceability on market interactions and on the firms' enforcement strategies is based on a truly exogenous *ceteris paribus* variation in the degree of third party enforceability. The *exogenous ceteris paribus* variation allows the researcher to make causal inferences on the impact of different degrees of third party enforceability. Such a data set permits, for instance, the examination of how the absence of third party enforceability affects the initiation of contracts in markets, the formation of long-term relations, or the level of wages and contract terms in general. The problem is, however, that it seems almost impossible to find or generate field data that approximates this ideal data set. Experiments designed suitably allow for causal inferences, however – because one can implement exogenous *ceteris paribus* variations in the degree of third party enforceability – thus overcoming some of the measurement and endogeneity problems present in the field data.

2.1. *Experiment Design*

We implemented the following three treatment conditions in order to examine how the absence of third party enforcement affects the formation of relational contracts and market interactions. In the first condition, which we call the complete contract condition (henceforth denoted as C condition), the experimenter exogenously enforced the effort level contractually agreed upon. In the second condition, which we call the incomplete contract condition (henceforth called ICF-condition), third party enforcement was absent; the worker could choose any feasible effort irrespective of the level contractually agreed upon. Firms and workers could enter into long-term relations in both the C and in the ICF conditions. Technically, repeated transactions with the same trading partner were possible because subjects had fixed identification (ID) numbers and contract offers could be addressed to specific traders (i.e., to specific ID numbers).³ Therefore, a firm could make offers to the same worker in consecutive periods and, if the worker accepted the offers, a long-term relation was established. Our major research questions can be examined by comparing market interactions and contract terms across the C and the ICF conditions.

In addition, we were also interested in the effectiveness of endogenous long-term relations as an effort enforcement device. Therefore, we implemented a third treatment, which we call the ICR condition. The ICR condition was identical to the ICF condition except for the fact that long-term relations were ruled out in the former. This was achieved by randomly reassigning the ID numbers for both the workers and the firms in each period of the game – hence the term ICR (Incomplete Contract condition with Random IDs). Thus, the ICR condition was organized in such a way that a worker with ID no. 8 in period t might have been assigned ID no. 3 in period $t + 1$, for example. Since no long-term relations were possible in the ICR, a comparison between the effort in the ICR and the ICF tells us to what extent the possibility of forming and terminating long-term relations contributed to the enforcement of more efficient effort levels.

This comparison is important because several other experiments (e.g., Fehr, Kirchsteiger and Riedl 1993) have demonstrated that fairness concerns may contribute to contract enforcement. This means that even in the absence of any possibility for long-term relations, generous contract offers to workers may induce non-minimal effort levels because fair workers increase their effort levels in response to wage increases.

There were 15 trading periods in each of the three conditions; a firm could employ at most one worker per period and a worker could accept a maximum of one job in this time frame. A trading period had two stages. In stage one, contract offers were made and, if a firm and a worker concluded a contract, they entered the second stage. In the second stage of the ICF and the ICR condition, the worker had to determine his effort level, while the computer automatically fixed the effort level at that contractually agreed upon in the C condition. During the second stage of the ICF and the ICR conditions, we also asked the firms to indicate an expected effort level and how certain they were that their expectations would be fulfilled.

The firms were the contract makers in all conditions, i.e., they alone could make contract offers to the workers, who themselves could not tender offers to the firms. A contract offer stipulated a wage w , a desired effort \tilde{e} , and the firm's identification number (ID). Firms could make private or public offers. For private offers, a firm also indicated the worker's ID number with whom it wanted to trade, and then only this worker was informed about the offer. In public offers, all workers and firms were informed about the offer. As a consequence, all workers could accept a public offer.

A firm could make as many private and public offers in a given trading period as it wanted to. However, as soon as a worker accepted one of the offers, the firm was matched with this worker and informed about his ID number. Once a firm's offer was accepted, all its other outstanding offers were immediately removed from the market so that they were no longer available. Firms were also informed about which workers remained in the market at any time during the trading

period. This was done to prevent them from making private offers to workers who had already concluded a contract with another firm.

The status quo at the beginning of each period in both the C and in the ICF conditions was that no worker had a job and no firm had its vacancy filled. Alternatively, we could have implemented the rule that a firm-worker relation automatically remains in force unless one of the parties dissolves it. Economically these two rules are equivalent if the parties are free to withdraw at the end of each period. The two rules may well have different behavioral effects, however, due to status quo effects (Samuelson and Zeckhauser (1988)). In our case, the parties have to take actions to continue the relationship; the alternative rule calls for taking actions to dissolve it. Therefore, status quo effects favor the formation of long-term relations under the alternative rule whereas our rule tends to weaken these effects. This means that our rule is less favorable for the emergence of long-term relations, making the actual emergence of long-term relations a stronger result.

Some aspects of our experimental design are similar to that in Kirchsteiger, Niederle and Potters (2001). They also allow the traders to make private and public offers and to form long-term relations. The focus of their paper is, however, quite different. They examine the role of private and public offers exclusively in a context of third party enforceable contracts while our work focuses on how private or public offers are used to support enforcement strategies in the presence of a moral hazard problem.

2.2. Parameters, Procedures, Information Conditions, and Subject Pool

We always had ten workers and seven firms in all three conditions, i.e., there was always an excess supply of three workers. The material payoff of a firm was given by

$$(1) \quad \pi_f = \begin{cases} 10 \cdot e - w, & \text{if a contract was concluded} \\ 0, & \text{if no contract was concluded.} \end{cases}$$

The material payoff of a worker was given by

$$(2) \quad \pi_w = \begin{cases} w - c(e), & \text{if a contract was concluded} \\ 5, & \text{if no contract was concluded,} \end{cases}$$

where $c(e)$ denotes the cost of supplying effort.⁴ The unemployment benefit of a worker who did not trade was 5. The set of feasible effort levels was given by $\{1, 2, \dots, 10\}$ and wages had to be in the set $\{1, 2, \dots, 100\}$. The cost schedule for the workers is depicted in Table 1. It shows that $c(e)$ is strictly increasing and exhibits increasing marginal costs. Since the marginal cost of effort is at most 3 while the marginal revenue is always 10, the efficient effort level is given by $e = 10$.

TABLE 1 here

Payoff functions (1) and (2), the number of firms and workers, the cost schedule $c(e)$, and the fact that there were 15 trading periods were common knowledge. Only the pair of traders involved was informed about the actual payoffs and effort level. Each firm was also continuously informed about the public offers of its competitors in the course of a trading period. Similarly, a worker did not only know all the private offers addressed to him, but also knew all public offers available as well.

The experiment was computerized and conducted by using the software “z-tree” (Fischbacher (1999)). There were two practice periods before the actual experiment in order to make the participants familiar with the bidding procedures. Subjects only went through the first (bidding) stage of the experiment in both practice periods and no money could be earned during these periods.⁵ After the practice periods the actual experiment, which lasted for 15 periods, began. At the end of each period, each participant was informed about the contract (w, \tilde{e}) he had

concluded, about e , his own payoff, as well as about the trading partner's payoff and ID number. Then the participants wrote this information on a separate sheet of paper, ensuring that each participant was always fully informed about his own trading history.

A total of 238 subjects participated in our experiments. We conducted five sessions in the ICF condition, five in the C condition, and four in the ICR condition. No subject participated in more than one session. A session lasted, on average, 90 minutes. Subjects were students from the University of Zurich and the Federal Institute of Technology in Zurich. On average, a subject earned CHF 62.30 (~\$ 48) in an experimental session.

3. PREDICTIONS

It is crucial for the predictions that all participants know that the experiment will end right after period 15. In case rationality and selfishness of all participants is common knowledge, it is easy to derive a solution: each worker will choose the minimal effort $e = 1$ in each period of the ICR and in the final period of the ICF, irrespective of the accepted contract (w, \tilde{e}) . Therefore, contract offers with $w = 5$ are optimal for the firms.⁶ All seven contract offers will be accepted. By backward induction, the same outcome will be obtained in all previous periods of the ICF. Thus, a very inefficient outcome will be obtained in the ICF and the ICR condition and the resulting small surplus per trade, $\pi_f + \pi_w - 5 = (10 \cdot 1 - 5) + (5 - 0) - 5 = 5$, will be reaped by the firms.

The experimenter enforces every feasible effort level in the C condition, i. e., also the maximum effort $e = 10$. At $e = 10$, the workers have opportunity costs of $5 + c(10) = 23$. Therefore the contract offer maximizing profit in $t = 15$ is $w = 23$ and $\tilde{e} = 10$. In equilibrium, all workers will accept this offer.⁷ The total surplus in the C condition is given by $100 - 23 = 77$ which, in equilibrium, is again fully reaped by the firms in each of the 15 periods. Thus, if rationality and selfishness of all participants is common knowledge we should observe $w = 5$, $e =$

1, and 7 trades in all periods of the two incomplete contract conditions, whereas in the C condition $w = 23$, $e = 10$, and 7 trades should be observed in every period. Moreover, the firms should be indifferent between making private and public offers in all three conditions because selfish workers will accept any offer that gives them a non-negative payoff, independently of whether it is a private or a public offer. This also means that we should observe no systematic differences in the share of private offers across treatments. Finally, there is also no reason for any party to engage in long-term relations. Nothing can be gained by entering a long-term relationship because the effort in the incomplete contract conditions will be minimal in any case, while in the C condition it will be $e = 10$ even in a short term encounter. Thus there should be no systematic differences in the relative frequency of long-term relations across the C and the ICF conditions.

If, however, rationality or selfishness of all traders is not common knowledge, very different outcomes may occur because reputation building may become profitable⁸. If, for example, the firms in the ICF condition believe that there are a sufficient number of fair persons among the workers, it may be possible to sustain non-minimal effort levels for many periods in the ICF condition. Fair players respond to friendly actions in a friendly manner and retaliate in response to hostile actions, even when these responses are costly for them. These friendly and hostile responses also prevail in one-shot situations.⁹ Thus, fairness means that an increase in the generosity of a contract offer is reciprocated by an increase in the effort level even in a pure one-shot transaction. The generosity of the contract offer can be measured in our context by the current rent, $\pi_w(w, \tilde{e}) - 5 = w - c(\tilde{e}) - 5$, that is implied by the offer. Numerous experiments have documented that many people do in fact have a propensity to behave in a reciprocally fair manner in one-shot encounters (see, Roth 1995, Camerer 2003).

