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CAN RELATIONAL CONTRACTS SURVIVE STOCHASTIC INTERRUPTIONS?

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Abstract

This paper investigates the robustness of the "two-tiered labor market" experimental results of Brown, Falk and Fehr (2004) by subjecting relationships to stochastic interruptions. Using two different subject pools, we first replicate the basic pattern of high quality private contracting and low quality public contracting. We then study the impact of exogenous random 'downturns' in which firms cannot hire workers for three periods. Our hypothesis is that 1. job rents are lower in downturns 2. this will lower wages and effort, unless strong reconnection norms exist. We do find that job rents are lower, but surprisingly, the downturns do not harm aggregate market efficiency. Stochastic interruptions delay the formation of relationships, necessitating the use of public offers, which increases the competitiveness of the short term market. The high tier (private) markets responds by raising wages, thus increasing average worker surplus per trade. We also find evidence that 50-50 pre-downturn worker-firm surplus sharing predicts post-downturn reconnections.

JEL classification numbers: D64, C90, L30

Key words: experiments, labor, contracting, organizational design

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1 Introduction

Typical employment contracts only loosely specify the duration and terms of employment, leaving many details implicit.[1] Implicit contracts which reflect historical norms are often called "relational contracts". Because these contracts are implicit, it is often difficult to measure their terms directly, but these limited duration contracts often lead to repeated future contracts. However, circumstances outside of the workers' performance, such as stochastic drops in demands for a firm's products or changes in personal circumstances of an employer, often affect the probability of future contracts. This paper is an attempt explore how much these stochastic interruptions affect the labor market.

Because individual level data linking a worker's pay with productivity are scarce, experiments in which contract terms can be exogenously manipulated play an important role in understanding relational contracts. Our paper replicates and extends an experimental "gift exchange" paradigm used by Brown, Falk and Fehr (2004, 2009, henceforth BFF1 and 2) to study relational contracts. In this paradigm firms offer prepaid wages and workers who accept wages then exert costly effort. Since effort is not contractible, there is a classic moral hazard problem; one possible outcome is that workers exert little effort and firms, anticipating this, pay minimum wages. BFF1 extends the paradigm by attaching ID numbers to all firms and workers, and allowing "private" offers to be extended to a particular worker. A two tier labor market emerges rapidly in which private contracts sustain high wages and effort while public contracts sustain low wages and effort.

Our paper makes two contributions. First, we directly replicate the BFF1 experiment and check its robustness to subject pool and time horizon. The central stylized facts replicate rather well, though there are some small differences in behavior. Second, and

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[1]Most US firms uses "employment at will" clauses, which states that an employment contract of indefinite duration can be terminated by either the employer or the employee at any time for any reason.

more importantly, we investigate the robustness of relational contracting and market efficiency to stochastic downturns. In every period of trading, each firm faces a probability p of being hit by a downturn, in which no hiring is possible for three periods.[2]

Temporarily removing firms from the labor market creates uncertainty about future relationships that require the emergence of *loyalty norms*. These norms determine the type of firm and worker behavior that signals commitment to rehire a worker and rejoin a firm after the downturn. These norms are an important part of the effect of stochastic interruptions on relationships, and consequently, on a worker's future utility of not shirking (*job rents*). If loyalty norms are weak, workers will start relationships with new firms as soon as their firm is hit by a downturn. Returning firms (after downturns) will then have to dip into the labor market for a new worker. Shirking will be less costly for a worker since the probability of being rehired is high if they are "fired" (i.e. their private contract is not renewed), and hence the market may unravel. However, we show theoretically that with strong loyalty norms, high quality contracts can be maintained despite stochastic interruptions .

The experimental data shows that while stochastic interruptions do have some disruptive effects, the net effect is actually beneficial (excluding lost production from downturns) in an interesting way. Consistent with our theoretical predictions, job rents (wages minus effort cost) in downturns are lower than job rents in baseline. However, wages are actually higher in downturn, especially in the second half of the experiment. But since efforts are *not* higher, the average worker profit per trade is significantly higher.

The reason for this is complex: firms, perhaps out of fear of loss earnings from non-trading periods, demand more out of workers in downturns before renewing relationships. This delays the separation of the two tiers of the market, improving the wage and effort in the short term public market to such an extent that it is difficult to get workers to resist public offers and stick with renewed private contracting. In the end firms are ironically forced to spend more for the same level of effort. However, the best pairings are largely unaffected by the interruptions: firms and workers who are sharing their surplus 50-50 before the downturn have strong loyalty norms and reconnect after the downturns. Like many previous experiments, this positive effect of downturns illustrates the fact that an expanding labor economics analysis including considerations of reciprocity and fairness can someimes overturn conventional intuitions.

[2]Note that our specification was not designed to resemble any particular macroeconomic type of downturn. (In the economy downturns are often correlated across firms, due to business cycles, and their length is stochastic rather than fixed.) When downturns are uncorrelated, strategic behavior from anticipating future downturns is minimized, thus allowing us to better isolate the resilience of relational contracts from stochastic interruptions.

2 Theoretical Framework

The celebrated folk theorem in game theory established that payoffs which are Pareto-superior to those achievable in the one-shot Nash equilibrium can arise given sufficiently likely repetition of a one-shot game. However, these results are sensitive to disruptions and noise. For example, tacit collusion among firms to produce their share of monopoly output dissolves into Cournot behavior when demand fluctuations not directly observable by firms lower prices sufficiently (Green and Porter, 1982). Furthermore, in theory, if a worker-firm game is only repeated finitely, there should be shirking in the last period which unravels to shirking immediately. However, in experiments and naturally-occurring settings with known finite horizon, cooperation typically occurs until close to the end (e.g., Camerer, 2003). One explanation for this pattern, in labor market trust settings, is gift exchange due to norms of reciprocity or moral obligation (e.g., Akerlof, 1982, 1984; Rabin, 1993; Fehr, Kirschsteiger and Reidl, 1993). That is, firms pay above-market wages and workers reciprocate the "gift" with costly effort.

BFF1 shows that introducing fair types into a labor market with excess supply makes it possible to attain a high-efficiency equilibrium. In this equilibrium all firms offer fair wages and selfish firms offer rent at the last period, inducing both fair and selfish types to put in the requested effort until the end. A worker who shirks is immediately punished by nonrenewal of the private contract; shirking hence has a very high cost since reemployment is unlikely given the excess supply in this labor market. Selfish workers and fair workers act undistinguishably until the final period, when the selfish workers will finally shirk. Their followup paper, BFF2, shows that the existence of a high-efficiency equilibrium does not depend on the threat of unemployment. In a labor market with excess demand with inequity-averse types,[3] the high equilibrium can be attained when public offers feature lower wages than private repeated offers.

How could stochastic interruption affect behavior? Specifically, what is the impact of temporarily removing firms from the labor market on the development of relational contracts?

First, the increased uncertainty of being repaid for high efforts with a renewed contract may drive workers towards more shirking. On the other hand, the higher threat of possible exogeneous unemployment may drive employed workers to try to protect their jobs by consistently delivering high effort.

A second possible effect is that the expected job rents of workers in the high wage-high effort equilibrium might be lower in the downturn market than in the baseline market because of the statistical impact of future disruptions. This will generally lead to a lower sustainable effort level in the downturn market compared to the baseline market.

A third possible effect comes from the prospect of interruption serving as a selection criterion. In repeated games where the folk theorem applies, there are always inefficient

[3]Note that BFF2 employ a different behavioral assumption of fair workers than BFF1

equilibria as well as efficient ones. The fact that there is a possibility of interruption, per se, could serve as a public correlating device that implements the inefficient equilibrium.

In this paper we introduce the idea that loyalty norms can influence the net effect of stochastic interruption. Suppose that all firms form relational contracts, and wages and efforts are high. Then a firm is hit with a shock and exits the market for a known number of periods. When loyalty norms are strong, the firm's previous worker simply waits out the interruption period, and when the firm returns to the market, the firm makes a private offer to that worker, thus continuing the relationship. This strong loyalty norm would produce aggregate behavior very similar to the perfectly efficient relational contracting with "missing data" (from the downturn periods).

On the other extreme, suppose there are no loyalty norms. Then workers laid off in downturns will immediately accept any public or private offer, and firms returning from downturns will not expect to rehire old workers, so they will make new public offers and to kindle new relationships. Then shirking is less costly for the workers and relationship lengths will be shorter.

