Competition and Relational Contracts

Martin Brown*, Armin Falk**, Ernst Fehr***

March 7, 2005

Please do not cite without permission.

Abstract

This paper examines whether long-term relations between firms and workers can overcome moral hazard when unemployment does not act as a disciplining device. We implement an experimental market in which there is an excess demand for labour and effort of workers is not contractible. We show that implicit agreements do emerge in which firms reward well performing workers with wages that exceed the going market rate. This motivates workers to provide high effort, even though they could always shirk and switch to a new firm which did not observe their prior behaviour. Our results suggest that unemployment is not a necessary disciplining device in occupations that are subject to moral hazard. They also confirm that implicit contract enforcement may be a major source of wage rigidities across business cycles.

JEL: D82, J3, J41, E24, C9

Keywords: Relational Contracts, Involuntary Unemployment, Wage Rigidity

---

*Swiss National Bank, Börsenstrasse 15, CH-8022 Zürich martin.brown@snb.ch. ** IZA & University of Bonn, Schaumburg-Lippe-Str. 7-9, D-53113 Bonn, falk@iza.org. *** Institute for Empirical Research in Economics, University of Zürich, Blümlisalpstrasse 10, CH-8006 Zürich, efehr@iew.unizh.ch. We thank participants in seminars at the University of Zürich and the Swiss National Bank for helpful comments.

1. Introduction

When explicit contracts are costly to design and enforce principals and agents may choose to rely on implicit, or relational contracts (Williamson 1975; MacLeod, 2000). Relational contracts specify mutual obligations in implicit, non-verifiable agreements between trading partners (Baker et. al., 2002). Such implicit agreements are self-enforcing if the future value of the relationship is high for both parties (Bull, 1987).

Recent experimental evidence shows that markets will be pervaded by implicit agreements when explicit contracts are not enforceable. Brown et. al. (2004) find that firms seek long-term relations with individual workers when labor contracts are not enforceable. They show that firms practice a performance contingent employment and wage policy which elicits high effort from workers. Fehr and Zehnder (2004) show that in credit markets where the project choice of debtors is not contractible, relationships between particular borrowers and lenders motivate borrowers to choose efficient projects and to repay loans. This experimental evidence supports findings from field data that firms and workers do pursue long-term relations in credit markets (Petersen and Rajan, 1994; Elsas and Krahnen, 1998), service markets (Banerjee and Duflo, 2000) and the labor market (Hall, 1982; Auer and Cazes, 2000).

The potential for self-enforcing relational contracts may, however, depend on market conditions. Market conditions affect the outside options of agents and therefore whether a relation with a particular principal can motivate an agent to perform well (Kranton, 1996, Hörner, 2002). Consider a labour market in which there is only one employer or high unemployment. In this market a worker who does have a job will fear shirking as this would certainly jeopardize his future employment prospects. If, however there are many other employers offering jobs the worker may be more tempted to shirk.

In this paper we examine the emergence and effectiveness of relational contracts under full employment. We implement an experimental labour market in which there is an excess demand for workers and effort is not third-party enforceable. In our experiment firms and workers can choose to transact repeatedly with each other, so that long-term relations can emerge endogenously. By examining the wage and employment policy of firms as well as the effort decisions of workers we can establish whether relations emerge and whether these motivate workers to perform high effort.

Labor market models suggests that relational contracts can sustain high effort of workers independent of market conditions. MacLeod and Malcolmson (1998) show that

implicit agreements between firms and employees can be sustained in a market with unemployment or full employment. They show that merely the nature of implicit agreements changes with market conditions: As proposed by Shapiro and Stiglitz (1984) simple rents, i.e. "efficiency wages" can motivate workers who are threatened by unemployment. In contrast, under full employment firms must offer relation-specific quasi-rents to workers in order to motivate high performance. MacLeod and Malcolmson (1998) show that post-effort bonus wages can generate such quasi-rents within a relation. Indeed, any remuneration package which offers deferred wages, such as "seniority wages" (Lazear, 1982) or explicit "bonding" (Carmichael, 1984) can sustain an implicit agreement under full employment. Credit market models show that relational contracts without deferred payments can also motivate effort under high demand for agents as long as they generate “insider” information for principals. Boot and Thakor (1994) show that banking-relationships in which a bank offers below market interest rates to well performing borrowers can motivate high effort from borrowers even if alternative spot-market financing is available. It is profitable for banks to offer below-market interest rates, because information on prior behaviour gives them superior information on the quality of a borrower.

Despite the predictions that market conditions should not matter, labor market evidence suggests that implicit agreements between firms and employees may be more difficult to sustain when labor demand is high. Employment statistics show that tenure behaves counter-cyclically. Examining data from several industrialized countries Auer and Cazes (2000) find that job-tenure drops when economic growth leads to high demand for labor. Moreover, examining worker-flow data from the US, Bleakley et. al. (1999) show that workers switching behaviour is responsible for this breakdown of long-term employment relationships. They find that there are significantly more voluntary quits by workers during expansionary periods of the business cycle than during recessions.

However, the fact that tenure behaves counter cyclically does not imply that relational contracts break down under high demand for labour. Tenure may fall simply because workers who are not in relational contracts switch more often while relational contracts remain stable. In contrast to the field evidence cited above, our experimental design allows us to identify whether firms and workers can maintain relations under a high demand for labour. Moreover, we can also systematically test the impact of increased competition for workers on the emergence and enforcement power of

relational contracts. We do this by comparing the outcome of our experiment to that of our recent experiment (Brown et. al., 2004) where we implemented an excess supply of workers.

We find that implicit agreements do emerge even when workers are not threatened by unemployment. Firms reward well performing workers with wages which exceed the average market level. The performance contingent offer of above-market wages motivates workers to provide high effort even thought they could shirk and switch firms at any time. Indeed, we find relational contracts are so effective that aggregate market performance under a high demand for labour is almost identical to that in a market with where jobs are scarce. This result suggests that unemployment is a not a necessary disciplining device in labour markets

When implicit contracts govern labor relations, the distribution of surplus may be unaffected by competitive conditions in the labour market. MacLeod & Malcolmson (1998) predict that wage levels in implicit agreements are not fully determined by market forces, but rather by social norms which prevent either firms or workers from using a strong market position to renegotiate terms. As these social norms may remain stable over market conditions, wage levels will be rigid. This prediction is supported by Brandts and Charness (2004) who find that norms of gift-exchange prevent major variations of wages across market conditions. In this paper we show that wages are highly rigid across market conditions when exchange is governed by relational contracts. This result provides strong evidence that contractual incompleteness is an important source of wage rigidity over business cycles.

The paper is organized as follows. In part 2 we present our experimental design. Chapter 3 presents our results on the emergence of relational contracts under a high demand for labour. In part 4 we examine the impact of relational contracts across market conditions by comparing our results with those in Brown et. al. (2004). In part 5 we conclude.

2. Experimental Design & Predictions

Our experiment implements a gift-exchange game with endogenous partner choice as introduced by Brown et. al. (2004). The experiment lasted 15 trading periods and each trading period had two stages: At stage 1 firms made contract offers to workers stipulating a desired effort $\tilde{e}$ and a non-contingent wage w. At the second stage the

actual performance of the worker e was determined. The posting and acceptance of contracts was conducted in a continuous auction involving all firms and workers. There were 10 firms and 7 workers in the market. As a worker could only trade with one firm in each period the experiment implemented an excess demand for workers.

2.1. The Incomplete Contracts (IC) Treatment

Our main treatment is called the Incomplete Contracts (IC) treatment. In this treatment contracts were not exogenously enforced. Therefore, the worker could choose any feasible effort e irrespective of the contractually proposed level $\tilde{e}$.

Firms were the contract makers, i.e. they could make contract offers to the workers. A firm could make private or public offers. In case of a private offer, the firm indicated the identification (ID) number of the worker with whom he wanted to trade and then only this worker was informed about the offer. In case of a public offer all workers and all other firms were informed about the offer. As a consequence, all workers could accept a public offer. In a given trading period a firm could make as many private and public offers as he wanted. As soon as a worker accepted one of the offers, the firm was matched with this worker and informed about the ID number of the worker. Once an offer was accepted all other outstanding offers of the firm were immediately removed from the market so that they were no longer available. At any time during a trading period firms were informed about which workers were still in the market. This was done to prevent private offers to workers who had already concluded a contract with somebody else.

In the IC treatment firms and workers had the possibility of trading repeatedly with each other. Technically, repeated transactions with the same trading partner were possible because subjects had fixed ID numbers throughout the experiment. Therefore, a firm could make offers to the same worker (ID number) in consecutive periods and, if the worker accepted the offers, a long-term relation was established.

The material payoff of a firm per period was given by:

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

The material payoff of a worker was given by:

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

where $c(e)$ denotes the cost of supplying effort e.

The set of feasible effort levels was given by $e\in[1,2,..,10]$ and wages had to be in the set $w\in[0,100]$. The cost schedule for workers $c(e)$ is displayed in Table 1. It shows that $c(e)$ is strictly increasing and exhibits increasing (but not strictly increasing) marginal costs. Since the marginal cost of effort is at most 3 while the marginal revenue of effort for the firm is always 10, the efficient effort level is given by e=10. The maximum earnings which firms and workers could share from a single trade was $10\cdot10\text{-}18=82$. As firms had no outside option while workers had an outside option of 5 the maximum gains from trade were 82-5=77.

Table 1: Cost of Effort Schedule

effort, e	1	2	3	4	5	6	7	8	9	10
cost of effort, $c(e)$	0	1	2	4	6	8	10	12	15	18

The payoff functions, the number of firms and workers, the cost of effort schedule and the fact that there were 15 trading periods were common knowledge. At the end of each trading period each participant was informed about the contract $[w,\tilde{e}]$ he or she had concluded, the performed effort level, e, their own payoff, the payoff of the trading partner and the ID number of the trading partner. The participants then wrote this information on a separate sheet of paper to ensure that each participant was always fully informed about his or her own trading history.

The experimental instructions were framed in a neutral goods market language in order to isolate behavior from preconceptions of participants on how the labor or credit market "should" work. The experiment was conducted using the software "z-tree" (Fischbacher, 1999). Prior to the 15 trading periods, participants in both conditions absolved two practice periods in order to get accustomed to the computer environment. In both practice periods subjects only went through the first (bidding) stage of the experiment and no money could be earned during these periods.

2.2. Control Treatments

Our experimental design incorporated two control treatments to the IC treatment. In the **Complete Contracts (C) treatment** the proposed effort $\tilde{e}$ of the firm was exogenously enforced by the experimentator. Thus if a worker accepted a contract $[w,\tilde{e}]$ at stage 1 of a period then at stage 2 the worker had to perform e= $\tilde{e}$. Otherwise all procedures and parameters were identical to those in the IC treatment. In particular, all participants had fixed ID numbers so that a firm could establish a relation with a particular worker (and visa versa). This control treatment allows us to establish whether firms and workers try to establish relations in order to overcome contract enforcement problems. Field data can typically not distinguish whether employment relationships are established in order to overcome contracting problems or for pure transactional reasons such as turnover costs (Hutchens, 1989). This also applies to our IC treatment where participants may choose to trade repeatedly with the same partner out of pure convenience. However, if convenience drives relations then we should see a similar exchange pattern in the C treatment. On the other hand, if contracting problems are responsible for the emergence of relations we would observe significantly more relations in the IC than in the C treatment.