We use the model of Fehr and Schmidt (1999) in the appendix to show that – in the presence of a sufficient number of fair subjects – there is an equilibrium in the ICF in which *all* the workers provide high effort levels in the first 14 periods, while in period 15 only the fair types

perform at non-minimal levels.¹⁰ We also show that higher average effort levels can be enforced in equilibrium in the ICF than in the ICR because of the possibility of forming long-term relations in the ICF. The key mechanism in our argument is the existence of a positive rent for the workers in the final period of the ICF. A rent exists if a worker with a job earns strictly more than a worker without one. The rent is generated in our context by the existence of fair workers. Since they respond to generous contract offers with generous effort levels, they make it profitable for firms to pay rents in the final period. It is possible to discipline the selfish workers with this rent in the first 14 periods, i.e., selfish workers mimic the behavior of the fair workers so that their type is not revealed in the first 14 periods.¹¹

If workers earn a positive rent in the final period of the ICF condition, the threat of termination of the trading relation at the end of period 14 induces a selfish worker to bear positive effort costs in period 14. As long as the effort cost $c(\tilde{e})$ is below the expected rent in period 15, the worker will be willing to provide $e = \tilde{e}$ in period 14. Note that the expected *future* rent is what disciplines the worker in period 14 while the current rent paid in period 14 is completely irrelevant for the effort choice of a selfish worker. As long as the selfish worker believes that the provision of the desired effort level will be rewarded with the continuation of the relation in $t = 15$, he will provide $e = \tilde{e}$ in period 14, irrespective of the current rent in period 14. This raises the question why the firm does not pay a very low or no rent in period 14 but “promises” to pay a substantial rent in period 15. Yet, if the worker believes that a low rent in period 14 is a signal that the relation will be terminated at the end of the period, the current rent in period 14 will also affect the incentives for the worker in that period. A low current rent in period 14 is then essentially a signal that there will be no *future* rent and the selfish worker thus has no longer an incentive to perform in period 14.¹²

The belief that a low current rent signals the absence of future rents seems quite natural in a world in which fairness is a prominent concern. A low wage may be taken as an indication that the firm is not much concerned about fairness, and why should an unfair firm not consequently

break its promise and change the trading partner in the next period? Whatever the source of the worker's belief is, as long as a low rent is believed to signal the termination of the relation at the end of the current period, the firm has an incentive to pay a high rent in the current period because this induces the selfish worker to perform well in the current period. Yet, if the selfish worker also receives a current rent in $t = 14$ the *total* expected income loss from the termination of the relation at the end of period 13 is even higher because the fired worker may lose rents for two periods. Thus, in period 13 as well as in all previous periods, even higher effort levels are enforceable by the threat of terminating the relationship.

The argument above rests on the possibility that firms and workers can form long-term relations. By design, the ICR rules out the reemployment of previous workers. Therefore, selfish workers cannot be disciplined in the ICR and, as a consequence, the average effort will be lower. This argument also provides an equilibrium account for why firms may want to rely on private offers in the ICF. Since a long-term relation cannot be established through public offers because any worker can accept such an offer, firms who want to maintain a long-term relation will rely on private offers.¹³

What is the potential impact of fair persons in the C condition? Since the contract enforcement problem is absent in the C condition, there is no need for the firms to discipline workers and, hence, there is no incentive for the firms to offer rents to induce non-minimal effort choices. As a consequence, there is also no reason for entering into long-term relations and for relying on private offers. In fact, the existence of fair players may even provide a reason for the firms to rely primarily on public offers. This is so because a fair player is willing to reject an offer that is perceived to be unfair if the rejection decreases the firm's payoff with a sufficiently high probability. In contrast, a selfish player will accept any offer that gives him a positive material payoff. In case the firms believe that there is a large enough percentage of fair workers, and in case that the workers' types have not yet been revealed, firms have an incentive to make public offers because by making a public offer they can ensure that selfish players can also

accept their offers. Public offers are thus likely to increase the probability that low offers are accepted.

Our discussion has shown that in the presence of fair persons, long-term relations may be part of an equilibrium even in finitely repeated games like the ICF. However, it is well known that there are typically a large number of equilibria in repeated games and our ICF condition is no exception. Thus, the subjects' actual behavior in our experiment could deviate from that outlined above simply because they play a different equilibrium.¹⁴ This plethora of equilibria in repeated games increases the necessity for the study of the subjects' actual behavior in repeated settings. Despite the limited predictive power of repeated game models, they are very useful in our view for heuristic purposes because the behavioral patterns that prevail in particular equilibria suggest specific testable hypotheses. Thus, although the non-uniqueness of the equilibrium renders precise quantitative predictions impossible, focusing on particular equilibria provides fruitful qualitative hypotheses.

In particular, the equilibrium in the ICF which we described above suggests the following testable hypotheses. To solve the effort enforcement problem in the ICF, firms trade repeatedly with the same worker if he performed well in the past. Thus, the effort enforcement problem can be solved successfully by means of long-term relations between firms and workers. The establishment of long-term relations, in turn, requires that firms make private offers in the ICF. Therefore, we predict a larger share of private offers in the ICF than in the other two conditions. Likewise, we predict that a larger share of trades in the ICF is executed in long-term relations compared to the C condition. Furthermore, firms rely on the payment of fairness-driven efficiency wages to solve the effort enforcement problem both in the ICF and in the ICR, implying that the workers' share of the gains from trade is much larger in the ICF and the ICR compared to the C condition. However, firms cannot fire workers in the ICR because long-term relations are ruled out. Therefore, firms pay efficiency wages in the ICR to elicit reciprocal effort responses from the fair workers. This contrasts with the ICF, where firms combine the payment

of efficiency wages with the threat of terminating the relationship. This threat also enables the firms to discipline the selfish workers. Thus, the average effort level in the ICF is predicted to be higher than that in the ICR. Moreover, since the higher effort levels in the ICF increase the available surplus per trade, the dictates of fairness demand that firms pay higher efficiency wages in the ICF compared to the ICR. Finally, since effort enforcement is no problem in the C condition, we also predict that wages in the ICF are higher than in the C condition.

4. RESULTS

In the first part of this section, we examine how the absence of third party enforcement of effort affects the nature of market interactions in the ICF relative to the C condition and to the ICR. In this context, we investigate the relative frequency of private offers (Section 4.1), the relative importance of long-term relations (Section 4.2), and the wage levels across treatments (Section 4.3). In Section 4.4, we examine the impact of workers' effort choices on firms' subsequent willingness to renew the contract which paves the way for an understanding of the effort differences between ICF and ICR in Section 4.5. In the final two subsections, we analyze the impact of long term relation on efficiency and earnings (Section 4.6) and we identify factors which contributed to the establishment of successful long-term relationships (Section 4.7).

Since there were seven firms, ten workers, and 15 periods in each session, the total number of potential trades per session is 105. In the five ICF sessions we observed in total 523 trades, in the five C sessions there were 519 trades, and in the four ICR sessions we had 417 trades. This indicates that there are no differences across treatments with regard to the number of actual trades, i.e., the potential number of trades was (almost) completely exhausted in all sessions.

4.1. *Private versus Public Offers*

If higher effort levels can be achieved via long-term relations in the absence of third party enforcement, firms in the ICF have a reason for tendering private offers: they use them to establish long-term relations. Therefore, we predict that private offers are more frequent in the ICF compared to the ICR or the C condition. Figure 1 indeed shows that throughout all the periods, the relative share of privately initiated trades is substantially larger in the ICF condition than in the other two. The difference between the ICF and the C condition is roughly 10 percentage points in the first two periods. After period two, this difference increases substantially, and in the final five periods it varies between 60 and 70 percentage points. Thus, Figure 1 unambiguously shows that private offers are the preferred choice in the ICF condition while public offers are the favored selection in the C condition. The difference between the ICF and the ICR condition is less heavily dependent on time; from the beginning, the relative share of privately initiated trades is 25 to 40 percentage points higher in the ICF condition.

Figure 1 shows the aggregate picture if we average over all sessions. Despite some variability within the different treatments, similar results also hold for the individual sessions. We have computed the relative share of trades that are initiated by private offers for each session to show this similarity. The relative share of private offers varies between 61 and 90 percent across the ICF sessions, it varies between 9 and 43 percent in the C sessions, and it varies between 27 and 47 percent in the ICR sessions. Non-parametric Mann Whitney tests, with the relative shares in each session as observations, indicate that the ICF-C difference ($p = 0.008$) and the ICF-ICR difference ($p = 0.016$) is significant whereas the ICR-C difference is not significant ($p = 0.19$).¹⁵ However, the share of private offers decreases slightly over time in the C condition (see Figure 1), whereas this share increases from 11 percent in period 1 to 52 percent in period 15 in the ICR condition. In fact, if we take just the observations of the last five periods, the ICR-C difference becomes significant ($p = 0.016$). This suggests that the absence of third party enforcement alone, i.e., even if long-term relations are excluded, favors a trend towards private offers. We will see

later (in Section 4.5) that this may be caused by specific enforcement benefits associated with private offers which have nothing to do with the possibility to form long-term relations.

FIGURE 1 here

If private offers are an instrument for the establishment of long-term relations, they should be mainly addressed to the previous worker. Table 2 displays the evolution of the frequency of private offers to the previous trading partner relative to all the private offers. It indicates that the clear majority of private offers is tendered to the previous worker. After period five, between 63 and 79 percent of all the private offers go to the previous workers. This can be taken as a first indication that the firms are interested in forming long-term relations with particular workers. In this context it is also interesting to know the relative frequency of private offers after the break-up of a relationship. Figure 1 shows that after period 5 the overall relative frequency of private offers varies between 80 and 90 percent in the ICF. However, after the break-up of a relationship, i.e., when a firm no longer made an offer to its previous worker, the relative frequency of private offers drops to roughly 50 to 60 percent. Over all periods the relative frequency of private offers after the break-up of a relationship is 52 percent in the ICF. This is somewhat higher than in the ICR where the overall relative frequency of private offers is 37 percent. This difference is, however, not significant ($p = 0.175$, Mann Whitney test with session averages as individual observations).