The theoretical model presented next illustrates the intuition behind our experiment. For simplicity, we model the downturn as a single period interruption instead of the three period interruption in our experiment. Like the framework from BFF1, there is an excess supply of labor and selfish workers imitate fair workers at period $t < T$ for fear of unemployment. We use BFF2 behavioral assumptions: all firms are utility maximizers, a fraction p of workers are *fair*, and the rest are selfish utility maximizers. In order to model employment choices while a firm goes into a downturn, we assume there are two firms and $n > 2$ workers (which depart from BFF1's model of a single firm and many workers or BFF2's model of a single worker and many firms). We first discuss our prediction for the baseline labor market before analyzing the downturn market.

Without stochastic interruptions, a single period of the game proceeds as follows:

1. Firms simultaneously offer contracts that stipulate wages and desired effort levels $[w, \tilde{e}]$ to all workers through public offers or to a single worker through private offers.

2. Workers receive all contracts at once and decide which one (if more than one) to accept.

3. If a worker accepts the contract, he chooses an actual effort level $e \in [1, 10]$ to deliver. If a worker rejects a contract, the firm can offer another contract.

4. After e is chosen, firm earns $10e - w$ and worker earns $w - c(e)$ (see Table 2 Row 1 for cost of effort). Unmatched firms earn 0; unmatched workers earn 5.

Stochastic interruptions happens at the beginning of the period before the firm makes offers. With probability δ, a firm experience a temporary (observable) shock in demand and cannot hire for one period.

$\tilde{e}_T$	1	2	3	4	5	6	7	8	9	10
1. $c(\tilde{e}_T)$	0	1	2	4	6	8	10	12	15	18
2. $\hat{w}(\tilde{e}_T)$	5	12	16	22	28	34	40	46	53	59
3. $\hat{w}(\tilde{e}_T) - c(\tilde{e}_T)$	5	11	14	18	22	26	30	34	38	41
4. $\hat{w}(\tilde{e}_T) - 5$	0	7	11	17	23	29	35	41	48	54
5. $\tilde{e}_{T-1}$	1	5	7	9	10	10	10	10	10	10

Table 1: Theoretical fair contracts at T and corresponding effort level at $T-1$

The utility of a fair worker follows the BFF2 model: workers have a bad conscience if they do not fulfill a contract that offers an equal (or better) split of surplus. Letting $\hat{w}(e)$ denote fair wages, Table 2 Row 2 provide $\hat{w}(\tilde{e}) = 5e - c(e)/2$ for each effort level. The marginal disutility b of not fulfilling a fair contract is assumed to be high enough such that fair workers will always provide the requested effort if they accept a fair contract.

Definition 1. *A fair worker is an agent whose utility for an accepted a contract of* $[w, \tilde{e}]$ *is* $w - c(e)$ *if* $w < \hat{w}(\tilde{e})$ *and* $w - c(e) - bmax(\tilde{e}, e)$ *otherwise.*

Proposition 2.1. *Consider a game of* $T = 1$ *period with two firms and* $n > 2$ *workers where a proportion* $p \in (0, 1)$ *of workers are fair as defined above. If* $p < .55$*, there exist no PBE where the firm offers more than* $(5, 1)$ *and workers perform* $e > 1$*. If* $.55 \leq p < .6$*, there exist a PBE where fair workers perform* $e = 2$ *and selfish workers perform* $e = 1$*. If* $.6 \leq p < .65$*, there exist a PBE where fair workers perform* $3 \leq e \leq 8$ *and selfish workers perform* $e = 1$*. If* $p \geq .65$*, there exist a PBE where fair workers perform* $e > 8$ *and selfish workers perform* $e = 1$*.*

We now consider a multi period model. All the variable are indexed with t to denote the period. Since all offers will be fair in equilibrium and fair workers will always deliver the requested effort of a fair offer, we only need to consider the shirking behavior of selfish workers. Let V_{t+1} be the expected future utility of not shirking at period t and U_{t+1} be the expected future utility of shirking at t. The selfish type will shirk if future job rents, defined as $V_{t+1} - U_{t+1}$, are not larger than current cost of delivering the requested effort.

$$V_{t+1} - U_{t+1} > c(\tilde{e}_t) \tag{1}$$

Proposition 2.2. *Consider a game of* $T > 1$ *periods with two firms and* $n > 2$ *workers where* $p = .6$ *are fair as in Definition 1. The following strategies and beliefs constitute a perfect Bayesian equilibrium in which both worker types perform maximum effort in all non final period* $t < T$*:*

- *At* $t = 1$ *all firms make public offers with the identical payoff splitting contract* $[59, 10]$*.*
- *A firm offers to his previous worker a contract of* $[59, 10]$ *in all periods* $1 < t < T$ *and* $[46, 8]$ *in period* T *if the worker performed the demanded effort in all previous periods. If the worker ever shirked, the firm privately offers the contract to a never employed worker. If all workers have shirked, firm makes public offers of* $[5, 1]$ *in all future periods.*

- *In period 1, two workers accept the two public offers and perform the desired effort* $e_t = 10$ *(whether they are selfish or fair). At period* T *a selfish worker performs* $e_T = 1$ *while a fair worker performs* $e_T = 8$*. Pairing happens at the first period and continues throughout;* $n - 2$ *workers remain unemployed for all* t*.*

- *Out of equilibrium beliefs: a firm believes that if a worker ever shirks he is selfish.*

We now consider downturns. Let μ be the probability of receiving employment offers from someone other than the current firm. The value of μ depend on contracting norms: for example, if all firms that went into downturn make new offers upon returning, then $\mu = \delta$. If firms only make private offers to their previous trading partner, then $\mu = 0$. It is also possible that some firms are unmatched in period $t > 1$, either because they are hit by a downturn before forming relationships, or because their offers upon returning are rejected, thus requiring public offers. Here $0 < \mu < \delta$.[4]

Let V^{δ}_{t+1} be the expected future utility of not shirking at period t and U^{δ}_{t+1} be the expected future utility of shirking at t when firms go into a downturn with probabilty δ. Suppose firms attempt to reconnect with workers that did not shirk after a downturn but some firms remain unmatched at period $t > 1$ ($\mu > 0$). Let j_t be the shorthand for $\hat{w}(\tilde{e}_t) - c(\tilde{e}_t)$.

$$V^{\delta}_t = (1-\delta)(j_t + V^{\delta}_{t+1}) + \delta[\mu(j_t + V^{\delta}_{t+1}) + (1-\mu)(5 + j_{t+1} + V^{\delta}_{t+2})] \tag{2}$$

With probability $1 - \delta$ the firm does not go into downturn and the pair continues their relationship. With probability δ firm goes into a downturn. When this happens, with probability μ agent accepts a public offer from another firm, and with probability $1 - \mu$ agent is unemployed at period t and returns to the incumbent firm when he returns from the downturn.

Let U^{δ}_{t+1} be the expected future utility of shirking at t when firms go into downturn with probabili ty δ.

$$U^{\delta}_t = \mu(j_t + V^{\delta}_{t+1}) + (1-\mu)(5 + U^{\delta}_{t+1}) \tag{3}$$

With probability μ agent accepts a public offer from another firm, and with probability $1-\mu$ agent is unemployed at period t and faces period $t+1$ with the same uncertainty.

Proposition 2.3. *For* $\delta > 0$ *and* $\mu \geq 0$
(i) job rents are positive $V^{\delta}_t - U^{\delta}_t > 0 \; \forall t \leq T$ *for all* $e_T > 1$
(ii) stochastic interruptions lower job rents

$$V_t - U_t > V^{\delta}_t - U^{\delta}_t \quad \forall t \leq T$$

Since job rents are lower in downturn, the incentive constraint in Eq.1 binds more frequently. For example, suppose $(1 - \mu)(1 - \delta) = 0.5$. The second to last period

[4] μ may also depend on subjective beliefs (optimism).

effort level that can be sustained given $\tilde{e}_T = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ has now decreased to $\tilde{e}_{T-1} = \{1, 3, 4, 6, 7, 8, 9, 10, 10, 10\}$ (where each from vector entry correspond to the same sequenced value $\tilde{e}_T$) from $\{1, 5, 7, 9, 10, 10, 10, 10, 10, 10\}$ when there is no downturn. Notice that given the same marginal cost of effort (e.g $c'(e) = 2$), higher effort levels are affected less than in the downturn (for $e_T = \{3, 4, 5, 6, 7, 8\}$, the reduction in e_{T-1} due to downturn is $\{3, 3, 3, 2, 1, 0\}$).