Our second control treatment is called the **Incomplete Contracts, Random ID (ICR) treatment**. Like in the IC treatment effort was not enforceable in this control treatment. In addition though, information conditions prevented firms and workers from establishing relations. This was done by randomly assigning ID numbers to participants in each period. Participants could therefore not identify who they had traded with in the past and thus they could not maintain relationships. A comparison between the ICR and IC treatment allows us to establish the efficiency implications of relational contracts. Due to information conditions each period of the ICR treatment can be characterized as a one-shot situation. Comparing actual effort in the IC treatment to that in the ICR thus allows us to establish whether the potential for repeated transaction significantly increases market performance above the one-shot level.

We conducted five sessions of each treatment and thus a total of 15 sessions. Subjects were students from the University of Zurich and the Swiss Federal Institute of Technology in Zurich. No subject participated in more than one session so that in total 255 subjects (17 in each session) participated in the experiment. On average a session lasted 120 minutes and each subject earned roughly CHF 60 (1 CHF =1.2$ in February 2005).

2.3. Predictions

All three treatments constitute repeated games of finite length. With common knowledge of rationality and selfishness our IC and ICR treatments would therefore lead to very inefficient outcomes. If workers are selfish and effort is not enforceable, firms will anticipate that all workers will perform the minimal effort level e=1 in period 15 no matter what the history of the experiment. Competing for workers, firms will bid each other up to the highest wage which gives them a non-negative profit anticipating that e=1. Principals will therefore offer a contract $[w,\tilde{e}]$=[10,1] in period 15. By backward induction firms will offer the same contract in period 1 through 14 and workers will always perform the minimal effort. These predictions are in strong contrast to the C treatment where contracts are enforceable and thus (value maximizing) full performance can be implemented. With common knowledge of rationality and selfishness firms in the C treatment will offer the contract which is most preferred by selfish workers. As the maximum effort e=10 leads to the highest surplus, firms would offer contracts which demand the maximum effort and a wage so that workers reap the entire gains from trade. Thus with common knowledge of selfishness and rationality the equilibrium contract in each period of the C treatment is $[w,\tilde{e}]$=[100,10].

The assumption of common knowledge of selfishness and rationality is questionable in our experiment, as it is in the labor market. Experimental studies find that fairness concerns motivate the behavior of some subjects in a wide range of economic settings (see e.g. Camerer, 2003). This is confirmed by interview studies with human resource managers which suggest that the performance of workers is strongly affected by the fairness of their remuneration (Bewley, 1995; Blinder and Choi, 1990). If firms in our experiment believe that some workers have social preference so that they always honour a contract or at least one with "fair terms" then non-minimal effort can be sustained in the ICR and IC treatments. More importantly as our following analysis shows reputation incentives can sustain much higher performance in the IC than in the ICR treatment.

In the following we examine predictions for our experimental treatments under the assumption that a fraction p of workers are "fair". We assume that fair workers honour a contract $[w,\tilde{e}]$ if and only if it offers them an equal share of earnings: w-c($\tilde{e}$)$\geq$ q$\tilde{e}$-w [1]. If

[1] This is obviously a very simplified model of "fair" behaviour. For more elaborate models see Fehr and Schmidt (1999) or Falk and Fishbacher (forthcoming).

the contract does not offer them an equal split of earnings fair workers just maximise their monetary payoffs. The remaining share 1-*p* of workers are selfish and simply maximise their monetary payoff.

In the **ICR treatment** participants are randomly assigned an ID number at the beginning of every period and they do not receive any information on their prior behaviour of any other participant. This treatment thus essentially implements a series of one-shot transactions and can therefore be analysed by a one-period game. Proposition 1 summarises the perfect Bayesian equilibrium of this one-period game.

Proposition 1: If and only if $p \geq .6$ do firms in the ICR treatment offer contracts which demand maximum effort $\tilde{e}=10$. Fair workers perform the desired effort while selfish workers shirk. Equilibrium contracts yield zero expected profits for firms. Expected effort in equilibrium is $10p$

Proof: see Proposition A1 in the Appendix

Proposition 1 shows that if there are sufficient fair workers firms can profitably offer non-minimal contracts even if selfish workers shirk in the one-period game. The presence of fair workers who perform the desired effort compensates for the potential loss from a selfish worker. Given the competition for workers firms yield zero expected profits even when they do offer non-minimal contracts.

If some workers are fair our **IC treatment** becomes a repeated game of incomplete information. In this setting reputational concerns may motivate even selfish workers to perform high effort (Kreps et. al., 1982). If past performance affects future employment prospects selfish workers may have an incentive to imitate fair workers in order to receive better future contracts. However, the market conditions in our IC treatment make it difficult for reputational incentives to emerge. Remember that information on prior performance of a worker was private. Thus, if a worker shirks in the IC treatment only his incumbent firm is informed about it, while all other firms are not. But due to the excess demand for labour, workers do not rely on their incumbent firm for future employment. Under a high demand for labour reputational incentives only arise if the worker estimates the value of the current relationship to be higher than that if he or she switches to an another firm. Thus self-enforcing relational contracts require that

incumbent firms offer higher wages than a worker can get in the public market. Proposition 2 shows that this is feasible:

Proposition 2: Suppose that the share of fair workers is p=0.6 so that expected effort in the ICR treatment is 10p=6. In the IC treatment there exists a perfect Bayesian equilibrium in which:

- In period 1 all firms offer an identical contract $[w,\tilde{e}]_1$ which demands $\tilde{e}_1$=10 and offers $w_1 \geq 59$. Both fair and selfish workers accept and adhere to the contract.
- In period 2 through 15 "outside" firms (those who didn't trade in the prior period) offer the minimal contract $[w,\tilde{e}]_{out}$.= [10,1].
- In period 2 through 15 incumbent firms offer a renewed contract $[w,\tilde{e}]_{inc}$.= [59,10] to a worker who performed in the prior period.
- In period 2 through 15 fair workers always honour a contract. Selfish workers perform with maximum effort in periods $1<t<15$ while they shirk fully in period 15.

Proof: see Proposition A4 in the appendix

Proposition 2 shows that a perfect Bayesian equilibrium exists for the IC treatment in which selfish workers perform e=10 in all non-final periods. In this equilibrium outside firms believe that workers who do switch are likely to be selfish. For this reason they offer no contracts to a worker they did not trade with before. Incumbent firms do offer contracts with significant rents for workers, as they believe that fair workers will otherwise shirk. These superior contract terms create sufficient reputational incentives for selfish workers to perform. Note that the equilibrium described by Proposition 2 does not necessarily imply a rising wage-tenure schedule as predicted by deferred-payment models of the labour market. The wage-schedule of incumbent firms in all periods t>1 is flat. The important prediction is that wages of incumbent firms exceed those of "outside" firms by at least the cost of desired effort $c(\tilde{e}_{inc})$. Workers are thus at least as well off in one-shot or repeated relations. Firms earn zero expected profits ex-ante, but those who do manage to establish a relationship earn substantial quasi-rents.

The presence of honest workers does not change the predictions for our **C treatment**. In that treatment effort is third-party enforceable so that maximum effort is implemented even if all workers are selfish. This will also be the case with some fair workers. Note that performance in the C treatment is not dependant on the formation of relations. Proposition 1 and 2 thus lead us to the following qualitative hypotheses:

H1: In the IC treatment the probability of a firm offering a repeat contract to a workers is contingent on the workers past performance. The wages offered in repeated contracts are higher than those available to workers in the public market.

H2: Average performance in the IC treatment is higher than in the ICR treatment as selfish workers in the IC treatment perform non-minimal effort out of reputational concerns.

H3: Tenure is higher in the IC than in the C treatment as relational contracts are established by firms and workers. Long term relations in the IC treatment display higher earnings than one-shot interactions.

3. Relational Contracts when Labour Demand is High

In this section we present the results of our IC, ICR and C treatments. We first examine whether the wage and employment policies of firms provide reputational incentives for workers in the IC treatment. We then examine whether these incentives actually motivate workers in the IC treatment to perform higher effort tha workers in the ICR treatment. Finally we examine the prevalence of relations in the IC treatment and the earnings yielded in these relations.

3.1. Firms' Wage and Employment Policies

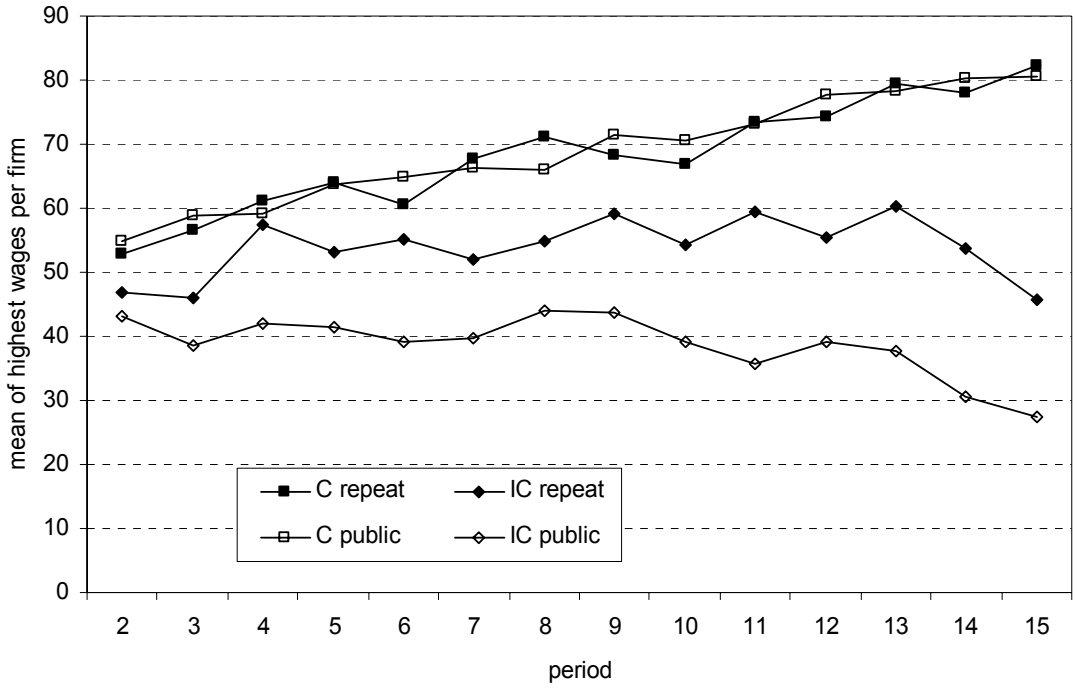
Our predictions suggest that in the IC treatment firms can only create reputational incentives if they reward well performing workers with higher wages than these can get in the public market. Figure 1 shows that this is the case: Wages in repeat contract offers were substantially higher than those offered on the public market. As firms typically made several offers in each period[2] we consider the highest public wage offered by each firm as well as the highest "repeat" wage offered by each firm to his

2 In the IC treatment firms made on average 4.6 offers each per period.

prior worker. The figure reports the mean of these highest "public" wages and highest "repeat" wages across firms by period. Figure 1 shows that throughout the IC treatment firms offered substantially higher repeat wages to workers than these could get in the public market. Public market wages hovered around 40 in the IC treatment while repeat wages rose from under 50 in period 2 to roughly 60 in period 13. The difference between repeat and public wages therefore rises steadily from 3.8 in period 2 to more than 20 from period 11 onwards. Aggregated over all periods the difference between repeat and public wages is 14.6.