TABLE 2 here

4.2. The Relevance of Long-Term Relations

In the ICF long-term relations arise in the equilibrium described in Section 3 as an attempt to solve the effort enforcement problem. In contrast, firms have no reason to establish long-term relations in the C condition. Thus, we should observe that a larger number of trades take place in

long-term relations in the ICF as compared to the C condition. Figure 2 indicates that the data clearly supports this prediction. The figure presents the cumulative frequency of trades in firm-worker relationships of different lengths across the two conditions. More than 70 percent of all the trades in the C condition took place in one-shot encounters and 90 percent of the trades took place in interactions that lasted one or two periods. This differs sharply from the ICF condition, where only one-third of the trades took place in one-shot encounters and roughly 50 percent took place in relations that lasted over four or more consecutive periods. Moreover, roughly 40 percent of the trades in the ICF took place in relations that lasted 8 or more consecutive periods. Thus, whereas the majority of trades in the ICF take place in long lasting relations, the vast majority in the C condition is executed in one-shot transactions.

A similar picture emerges at the session level. To document this result, we computed for each trade how long the trading parties had stayed together previous to this trade. Then we took the average “length of the relation previous to the trade” for each session. It turns out that this measure is lower in all five C sessions than in any of the five ICF sessions. Thus, the difference across treatments is significant ($p = 0.008$, Mann Whitney test).

Most one-shot encounters in the ICF condition took place in early periods. The separation rate, i.e., the rate at which the traders change their trading partners, is roughly 80 percent in period 1 and slightly more than 60 percent in period two and period three. The separation rate declines sharply after period three (eventually reaching a level of about 20 percent). This suggests that there was a search phase at the beginning of the session during which the traders attempted to find a good match; once they had found one, they tended to continue the relation.

FIGURE 2 here

4.3. Wages

According to the equilibrium described in Section 3, firms in the ICF combine the threat of firing with the payment of efficiency wages whereas firms have no reason to pay efficiency wages in the C condition. Therefore, we expect higher wages in the ICF compared to the C condition. Moreover, since selfish workers can be disciplined in the ICF, it pays for firms to offer higher wages in the ICF than in the ICR. Both fair and selfish workers provide the desired effort level in the ICF, albeit for different reasons, if that level distributes the gains from trade equally. In the ICR, only the fair workers are willing to do so.

A comparison of the different treatments shows that wages in the ICF condition are indeed much higher than those in the other two conditions (see Figure 3). Wages are always higher in the ICF condition than in the ICR condition. Moreover, this difference increases over time. After period 5, ICF wages were almost always at or above 40 while ICR wages were always at or below 25. Likewise, ICF wages were higher than C wages except for in the first few periods. This result also holds at the level of individual sessions. Average wages in the ICF sessions varied between 32 and 47, in the C sessions they fluctuated between 24 and 32, and we observed average wages in the ICR sessions between 19 and 37. Mann-Whitney tests with session averages as individual observations indicate that ICF wages are significantly different from C and ICR wages. The ICF-C difference is significant at the $p = 0.095$ level if we take the average over all periods and at the $p = 0.016$ level if we take the average over periods 5-15. The ICF-ICR difference is significant at $p = 0.050$, whereas the ICR-C difference is not significant ($p = 0.221$).¹⁶

FIGURE 3 here

The higher wages in the ICF relative to the C condition also led to a significantly different pattern of contract formation within periods. Workers quickly accepted the existing offers in the ICF condition while they were much more reluctant to do so in the C condition. In fact, firms made 8 to 9 offers in most ICF periods, i.e., only 1 or 2 offers in excess of the available number of trades. This contrasts sharply with the C condition, where firms frequently made 10 and more offers above the available number of trades. The larger number of excess offers in the C condition were due to the fact that, after the first few periods, firms typically started with very low offers. The workers were reluctant to accept these offers, which in turn induced the firms to increase them. Therefore, the number of excess offers per session in the C sessions varied between 85 and 204 while we observed only between 16 and 38 excess offers per session in the ICF sessions, a difference that is highly significant ($p = 0.008$, Mann Whitney test).

4.4. *Contingent Contract Renewal and Rents*

Firms had the opportunity to discipline the workers in the ICF by paying rents and terminating the relation in case of low effort. To what extent did firms use this opportunity? Figure 4 provides a first answer to this question, illustrating the probability of contract renewal as a function of the worker's effort in the previous period. The figure reveals that the chances of contract renewal depend strongly on the worker's previous effort. This probability is roughly 0.2 or less for effort levels below seven while it is substantially above 0.5 for $e \geq 7$. If the worker provided the maximum effort in $t-1$, the probability of getting a new contract in t is close to 1.

FIGURE 4 here

Figure 4 strongly suggests that the firms adopted a policy of *contingent contract renewal*: high and satisfactory performance was rewarded with a new contract while low and

unsatisfactory performance led to a high probability of “firing”. Further evidence for this interpretation is given in Table 3. This table presents the results of a probit-regression that regresses the probability of contract renewal on the worker’s previous effort, on positive and negative surprise, and on the previous length of the relationship controlling for session fixed effects (with robust standard errors for each coefficient estimate in parentheses). Table 3 shows a strong and significant positive impact of the previous effort. In addition, if the worker provided effort in excess of that which the firm expected (positive surprise), the probability increases significantly while if the firm’s expectation was not fulfilled (negative surprise), the probability decreases.¹⁷ Interestingly, the previous length of the firm-worker relation is also highly significant. This can be interpreted as an indication that long-term relations give rise to relation-specific reputational capital, making firms reluctant to fire workers with whom they have interacted more often in the past.

TABLE 3 here

To what extent did the denial of contract renewal impose costs on the worker? To examine this question, we computed for every period t a proxy for the *total* rents of the trading workers. We computed the average of all present and future incomes of those workers trading in period t . The average income of a worker who trades in t over all periods from t to $T = 15$ represents the average value of a job in t . We denote this value by V_t^e (e stands for “employed”). In addition, we computed the average value of being without a job in period t which we denote by V_t^u (u stands for “unemployed”). V_t^u is given by the average income of a worker who is unemployed in period t , from period t to $T = 15$. The difference $V_t^e - V_t^u$ represents a proxy for the *total* rent of a worker who is employed in t . Table 4 shows the evolution of $V_t^e - V_t^u$ over time. It turns out that the total rent is large and positive in all 15 periods.

TABLE 4 here

Table 4 implies that the denial of contract renewal, in any period $t < 15$, imposed considerable costs on the worker. Assume, e. g., that the probability of finding another trading partner in period t is $\mu < 1$ for a worker who does not get a contract in period t from his previous firm.¹⁸ The worker's expected future income is thus $\mu V_t^e + (1-\mu)V_t^u$. If, instead, the worker can trade with certainty with his previous firm in period t , his expected future income is V_t^e . Therefore, the firm can impose an expected loss of $(1-\mu)(V_t^e - V_t^u)$ on the worker by not renewing the contract. Note also that the probability of not getting a new trading partner, $(1-\mu)$ increases with a growing number of bilateral long-term relations in the market. The existence of rents also means that employed workers were on average always better off than unemployed workers. Unemployment was thus involuntary in the sense that unemployed workers would have strictly preferred a job at the prevailing wages. Another noteworthy feature of Table 4 is that workers also earn sizeable rents in period 15. This is insofar important as the existence of a rent in period 15 is one important driving force behind the high-effort equilibrium described in Section 3.

4.5. *The Effort Consequences of Contingent Contract Renewals*

Our previous results taken together show that the absence of third party enforcement and the possibility for forming long-term relations cause markets to function very differently. Firms pay relatively low wages in the C condition; they rely predominantly on public offers and the vast majority of trades take place in short-term interactions. In the ICF, firms depend predominantly on private offers, and a large share of all trades takes place in long-term relationships. Firms pay high wages involving considerable rents and threaten to terminate the relationship in case of malfeasance, a policy which imposes high costs on low-performing workers. Since this

discipline device is not available in the ICR, we predict a significantly higher effort in the ICF. Figure 5 shows unambiguously that our data supports this prediction. The effort level is considerably higher in the ICF in all periods compared to the ICR. We find it particularly remarkable that there is already a large effort gap between the two conditions in period 1, indicating that it takes little time for the workers to understand that the provision of high effort pays off in the ICF. Moreover, whereas there is a strong increase in effort levels in the ICF over time, the effort in the ICR decreases from 4 to only slightly more than 3 units in the first few periods. Finally, there is a substantial drop in the average effort in the ICF in the last period, although it is still considerably higher than in the ICR. Figure 5 also shows that effort is highest in the C condition but, given the absence of an effort enforcement problem in this condition, this is not surprising. A remarkable feature of Figure 5 is that the effort in the ICF is relatively close in some periods to that in the C condition.

The differences between the ICF and the ICR also emerge at the level of individual trades. The maximum effort was rarely achieved in the ICR and the most frequent effort level was $e = 1$. The workers chose the minimal effort in 43 percent of all the trades in the ICR and $e \geq 7$ was observed in only 14 percent of the trades. The ICF sharply differs from this because the minimal effort was provided in less than 10 percent of the trades whereas the maximum effort was achieved in 36 percent of the trades. Effort is between 7 and 9 in another 29 percent of the trades in the ICF.

FIGURE 5 here

We examine the significance of the effort difference between the ICF and the ICR sessions in Table 5 by regressing effort on an ICF dummy and controlling for potential nonlinear time trends by including “period” and “period squared” into the regression. All regressions in Table 5 take

the censoring of effort levels into account and all significance results are based on robust standard errors adjusted for clustering on sessions. Regression (1) shows that the treatment dummy has a big and highly significant coefficient. This can be taken as a first indication that contingent renewal policies are an effective device for the elicitation of high effort levels when there is an excess supply of workers. However, we already know from Section 4.3 that firms also pay higher wages in the ICF than in the ICR. Previous studies of gift exchange markets (Fehr, Kirchsteiger and Riedl (1993), Fehr and Falk (1999)), which are similar to our ICR, indicate that higher wages encourage higher effort levels on average. This effect is due to the existence of a substantial percentage of fair workers who reciprocate high wages with high effort levels. Since it is likely that many workers also behave in this way in the ICF, the higher effort could be due to the payment of higher wages. To control for this possibility, we included wages as a control variable in regression (2) of Table 5. The regression shows that wages indeed have a sizeable and significant positive effect on effort. A wage increase by ten units increases effort by roughly 2 units. The ICF dummy is, however, still large and highly significant.