The next proposition shows that an equilibrium exists where workers and firms have strong loyalty norms.

Proposition 2.4. *Consider a game of $T > 1$ periods where a firm can be hit by a downturn at any period with probability $\delta < 0.5$.*[5] *There are two firms and $n > 2$ workers where $p = .6$ are fair as defined above. The following strategies and beliefs constitutes a perfect Bayesian equilibrium in which both worker types perform maximum effort in all non final periods $t < T$:*

- *At $t = 1$ all firms that are not in downturn make public offer of $[59, 10]$.*
- *If a firm is in a downturn at $t = 1$, when returning it makes a private offer to a never employed worker of $[59, 10]$. If there are no workers that are never employed, firm makes a public offer of $[5, 1]$.*
- *A firm offers to his previous worker a contract of $[59, 10]$ in all periods $1 < t < T$ and $[46, 8]$ in period T if the worker performed the demanded effort in all previous periods. If the worker ever shirked, the firm privately offers the contract to a previously unmatched worker. If all workers have shirked, firm makes public offers of $[5, 1]$ in all future periods.*
- *When a firm returns from a downturn, it makes a private offer to the previous worker if he has not shirked.*
- *Workers accept all offers and performed the desired amount $e_t = 10$ at $t < T$. Workers choose the incumbent firm when they receive identical competing offers.*
- *Out of equilibrium belief: a firm believes that if a worker ever shirks he is selfish.*
- *In period 1, two workers accept the two public offers and perform the desired effort $e_t = 10$ if he is selfish or fair. At period T a selfish worker performs $e_T = 1$ while a fair worker performs $e_T = 8$. Pairing happens at the first period and remain throughout; $n - 2$ workers remain unemployed for all t.*

Stochastic interruptions reduce job rents, however, if the equilibrium wage /effort package provides high enough profit (j_T) and reconnection norms are adequately strong, relationships and quality of contracts will survive downturns. Lower equilibrium wage/effort

[5] Except when a firm has just returned from the downturn. A firm cannot be hit by two consecutive downturns.

will be more affected by the discounting caused by the stochastic interruptions, and lower reconnection norms (large μ) will further reduce the job rents ($V_t - U_t$), thus making the incentive constraint binds more frequently and reducing the quality of contracts that can be sustained in equilibrium.

Our experimental investigation will focus on the following questions: first, are job rents actually lower in downturns? If so, do lower rents lower wages and effort? What sort of loyalty norms exist between firms and workers and how do these norms affect contracts?

3 Experiment

Many experiments have been done in the basic "gift exchange" paradigm (see Camerer and Weber (2008), Fehr and Gchter (2000)). The general finding is that wages and efforts are persistently above the minimum level.[6] The general interpretation of these effects is that many workers feel a sense of positive reciprocity toward firms that pay generous wages. However, there is also typically a noticeable drop in effort in the last period, which is a reminder that some workers are purely self-interested and will shirk when reputational concerns are absent.

BFF1 ran their experiments with 7 firms and 10 workers. They found that when effort is non-contractible and firms can make private offers (using worker IDs and privately-known effort history), about half of the total trades take place in relationships that last at least half of the total number of trading periods. Effort becomes a function of wage and private offer and the length of the relationship.

In their experiments "two-tiered" labor markets emerge reliably. Long term relationships conform to the theoretical prediction above and are characterized by repeated private offers, high wages, and high (costly) effort. The longer the previous length of relationship and the more positive the effort surprise is,[7] the more likely it is that a private contract will be repeated. On the other hand short term relations also exist in which contracts are mostly initiated through public offers with low offered wages and delivered efforts are low. Some of these results are detailed below in Section 4.1 and compared to our baseline replications of their design.

We ran two types of experimental sessions: baseline sessions replicating the structure of BFF1 with 9 firms and downturn sessions in which there are commonly-known prob-

[6] When the total surplus from higher effort is smaller, efforts are lower too. Some experiments have shown boundary conditions under which wages and efforts are not very much higher than the minimum (e.g., Rigdon (2002)). Note, however, that in all cases (including the latter) when efforts are regressed against prepaid wages there is a strong, significant correlation.

[7] Surprise is defined in BFF1 as the difference between delivered effort and expected effort, which is elicited from firms after the workers have accepted the contract but before effort is revealed. We will use the same definition here.

Location	Treatment	Firms	Workers	Periods	Number of sessions
Caltech	Baseline	9	10	30	2
	Downturn $p = 0.05$	8	9	30	1
	Downturn $p = 0.05$	9	10	30	1
	Downturn $p = 0.1$	9	10	30	1
UCLA	Baseline	9	10	30	2
	Downturn $p = 0.1$	9	10	30	2

Table 2: Experimental treatments (Caltech and UCLA)

ability (.05 or .10) of a firm-specific downturn which lasts 3 periods. The experiments were run in Spring 2008. Table 2 shows the treatments and subject pools in all sessions.[8]

Our session features were modified step-by-step to pursue what we thought were the most interesting variations. We first explore a labor market where in every period firms face a downturn probability of .05. This did not produce enough downturns to give statistical power so we increased the downturn probability to .10. We explored subject pool heterogeneity by running sessions at both California Institute of Technology (Caltech) and University of California in Los Angeles (UCLA). The subject pool at Caltech is small, often unusually cooperative, and have substantial experience with laboratory experiments, while UCLA subjects resemble the typical large-university group more closely.

4 Results

Our analysis is summarized in four results. Section 4.1 shows the replication of baseline markets in UCLA and Caltech. In Section 4.2 we present the impact of downturns on job rents and contracting: even though job rents are lower, market efficiency is unharmed. We investigate the reason for this robustness in the last two sections. Section 4.3 shows that temporary market (short term relationships) actually improves with downturn threats. Ironically, this is because firms demand more out of public workers before renewing relationships, thus delaying the separation of the two tiers of the market and shortening relationships. The improvement in wages and effort in the temporary market increases the reservation value of workers, which induces firms desiring relationships to raise wages in order to achieve adequate separation. However, Section 4.4 shows that firms and workers who are sharing their surplus 50-50 remain unaffected. These pairs have strong loyalty norms that allow them to reconnect after downturns. Reconnection is fairly sharply predicted by whether firms offer surplus shares around 50% .

[8]Two pilot baseline session with 15 periods were ran in January 2008. These pilot sessions replicated the BFF1 results.

4.1 Replication of Baseline Result in Two Subject Pools

Our experiments replicate the basic patterns of contracting, wages and effort in BFF1 quite closely using two different subject pools and extending number of contracting periods from 15 to 30 (see Figure 1). The efficiency of the UCLA market is lower than that of the Caltech sessions which is slightly higher than the BFF averages. Wage, effort, private offers, and relationship length are remarkably consistent.

The top left panel of Figure 1 shows the pattern of wages for accepted offers. Average contracted wages are increasing as a function of time. Qualitative and quantitatively, wages are very similar in BFF1's sessions and our baseline replications. The average plots mask a lot of cross-firm variability however. Many private offers are made persistently around a wage of 60, while public offers are lower, around 20.

The top right panel shows the pattern of worker efforts. Average delivered effort increases in time with a last period effect. There is upward movement across the time with a last period effect; the effort levels are similar across BFF1's sessions and both of ours. The bottom left panel shows the percentage of offers that are private (i.e., which earmark an offer for a particular ID-numbered worker). That percentage starts off at about 30% and moves upward to around 80% before levelling off. Private relational contracting clearly comes to dominate in all subject pools.

One useful statistic is the average job tenure, summarized by the distribution of the fraction of total periods in which a firm hires the same worker. (Note that these do not have to be continuous runs of identical hiring). The bottom right panel of Figure 1 shows the cumulative distribution of this statistic. There are more short term relationships in BFF1; about 1/3 of trades in BFF1 take place between partners that interacted 1/10th of the time (1 to 2 periods) while in LC (Linardi-Camerer) sessions only 1/6 of total trades fall within this category. In contrast, about 1/3 of the matches in our replications last through more than 90% of the session (27-30 periods); this number is much smaller in BFF1. Except for these modest differences in extreme short and long matching, however, the typical job tenures are not far apart. The differences are likely due at least in part to the fact that longer relationships can develop over 30 periods (LC) than over 15 periods (BFF).