Proposition 2 suggests that wages in relations must exceed the public market wage by the cost of desired effort c($\tilde{e}$) in order to motivate selfish workers to perform $e=\tilde{e}$. The large difference between repeat wages and public wages shown in Figure 1 suggests that on average selfish workers would have had the incentives to provide very high effort levels. Remember that the cost of effort $c(e)$ for effort levels e=8,9,10 was 12, 15 and 18 respectively.

Figure 1: Wages in the IC Treatment

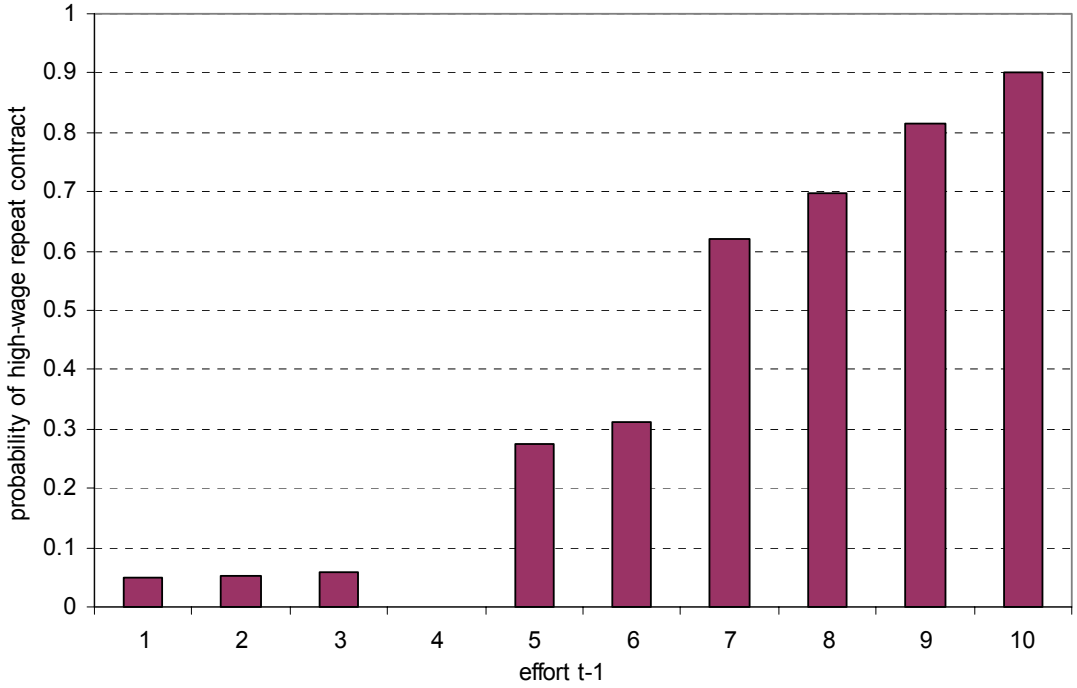


Our conjecture is that repeat wages are higher in the IC treatment because incumbent firms have superior information on workers and use this information to offer incentive compatible contracts. However, an alternative explanation is that this is simply a selection effect: as workers always accept the highest available wages, those firms who

get to trade (and thus by definition get to offer a repeat contract) are those who offer the highest wages. If this selection effect explained higher "repeat" wages we should see an identical pattern in the C treatment where contracts are enforceable. However Figure 1 shows that in the C treatment there was no difference between public and repeat wages at all. Indeed the difference between public and repeat wages in the C treatment is merely 0.1 when averaged over all periods. The figure thus suggests that it is the non-enforceability of contracts which gives rise to higher wages in repeated contracts.

Relation-specific wages can only motivate selfish workers in the IC treatment if these wages are contingent on performance. If firms offer high wages only to performers while they expel shirkers then selfish workers will be motivated to provide the desired effort. If, on the other hand, the probability of receiving a high-wage repeat contract does not depend on a workers prior performance, then selfish workers have no incentive to provide a high effort. Figure 2 displays the probability of a worker receiving a repeat contract with a high wage in period t depending on his effort in period t-1. In accordance with Figure 1 a high wage contract is defined as a contract in which the wage exceeds the mean of the best public wage per firm in that period. The figure shows that the probability of receiving such an offer is very much dependent on a workers prior performance. If a worker provided an effort level of $e<6$ in period $t-1$, then his probability of getting a lucrative repeat contract was below 30%. If, however, the worker performed an effort of $e\geq 7$ this probability rose to above 60%. A worker who performed the maximum effort was virtually assured of a high-wage repeat contract.

Figure 2: Contract Renewal in the IC



Figures 1 and 2 suggest that firms practised a performance contingent policy of offering high wages to workers who performed well, but firing workers who performed badly. This interpretation is confirmed by the regression analysis reported in Table 2. We conducted a probit analysis in which the probability of a contract renewal is regressed on the workers previous performance. Regression (1) analyses the probability of a worker receiving a high-wage repeat contract, and thus the dependant variable is a dummy variable which takes the value 1 if a firm offered a repeat contract in period t with a wage which exceeded the average public market level. We regress this dummy variable on the effort of the worker in the previous period e_{t-1}, the previous length of the relationship and the period of the experiment. We include the previous length of a relationship as an explanatory variable as firms may be more likely to offer a renewed contract to a worker who they have known for longer, even if he did not perform well in the prior period. We include the period of the experiment as an explanatory variable as firms may be more reluctant to expel a worker later on in the experiment. If firms expect that all "fair" workers are gradually engaged in relationships over the course of the experiment, then they may be more willing to renew the contract with an existing worker, providing he or she does not shirk altogether.

Table 2: Probability of Contract Renewal in the IC[a]

	(1) high-wage	(2) any contract
effort in *t-1*	.134*** (.013)	.080*** (.011)
previous length	.034* (.019)	.052*** (.021)
period	.006 (.007)	.004 (.004)
	N = 484 Wald (3) = 122.95 Prob = .000 Pseudo R^2 = .41	N = 484 Wald (3) = 241.85 Prob = .000 Pseudo R^2 = .29

[a] Maximum likelihood probit 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.

The coefficients reported in Table 2 are maximum likelihood estimators of the marginal effect of each explanatory variable. We controlled for heteroscedaticity in sessions by clustering on sessions. The significant and positive coefficient of "effort in t-1" in regression (1) confirms that firms are more likely to offer a high-wage contract to workers who performed well in the prior period. An increase in effort by one point raises the workers probability of receiving a high-wage repeat contract by 13%. The coefficient on "previous length" is of weak significance in regression (1) while the coefficient on "period" is not significant at all. This suggests that when considering whether to offer a lucrative repeat contract firms only consider the immediate performance of the worker. This is not the case in regression (2) which looks at the probability of a worker receiving any contract renewal at all. There we see that not only the previous effort, but also the previous length of a relationship has a significant impact on whether the worker is expelled or not. The positive coefficient of "previous length" in regression (2) suggests that firms are more reluctant to fire workers the longer they have traded with them already. However, as we see from regression 1 this does not mean that the worker will automatically be offered a high wage. Figures 1 and 2 as well as Table 2 confirm our hypothesis H1 and lead us to our first result:

Result 1: *In the IC treatment firms practice a performance contingent wage and employment policy. They reward well performing workers with wages that exceed the*

public market rate. On the other hand they fire shirkers even though market conditions make it difficult to fill vacancies.

3.2. Workers Effort

Our results so far show that firms in the IC treatment pursue a performance contingent wage and renewal policy. Our predictions suggest that such a policy could motivate even selfish workers to provide high effort levels. Figure 3 examines whether this the case by comparing the performance levels in the IC treatment to those in the ICR treatment. In the ICR treatment reputational effects were not possible as participants' identities were freshly assigned in each period. Thus if the wage and employment policy of firms do create reputational incentives for workers we should see higher effort levels in the IC than in the ICR treatment.

Figure 3 shows that the maximum effort level is the most frequent effort level in the IC treatment, with workers performing e=10 in over 30% of all trades. Moreover, roughly 60% of all trades in the IC are characterized by an effort level of $e\geq7$. Remarkably, workers perform the minimal effort level e=1 in only 15% of all trades, although the high demand for their services assures them a future contract even if they shirk. As a result the mean effort level in the IC treatment is 6.7 with session averages of 5.4, 5.7, 6.0, 7.4 and 8.0.

In contrast to this, the maximum effort level e=10 is performed in only 7% of trades in the ICR treatment. The most common performance level in the ICR is e=5, which is performed in 21% of all trades. The mean effort level in the ICR treatment is 4.9 with session averages of 3.6, 4.6, 4.7, 4.7, and 7.2. A one-sided Mann-Whitney test[3] comparing session averages confirms that performance in the IC treatment is significantly higher than in the ICR (p=.028).