In regression (3), we included “private offer” and the interaction between “private offer” and the ICF dummy as further controls. “Private offer” is a dummy variable that is one if the trade has been initiated by a private offer and zero otherwise. This regression was motivated by the fact (see Section 4.1) that the share of private offers is much higher in the ICF compared to the ICR. We hypothesized that a private offer may have a positive effect on effort levels for purely psychological reasons. The mere fact that a firm singles out a particular worker in a situation of excess supply of workers may render the worker grateful, which in turn may raise his effort. If this argument is correct, we should observe a positive effect of the private offer dummy in the ICR. However, private offers were predominantly made to the previous worker in the ICF, while this was not possible in the ICR. Therefore, private offers in the ICF signal that the firm implemented a policy of contingent renewal. Anything that fosters a worker’s belief in a firm’s contingent renewal policy strengthens the material incentives associated with this policy.

Therefore, private offers in the ICF are predicted to have a positive effect beyond the psychological effect that may also be present in the ICR because they capture a part of the impact of contingent renewal policies on effort. If our arguments are correct, “private offer” and the interaction between “private offer” and the ICF dummy should be positive and significant. Regression (3) shows that this is indeed the case. A private offer in the ICF has a sizeable and significant effect on effort and the effort increase due to private offers in the ICF is significantly larger than in the ICR. The positive impact of “private offer” in the ICR may explain why the frequency of private offers is already relatively high there (see Figure 1). The extra effect of “private offer” in the ICF may partly explain why firms in the ICF rely more on private offers than do firms in the ICR. Note also that even if we control for wages and private offers, the ICF dummy is still significantly positive.

TABLE 5 here

An interesting feature of Figure 5 is that the effort in the final period is more than two units higher in the ICF than in the ICR. We performed regression (4), which uses only the ICF and ICR data of the final period in order to examine the reasons for this difference. Note that all variables related to a contingent renewal policy, i.e., the ICF dummy and the interaction between the ICF dummy and private offer, should no longer play a role in the final period, because the workers’ contracts cannot be renewed. In contrast, the variables that are hypothesized to have an impact even in one-shot interactions should still play a role. Regression (4) shows that the data supports these predictions. The ICF dummy and the interaction variable are far from being significant whereas the wage and private offer have still sizeable coefficients and are significant. We know from figures 1 and 3 that firms make more private offers in the final period and pay

higher wages in the ICF. Therefore, the higher effort level in the final period of the ICF can be attributed to the differences in firms' behavior across ICF and ICR.¹⁹

4.6. Efficiency and Distribution in Long-Term Relations

We showed in Section 4.2 that many more trades took place in long-term relations in the ICF than in the C condition. An important precondition for the existence of long-term relations is that both workers and firms gain when they remain together. In particular, if workers can earn more money with a strategy of “take the money and run”, i.e., by interacting only a few times with a firm, until the firm trusts them and pays high wages, after which the worker shirks, long-run relations will be a transient phenomenon. In Figure 6, we depict firms' profits and workers' earnings in the ICF as a function of the ultimate duration of their relationship. The figure shows that both workers and firms earn the more money from a trade the longer their relationship ultimately lasted. The highest incomes from a trade are experienced in relations which ultimately lasted between 11 and 15 periods. Workers earn almost twice as much, and firms earn more than twice as much in such long-term relations as compared to short-term relations which lasted 1 or 2 periods. Regression analyses also support this result. We regressed both the firms' profit and the workers' earnings per trade on the final duration of the relationship, controlling for “period” and “period squared”. A one-period increase in the ultimate length of a relation significantly increases firms' profits by 1.7 units and workers' earnings by 1.3 units.

Another noteworthy feature of Figure 6 is that, irrespective of how long the relation lasted, the earnings from trade are distributed rather equally between workers and firms in the ICF. The workers' share in the total earnings is on average 50 percent in the ICF. Figure 6 also shows firms' profits and workers' earnings per trade in the ICR and the C condition.²⁰ The workers' share is 69 percent in the ICR while it is only 22 percent in the C condition. Thus, the firms' extract most of the gains from trade for themselves in the C condition, whereas they share it

equally in the ICF. The earnings sharing in the ICF is also neatly illustrated by the relation between the offered earnings from a trade, $w - c(\tilde{e})$, and the desired effort level \tilde{e} . There is a strong positive relation between \tilde{e} and the offered earnings from trade in the ICF. This means that firms not only compensate their workers for the effort they request from them but also offer them a part of the higher overall income generated by the provision of \tilde{e} . This contrasts sharply with the C condition, where the earnings offered per trade are generally low and where the relation between the offered earnings and \tilde{e} is flat. Thus, the ICF can be characterized as a surplus-sharing economy while surplus-sharing is absent in the C condition.

FIGURE 6 here

The egalitarian sharing of the overall earnings from a trade in the ICF occurs throughout the whole experiment, i.e., in all periods. This fact is interesting for several reasons. First, it indicates that unemployment was involuntary in all periods because the unemployed workers would have been better off if they had had a job. Moreover, as the very low earnings for the workers in the C condition show, the unemployed workers would have been willing to work at substantially lower wages. Second, the workers' high earnings from trade in the ICF show that the entrance fee critique against the disciplining version of the efficiency wage hypothesis does not apply here. This critique says that firms will extract any rent up-front that the workers earn in future periods by charging an entrance fee (Carmichael 1985). While it was not possible to charge an entrance fee in our experiment, it was possible to pay wages of zero. The firms could at least extract part of the huge future rents from the workers by paying $w = 0$ in period t and demanding the maximum effort. However, there is simply no evidence that firms ever tried such a policy. Instead, they shared the total earnings from a trade *in each period*. In periods 1-14 the workers' share in the gains from trade varied between 45 and 57 percent; in period 15 the share

was 71 percent which is close to the average share in the ICR. This sharing policy was quite rational in view of the workers' behavior because the workers' effort choice in t strongly varied with the wage in t . Thirdly, the workers' high earnings from trade provide a rationale for the absence of disagreements about contract conditions in the ICF. The firms took advantage of the excess supply of workers in the C condition, and their attempts to enforce low wages led to a considerable number of unaccepted offers. Workers in the ICF had little reason not to accept the prevailing contract because the firms' offers were generous.

4.7. Preconditions for Successful Long-Term Relations

If long-term relations are so much better for both firms and workers, how do the parties establish successful relationships? One possibility is that firms and workers gradually build up trust, i.e., wages and effort gradually increase over the course of a relationship. The other is that successful relations exhibit high wages and high effort levels from the very beginning. The renewal probabilities of relations of different length suggest that the first two periods are critical for the success of a relationship. Only 25 percent of the one-period relations are renewed for a further period. This figure increases to 60 percent for relations that have lasted for two periods, while the renewal probability is roughly 80 percent for relations with duration in excess of two periods. This suggests that if a trading relation survives the first one or two periods, the chances for the establishment of longer lasting relations are relatively high.

This raises the question of which actions by firms and workers during the first two periods contributed to a successful long-term relation. To answer this question, we classified the observed trading relations according to whether their ultimate duration was 1-2 periods, 3-5 periods, or 6-15 periods. We then computed the evolution of average wages and average effort over the course of the relationships in the different relationship classes (see Figure 7). The figure indicates that even in period 1 of a relationship, there were sizeable wage differences across

relationships of different ultimate durations. For instance, the first period wage was 43 in those relationships that finally lasted 6-15 periods, which was 10 to 15 units higher than that in those relationships that ultimately lasted only 1-2 or 3-5 periods.²¹ The evolution of effort across relationship classes, which is measured on the right vertical axes of Figure 7, resembles the wage picture. The first period effort was higher in those relations that ultimately lasted 6-15 periods than in those with a final duration of less than 6 periods. The same holds for expected effort. Firms in long lasting relations already expect considerably higher effort levels at the beginning of the relationship. From the effort regressions in Table 5, we know that higher wages are associated with higher effort levels. Thus, Figure 7 and Table 5 suggest that high wage levels in the first period of a relationship induced high effort levels in that period, facilitating the emergence of long-term relations. However, Figure 7 also shows that there is a gradual wage and effort increase in the first three periods in those relations that ultimately lasted 6-15 periods. This suggests that, in addition to the seeds planted by high first period wages, the establishment of successful long-term relations is further supported by a gradual increase in mutual trust.

FIGURE 7 here

We also ran censored regressions with the ultimate duration of relations as a dependent variable and the wage in the first one or two periods of a relation as the independent variable. Wages in both the first period ($p = 0.030$) and in the first two periods ($p = 0.008$) are highly significant predictors of the ultimate duration. An increase of the first-period wage by 10 units increases the ultimate duration by 2.5 periods on average. We also hypothesized that the extent to which a worker meets or exceeds the firm's effort expectations in the first period of a relation could contribute to the ultimate duration of a relation. If, in addition to wages, we include a dummy variable indicating whether the worker met or exceeded the firm's expectations, the

positive wage effect on ultimate duration remains significant and the dummy variable has a large and significant positive effect. The same result holds true if we take wages and the dummy in the first two periods of a relation as predictors of ultimate duration. We also ran regressions with a dummy indicating whether the worker's actual effort in period 1 of a relationship equaled or exceeded the firm's desired effort level. It does not matter whether we use the firm's desired or expected effort as a reference level, however. In both cases, a dummy variable indicating whether the reference level is met or exceeded has a large positive impact on ultimate duration.

Taken together, these results suggest that the trading parties' behavior in the first or the first two periods is important for the establishment of successful long-term relations. Both firms' and workers' actions are important. A firm can initiate a trustful long-term relation by already paying relatively high wages at the beginning of the relationship and the worker can signal that he can be trusted by providing effort that meets or exceeds the firm's expectations. In addition, we also observe a gradual increase in trust over the first few periods of long-term relations. Of course, a relation will ultimately only be successful if the firm continues paying fair wages and the worker persists in providing satisfactory effort. Yet, the discussion above tells us that the situation at the very beginning of a relationship significantly affects whether this will occur.