Surplus sharing and the relation between profits and relationship length are similar in BFF1's sessions and our sessions (see Figure 4 in the Appendix). Surplus sharing in very short relationships (temp market) is filled with shirking, which benefits workers. Then in the entry level of the high tier relationship, the workers pay their dues in higer effort to gain trust of the firm, sacrificing their surplus. As the relationship grows, the surplus sharing becomes more equal, eventually reaching approximately 50-50 for the longest relationships. Earnings per trade for both firms and workers rise with relationship length in both sessions.

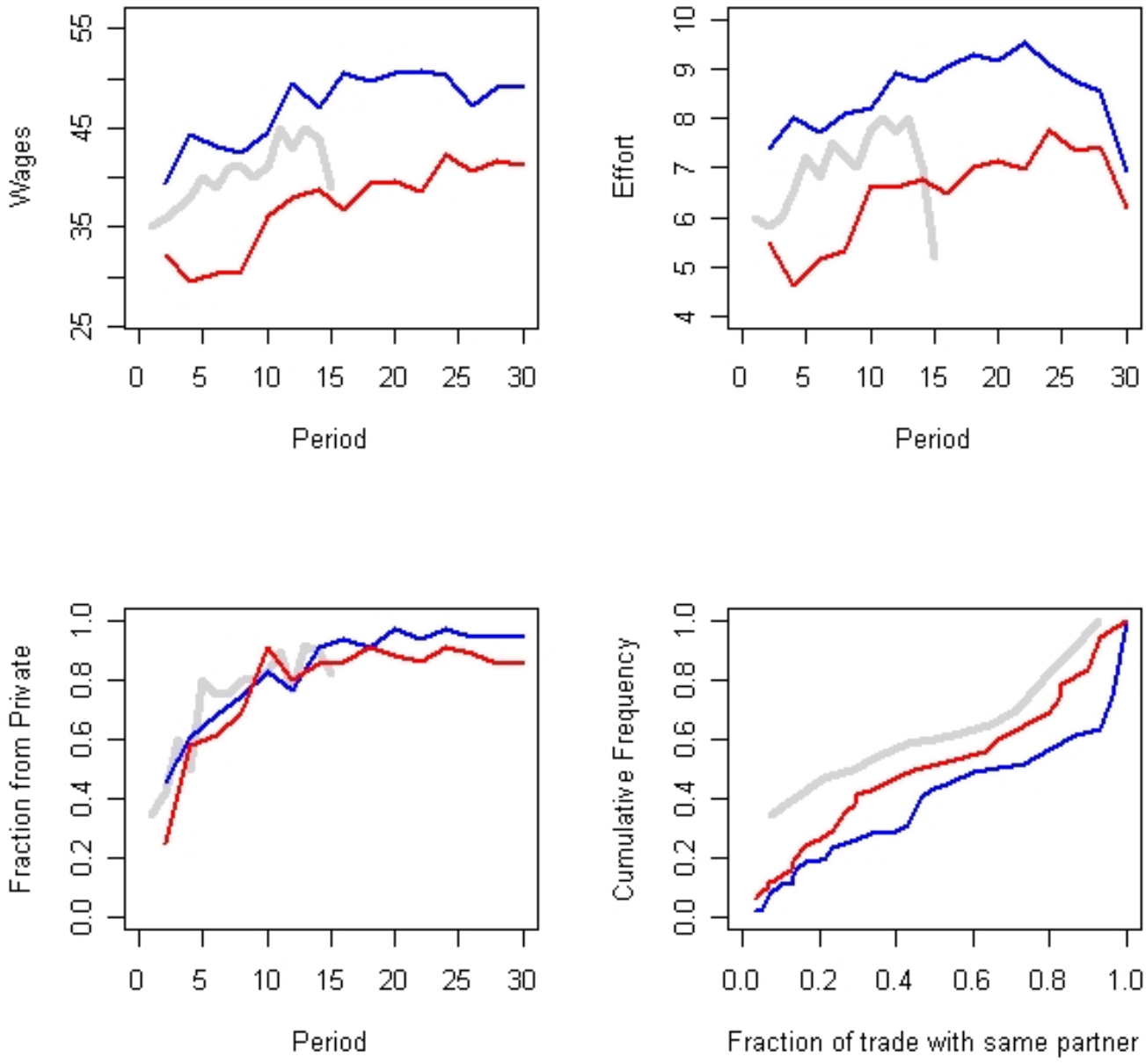

Figure 1: Patterns of relational contracting in BFF (gray) replicated at Caltech (dark blue) and UCLA (light red).

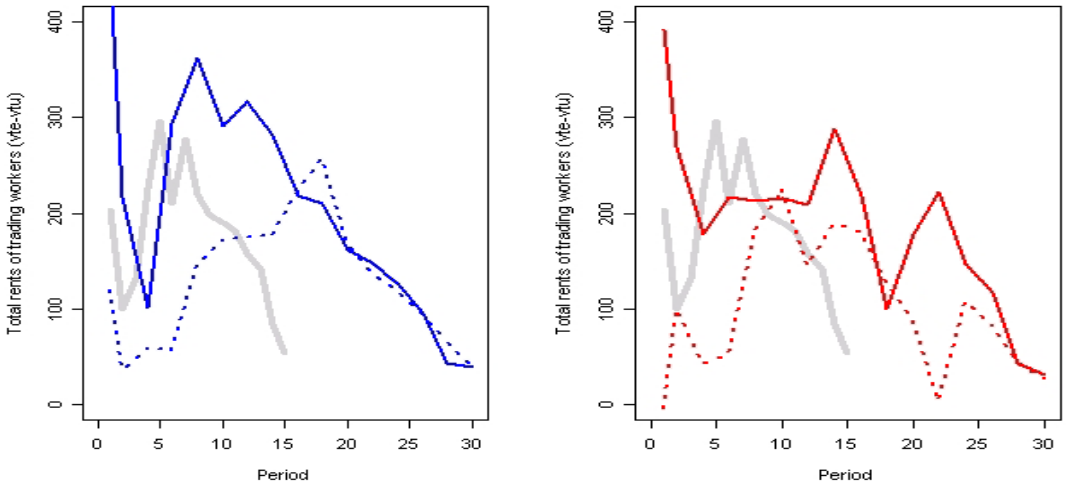

Figure 2: Job rents in Baseline (solid) is higher than Downturn (dotted) at both Caltech (L) and UCLA (R).

4.2 Impact of Downturn on Job Rents and Contracting

The key mechanism in the argument for sustaining a high equilibrium in finitely repeated contracting is the existence of positive rent for workers in the final period. This rent exists if there is difference in earnings between workers with a job and those without one. This rent makes it optimal for workers to not shirk in earlier periods, which makes it profitable for firms to offer high wages (as in efficiency wage theory). We predict that when stochastic interruptions can happen, job rents are lower because workers that are employed may be unemployed in the future. We computed the average of all present and future incomes of all workers trading in period t. The average value of a job in period t (denoted V_t) is calculated from total current and future income of workers employed in period t. The average value of being without a job in period t (U_t) is the average future income of a worker who is unemployed in period t.[9] Generally, Vte and U_t are declining in t since there are fewer periods remaining. In a spot market where there are no relational contracts and workers freely move from firm to firm, V_t and U_t will be similar. In a highly relational market with excess labor supply, in which all workers form long-term attachments, there will be a large separation between V_t and U_t which represents the cumulative job rent from having a relational contract. BFF finds large and positive job rents in all 15 periods.

Figure 2 compares job rents in Baseline (Solid black)to Downturn (dotted black) and BFF (gray, 15 periods). As predicted, job rents (V_t-U_t) are lower in the downturn treatments almost throughout the entire period. Rents are always large and positive in all markets (as comparison, we rescale BFF's job rents by two to take into account the

[9]This includes both matched workers who are left unemployed when their firms go into downturn and those who have been unmatched all along. We will look at the matched workers more carefully in Section 4.4.

difference in the number of periods in our experiment). The evolution of job rents across the three markets show remarkable similarities: the downturn job rents seem to be a lower, lagged version of the baseline job rents.