Figure 3: Frequency of Effort Levels in the IC and ICR

3 As we have a directed hypothesis we apply the one-sided test with m=n=5.

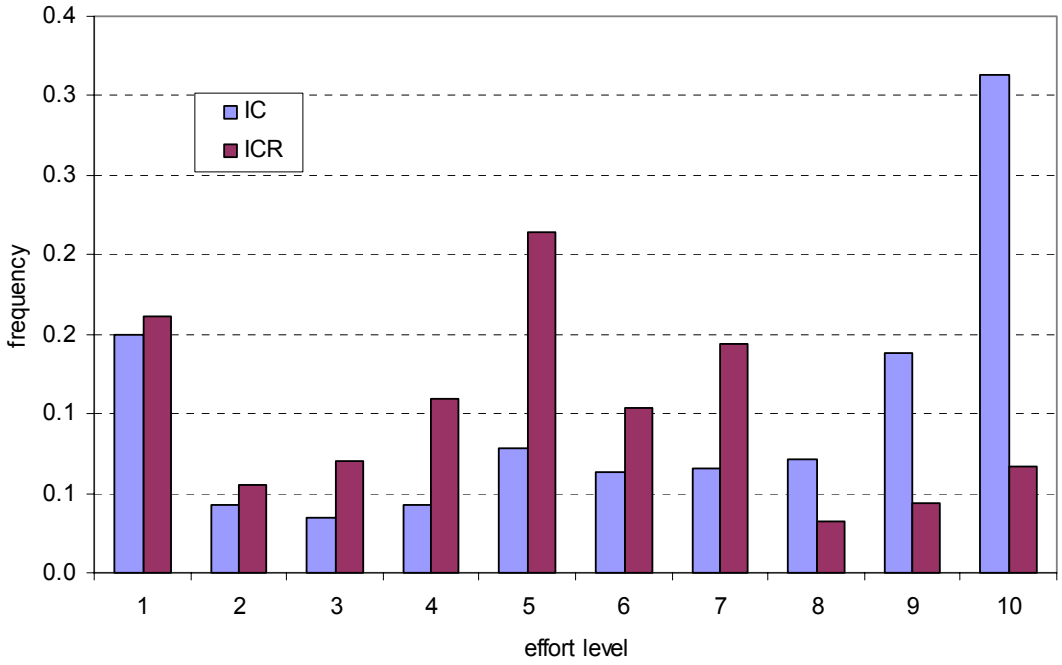


Figure 3 does not allow us to conclude that selfish workers were motivated to perform high effort in the IC treatment out of reputational concerns. An alternative explanation for higher performance in the IC than the ICR is simply that fair workers exert more effort in the IC treatment than in the ICR treatment while selfish workers shirk in both. This could be the case if firms offer higher wages in the IC than in the ICR and fair workers reciprocate these wages with higher effort. In order to control for differences in offered contracts between the two treatments we therefore conduct a multivariate analysis of workers performance.

Table 3 presents a censored regression analysis of workers effort in the IC and ICR pooling the data from the two treatments. In regression (1) we assume that the effort-wage relationship has an equal slope in the two treatments. Therefore, in this regression our main explanatory variable is the dummy variable "IC" which is 1 if the observation is from the IC treatment and 0 if it is from the ICR. This variable elicits whether on average any given wage offer leads to a higher effort in the IC treatment. We control for the wage offered by the firm by including the variable "Wage". The regression also includes two control variables for time effects. The dummy variable "Finalperiods" is 1 if a trade took place in period 11 or later and 0 otherwise and the interaction term "IC*Period". We expect no time effects on effort in the ICR treatment as this is essentially a series of one-shot games. We therefore predict an insignificant coefficient on the variable "Finalperiods". In contrast we do expect a time effect on effort in the IC

treatment. We predicted that in the IC treatment reputational incentives for selfish workers wear off towards the end of the experiment. Thus if high performance is a result of reputation induced effort of selfish workers we should see a negative time trend in effort. This would be captured by a negative coefficient on "IC*Finalperiods".

Table 3: Effort in the IC and ICR treatments

	(1)		(2)	
IC	0.18	(2.45)	-5.89 **	(2.45)
Wage	0.20 ***	(0.06)	0.14 **	(0.06)
IC*Wage		(0.07)	0.13 **	(0.07)
Finalperiods	-0.29	(0.18)	-0.23	(0.18)
IC*Finalperiods	-0.66 *	(0.41)	-0.85 **	(0.41)
	N=	1023	N=	1023
	Wald (4)=	32.95	Wald (5)=	249.80
	Prob=	0.00	Prob=	0.00

[a] Censored Regressions with robust standard errors adjusted for clustering on sessions (in parentheses). *** indicates significance at the 1% , ** at the 5% level and * at the 10% level, respectively.

Regression (1) in the table shows a puzzling result. It appears that there is no treatment effect at all in the wage-effort relationship. The coefficient of "IC" is insignificant, indicating that on average a contract with a given wage *w* did not elicit a higher effort in the IC than in the ICR treatment. Does this imply that higher performance in the IC treatment is simply due to the reaction of fair workers to higher wages, while selfish workers are not motivated at all? Not necessarily. Remember that we expected selfish workers only to perform well in the IC treatment if they receive a wage which exceeds the public market wage level. Thus we expect additional motivation effects only at high wage levels in this treatment. Moreover, due to selection effects, we may see lower effort levels for low wages in the IC than in the ICR treatment. In the ICR treatment both fair and selfish workers accept low wages. In the IC treatment we predict however that only selfish workers (who shirked and were fired) will receive low-wages, while all fair workers and those selfish workers who are in relationships receive high wages. Thus, our predictions suggest that the wage-effort relationship differs in the initial value (lower in the IC) as well as in the slope (higher in the IC). As a consequence it is possible that averaged across wages we find no significant differences in the relationship.

Regression (2) in the table allows for the above described variety in the effort-wage across treatments. In this analysis we include an interaction term "IC*Wage*, so that the "IC" dummy now captures the difference between effort at w=0, while the interaction term captures differences in the slope of the wage-effort relationship. The results for regression (2) show indeed that there is a significant difference in the wage effort relationship between the IC and ICR treatments. As predicted the initial value captured by "IC" is significantly negative suggesting that at low wages effort is lower in the IC than in the ICR treatment. The positive coefficient on "IC*Wage" shows, however, that higher wages have a stronger motivation effect in the IC than in the ICR. Combining the two effects we see that effort is indeed higher in the IC treatment for high wage levels. A simple linear combination suggests that wages exceeding 46 would yield higher effort in the IC than in the ICR treatment. Actually, average wages exceeded 46 in every period of the IC treatment!

The time effects on performance reported in Table 3 also suggest that selfish workers were motivated to provide high effort out of reputational concerns. The interaction term "IC*Finalperiods" shows that effort fell significantly in the final periods of the IC treatment cet. par. This confirms our predictions that reputational incentives wear off towards the end of the IC treatment, inducing selfish workers to shirk more. This interpretation is supported by the fact that there is no significant time effect on effort in the ICR treatment, as reported by the insignificant coefficient on "Finalperiods". Figure 3 and Table 3 confirm our hypothesis H2 and lead us to our second result:

Result 2: *The employment policies of firms motivate selfish workers in the IC treatment to perform high effort out of reputational concerns. As a consequence aggregate effort is higher in the IC treatment than in the ICR treatment.*

3.3. Relationships and Earnings

Our results so far suggest that firms and workers are successful in establishing relational contracts in the IC treatment. We should therefore observe that the pattern of trade in this treatment is dominated by repeated transactions between particular firms and workers. Table 4 displays the share of relations which are renewed in the IC treatment by period. The table shows that the incidence of contract renewal rises from

26% in period 2 to over 45% in period 11. Aggregated over all periods existing relations are continued in 39% of all possible instances in the IC treatment.

More importantly, the table shows that contract renewals are much more frequent in the IC than in the C treatment. In the C treatment the share of contract renewals hovers around 10% over the whole course of the experiment. We argued above that contract renewals in the IC treatment may arise out of pure convenience of firms and workers. However, in this case we should see similar rates of renewals in the IC and C treatments. The fact that there are more contracts renewals in the IC than the C suggests that relational contracts are the cause for most long term relations in the IC treatment. A one-sided Mann-Whitney test on session averages confirms that contract renewals are significantly more frequent in the IC than in the C treatment (p=.004).

Table 4: Contract Renewals

	Period													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IC	0.26	0.24	0.29	0.39	0.43	0.37	0.43	0.35	0.43	0.46	0.43	0.43	0.40	0.37
C	0.12	0.11	0.12	0.12	0.09	0.03	0.14	0.06	0.03	0.21	0.06	0.09	0.09	0.14

Our predictions suggest that long-term relations should not only be prevalent in the IC treatment, but they should also be responsible for the substantial performance in this treatment. We therefore examine the relationship between tenure and earnings per trade in the IC treatment. Figure 4 reports the earnings of firms and workers in the IC treatment by the final duration of a relationship. If long-term relations are governed by effective implicit agreements we expect that mean earnings per period will be higher in long relations than in short ones. Figure 4 shows, indeed, that in the IC treatment earnings per period were strongly correlated with relationship duration. Remember that maximum e=10 effort of workers leads to total earnings per trade of $10 \cdot 10\text{-}18=82$. One-shot transactions in the IC treatment were highly inefficient generating an average earnings of 44.45 points per period and thus just 54% of potential earnings. In contrast to this medium-term relations (2-10 periods) generated earnings and over 72 points and thus roughly 90% of potential earnings per period. Moreover, the longest relations (11-15 periods) generated average earnings of 81.44 and thus 99% of those possible.

Figure 4: Relationships and Earnings

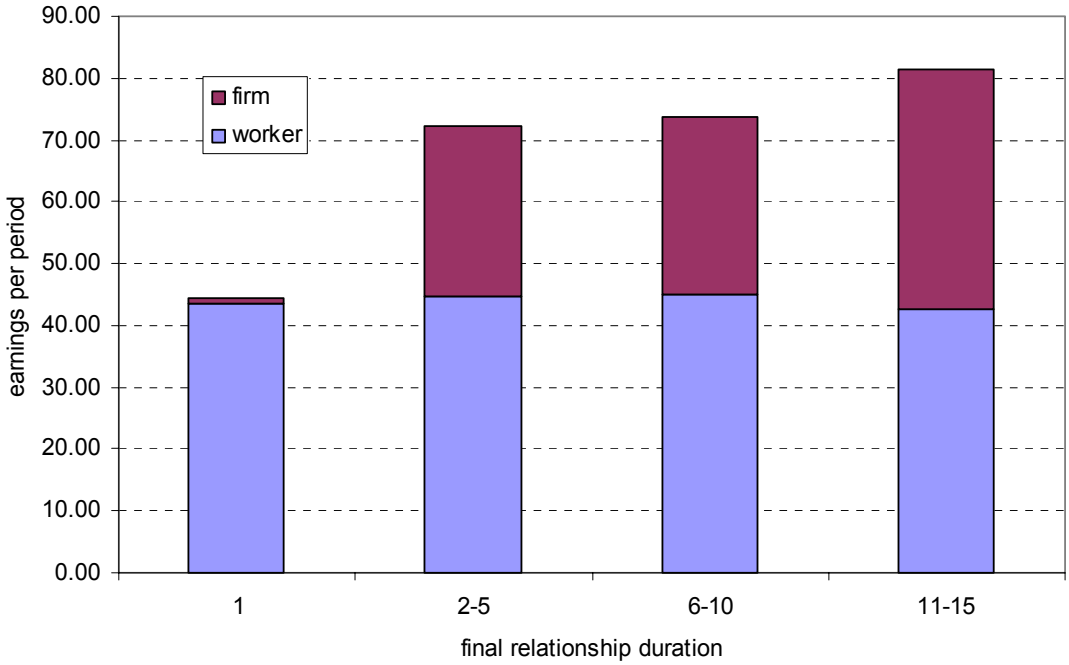


Figure 4 also provides us with interesting results concerning the distribution of gains from trade. First, the figure shows that firms in the IC treatment only earn positive payoffs if they are able to establish a long-term relation with their worker. On average firms barely earned anything in one-shot transactions with workers reaping all gains from trade. In medium-term relations (2-10 periods), however, firms earn a mean payoff of roughly 28, and in long-term relations they earn an average payoff of 38.83. The figure suggests that firms in the IC treatment have strong incentives to establish implicit agreements as they otherwise earn nothing. The figure however also shows that establishing such relational contracts might be very difficult as workers do not benefit greatly from them. The figure shows that workers in the IC treatment earn similar payoffs (between 42 and 45) in one-shot transactions and medium & long relations. Table 4 and Figure 4 confirm our hypotheses H3 and lead us to our third result:

Result 3: *Long term relations do emerge in the IC treatment and yield higher earnings than one-shot transactions. Firms are strictly better off in relationships, while workers are just compensated for their higher effort costs.*

4. Market Conditions and the Impact of Relational Contracts

In the previous section we showed that relational contracts can emerge even when the threat of unemployment cannot discipline workers. This astonishing result leads us to two further questions: First, are implicit agreements equally effective under a high as under a low demand for labour or is the enforcement power of relational contracts affected by market conditions? Second, if relational contracts do emerge under a low and high demand for labour how does this affect wage flexibility across market conditions?