5. CONCLUSIONS

We have shown in this paper that the absence of third-party enforceability of contracts changes the nature of market interactions in a fundamental manner. When contracts are third-party enforceable, the identity of the trading partner is irrelevant and the vast majority of trades take place in one-shot transactions. The short side of the market exploits its bargaining power and the gains from trade are distributed rather unequally. In contrast, in the absence of third-party enforcement, firms care a lot about the identity of their workers, they pay high wages, and they share the gains from trade relatively equally with their workers. They voluntarily limit their

set of trading partners by tendering their offers exclusively to particular workers with whom they form long-term relations. Firms initiate successful long-term relations by already offering high wages in the first period of a relation; workers contribute to successful relations by meeting or even exceeding firms' effort expectations. Long-term relations are successfully managed by a policy of contingent contract renewal rewarding high and satisfactory performance with the renewal of the contract. Both firms and workers are better off if they are allowed to engage in long-term relations. The average income of both parties is much higher in long-term relations than in short-term relations. When we remove the possibility of renewing the contract with the previous worker, there is a substantial drop in the average effort and the minimal effort becomes the most frequently chosen effort level.

It is costly for the firms to extract current or future rents from the workers by low wage offers in the absence of third-party enforceable effort because this leads to an immediate reduction in the effort level. We also find some evidence suggesting that workers accumulate reputational capital in the course of long-term relations. Firms expect higher effort levels and workers do provide higher effort levels in longer lasting relations, making firms, *ceteris paribus*, more reluctant to fire them.

We believe that our experiments provide methodological returns in addition to the insights provided by this paper. Our experimental set-up can be used with appropriate modifications and additional treatment conditions to examine a host of interesting questions. One could, for instance, easily study the market and efficiency consequences of employment legislation which increases layoff costs for firms. Another interesting question is what happens if firms receive information on the unemployment history of the workers. Are workers who have been unemployed for prolonged periods of time stigmatized, *i.e.*, do they get fewer and worse offers? A further important question is how markets where the sellers can acquire a general reputation for being trustworthy work. The workers could only acquire a relation-specific reputation in our

experiments because the other firms did not know how well a particular worker worked. While this is a natural condition in many labor markets, there are clearly many goods markets where the sellers can acquire a general reputation. Moreover, one could allow the sellers to invest in costly advertising to create a general reputation. Also, questions regarding the interaction between explicit and implicit incentives have remained largely unexplored empirically. For instance, is it indeed the case that the availability of better explicit incentives makes self-enforcing agreements less likely – as hypothesized by Baker, Gibbons and Murphy (1994) and Schmidt and Schnitzer (1995). Or: How do decisions with regard to vertical integration interact with relational contracts (Baker, Gibbons and Murphy (2002))?

Finally, our set-up lends itself to the analysis of the question of the extent to which self-enforcing implicit agreements are associated with price or wage stickiness. In our view, relational long-term contracts may well introduce considerable inertia into the system. Our results suggest that long-term relations are embedded into a system of implicit obligations and beliefs about obligations that render fairness concerns prominent. Once a worker and a firm have established a long lasting implicit agreement, fairness concerns and the coordination problems involved in reaching a different implicit agreement may render the parties unwilling to change the agreement despite the existence of large supply or demand shocks.

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APPENDIX

We show in more detail in this appendix how high effort levels can be sustained in a perfect Bayesian equilibrium in the ICF condition if a sufficient number of fair subjects who reciprocate generous contract offers with generous effort levels are present. For tractability reasons our argument relies on the theory of fairness developed by Fehr and Schmidt (1999). The utility function of fair players in the two-player case is thus given by

$$U_i(x) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\},$$

$i \in \{1, 2\}$, $i \neq j$, where $x = (x_1, x_2)$ denotes the vector of monetary payoffs and $\beta_i \leq \alpha_i$, $0 \leq \beta_i < 1$.

The term weighted with α_i measures the utility loss stemming from inequality to i 's disadvantage, while the term weighted with β_i measures the loss from advantageous inequality. We use a grossly simplified version of this theory. We assume that there are 40 percent self-interested persons ($\alpha_i = \beta_i = 0$) and 60 percent fair persons. Fair subjects exhibit $\alpha_i = \beta_i = 0.5 + \varepsilon$, where ε is a small positive number. Fair subjects thus are willing to pay in order to achieve equality. If the inequality is to their disadvantage, they are prepared to engage in costly "punishment" in order to reduce the payoff to their opponent. If the inequality is to their advantage, they are willing to spend resources in order to benefit the other player. Subjects with $\alpha_i = \beta_i = 0.5 + \varepsilon$ are willing to share the surplus of a contract equally.

We make two further simplifying assumptions for our application. We assume that, once a contract has been accepted, the only reference agent for a subject in our experiment is his trading partner. This allows us to use the two-person utility function above to study the workers' effort behavior. We believe that this assumption approximates the subjects' perception of the situation well because they do not know the effort provided in other trades. In addition, the trading partner has clearly a salient position for a subject in our experiment once a contract has been concluded. We also assume for reasons of tractability that each firm can make exactly one offer, private or public, per period and that the firms' offers are made simultaneously. The strategy space of

continuous auctions, where many firms and workers interact and where the traders can make offers continuously during the trading period, is so large that this situation has defied a fully rigorous analysis for now. Therefore, we approximate this situation with a posted contract institution where each firm makes one offer simultaneously per period.

The following strategies can be shown on the basis of the assumptions above to be part of a perfect Bayesian equilibrium in the ICF. The workers' strategy is as follows: fair workers choose the payoff equalizing effort level in all periods. They accept any contract that gives them a non-negative payoff. Selfish workers also accept any contract giving them a non-negative material payoff. They perform at the desired effort level if the cost of the desired effort in period $t-1$ is less than or equal to the expected loss from being fired.

The firms' strategy is as follows: a firm renews the contract in all periods with the previous worker if the worker provided the desired effort level. Otherwise, the worker does not get a new offer from his previous firm. Firms make a public offer in period 1, and whenever they do not renew the previous worker's contract. All firms offer a contract $(w, \tilde{e}) = (59, 10)$ from period 1 to 13. This contract equalizes the material payoff if the worker chooses $e = 10$. All firms offer the contract $(w, \tilde{e}) = (40, 7)$ in period 14. This contract equalizes the material payoff if the worker chooses $e = 7$. In period 15, the selfish firm offers $(w, \tilde{e}) = (32, 6)$ while the fair firm offers $(w, \tilde{e}) = (5, 1)$. A fair firm's period 15 contract gives all workers a payoff of 5, which is identical to the unemployment benefit of 5, in contrast with a selfish firm's contract. This contract gives the fair workers a payoff of 24, and the selfish workers (who shirk in the final period) a payoff of 32.

The strategies described above are supported by the workers' out-of-equilibrium beliefs that the firm terminates the relation at the end of the period if it does not pay a "fair" wage in this period. The "fair" wage is the wage that equalizes the payoff if the worker chooses the desired

effort level \tilde{e} . If, however, the firm pays a fair wage in period t , the worker believes that he will get a new offer in period $t+1$ with probability 1 if he performs at \tilde{e} .

The crucial intuition behind this equilibrium is the existence of a rent in period 15. Note that when all subjects are selfish, firms have no incentive to offer a rent in period 15. In the presence of fair workers, however, the selfish firms have an incentive to pay a relatively high wage in period 15 because the fair workers respond to high wages in any given period t with payoff equalizing effort levels in period t . This makes it profitable for the selfish firms to pay a high wage in period 15. In contrast, the fair firms do not pay a high wage in period 15 because they derive extra disutility from the shirking of selfish workers. The reason is that shirking causes inequality to the disadvantage of the firm, which fair firms value negatively. Thus, the fair workers induce the selfish firms to pay a high wage in period 15 while the selfish workers induce the fair firms to pay a low wage.

To be more precise, remember our assumption that there are 60 percent fair persons and 40 percent selfish persons. The fair workers prefer an effort level for any given wage that equalizes π_f and π_w , i.e., an effort such that $10e - w = w - c(e)$ holds. Differentiating this equation yields $\partial e / \partial w = 2 / [10 + c'(e)]$. We consider the effort and wage decisions in period 15 first. Remember that in equilibrium, the workers' type has not yet been revealed when the firms decide on their contract offer in $t = 15$. A firm's expected material payoff is $E\pi_f = 0.6[10e(w) - w] + 0.4[10 - w]$ where $e(w)$ denotes the fair worker's effort level. Differentiation with respect to w yields $\partial E\pi_f / \partial w = 6(\partial e / \partial w) - 1 = [12 / (10 + c'(e))] - 1$. This derivative is zero if $c'(e) = 2$, which is the case for all $e \in \{3, 4, \dots, 8\}$. Thus, the firm's profit is the same for all wages that induce effort levels in the set $\{3, 4, \dots, 8\}$. They all generate an expected profit of $E\pi_f = 8$.²² This means that the selfish firm is indifferent between any $\tilde{e} \in \{3, 4, \dots, 8\}$. The fair firm, however, prefers $\tilde{e} = 1$ and $w = 5$. This gives it an expected utility of $EU_f = 10 \cdot 1 - 5 = 5$. The selfish worker will shirk

for any $\tilde{e} > 1$ which causes disadvantageous inequality for the fair firm. For example, a firm has to pay $w = 14$ to induce a fair worker to choose $\tilde{e} = 3$. The expected utility of this wage offer is $EU_f = E\pi_f - 0.6\beta[30 - 14 - (14 - 2)] - 0.4\alpha[14 - (10 - 14)] = 8 - 9.6\alpha$. The term in the first brackets is the payoff difference between π_w and π_f if the worker performs, which happens with probability 0.6. The term in the second brackets is the payoff difference between π_w and π_f if the worker shirks, which happens with probability 0.4. It is easy to see that for $\alpha \geq 1/2$, $EU_f < 5$, i.e., the fair firm prefers $\tilde{e} = 1$ over $\tilde{e} = 3$. The same holds for all wages inducing $\tilde{e} > 1$. Thus while $(w, \tilde{e}) = (5, 1)$ is the utility maximizing offer for fair firms in $t = 15$, $(w, \tilde{e}) = (32, 6)$ is a (non-unique) utility maximizing offer for selfish firms. The rest of our argument is based on the assumption that selfish firms offer $(32, 6)$ in $t = 15$, but in view of the non-uniqueness of the best offer different assumptions would be equally legitimate.