Consistent with the lower job rents, relationship lengths are also slightly shorter - trading parties in downturns have on average interacted two periods less than in the baseline (Table 3 Row 9). There is a 13% increase in trade taking place in relationship of length 4 or shorter (there's a 6% increase in one-shot contracts alone). Row 12 shows that in the downturn 5% fewer contracts led to renewal compared to baseline. To take account of the differences in total trading periods introduced by the downturns, we define (firm) ARL (adjusted relationship length) as the number of trades between two partners divided by the total number of period the firm has been active. An ARL of 1 means that the firm has traded only with this partner. ARL in downturns are 6% shorter than in baseline (Row 10). These shorter relationships meant more pairings: 52% of all possible matches in the downturn markets actually occur, compared to 47% in baseline markets.[10]

Does this imply that the wages and effort levels that can be sustained in the downturn market are lower? Suprisingly, the answer is no. Table 3 shows that offered wages are actually significantly higher (Row 1) and so are contracted wages (Row 5). Effort level remains the same (Row 11) at around 7.5, resulting in a small shift of surplus sharing towards workers in the downturn treatment (Row 3). Figure 5 in the Appendix plots the patterns of contracting (wages, effort, private offers, and relationship lengths) against time in the baseline and downturn markets.

4.3 Slow Separation Leads to Higher Prices

The instability from the downturn market creates smaller job rents and shorter relationships. Since the size of job rents determines the severity of the threat of unemployment and relationship lengths are positively correlated with high wages, this makes the higher average wage in the downturn sessions even more of a puzzle.

Plotting the average public and private wages offers separately against periods (Figure 3), we see that in the downturn market (dotted line), there is little separation between the two tiers of the market (public and private) until the second half. In the baseline market (solid lines), the two tiers separated early. Private offers in the first half of the downturn are only 3.35 (std.dev. 1.26) higher than public offers. But private offers in the first half of baseline are 12.16 (1.29) higher than over public contracts.

There is a striking difference in the quality of the short term market in the downturn treatment compared to the baseline. The average downturn wage offer is 29.75 (dotted line with white marker), compared to 18.59 (solid line with black marker) in baseline. The difference is significant at $p < 0.01$. The improvement in offers resulted in a much

[10]Note that when there are 9 firms and 10 workers, 90 distinct firm-worker matches are possible in each experimental session.

	Caltech		**UCLA**	
	diffe	diffSE	diff	diffSE
Offers:				
1.Wage	3.70	0.80	2.04	0.98
2.Desired Effort	0.43	0.09	0.39	0.14
3.Worker/Total Surplus	0.01	0.01	0.04	0.01
4.Fraction Private	0.03	0.02	-0.04	0.02
Accepted Offers				
5.Wage	2.21	0.81	-1.70	1.28
6.Desired Effort	0.22	0.09	-0.52	0.16
7.Worker/Total Surplus	-0.01	0.02	0.05	0.01
8.Fraction Private	-0.02	0.02	-0.06	0.03
9.Relationship Length	-2.25	0.43	-2.54	0.43
10.A.r.l	-0.07	0.02	-0.08	0.02
Actual				
11.Delivered Effort	0.04	0.14	-0.30	0.20
12.Effort Surprise	0.13	0.09	0.00	0.12
13.Buyer Profit	-1.85	0.91	-1.35	1.26
14.Seller Profit	2.28	0.58	-0.77	0.96
15.Worker/Total Surplus	0.04	0.04	0.04	0.03
16.Renewed Immediately	-0.01	0.03	-0.14	0.03

Note:
Surprise = Expected Effort(not reported) – Delivered effort
A(djusted).r(elationship).l(ength) = Previous trades/Number of active trading period

Table 3: Summary statistics of the effect of downturn.

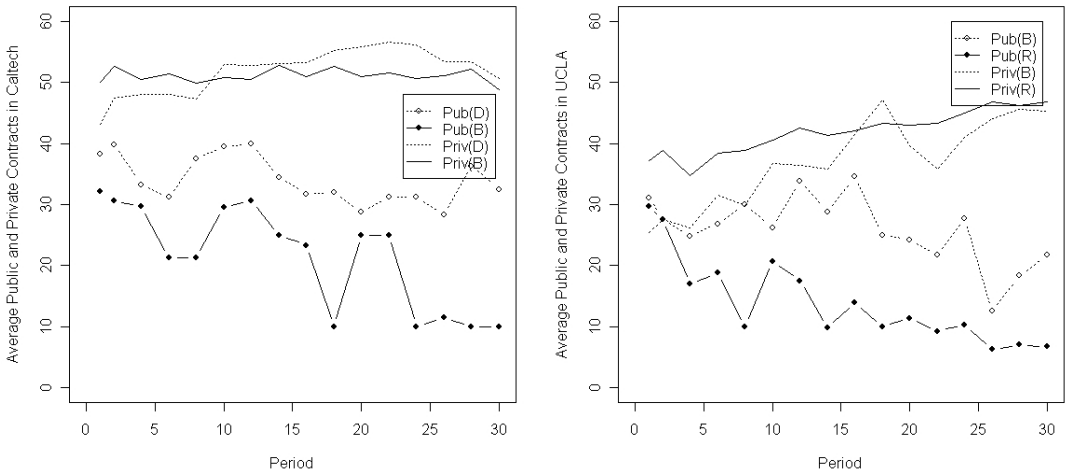

Figure 3: Stochastic noise delays separation of the two tiers of the labor market in Caltech (L) and UCLA (R).

higher contracted wage/effort level for the second half as well. For the downturn market the average second half wage is 27.8, sustaining average effort level of 4.3. The baseline wage in the second half is a much lower 9.3, sustaining low average effort of 2. ($p < 0.01$)

We now focus on the determinants of wage, acceptance, effort, and renewal. In Table 4 first look only at the first period because each period affects the following period. Similar to the results of BFF, the strongest driver of wage is requested effort. Private offers in baseline provide the workers with a bonus, but in downturns comes with a premium charge for the workers. Offers with higher surplus sharing are accepted more readily: higher wages and lower desired efforts. Effort is a function of increase in wage and requested effort. This effort response to wages has been found, strongly, in every lab experimental study of this type (see Camerer and Weber, 2008).

A contract renewal occurs when a firm makes a private offer to the employee hired in the previous period. In downturns firms are less likely to renew contracts. As we have seen before, the level of relational contracting in UCLA is slightly lower: equilibrium wages and effort are lower in UCLA and renewals are also lower.

Table 5 includes all 30 periods with controls for each period, relationship length, and last period effect. As play continues, relationship length becomes increasingly important: it increases wages offered, rate of acceptance, and contract renewals. The private offer bonus continues to be missing in the downturn. Because stable relationships are relatively harder to come by for workers in downturn, the workers are willing to reward long term firms more: long term offers are even more likely to be accepted and rewarded with high effort in downturn. Firms' unwillingness to renew contracts gradually lessened as periods go on, the coefficient in the contract renewal for downturns continue to be negative, but is no longer significant. Other factors such as whether the delivered effort

	OLS: Wage Offer			Logit: Acceptance			OLS: Effort			Logit: Renewal		
	Coef		S.E	Coef		S.E	Coef		S.E	Coef		S.E
Intercept	-6.13		7.40	3.02	*	1.63	0.73		1.12	1.63		1.41
Wage				0.07	**	0.03	0.07	**	0.03			
Surprise										0.25		0.22
Desired Effort	4.84	***	0.87	-0.52	**	0.22	0.45	**	0.20			
Actual Effort										-0.12		0.18
Private	6.43	*	3.34	-2.66	***	0.65	0.62		0.74	0.86		0.91
UCLA	-5.38	**	2.29	-0.14		0.39	-1.19	**	0.48	-1.27	*	0.67
Downturn	11.36		10.21	-1.73		2.01	0.42		1.65	-6.53	***	2.46
Downturn*Wages				-0.02		0.03	0.00		0.04			
Downturn*Surprise										0.08		0.40
Downturn*DesEffort	-1.15		1.30	0.25		0.29	-0.08		0.27			
Downturn* Ac.Effort										0.68	**	0.32
Downturn*Private	-10.37	**	4.71	0.64		0.84	-0.76		0.99	2.00		1.56
N	186			186			71			71		
Adjusted R2	0.29			0.40			0.56			0.43		

***p=<1%, **p<5%, * p<10%

Table 4: Initial ($t = 1$) determinants of firm and worker behavior.
Note: Firms in the Downturn treatment start out with lower private wages (-10.37) and are less likely to renew private offers (-6.53). This suggests that firms are being choosy about their private contracting partner under the threat of stochastic interruptions.