In this section we compare the performance and distributional effects of relational contracts across market conditions. We do this by comparing market outcome in the IC treatment to that in Brown et. al. (2004) where we implemented an identical experiment with opposite market conditions. The experimental design in this paper and that in our former paper differed only in respect to the number of firms and workers in the market. In the IC treatment described above there were 10 firms and 7 workers in each period. Our former paper implemented the opposite market conditions of 7 firms and 10 workers in each period. Otherwise, all experimental procedures and parameters were completely identical. In the following we can therefore compare market outcome under an excess demand for labour (IC) to market outcome when jobs are scarce. We will henceforth call the respective treatment from our former paper the IC* treatment. We validate our results through identical comparisons for our control treatment with enforceable contracts (C and C* conditions).

Proposition 3 summarises our predictions for the IC* treatment assuming an identical share of fair workers to that in Proposition 2.

Proposition 3: Suppose that the share of fair workers is $p<0.3$ os that maximum effort is never performed in the ICR treatment.. In the IC* treatment there exists a perfect Bayesian equilibrium in which:

- In period 1 through 15 all firms offer an identical contract $[w,\tilde{e}]=[59,10]$ demanding maximum effort.
- In period 1 through 14 all fair and all selfish workers accept and adhere to the contract.

- In period 15 fair workers perform the desired effort in period 15 while selfish workers shirk.

Proof: see Proposition A3 in the appendix.

Comparing Proposition 3 to Proposition 2 we see that equal performance is possible in the IC and IC* treatments. This replicates the finding of MacLeod & Malcolmson (1998) that implicit contracts can be equally effective across market conditions. However, high effort of selfish workers is much ”easier” to sustain in the IC* than in the IC treatment. With an excess supply of labour simple rents (“efficiency wages”) are sufficient to generate reputational incentives, because workers know that it is definitely hard to get a new contract if they shirk. In the IC treatment we require not only that incumbent firms offer rents, but also that “outside” firms regard switching workers as less trustworthy. If workers believe that some outside firms do not discriminate against switching workers then reputational incentives in the IC treatment collapse. In view of the greater difficulties to motivate effort in the IC treatment we predict that aggregate performance is higher in the IC* than in the IC.

Proposition 2 and 3 also provides us with predictions regarding wage rigidity across treatments. The propositions suggest that firms will offer identical contract terms across market conditions, implying very strong wage rigidity. In contrast wages in the complete-contracts treatments vary strongly between market conditions. In the C treatment we predicted that all gains from trade will be reaped by workers so that wages are at their maximum. In the C* treatment scarce jobs would imply that firms yield all gains from trade so that wages just compensate workers for their cost of effort. We can therefore establish two hypotheses regarding the emergence and impact of relations across market conditions:

H4: Market performance, i.e. the mean effort level, is higher in the IC* than in the IC treatment.

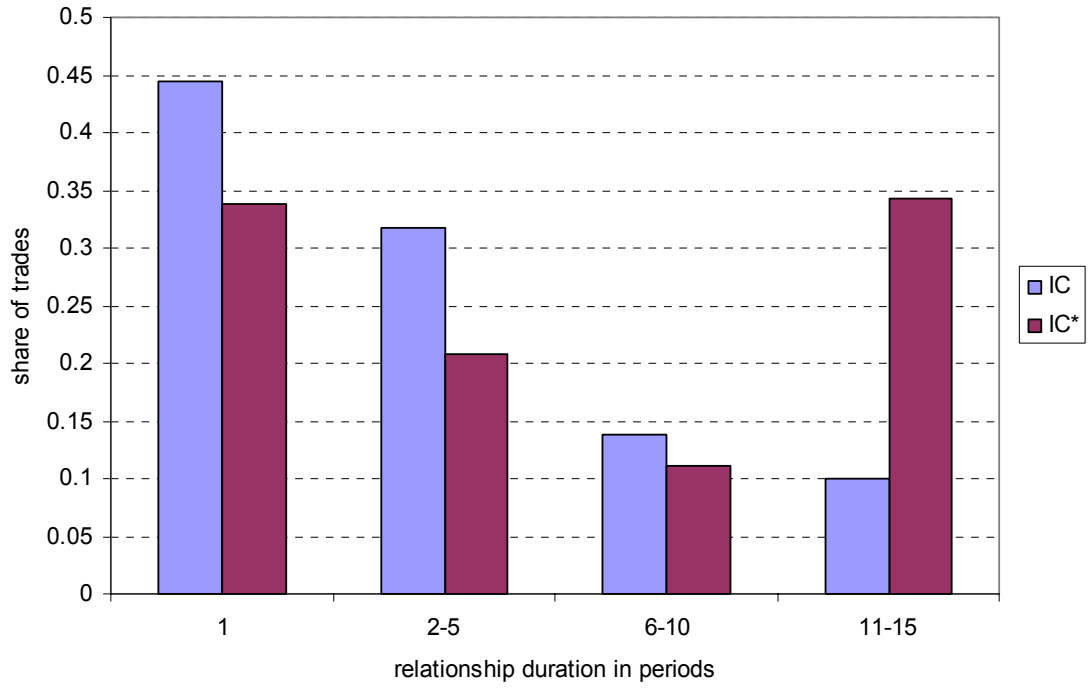
H5: Relational contracts lead to strong rigidities in distribution across market conditions. Mean wages vary much less between the IC and IC* treatments than they do between the C and C* treatments.

4.1. Relations and Efficiency

Figure 5 illustrates the frequency of long term relations in the IC and IC* treatments. The figure classifies relations according to their total length. We distinguish between one-shot transactions (relation was broken off after only 1 period), short relations of 2-5 periods, medium-term relations of 6-10 periods and long-term relations with a total duration of 11-15 periods. For each trade we identified the final length of the relationship in which it took place. The figure shows the share of all trades which took place in one-shot, short, medium-term and long-term relations.

Figure 5 shows that long-term relations are much less frequent in the IC than in the IC* treatment. In the IC* treatment over a third of all trades take place in relations of 11 and more periods while 45% of all trades take place in relations of 6 and more periods. In contrast, in the IC treatment only 10 % of all trades take place long-term relations while only 25% take place in relations of less more than 5 periods.

Figure 5: Market Conditions and Relations



A non-parametric test confirms that average tenure is significantly lower in the IC than in the IC* treatment. For each trade we computed the previous length of the relationship between the trading parties. Then we took the mean "previous length of the relationship" across trades for each session. This measure of duration is 1.7, 1.9, 2.59, 2.59, and 3 in the five IC sessions while it is 2.2, 2.62, 3, 5.2 and 6.2 in the five IC*

sessions. A (2-sided) Mann-Whitney Test comparing these session averages rejects the hypothesis that relationship duration is identical in the IC and IC* treatments. However, due to the strong variance in session outcome of the IC* this result is only of borderline significance (p=.075).

Figure 5 suggests that high competition for workers makes it more difficult to sustain relational contracts, as workers are no longer reliant on their incumbent principle. This conjecture is confirmed by examining the break up of relations in the IC and IC* treatments. A contract renewal required two decisions in our experiment. First, the firm had to offer a private contract to his prior worker. Then the worker had to accept this offer from among the available private and public contracts. If favourable market conditions for workers are responsible for less relations in the IC treatment, we should see that repeat trades fail at the second stage: The break up of relations in the IC would be due to workers not accepting repeat contracts of firms. A regression analysis confirms that this is the case.

Using the maximum-likelihood probit method we regressed the probability of a firm offering a repeat contract on his workers prior effort and a dummy variable "IC" which is 1 for all trades in the IC treatment and 0 for all trades in the IC* treatment. Controlling for session effects and applying robust standard errors we find that the IC dummy is insignificant (coeff =.075,prob=.325). Thus firms are equally likely to offer a repeat contract under both market conditions, ceteris paribus. We then regressed the probability of a worker accepting a repeat contract on the wage offered by the firm and the IC dummy. Controlling again for session effects and applying robust standard errors we find a significant negative coefficient for the IC dummy (coeff =-.440, prob=.001). A renewal contract with an identical wage offer had a 44% lower chance of being accepted by the worker in the IC treatment than in the IC* treatment.

Figure 5 provides us with a first indication that higher demand for workers may lead to less relational contracts than when workers must fear unemployment. However, less long-term relations does not necessarily imply that relational contracts are less effective in the IC than in the IC* treatment. Our predictions suggest that workers in the IC treatment are motivated by the promise of quasi-rents in their incumbent relation. They perform high effort because they expect their incumbent firm to offer them higher future wages than they might get in the public market. Figure 2 showed that workers in the IC treatment do indeed have a higher probability of receiving lucrative future contract terms if they perform well. Thus workers can "insure" themselves against lower wages

in the public market by performing well. This, however, does not mean that a worker will not break off a relationship if he gets the chance of a higher wage elsewhere. Thus, we may observe more break-offs of relations in the IC than in the IC* treatment (where such opportunities for switching are lower) although implicit agreements are actually at work.

The effectiveness of implicit agreements in our experiment is determined by the number of actual trades and the effort level provided by workers in these trades. As the maximum number of trades were sealed in each treatment[4] a comparison of market performance between the treatments can rely on a comparison of mean effort. Figure 6 illustrates the mean effort level for the IC, IC*, C and C* treatments by period.