In order to compute the expected loss of the workers from shirking in $t = 14$, it is important to recall that the workers do not know the type of their firm in $t = 14$. Thus, they do not know for sure which offer they will receive in $t = 15$ in case they meet the desired effort in $t = 14$. Since there are 60 percent fair firms and 40 percent selfish firms, a fair worker who does not know his type has an expected payoff of $E\pi_w = 0.6 \cdot 5 + 0.4[32 - 8] = 12.6$ in period 15. A selfish worker who does not know his firm's type has an expected payoff of $E\pi_w = 0.6 \cdot 5 + 0.4[32 - 0] = 15.8$ in period 15. Therefore, the payoff gain from being employed in the final period is $15.8 - 5 = 10.8$ for the selfish worker and $12.6 - 5 = 7.6$ for the fair worker.²³ This means that the implicit threat of firing the worker in case he shirks in $t = 14$ induces a selfish worker to provide up to $\tilde{e} = 7$ in period 14. The selfish worker prefers, however, to shirk if the firm demands $\tilde{e} > 7$ in $t = 14$ because $c(\tilde{e}) \geq 12$ for $\tilde{e} > 7$.

Given the selfish worker's behavior, a demand of $\tilde{e} = 7$ in $t = 14$ and a payoff equalising wage $w = 40$ for that effort level is optimal for all firms. It does not pay to offer $w > 40$ because

only fair workers will reward this nor does not pay to offer $w < 40$. In the latter case, the workers believe that the contract will not be renewed in $t = 15$. Therefore, $w < 40$ induces full shirking of the selfish worker and – depending on the value of w – partial shirking ($1 < e < \tilde{e} = 7$) of the fair worker. It is also obvious that in case of $e = \tilde{e}$ in t , the firm must make a *private* offer to the previous worker because otherwise the firm risks being paired with a new worker in $t + 1$. Since this would be anticipated, it would dilute the incentives of the selfish worker in t .

If a worker has shirked and the firm does not renew the contract with this worker, the firm is indifferent between a private and a public offer, i.e., the public offer is also optimal. In $t = 13$ the expected rent from employment in the final two periods for a selfish worker is $[(40 - 10) - 5] + 10.8 = 35.8$. This means that in $t = 13$ the selfish worker can be induced to provide $\tilde{e} = 10$ because $c(10) = 18 < 35.8$. Therefore, it is optimal for all firms to offer contracts $(w, \tilde{e}) = (59, 10)$ in $t = 13$. By backward induction, this is also the optimal offer in all previous periods. The fair workers choose $e = \tilde{e} = 10$ because at $w = 59$ this is the fair choice while selfish workers choose $e = 10$ because the threat of not getting the contract renewed provides enough incentives.

Finally, note that accepting any offer with a non-negative payoff is rational for a fair worker as long as the worker believes that there are selfish unemployed workers. Since the selfish workers accept any non-negative payoff, a fair worker can never punish a firm by rejecting a low offer.

The previous argument shows that it is possible to sustain the maximum effort level in the ICF in the first 13 periods. Since only one-shot interactions can take place in the ICR, the maximum effort level cannot be enforced in this condition.

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FOOTNOTES

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² There is, e.g., no control condition in which the formation of long-term relationships is ruled out. Therefore, it is impossible to examine the enforcement power of endogenous partner choices. We parametrize our experiment such that there is a unique competitive equilibrium (with selfish preferences) while in Kollock (1994) – due to overlaps between supply and demand curves – every feasible price level that generates non-negative profits constitutes a competitive equilibrium. This makes it impossible to detect Non-Walrasian outcomes because every division of the gains from trade is a Walrasian outcome. Another important difference is that in our experiments workers chose their effort level *after* they had been employed at a certain wage. This means that we examine ex-post opportunism while Kollock (1994) studies ex-ante opportunism. In our set-up the effort level could thus respond to the wage level within a given period. In Kollock's set up sellers could not reciprocate high price offers in this way.

³ Hence, ICF means Incomplete Contract Condition with Fixed IDs.

⁴ The experimental instructions were framed in a neutral goods market language. The reason for this was that most subjects know that in the labor market long-term relations are pervasive. Therefore, we thought that long-term relations emerge more easily if the experiment is framed in labor market terms. Thus, if long-term relations emerge in the context of a goods market frame we have a stronger result. Translated instructions for the ICF-treatment are presented in Brown, Falk and Fehr (2002) which can be downloaded from <http://www.iew.unizh.ch/wp/index.php>.

⁵ Since the practice periods did not involve any payments the workers would have had no real effort costs in these periods. This would have allowed them to fool the firms with regard to their true willingness to provide effort. To prevent this we did not conduct the second stage in the practice periods.

⁶ Since w had to be an integer, $w = 6$ is optimal if $w = 5$ is rejected by the workers. For empirical purposes this difference is, however, negligible.

⁷ Since w had to be an integer there is also an equilibrium at $w = 24$.

⁸ For a model of reputation building see, e.g., Kreps, Milgrom, Roberts and Wilson (1982).

⁹ See Rabin (1993) for this definition of reciprocal fairness. Recently several new models of social preferences have been developed that are consistent with reciprocal responses in one-shot interactions (Levine (1998), Dufwenberg and Kirchsteiger (1999), Falk and Fischbacher (1999), Fehr and Schmidt (1999), Bolton and Ockenfels (2000), Charness and Rabin (2002)). For the purposes of this paper it is not necessary to go into the details of the motives that may generate reciprocal responses. For our purposes it is important that a fraction of the subjects exhibits reciprocal behavior in one-shot interactions while the precise source of this behavior does not interest us here.

¹⁰ We use the Fehr-Schmidt model because it is easy to apply in our context and captures some aspects of reciprocal behavior in a simple way. We do not regard our experiments as the appropriate environment for testing different fairness models. Other fairness models probably generate very similar equilibrium behaviors in our context.

¹¹ The fair workers need not be disciplined because they are willing to provide high effort levels in period t as long as they receive sufficiently generous offers in period t .

¹² Our argument here is essentially an application of an argument in MacLeod and Malcomson (1998) to the context of a finitely repeated game. A crucial point in MacLeod and Malcomson (1998) is that firms cannot extract the *future* rents of the workers up-front by paying low wages or by charging entrance fees in the current period if this induces a belief that there will also be low wages (i.e., no rents) in the future. Given this belief, workers reduce their effort in the current period if they receive low wages in the current period. Note that in our context the belief is slightly different. If the workers do not receive a rent in the current period this is taken as a signal that the relation will be terminated at the end of the period.

¹³ Our rationale for long-term relations in the ICF is certainly not the only possible one. For example, it is well known, that reputation building may occur even in situations where there are in fact no fair players but some players believe that there are fair players (see, e.g., Kreps, Milgrom, Roberts and Wilson (1982)). It may then be profitable for selfish players to behave as if they had a preference for fairness. Thus, it may be possible to construct somewhat similar equilibria as the one we have constructed even if there is only a very small number of fair subjects.

¹⁴ There is, of course, also the possibility that subjects do not play any equilibrium.

¹⁵ All tests reported in this paper are two-sided.

¹⁶ If we regress individual wages (from all periods) on a constant, the time period, a dummy for the ICF and a dummy for the ICR both the ICF dummy ($p = 0.036$) and the ICR dummy ($p = 0.049$) are significant. These significance levels are based on robust standard errors adjusted for clustering on sessions. Thus, according to the regression the ICR-C difference is also significant. When comparing the wage levels in the ICR and the C-

condition one also has to take into account that effort levels and, hence, effort costs were much higher in the C-condition than in the ICR (see Section 4.5 below).

¹⁷ We also experimented with “shirking”, i.e., $e < \tilde{e}$ and excess effort ($e \geq \tilde{e}$) as regressors. It turns out, however, that when previous effort is included, shirking and excess effort have sometimes weak explanatory power while positive and negative surprise are always significant and have the expected sign. We also ran separate probit regressions for the individual sessions. Yet, the general pattern is the same across sessions.

¹⁸ Let n_t denote the number of workers who trade with the previous firm in period t . $10 - n_t$ denotes the workers who are in the market and search for a job in period t and $7 - n_t$ is the number of firms who do not trade with their previous worker and search for *another* worker in t . Then a worker who is denied contract renewal in period t has probability $\mu_t = (6 - n_t)/(9 - n_t) < 1$ of trading with *another* firm.

¹⁹ According to our model in the appendix there are multiple equilibria, involving different wage-effort pairs, in the final period of the ICF and in the ICR. Therefore, a higher wage and a higher effort in the final period of the ICF, relative to the ICR, is not inconsistent with the model.

²⁰ Since 90% of all trades in the C-condition, and 100% of the trades in the ICR, take place in short-term interactions it makes no sense to distinguish between short- and long-term interactions in these treatments.

²¹ The partitioning of the periods into different classes does not affect this result. The higher the first period wage in a relationship the longer the relationship lasted on average.

²² Note that in order to induce an effort of 3 in period 15 firms must only offer a fair worker a wage of 14 rather than the payoff equalising wage of 16. This is because fair workers would reap a lower utility by reducing their effort to 2, as this leads to inequality to their advantage. For similar reasons the wages required to induce effort levels of {4,5,6,7,8} are {20,26,32,38,44} respectively.

²³ Note that the probability of getting reemployed by a different employer, after a unilateral deviation from the equilibrium effort, is zero because, in equilibrium, all other employers renew the contracts with their previous workers.