	OLS: Wage Offered			Logit: Acceptance			Ols: Effort			Logit: Renewal		
	Coef		S.E	Coef		S.E	Coef		S.E	Coef		S.E
Intercept	-16.38	***	2.67	-1.90	***	0.48	-0.08		0.38	-3.97	***	0.46
Wage				0.05	***	0.01	0.10	***	0.02			
Surprise										0.39	***	0.09
Desired Effort	4.45	***	0.34	-0.06		0.06	0.28	***	0.08			
Actual Effort										0.13	***	0.05
A.r.I	18.42	***	2.17	6.58	***	0.71	0.33		0.36	3.44	***	0.42
Private	11.59	***	2.18	-2.57	***	0.36	0.94	***	0.26	2.01	***	0.37
Period	0.05		0.07	0.08	***	0.01	0.00		0.01	0.03	**	0.01
lastPeriod	-0.93		1.08	-0.98	***	0.19	-2.18	***	0.37	-14.20	***	0.69
UCLA	-3.32		1.61	0.73	***	0.27	-0.49	***	0.14	0.28		0.26
Downturn	7.97	**	3.92	1.49	**	0.60	0.44		0.55	-1.03		0.86
Downturn:Wage				0.00		0.01	-0.02		0.03			
Downturn:suprise										-0.11		0.19
Downturn:DesiredEffort	-0.09		0.52	-0.15	*	0.08	-0.03		0.15			
Downturn:ActualEffort										0.17		0.10
Downturn:A.r.I	-0.21		3.13	1.12	**	0.55	1.08	*	0.61	-0.74		0.68
Downturn:Private	-8.61	***	2.97	-0.05		0.29	0.18		0.35	0.13		0.58
Downturn:Period	0.13		0.11	0.01		0.01	0.01		0.01	-0.01		0.02
N	3435			3434			2091			2091		
adj R2	0.72			0.64			0.77			0.60		

***p=<1%, **p<5%, * p<10%

Robust standard error. For wage offered and contract renewal, standard error is clustered on firms. For acceptance and effort, standard error is clustered on workers.

Table 5: Determinants of firm and worker behavior, pooled across all periods. Note: Firms in the Downturn treatment continues to lower private wages (-8.61) but are no longer reluctant to renew private offers as the period progresses.

level meets expectation (surprises), relationship lengths, and whether the contract was private become more important.

Overall the result suggests that in a finitely repeated game, delay in forming relationships have long lasting repercussions. Firms in downturn correctly anticipated that with fewer firms active, workers experience higher competition for jobs. However, firms reacted by demanding more from a worker before extending long term relationships. First, they offer lower surplus sharing in private offers. For the earliest five periods, private offers in downturns are actually less fair than public offers (average private offer price is 30.5 with a surplus of 0.22 compared to public offers of 29.2 with surplus share of 0.29). This is the opposite of the situation in baseline, where average private offer prices of 34 (and surplus sharing of 0.23) serve as a bonus for the worker whose outside options are public offers of 24 (with surplus sharing of 0.18). Since fair surplus offers are accepted more frequently, private contracts constitute a significantly smaller fraction of total contracting in downturn market (42.5% in downturn) than in baseline (51.5% in baseline). This difference is significant at $p < .10$ with a one sided t-test).

The difference in surplus offered leads to further delay in relationship formation. Public offers are renewed less frequently than private offers. In addition, since public offers are more fair in downturn, workers' effort matches firms' expectations much more closely in downturns. Because public offers in downturn carry little penalty in terms of lower profits for both parties or suprises to firms,[11] there is little incentive for both partners to move away from public offers. Average rate of renewals in the first 5 periods of downturn is 41%, compared to 49% in baseline.

Even though these early period behaviors (such as penalty for private offers and firms' unwillingness to renew) decrease in time,[12] the effects lingered. In fact, aggregating across all periods, the difference in workers' earnings in a public offer (24.6) and a new private offer (26.9) is not statistically significant ($p = 0.12$). This is starkly different from baseline, where the average seller earnings from public offers is 16.9 and from new private offers is 23.85 ($p < 0.01$).[13] As a result, private contracts in downturn are conducted within a shorter relationship: average ARL of private contracts in downturn are 8% (0.01) shorter than in baseline while average ARL of public contracts in downturns are 1% (0.03) longer than in baseline.[14] Firms' unwillingness to commit in the early periods of downturn sessions ironically results in higher reservation prices for workers and loss of bargaining power due to shorter relationships, which requires the firm to pay much more in later periods for the same level of effort.

[11] Firms' average surprise from public offers is -1.36 (0.22) in the baseline and -0.31 (0.18). Baseline public contract suprises is significantly more negative ($p < 0.01$).

[12] Table 3 Row 3, Private contracts make up 81% of total contracts in baseline vs 78% in downturns

[13] For firms, the difference between public offer earnings and new private offer earnings is 19.8 vs 24.6 in downturn ($p < 0.05$), and 18.3 vs 28 in baseline ($p < 0.01$).

[14] The fact that the difference in ARL (adjusted relationship length) of private contracts is higher (-8%) than that of total contracting (-6%) suggests that as firms use private offers renewals less, repeated interactions are partially driven by workers who sought after public offers from their previous firms.

4.4 50-50 Surplus Sharing and Loyalty Norms

In the previous section we see that stochastic interruption slows down the formation of long term private contracting. In this section we ask whether downturn affects established relationships by looking more closely at the periods surrounding downturns.

There were 79 instances of downturns. Among them, there were 70 instances where firms have the opportunity to reconnect with the workers they have previously traded with. In the period before the downturn in these 70 cases, average wage contracted was 41.81 with average desired effort level of 7.9 (this implied an offered worker surplus share of 0.39). Workers provide an average effort level of 7. (See Table 10 in the Appendix). When downturn prevents firms from hiring, these "laid-off" workers go to a lower quality (short term) market where contracts are lower in wage and surplus sharing (Table 10 Column 2).

Two-thirds of the total 118 interim trades came from private offers. Those workers that have received many private offers in the past or have longer relationship lengths are more likely to get new private offers during this period (Table 6 Model 1). Workers simply grabbed whatever offers they got (Table 6 Model 2) - the primary determinant of their activity is the number of private offers they receive. Workers treat these contracts with the same norm of fairness as they had with their previous employers, delivering effort that ensure themselves 0.68 of the total surplus.

Firms try to squeeze a little bit upon return from the downturn (lowering surplus offers from 0.39 to 0.35) (Table 10 Column 3). Of the 70 firms returning from downturn, 40 tried to reconnect with previous workers. Reconnection attempts depend mostly on previously delivered effort and relationship length (Table 6 Model 3). The 30 other firms attempted to hire other workers (14) or made public offers (16).[15] Six reconnection attempts were rebuffed by workers, and two public offers were grabbed by previous workers, thus restarting the previous relationship. The overall reconnection rate was 54%.

Table 6 Model 3 and 4 model the empirical reconnection norms.[16] *Firm attempted* is 1 if the firm made a private offer to its previous employee. *Pair reconnected* is 1 if the firm made such an offer and it was accepted. More interim job searches lower the chance that firms attempt to reconnect and that workers accept reconnection offers, which supports our model of strong reconnection norms.[17]

There is a very striking effect of pre-downturn surplus sharing on successful recon-

[15]The public offers made by returning firms are often more generous in surplus sharing than average public offers (the mean returning firms' public offer is 0.37 as opposed to 0.29), which help keep the high surplus sharing norms in the downturn public offer.

[16]Model 1 is an OLS on the number of private offers received by workers left unemployed by downturns. Model 2 is an OLS on the number of trades these workers engage in. Model 3 is a logit regression on whether or not firms make a private offer to its previous worker after returning from the downturn. Model 4 is a logit regression on whether the firm-worker pair reconnected after the downturn.