Figure 6: Market Conditions and Market Performance

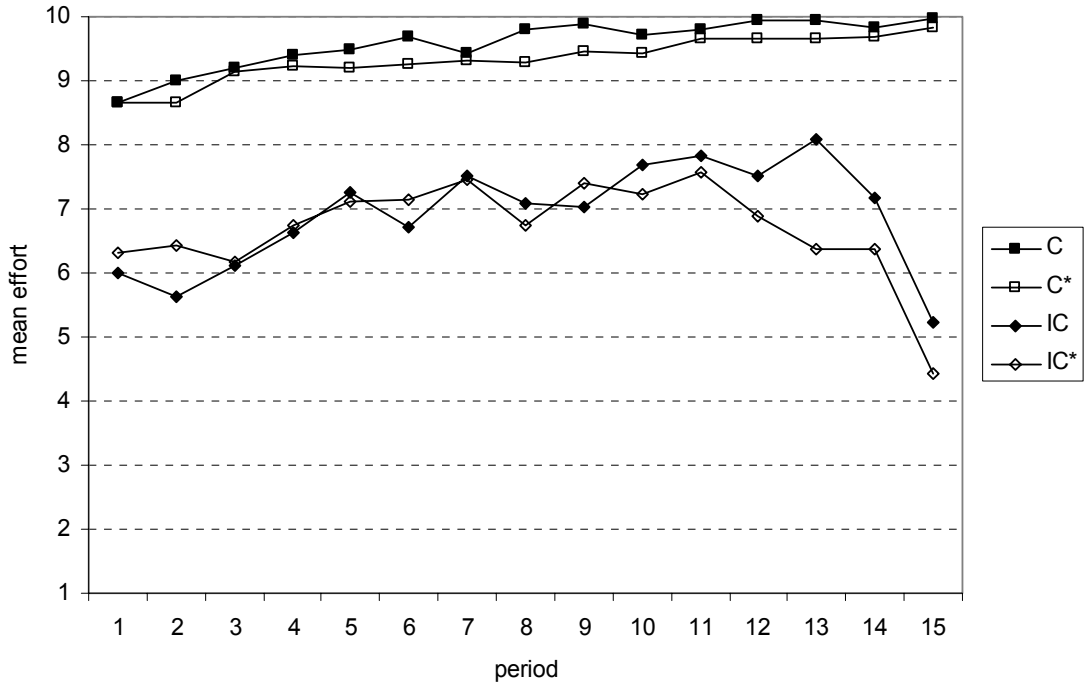


Figure 6 displays an astonishing result: market performance is not affected at all by higher demand for workers. Mean effort evolves nearly identically in the IC and IC* treatments, rising from an initial level of around 6 to roughly 8 and then suffering from an end-game effect which reduces effort to roughly 5. The end-game effect seems to set in earlier on in the IC treatment where competition for workers is higher. This is a slight

4 In each treatment a maximum number of 525 trades could be sealed (7 in each of the 15 periods in each of 5 sessions). In the C, IC, C* and IC* conditions 518, 520, 519 and 523 trades were made respectively.

indicator that when workers are less disciplined by market conditions contract enforcement may be more difficult. However, on aggregate market performance in the IC treatment with an average effort of 6.7 is all but equal to that in the IC* treatment (6.9). A (2-sided) Mann-Whitney Test on session averages suggests that market conditions do not affect market performance at all when contracts are not enforceable (p=.421). [5] Figure 6 rejects our hypothesis H4 and leads us to our fourth result:

Result 4: *The potential of relational contracts to enforce effort is stable across market conditions. High competition for workers leads to a lower frequency of long-term relations. However, market performance is not reduced as workers perform well in order to insure themselves against lower wages in the public market.*

4.2. Relational Contracts and Wage Rigidity

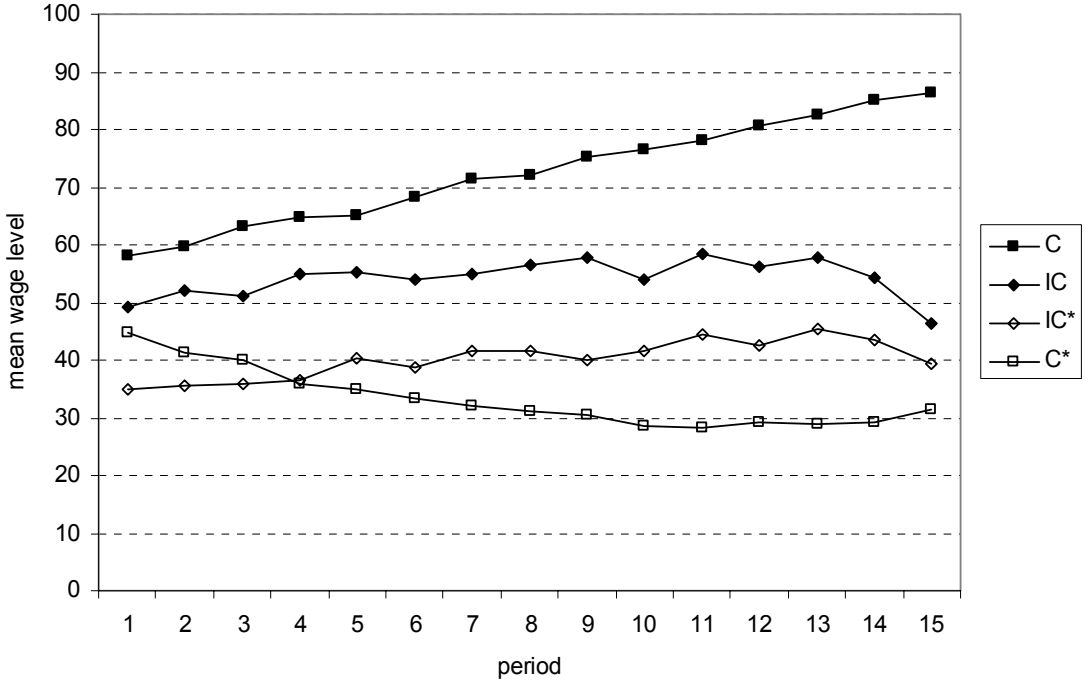
When relational contracts dominate exchange, the distribution of surplus is unlikely to vary strongly with market conditions. MacLeod and Malcolmson (1998) predict that distribution in implicit agreements will not fully be determined by market forces, but rather by social norms which prevent either firms or workers from using a strong market position to renegotiate terms. As these social norms may remain stable over market conditions, so may the distribution of surplus. This prediction is supported by Brandts and Charness (2004) who find that norms of gift-exchange prevent major variations of wages across labor market conditions.

As market performance is identical in the IC and IC* treatments (as well as in the C and C*) our design allows us to compare distribution of surplus by simply looking at average wages levels. Figure 7 shows the mean wage level by period for all four treatments. The figure shows that when contracts are enforceable the distribution of surplus is strongly affected by market conditions. In the C treatment firms compete strongly for workers, bidding wages up throughout the experiment. Payments rise from under 60 to well over 80 during the course of the C treatment. In contrast, in the C* treatment workers compete for contracts driving wages down to just over 30 during the

[5] Not surprisingly, market conditions do not affect market efficiency at all when contracts are enforceable. Figure 6 shows that effort levels are almost at their maximum in both the C condition and the C* condition. In the C condition average effort is 9.6 overall periods, while in the C* condition it is 9.3.

course of the experiment. The mean wage level over all periods is only 33.3 in the C* treatment compared to 72.5 in the C treatment. Thus when contracts are enforceable the difference in wages between market conditions is on average 29.8.

Figure 7: Market Conditions and Wages



When contracts are not enforceable wages are much more rigid. In the IC treatment the wage level hovers between 50 and 60 throughout the experiment leading to a mean wage of 54.2. In the IC* treatment (where workers compete for contracts) wages are lower at a mean level of 40.1. Market conditions therefore do affect distribution when contracts are not enforceable[6]. However, the impact of market conditions on distribution is substantially lower than when contracts are enforceable. The mean difference in wages between the IC and IC* treatment is 14.1, less than half the corresponding difference when contracts are enforceable!

Figure 7 confirms the prediction of MacLeod and Malcolmson (1998) that relational contracts do isolate distribution from competitive pressures. One could even argue that the figure only provides a conservative estimate of the actual rigidities which might arise in the face of a market shock. Remember that participants in our IC condition did not subsequently take part in IC* condition (or visa-versa). Thus if distribution is

6 This finding is confirmed by a 2-sided Mann Whitney test on session averages which rejects the hypothesis that wages are identical in the IC and IC* treatments (prob.=0.008).

influenced by social norms, then in our experiment these norms can develop independently according to market conditions, as participants have not experienced the opposite market condition. Now suppose that a firm and a worker establish a relationship in the IC treatment and then suddenly find themselves in the IC* treatment. If the social norm which influenced that relation does not change with market conditions, then we can expect that payment levels will be even more rigid.

Figure 7 confirms our hypothesis H5 and leads us to our final result:

Result 5: *The emergence of relational contracts leads to strong wage rigidities across market conditions.*

5. Conclusions

In this paper we have compared the emergence and impact of relational contracts across market conditions. We showed that effective implicit agreements can emerge even when workers are not "disciplined" by the threat of unemployment. Indeed, we find that increased demand for workers has no adverse effect on the potential of relational contracts to enforce high effort. With relational contracts dominating exchange across market conditions we find strong rigidities in the distribution of surplus between firms and workers.

With respect to the labor market our results show that unemployment is by no means a necessary disciplining device (Shapiro and Stiglitz, 1984) when employment contracts are costly to enforce. Our findings confirm the predictions of MacLeod and Malcolmson (1998) and Carmichael (1984) that involuntary unemployment is not a natural phenomenon of labor markets which suffer contracting problems. Our results further provide strong evidence that implicit agreements are an important source of distributional rigidities over the business cycle. This finding supports labor market theories (Akerlof and Yellen, 1990) and empirical studies (Fehr and Falk, 1999) which suggest that contract enforcement is a major source of wage rigidities.

Our results however also bear implications for the credit market where they can be applied to the impact of financial liberalization on credit market performance. On the one hand our findings confirm that lenders can enforce good behaviour of borrowers even when these have many alternative sources of credit (Boot and Thakor, 1994). Thus increased competition among lenders due to financial liberalization must not lower the

ability of lenders to discipline borrowers and therefore may not reduce the availability of credit. On the other hand our results show that borrowers may not benefit strongly from increased competition in credit markets. We find that relational contracts isolate the distribution of surplus from competitive pressures, so that in credit markets where contract enforcement is costly interest rates may not fall when competition among lenders rises.

References

Akerlof, G.A. and J.L. Yellen (1990): "The Fair Wage-Effort Hypothesis and Unemployment", Quarterly Journal of Economics, 105, 2, 255-283.

Auer P. and S. Cazes (2000): "The Resilience of the Long-Term Employment Relationship: Evidence from Industrialized Countries", International Labor Review, 139, 4, 379-408.

Baker, G., R. Gibbons and K.J. Murphy (2002): "Relational Contracts and the Theory of the Firm", Quarterly Journal of Economics, 109, , 1125-56.

Banerjee A.V. and E. Duflo (2000): "Reputation Effects and the Limits of Contracting: A Study of the Indian Software Industry", Quarterly Journal of Economics, 115, 3, 989-1017.