TABLE I

COST OF EFFORT SCHEDULE

Effort	1	2	3	4	5	6	7	8	9	10
Cost	0	1	2	4	6	8	10	12	15	18

TABLE II

EVOLUTION OF PRIVATE OFFERS TO THE PREVIOUS EMPLOYEE RELATIVE TO ALL THE PRIVATE OFFERS

Period	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Percent	57	38	54	47	68	73	63	73	66	73	79	74	63	69

TABLE III

PROBABILITY OF CONTRACT RENEWAL IN THE ICF TREATMENT^a

Effort in previous period	.125** (.052)
Positive surprise	.192** (.077)
Negative surprise	-.836** (.381)
Previous length	2.449*** (.653)
Constant	-5.045*** (1.535)
Controls for session fixed effects	YES
N = 488	
LL = -41.93	
Wald χ (3) = 11.89	
Prob = .000	
Pseudo R ² = .8747	

^aThe estimation procedure is a probit regression with robust standard errors (in parentheses). The regression includes dummies to control for session effects. *** indicates significance at the 1-percent level, ** at the 5-percent level and * at the 10-percent level, respectively.

TABLE IV

TOTAL RENTS OF TRADING WORKERS

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
$V_t^e - V_t^u$	102	50	66	113	148	105	139	110	99	95	91	79	71	42	27

TABLE V

DETERMINANTS OF EFFORT AND TREATMENT DIFFERENCES BETWEEN ICF AND ICR^a

	(1)	(2)	(3)	(4)
	all periods	all periods	all periods	period 15 only
ICF-Dummy	5.919*** (1.869)	1.978*** (.577)	1.332*** (.462)	.597 (1.691)
Period	.433 (.338)	.319* (.182)	.229 (.158)	
Period ²	-.026 (.019)	-.022* (.011)	-.018* (.010)	
Wage		.215*** (.011)	.203*** (.009)	.256*** (.033)
Private offer			.598*** (.199)	1.548** (.702)
Private offer × × ICF-Dummy			.829** (.362)	-1.124 (1.559)
Constant	.515 (1.610)	-3.737*** (.892)	-3.192*** (.737)	-6.516*** (1.197)
	N = 940	N = 940	N = 940	N = 62
	Wald $\chi(3)$ =	Wald $\chi(4)$ =	Wald $\chi(6)$ =	Wald $\chi(4)$ =
	12.22	927.68	823.07	140.29
	Prob = .007	Prob = .000	Prob = .000	Prob = .000

^aThe estimation procedure is a censored regression with robust standard errors adjusted for clustering on sessions (in parentheses). *** indicates significance on the 1-percent level, ** on the 5-percent level and * on the 10-percent level, respectively.