[17]Note the sample sizes are low (N=79) because downturns are rare ($\delta <= 0.1$), so strong results are unlikely to emerge.

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	1. OLS: # interim private offers			2. OLS: # of interim trades			3. Logit: firm attempt to reconnect			4. Logit: Pair reconnected		
	Coef		S.E	Coef		S.E	Coef		S.E	Coef		S.E
Intercept	1.34	**	0.53	1.01	***	0.36	-2.73	*	1.62	-3.92	**	1.96
Pre downturn variables:												
Wage	-0.02	**	0.01	0.00		0.01						
Delivered Effort							0.36	***	0.13	0.30	**	0.14
Offered Surplus	1.23	*	0.74	-0.25		0.42	-0.44		1.61	4.98	***	1.88
A.r.l (seller)	-0.21		0.63	0.56		0.38						
A.r.l (buyer)							2.70	***	1.03	2.45	**	1.09
Number of past private offers to seller	0.83	***	0.25	-0.19	*	0.10	0.21		1.27	0.39		1.40
# interim private offers				0.43	***	0.07						
# interim trades							-0.55	*	0.33	-0.96	***	0.38
N	70			70			70			70		
Adjusted R2	0.16			0.35			0.43			0.51		

***p=<1%, **p<5%, * p<10%

Robust standard error. For interim behavior, standard error are clustered on workers. For post downturn behavior, standard errors are clustered on firms.

Table 6: Determinants of firm and worker behavior surrounding downturn.

	Reconnection					
	No attempt by firm		Rejected by worker		**Accepted by worker**	
	Mean	S.E	Mean	S.E	Mean	S.E
Price	33.92	3.58	37.00	6.35	47.97	2.74
Offered Surplus	0.34	0.03	0.31	0.04	0.43	0.03
Actual Surplus	0.87	0.23	0.38	0.07	**0.51**	**0.03**
Relationship Length	2.80	0.54	4.50	1.18	7.89	1.02
	N=30		N=6		N=36	

Table 7: Characteristics of pre-downturn contracts and post-downturn relationships: 50-50 surplus sharing leads to reconnections.

nection: Higher previous surplus offers have a positive effect on successful reconnection and a negative effect on worker rejection of reconnection (i.e., workers tend to reconnect more often if the employer shared more surplus). In fact, Table 7 shows that the average predownturn surplus sharing of succesful reconnections is 0.51 - close to the 50-50 split. If the worker share was less than this, firms attempt to reconnect but will be refused by workers. If the worker's share was more than this, firms do not attempt to reconnect. The firms attempt and reciprocation from worker also depends on relationship length and wages offered. In conclusion, strong loyalty norm can protect relationships against stochastic interruptions: good workers and fair firms reconnect after the downturn.

5 Conclusion

This paper replicates the important experimental paper on wage-effort gift exchange by Brown, Falk and Fehr (2004) and extends it by creating exogenous layoff periods ("downturns" in which firms cannot hire for three periods). The key feature of their design, compared to earlier experiments, is that firms can make private offers that can only be accepted by a specified worker. The result is that a "two-tiered labor market" emerges spontaneously (even there are no true skill differences among workers). Some firms make public offers which any worker can accept and others lock in to "relational contracts" in which they make repeated offers to the same worker period after period. Firms sometimes "fire" their worker-by not repeating their private offer– if the worker's effort is too low, compared to a nonbinding level of effort requested by the firm. It is crucial to note that these are truly implicit long-term contracts since they only last one period, and there is no explicit communication at all that supports the relationship or clarifies what is expected, except for the time course of wages, effort requests, and actual efforts.

Our experiments replicate the basic patterns of contracting, wages and effort in BFF1 quite closely using two different subject pools and extending number of contracting periods from 15 to 30. Wage, effort, private offers, and relationship length are remarkably consistent.

The novel contribution of our paper is exploring the effect of exogeneous temporary drops in labor demand (firm downturns). We explored the hypothesis that anticipating stochastic downturn would undermine relational contracting. In a rational framework the lower capitalized that long-run value of a relational contract will lead workers to exert low effort and firms to expect low effort and pay lower wages. On the other hand, if the market is driven by strong "loyalty" norms that firms rehire their old (pre-downturn) workers then relational contracting might be immune to disruptions.

Consistent with the theoretical prediction, job rents in downturns are lower. This leads to shorter relationships: the average relationship length in private contracts are 8% lower in downturn and there is a 13% increase in trade taking place in relationship where partners' total trading history is 4 periods or less. Suprisingly, average wages in

downturn are higher.[18] Since average effort remains the same, this results in a shift of surplus sharing towards the workers.

The reason for this is the delayed separation of public and private contracts in labor market with downturns. In the baseline markets, firms provide a private offer bonus to workers in terms of higher wages and better surplus sharing compared to public offers. In the earlier periods of downturn, not only is the private offer bonus missing, but the surplus sharing is actually less fair than public offers. Renewal rates of comparable effort levels are also lower in downturns. One possibility is that firms in downturn correctly anticipated that with other firms unable to hire due to downturns, workers will compete harder for jobs. However, firms' initial strategy of demanding more from a worker before extending long term relationships actually backfired and resulted in higher reservation prices for workers (in the form of a much improved temporary market). The net effect is that firms' bargaining power is reduced and firms ended up paying much more for the same level of effort. Overall the result suggests that in this finitely repeated contracting game, delay in forming relationships can have long lasting repercussions.

We observe the following loyalty norms. When downturn prevents firms from hiring, workers left unemployed go to a lower quality (short term) market where contracts are lower in wage and surplus sharing. Workers grabbed offers if they get them. When firms return from the downturn, there is a very striking effect of pre-downturn surplus sharing on successful reconnection. The average predownturn surplus sharing of succesful reconnections is 0.50 - the 50-50 split that has appeared frequently in various laboratory and field experiments. If the worker share was less than this, firms attempt to reconnect but will be refused by workers. If the worker's share was more than this, firms do not attempt to reconnect.

A nice property of the gift exchange paradigm is that one can think of many follow-up experiments to do next. The downturns here are independent across firms, but one could correlate them in order to study business cycle effects. Typically downturn lengths are stochastic rather than lasting a fixed number of periods, as well, which is an easy design feature to change to measure the impact of uncertain downturn lengths.

6 Appendix: Additional Tables and Figures

[18] BFF2 studied relational contracting under full employment by inverting the labor market conditions of BFF1; their market is populated by 10 firms and 7 workers. Relationship lengths in BFF2 are shorter, confirming field studies (Bleakely et al., 1999) that workers are more likely to quit their jobs under full employment than when unemployment prevails. However, the lower frequency of long-term relationships does not affect aggregate performance across labor market conditions because it is compensated for by higher performance in short-term relationships. With no unemployment, high-performing workers receive higher wage offers from their current firm than from outside firms. This motivates workers to perform at a high level of effort, rather than to shirk and then switch firms.