Bewley, T.F. (1995): "A Depressed Labor Market as Explained by Participants", Amercian Economic Review, 85, 2, 250-54.

Bleakley H., A.E. Ferris and J.C. Fuhrer (1999) "New Data on Worker Flows During Business Cycles", New England Economic Review, July/August, 49-76.

Blinder A.S. and D. Choi D (1990): "A Shred of Evidence on Theories of Wage Stickiness", The Quarterly Journal of Economics, 105, 4, 1003-1015.

Brandts J. and G. Charness (2004) "Do labor Market Conditions Affect Gift Exchange? Some Experimental Evidence", Economic Journal, 114, 684-708.

Brown, M. (2005) “Relational Contracts in Finite Games, Mimeo.

Brown, M., A. Falk and E. Fehr (2004): "Relational Contracts and the Nature of Market Interactions", Econometrica, 72, 4, 747-780.

Boot, A.W.A, and A.V. Thakor (1994): "Moral Hazard and Secured Lending in an Infinitely Repeated Credit Market Game", International Economic Review, 35, 4, 899-920.

Boot, A.W.A, and A.V. Thakor (2000): "Can Relationship Banking Survive Competition?", Journal of Finance, LV ,2 , 679-713.

Bull, C., (1987): "The Existence of Self-Enforcing Implicit Contracts", Quarterly Journal of Economics, 102, 147-159.

Camerer C. F. (2003): Behavioral Game Theory: Experiments in Strategic Interaction, Princeton, Princeton University Press.

Carmichael, L. (1984): "Can Unemployment be Involuntary?: Comment", American Economic Review, 75, 5, 1213--1214.

Cetorelli N. and M. Gambera (2001): "Banking Market Structure, Financial Dependence and Growth: International Evidence from Industry Data", Journal of Finance, LVI , 2, 617-648.

Elsas R. and J.P. Krahnen (1998): "Is Relationship Lending Special? Evidence from Credit-File Data in Germany", Journal of Banking and Finance, 22, 1283-1316.

Falk A. and U. Fischbacher (forthcoming): A Theory of Reciprocity, Games and Economic Behavior.

Fehr E. and A. Falk (1999): "Wage Rigidity in a Competitive Incomplete Contract Market", Journal of Political Economy, 107, 1, 106-134.

Fehr, E. and K. Schmidt (1999): "A Theory of Fairness, Competition and Co-operation",Quarterly Journal of Economics 114, 817-868.

Fehr E. and C. Zehnder (2004): "Reputation and Credit Market Formation", Mimeo, University of Zürich.

Fischbacher, U. (1999): "z-Tree: Experimental Software", University of Zurich.

Hall R.E. (1982): "The Importance of Lifetime Jobs in the U.S. Economy", American Economic Review, 72, 4, 716-724.

Hörner J. (2002): "Reputation and Competition", American Economic Review, 92, 3, 644-663.

Hutchens, R. M. (1989): "Seniority, Wages and Productivity: A Turbulent Decade", Journal of Economic Perspectives, 1989, 3, 4, 49-64.

Kranton R. (1996): "Reciprocal Exchange: A Self-Sustaining System", American Economic Review, 86, 4, 830-851.

Kreps, D., P. Milgrom, J. Roberts and R. Wilson (1982): "Reputation and Imperfect Information", Journal of Economic Theory 27, 253-279.

Lazear, E. P. (1982): "Agency, Earnings Profiles, Productivity and Hours Restrictions", American Economic Review, 71, 606-620.

MacLeod, W. B. (2000) "Complexity and Contract", Revue d'Economie Industrielle, 92, 149-178.

MacLeod, W. B. & J. M. Malcolmson (1989): "Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment", Econometrica, 57, 2, 447-480.

MacLeod, W. B. & J. M. Malcolmson (1998): "Motivation and Markets", American Economic Review, 88, 388-411.

McMillan, J. and C. Woodruff (1999): "Interfirm Relationships and Informal Credit in Vietnam", Quarterly Journal of Economics, 114, 4, 1285-1320.

Petersen M.A. and R.G. Rajan (1994): "The Benefits of Lending Relationships: Evidence from Small Business Data", The Journal of Finance, XLIX, 1, 3-36.

Petersen M.A. and R.G. Rajan (1995): "The Effect of Credit Market Competition on Lending Relationships", The Quarterly Journal of Economics, 110, 2, 407-443.

Shapiro, C. & J. E. Stiglitz (1984): "Equilibrium Unemployment as a Worker Discipline Device", American Economic Review, 74, 433-44..

Williamson, O.E. (1975): Markets and Hierarchies: Analysis and Antitrust Implications, New York: The Free Press.

Appendix

In this appendix we prove the predictions established in setion 2. In order to simplify our analysis we examine a simplified version of our experimental game in which effort costs and revenues are linear in effort. We further simplify the analysis by normalising effort to lie within the range $e \in [0,1]$.

The Model

We analyse a game which lasts for a finite number of T periods, and in each period t two stages occur:

- At stage 1 the firm offers a contract to the worker. A contract stipulates a non-negative wage offer $w_t \geq 0$. The contract also states the desired effort level of the firm $\tilde{e}_t \in [0,1]$, whereby 0 is the minimum and 1 is the maximum effort level defined by the firms technology.
- At stage 2 the worker decides whether to accept or reject the offer. If the worker accepts the contract he chooses his actual effort level e. The worker can choose any feasible effort level $e_t \in [0,1]$, irrespective of what effort the firm desired.

At the end of each period the firm earns monetary payoffs of:

$$[A1]\ \ \pi_t = \begin{cases} qe_t - w_t & \text{if a contract offer is accepted} \\ 0 & \text{otherwise} \end{cases}$$

The worker earns monetary payoffs of:

$$[A2]\ \ v_t = \begin{cases} w_t - ce_t & \text{if a contract is accepted} \\ 0 & \text{otherwise} \end{cases}$$

The technology of the firm is such that the marginal revenue of effort q is constant and strictly positive. The marginal cost of effort to the worker c is also constant and strictly positive. We assume that the worker and the firm have an outside option of zero. We assume that $q > c$ so that surplus $(q-c)\,e_t$ is maximised in each period t when a worker performs the maximum effort level $e_t = 1$.

We assume that the worker may have preferences which incline him to provide non-minimal effort even in a one-shot situation. We assume that with probability $\delta \in (0,1)$ a worker is fair. The utility of a fair worker in any period t is given by:

$$[A3]\ \ u_t = \begin{cases} v_t & \text{if } w_t - c\tilde{e}_t < q\tilde{e}_t - w_t \\ v_t - b\max\left[\tilde{e}_t - e_t; 0\right] & \text{if } w_t - c\tilde{e}_t \geq q\tilde{e}_t - w_t \end{cases}$$

We assume that a fair worker has a bad conscience if he does not fulfill a contract which offers him "fair" contract terms. We assume that the marginal disutility of non-adherence b is higher than the marginal cost of effort c so that a fair worker will always adhere to any contract which offers him at least the

same earnings as the firm. If the firm offers unequal contract terms a fair worker does not suffer from a bad conscience if he shirks.

Incomplete Information in the One Period Game

We first examine a one-period game of incomplete information which resembles our ICR treatment.

Proposition A1: Consider a game of $T = 1$ period with of $n > 1$ selfish firms and 1 worker who is fair with probability $\delta \in (0,1)$. If $\delta < \frac{1}{2} + \frac{c}{q}$ there exists no perfect Bayesian equilibrium in which a worker performs a positive effort. If $\delta \geq \frac{c}{q}$ there exists a perfect bayesian equilibrium in which a fair worker performs maximum effort while a selfish worker shirks.

Proof of Proposition A1: Throughout this proof we drop the time index as we are looking at a one-period game.

The firm knows that with a probability $1 - \delta$ each worker is selfish. If a worker is selfish he will accept any contract and perform $e = 0$. The firm also knows that with probability δ each worker is fair. If a fair worker accepts a contract he will perform $e = \tilde{e}$ if he receives a fair contract, i.e. $w - c\tilde{e} \geq q\tilde{e} - w$ or $w \geq \frac{(c+q)\tilde{e}}{2}$. If he receives an unfair contract he will also shirk $w < \frac{(c+q)\tilde{e}}{2}$.The expected profit of a firm is given by

$$[A4] \quad \pi^e = \begin{cases} q\tilde{e}\delta - w & \text{if } w \geq \frac{(c+q)\tilde{e}}{2} \\ 0 & \text{if } w < \frac{(c+q)\tilde{e}}{2} \end{cases}$$

Firms can thus only profitably offer a contract if there exists a contract $[w, \tilde{e}]$ so that $q\tilde{e}\delta - w \geq 0$ and $w \geq \frac{(c+q)\tilde{e}}{2}$. This is only the case if:

$$[A5] \quad \delta \geq \frac{c+q}{2q}$$

From $[A5]$ we see that if $\delta < \frac{c+q}{2q}$ there is no contract which offers non-negative payoffs to the firm and motivates effort from a fair worker. Thus if $\delta < \frac{c}{q}$ no firms will offer a contract to the worker. If $\delta \geq \frac{c+q}{2q}$ there exist contracts which motivate positive effort from fair workers and non-negative expected profits for firms. The payoff of a fair worker is then maximized if $\tilde{e}^* = 1$ and $w^* = q\delta$. Thus if $\delta \geq \frac{c+q}{2q}$ the equilibrium contract in a one-period game is $[w^*, \tilde{e}^*] = [q\delta, 1]$. This will induce full performance of a fair worker while a selfish worker will shirk, so that the expected effort in equilibrium is δ.

This concludes our proof of Proposition A1.

Proposition A2: Consider a game of $T = 1$ period with 1 selfish firm and n workers who are fair with probability $\delta \in (0,1)$. If $\delta \geq \frac{c}{q}$ there exists a perfect bayesian equilibrium in which a fair worker performs maximum effort while a selfish worker shirks. The optimal contract offer of the firm is $[w_1^*, \tilde{e}_1^*] = \left[\frac{c+q}{2}, 1\right]$.

Proof of Proposition A2: From Proposition A1 we know that a firm can profitably offer a contract if and only if $\delta \geq \frac{c+q}{2q}$. With an excess supply of labour the firm can offer the contract which maximizes its profits $\pi^e = q\tilde{e}\delta - w$. However it must offer a contract which gives the worker at least half the total earnings, otherwise fair workers will shirk. The firm will thus offer a contract with $w = \frac{(c+q)\tilde{e}}{2}$ so that $\pi^e = q\tilde{e}\delta - \frac{(c+q)\tilde{e}}{2}$. As $\delta \geq \frac{c+q}{2q}$ this is obviously maximized at $\tilde{e} = 1$.

This concludes our proof of Proposition A2.