FIGURE 1

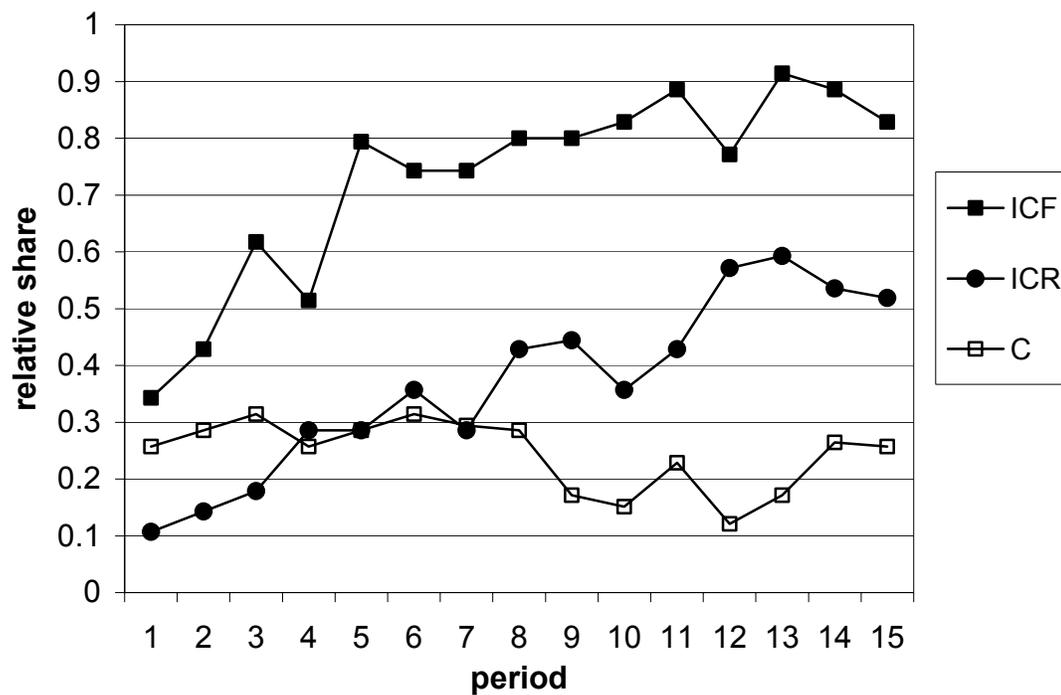


FIGURE 2

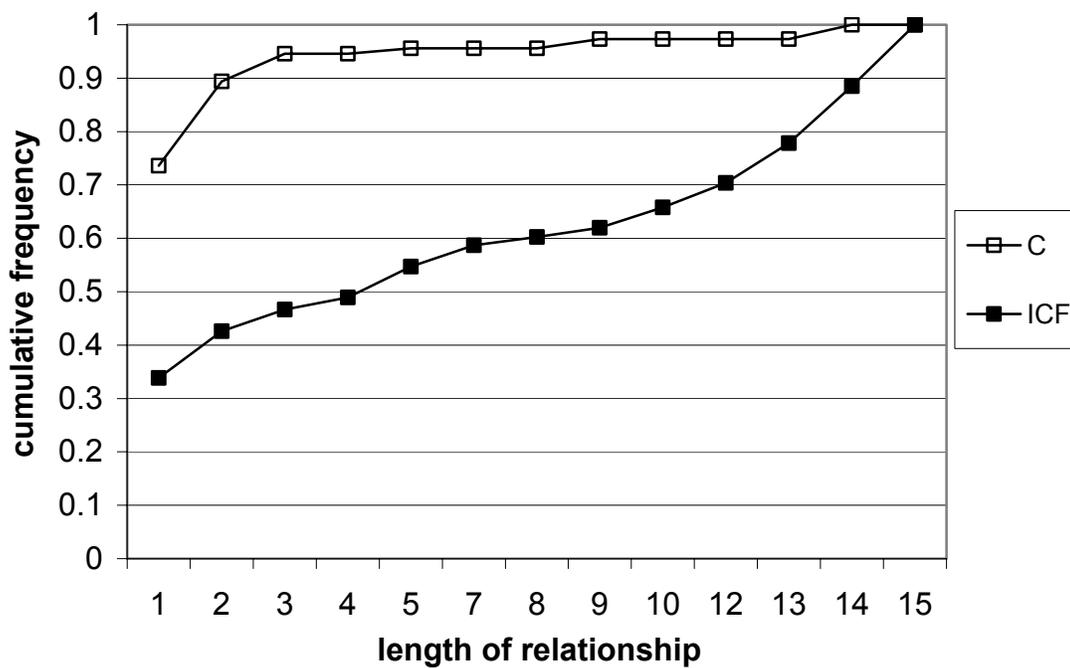


FIGURE 3

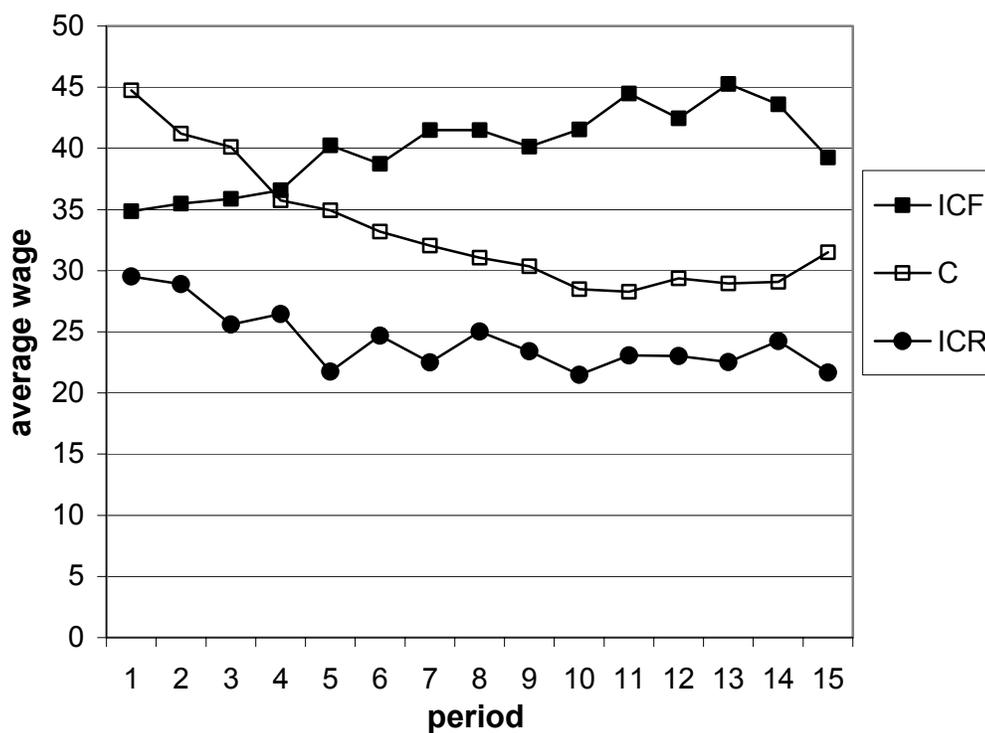


FIGURE 4

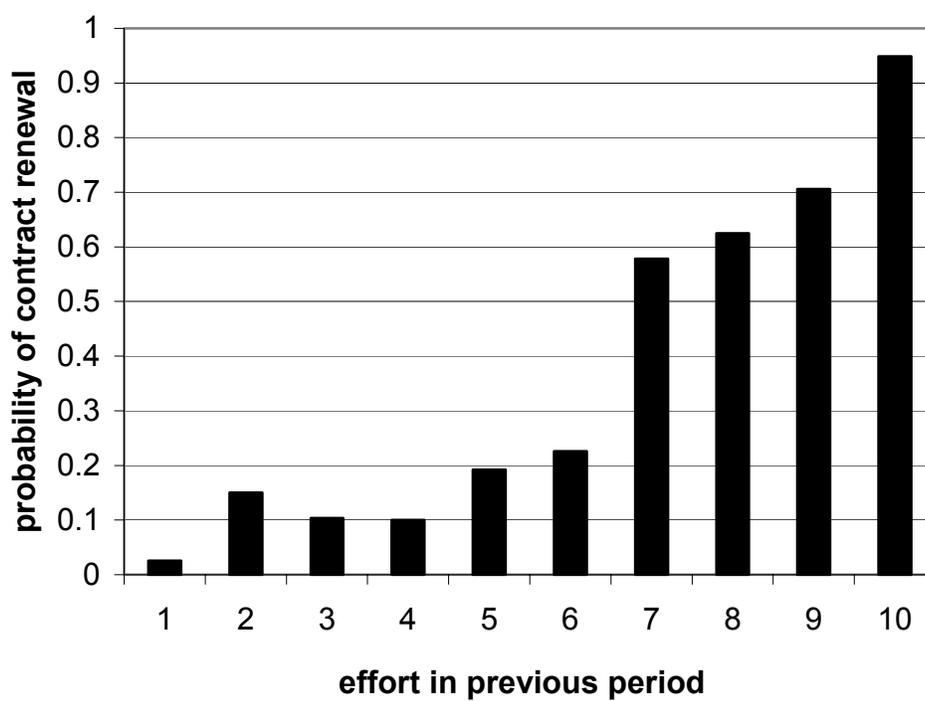


FIGURE 5

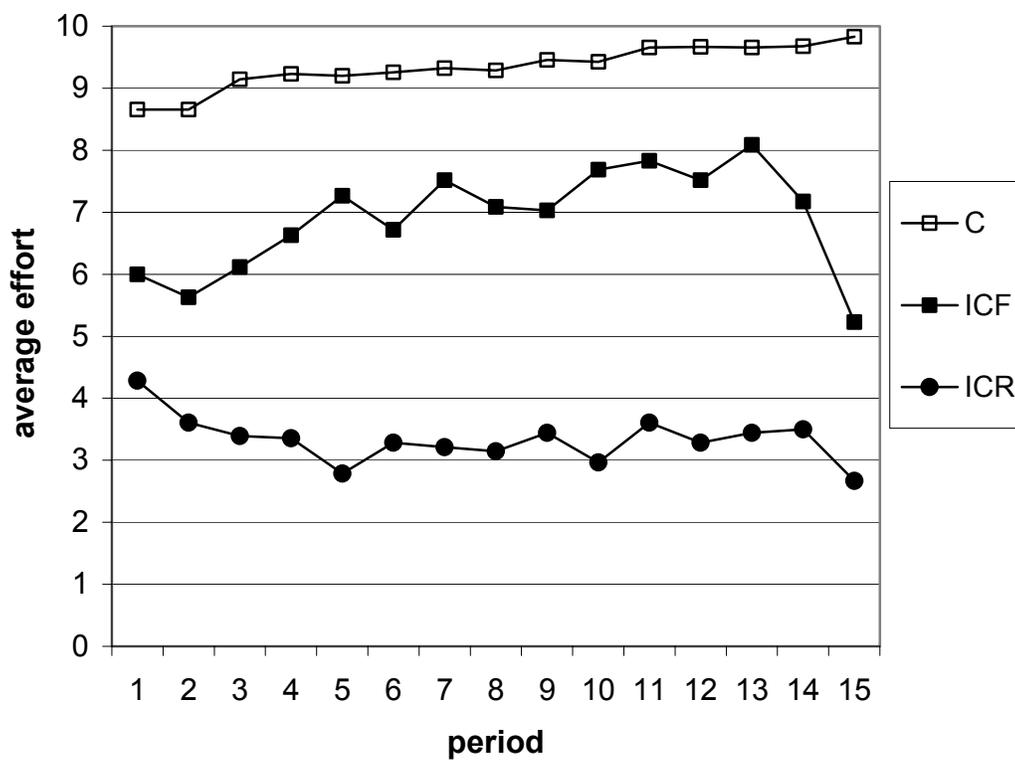


FIGURE 6

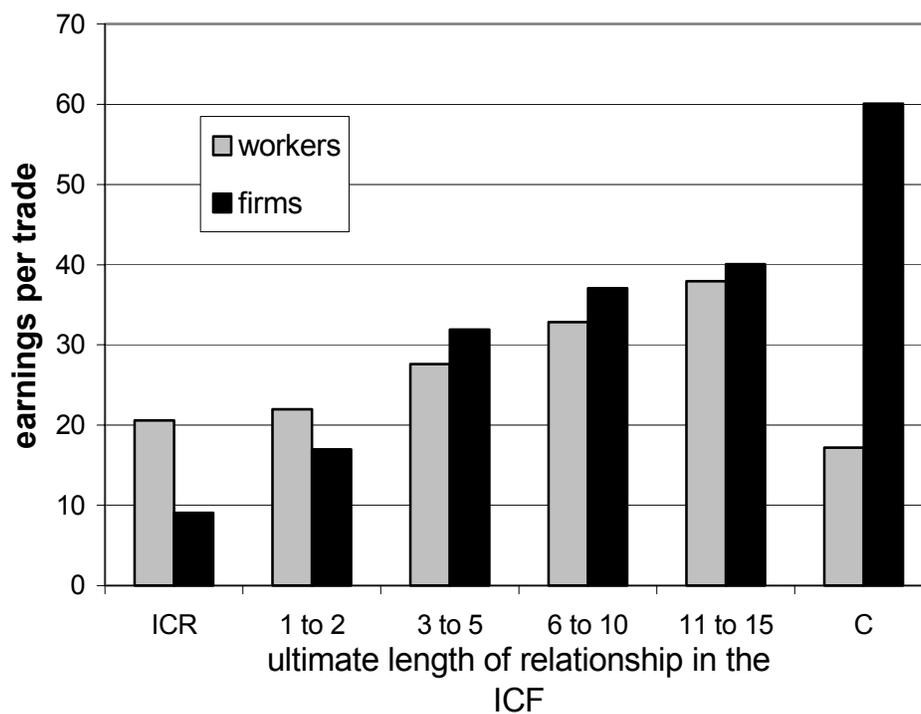


FIGURE 7

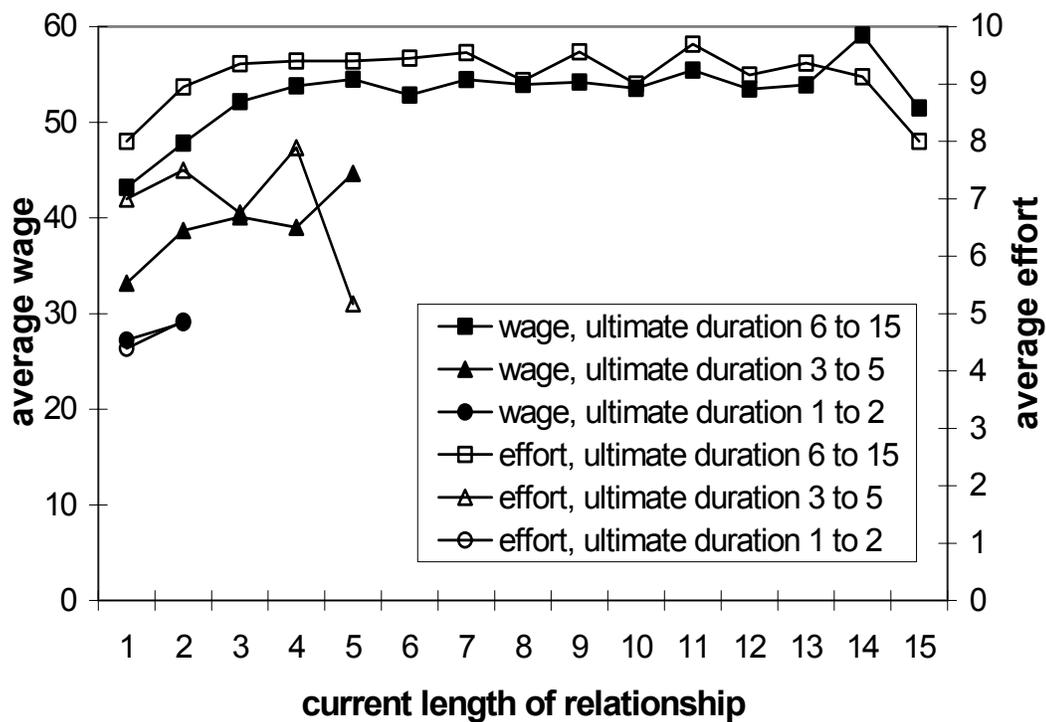


FIGURE CAPTIONS

FIGURE 1__ Relative share of trades initiated by private offers

FIGURE 2__ Cumulative frequency of trades in relationships of different lengths in the C and the ICF treatment

FIGURE 3__ Evolution of average wages over time

FIGURE 4__ Probability of contract renewal as a function of the worker's effort in the previous period (ICF treatment)

FIGURE 5__ Evolution of average effort over time

FIGURE 6__ Earnings of firms and workers per trade across treatments (earnings are displayed in the ICF as a function of the ultimate length of relationships)

FIGURE 7__ Average wages and effort levels dependent on the current duration of a relation for different classes of ultimate durations

LIST OF SYMBOLS

t : Period

$T=15$: Final period of experiment

e : Effort

\tilde{e} : Desired effort

w : Wage

$c(e)$: Cost of effort e

π_f : Material payoff of firm

π_w : Material payoff of worker

V_t^e : Average value of a job in t

V_t^u : Average value of being without a job in period t

μ : Probability of getting another trading partner

$x=(x_1, x_2)$: Vector of monetary payoffs of two trading partners

α_i : Measure for person i of inequity aversion to his or her disadvantage

β_i : Measure for person i of inequity aversion to his or her advantage

$U_i(x)$: Utility of person i from the monetary payoff vector x

ε : Epsilon

E : Expected value

p : p-value of statistic

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