Relational Contracts in Multi Period Games

Assume that it is common knowledge that $\delta \geq \frac{c+q}{2q}$ so that from Proposition 1 we know that the labour market exists in one period game. We now show that in a multi-period game relational contracts between firms and workers can sustain maximum effort also from selfish workers.

Excess Supply of Labour

Consider a multi-period game with an excess supply of workers. Suppose that there are $n > 2$ players of which $n - 1$ are workers, but only 1 is a firm. We assume that in each period the firm makes a contract to one of the workers. Only this worker is informed about the offer and he then chooses whether to accept the contract. Proposition 2 shows that in this game there exist perfect bayesian equilibria in which even a selfish worker performs high effort in non-final periods out of reputational concerns. The firm generates such reputational incentives by offering rents to performing workers.

Proposition A3: Consider a game of $T > 1$ periods with 1 firm and $n - 1 > 1$ workers who are fair with probability $\delta \geq \frac{c+q}{2q}$. The following strategies and beliefs constitute a perfect bayesian equilibrium in which both worker types perform maximum effort in all non-final periods $t < T$:

- The firm offers the contract $[w_1^*, \tilde{e}_1^*] = \left[\frac{c+q}{2}, 1\right]$ to a randomly chosen worker in period 1.
- In all periods $t > 1$ the firm offers the contract $[w_t^*, \tilde{e}_t^*] = \left[\frac{c+q}{2}, 1\right]$ to his incumbent worker, if the worker performed $e_{t-1} = 1$. If the incumbent worker performed $e_{t-1} < 1$ the firm offers the same contract to one of the workers he has not yet traded with. If $e_{t-1} < 1$ and he has traded with all workers, the firm offers no contract at all.
- In all periods t a fair worker accepts a contract and performs $e_t = 1$.
- In all periods $t < T$ a selfish worker accepts a contract and performs $e_t = 1$. In the final period a selfish worker accepts a contract and performs $e_T = 0$.

Proof of Proposition A3: We prove Proposition A3 in three steps:

Step 1 (behavior of a fair worker): In all periods the firm offers the same contract $[w_t^*, \tilde{e}_t^*] = \left[\frac{c+q}{2}, 1\right]$. It is a best response for a fair worker to always accept and adhere to this contract as $w_t^* \geq \frac{c+q}{2}$.

Step 2 (behavior of a selfish worker): From Proposition A1 we know that in the final period T a selfish worker will accept the contract if $w_T^* > 0$ and will perform $e_T^* = 0$. As $w_T^* = \frac{c+q}{2}$ it is a unique best strategy of the selfish worker to accept this contract.

Consider now the effort choice of a selfish worker in any period $t < T$. If he shirks he will get a future contract of $[w_k, \tilde{e}_k] = \left[\frac{c+q}{2}, 1\right]$ in all future periods $k > t$. If he performs the desired effort of his incumbent firm he incurs the costs for the demanded effort c, but receives a repeat contract in period $t+1$ where he expects a payment w_{t+1}^*. A selfish worker will perform the maximum effort $e_t = 1$ in any non final period $t < T$ if the following incentive constraint is met:

$$[A6] \quad -c + \sum_{k=t+1}^{T-1} \left[\tfrac{c+q}{2} - c\right] + \tfrac{c+q}{2} \geq 0$$

His participation constraint in any period $t < T$ is given by:

$$[A7] \quad \sum_{k=t}^{T-1} \left[\tfrac{c+q}{2} - c\right] + \tfrac{c+q}{2} \geq 0$$

As $q > c$ conditions $[A6]$ and $[A7]$ are met with inequality.

Step 3 (Contracts of the firm): In equilibrium the firm learns nothing from the behavior of workers in periods t<T as it is optimal for both worker types to perform. Given its out of equilibrium belief that only selfish workers shirk, it is however optimal for the firm to fire a shirker and hire a new worker in his place.

As the firm is not under competition for labour it can choose the profit maximizing contract in each period. Given the effort strategy of the workers the firm knows that all workers will perform its desired effort as long as $w_t^* > \frac{(c+q)\tilde{e}_t^*}{2}$ all t. Otherwise no worker will perform positive effort. From Proposition A2 we know that in this case the profit maximizing contract offer is $[w_t^*, \tilde{e}_t^*] = \left[\frac{c+q}{2}, 1\right]$ yielding profits of $\frac{q-c}{2}$ per period for the firm.

In period T the firm knows that only a fair worker will perform its desired effort even if it offers fair contract terms. Due to the pooling behavior of workers in equilibrium the rational belief of the firm in period T is $\delta \geq \frac{c+q}{2q}$. From Proposition A2 we again know that the profit maximizing contract offer of the firm in this case is $[w_T^*, \tilde{e}_T^*] = \left[\frac{c+q}{2}, 1\right]$

This concludes our proof of Proposition A3.

Excess Demand for Labour

We now consider a game in with an excess demand for workers. Suppose that there are $n > 2$ players of which $n-1$ are firms, but only 1 is a worker. We assume that in each period the $n-1$ firms simultaneously make one contract offer

each. After being informed about all offers the worker chooses his preferred one and then chooses a feasible effort level. Proposition A4 shows that also in this game there exist perfect bayesian equilibria in which a selfish worker performs maximum in all non-final periods out of reputational concerns.

Proposition A4: Consider a game of $T > 1$ periods with $n-1 > 1$ selfish firms and 1 worker who is fair with probability $\delta \geq \frac{c+q}{2q}$. The following strategies and beliefs constitute a perfect bayesian equilibrium in which both worker types perform maximum effort in all non-final periods $t < T$:

- All firms offer the identical contract $[w_1^*, \tilde{e}_1^*] = [w_1^*, 1]$ in period 1, whereby $w_1^* > \frac{c+q}{2}$.
- In all periods $t > 1$ the incumbent firm offers the payoff splitting contract $\left[w_t^{inc}, \tilde{e}_t^{inc}\right] = \left[\frac{c+q}{2}, 1\right]$ if the worker performed the demanded effort in all previous periods. If the worker ever shirked the firm offers no further contract.
- In all periods $t > 1$ "outside" firms offer no contract.
- In period 1 the worker selects one of the available contracts. Fair and selfish workers perform the desired maximum effort $e_t = 1$.
- In period $1 < t < T$ the worker accepts the contract of his incumbent firm and performs maximum effort if he is fair or selfish. In the final period the worker again accepts the contract of the incumbent firm. If he is selfish he performs $e_T = 0$. If he is fair he performs $e_T = 1$.
- (Out of Equilibrium beliefs): The incumbent firm believes that any worker who shirks is selfish. Outside firms believe that any worker who switches firms in any period $t > 1$ is fair with a probability of $\delta < \frac{c+q}{2q}$ and will switch again in the following period.

Proof of Proposition A4: We prove Proposition A4 in five steps:

Step 1 (behavior of a fair worker): A fair worker will perform maximum effort $e_t = 1$ in any period t if and only if this contract offers at least equal splitting of earnings $w_t^* \geq \frac{c+q}{2}$. From the strategy of the firms in period 1 and the incumbent firm in periods $t > 1$ we see that this is always the case. As outside firms offer no contract it is the best response for the worker to always accept and adhere to the contract of his incumbent firm.

Step 2 (behavior of a selfish worker): From Proposition A1 we know that in the final period T a selfish worker will accept the contract which offers the highest wage and will perform $e_T^* = 0$. If the selfish worker performed in all prior periods it is a unique best strategy of the selfish worker to accept the contract of the incumbent firm $\left[w_T^{inc}, \tilde{e}_T^{inc}\right] = \left[\frac{c+q}{2}, 1\right]$. Consider now the effort choice of a selfish worker in any period $t < T$. If he shirks he will get a future

contract of $[w_k, \tilde{e}_k] = \left[\frac{c+q}{2}, 1\right]$ in all future periods $k > t$. If he performs the desired effort of his incumbent firm he incurs the costs for the demanded effort $c\tilde{e}_t = c$, but receives a repeat contract in period $t+1$ where he expects a wage w_{t+1}^{inc}. A selfish worker will perform the maximum effort $e_t = 1$ in any non final period $t < T$ if the following incentive constraint is met:

$$[A8] \quad -c + \sum_{k=t+1}^{T-1} \left[\tfrac{c+q}{2} - c\right] + \tfrac{c+q}{2} \geq 0$$

The participation constraint in any period $t < T$ is given by:

$$[A9] \quad \sum_{k=t}^{T-1} \left[\tfrac{c+q}{2} - c\right] + w_T^{inc} \geq 0$$

As $c < q$ conditions $[A8]$ and $[A9]$ are always met with inequality. It is therefore the best strategy of the selfish worker to perform $e_t = 1$ in any $t < T$.

Step 3 (Contract of the incumbent firm in periods t > 1): In equilibrium gains no information from the behavior of the worker because it is the best strategy of both workers to perform. The out of equilibrium belief that a shirker is selfish makes it however optimal to fire any worker who shirked in the past.

Given that all outside firms offer no contract the incumbent firm is not under competition for a performing worker. It can therefore choose a contract to maximize profits. In any period $t < T$ both worker types perform in equilibrium. As a consequence we know from Proposition A2 that it is profit maximizing for the firm to offer the contract $\left[w_t^{inc}, \tilde{e}_t^{inc}\right] = \left[\frac{c+q}{2}, 1\right]$ which generates maximum effort and just offers the worker an equal share of earnings.

In period T the incumbent firm knows that only a fair worker will adhere to a contract. Given the rational belief $\delta \geq \frac{c+q}{2q}$ and the absence of competition from outside firms it is again profit maximizing to offer the contract $\left[w_T^{inc}, \tilde{e}_T^{inc}\right] = \left[\frac{c+q}{2}, 1\right]$.

Step 4 (Contracts of "outside" firms in periods t > 1): Outside firms believe that any worker who switches firms in any period $t < 1$ is fair with a probability of $\delta^{\text{out}} < \frac{c+q}{2q}$. They also believe that the worker will switch again in the following period so that they would be playing a one-period game if the contract was accepted. From Proposition A1 we know that given the belief δ^{out} there is no contract which an outside firm could offer to the worker in a one-period interaction. It is therefore the best strategy of the outside firms to offer no contract at all.

Step 5: (contracts of firms in period 1): In periods $t > 1$ the incumbent firm earns substantial rents. Thus in period 1 firms compete strongly to become the incumbent firm. In periods $1 < t < T$ they earn a profit of $\frac{q-c}{2}$. In period T they earn an expected profit of $\frac{(2\delta-1)q-c}{2}$.In period 1 firms will therefore bid each other up to a wage which generates zero expected future profits. The expected profits are given by:

$\pi_1^e = -w_1 + q + (T-2)\,\frac{q-c}{2} + \frac{(2\delta-1)q-c}{2}$ (period 1)

We therefore have
$w_1^* = q + (T-2)\,\frac{q-c}{2} + \frac{(2\delta-1)q-c}{2}$
As $q > c$ the first period wage obviously exceeds $\frac{c+q}{2}$
This concludes our proof of Proposition A4.