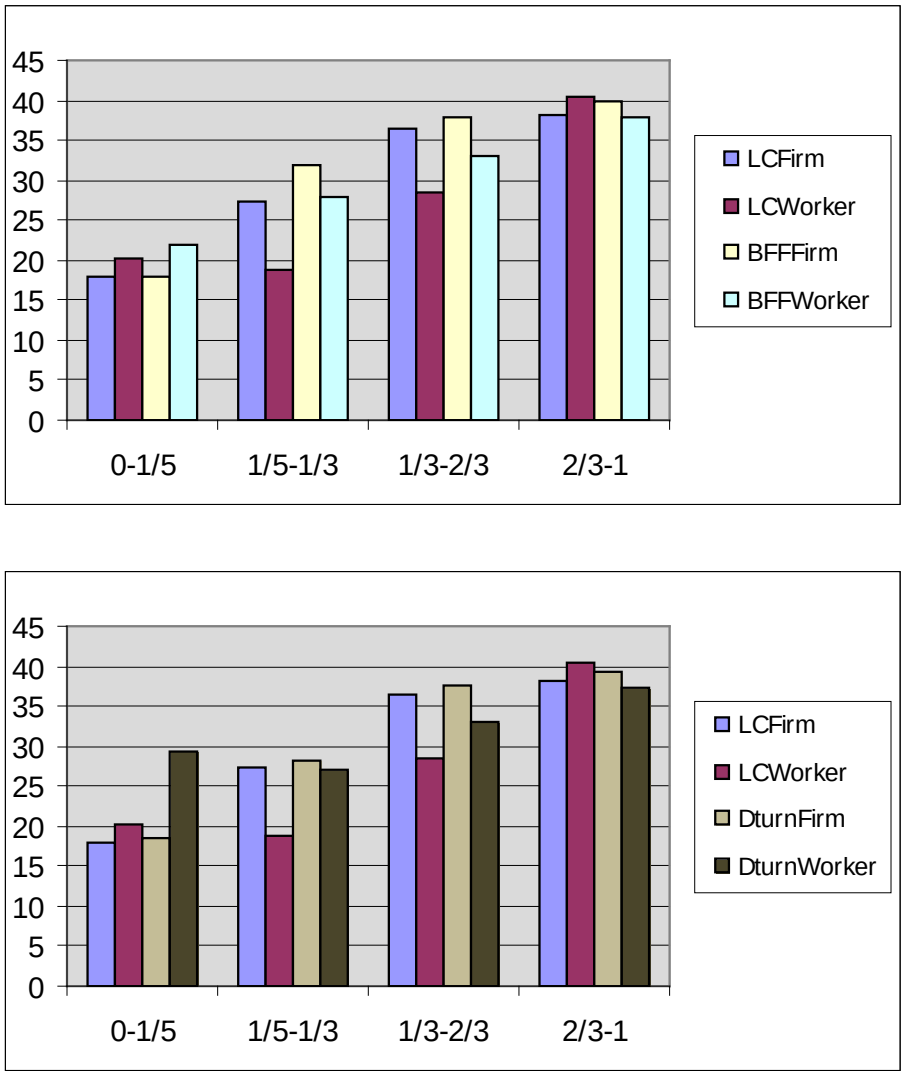

Figure 4: Surplus sharing (y) as a function of relationship length (x).
In the top panel, 30 period baseline LC sessions are compared to 15 period BFF sessions by binning relationship length into fractions of entire trading period. For example fraction 0-1/5 indicated relationship lengths up to 5 (out of 30) periods in fLC and up to 2 (out of 15) periods in BFF. Surplus sharing in shortest relationship (temp market) is filled with shirking, which hence benefits workers. The next shortest relationships are entry level of the high tier relationship where workers put in their dues to gain trust of the firm, sacrificing their share. As the relationship grows, the surplus sharing becomes more equal. The bottom panel shows the similarity of downturn sessions with the baseline session. Because wages are higher, workers in temp market gain a much larger share of the surplus when they shirk.

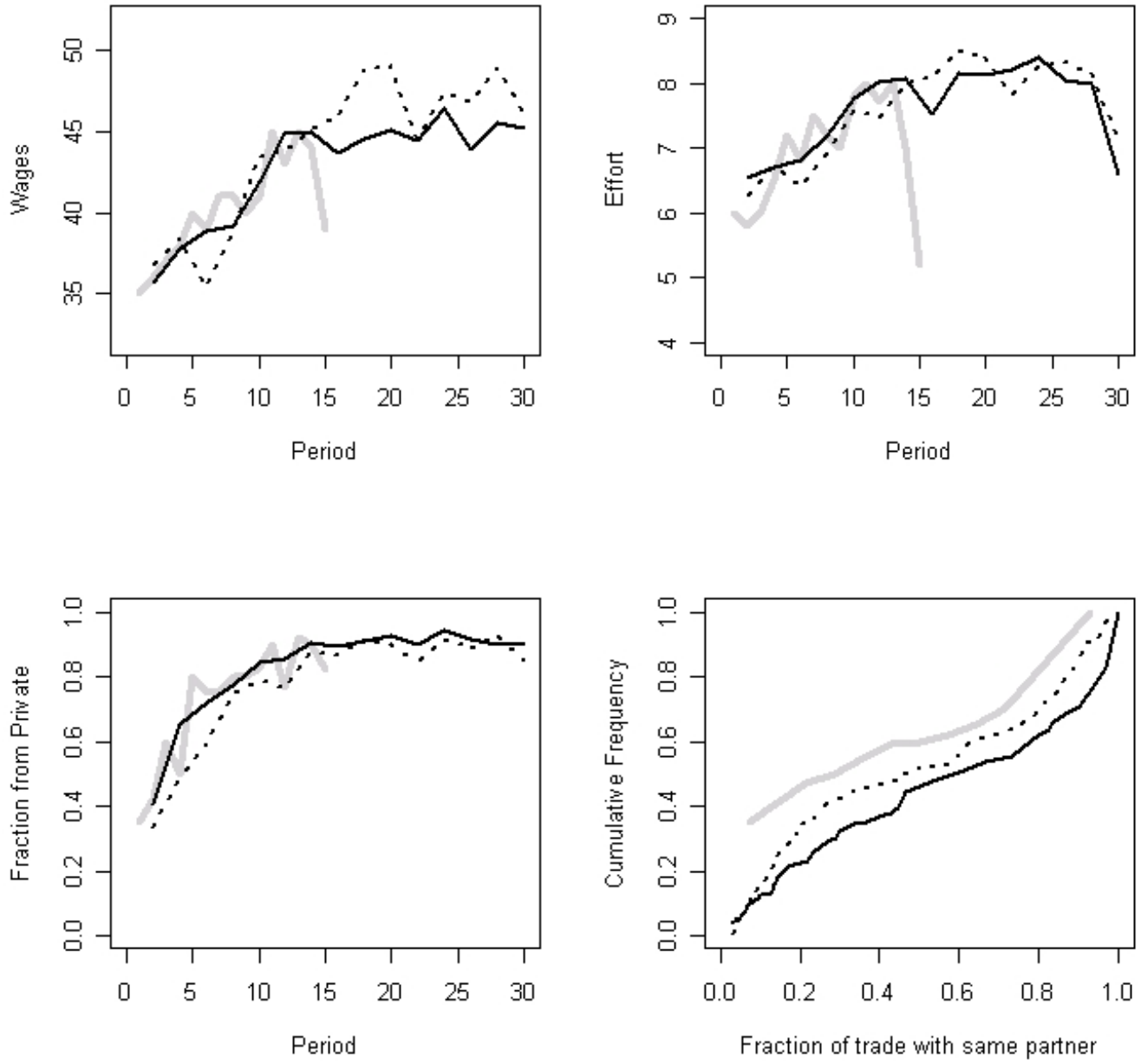

Figure 5: Wages, effort, private offers and relationship lengths in Baseline (solid) compared to Downturn (dotted).
The top left panel illustrates that average wages are suprisingly higher in the second half in Downturn (dotted lines) than it is in Baseline (solid lines black for LC, gray for BFF). The top right panel and bottom left panel shows no difference in average delivered effort or in fraction of contracting through private offers. The bottom right panel shows that relationships are shorter in downturns. Graph shows data pooled from Caltech and UCLA subjects.

	Model 1	Model 2	Model 3	Model 4
Downturn	2.99*	2.54*	2.42***	11.31**
	(1.30)	(1.08)	(0.46)	(3.61)
Desired effort	5.46***	5.47***	4.67***	4.80***
	(0.34)	(0.30)	(0.28)	(0.32)
Relationship Length	0.68***			
	(0.07)			
A.r.l		16.92***	15.31***	17.19***
		(2.49)	(2.03)	(2.89)
Private			7.74***	9.94***
			(1.65)	(1.43)
Period			0.11**	0.12*
			(0.04)	(0.05)
lastPeriod			-1.82*	-1.81*
			(0.9)	(0.9)
UCLA			-2.87***	-3.09***
			(0.77)	(0.83)
Dturn* Desired effort				-0.38
				(0.51)
Dturn*A.r.l				-4.36
				(3.64)
Dturn*Private				-4.08
				(2.97)
Dturn*Period				0.00
				(0.07)
Intercept	-11.12***	-15.05***	-13.78***	-17.62***
	(3.28)	(3.03)	(2.9)	(3.16)
N	2105			
Adj R2	0.62	0.63	0.67	0.68

Table 8: Determinants of accepted wages.

	Baseline		Downturn	
	diff	**diffSE**	**diff**	**diffSE**
Offers:				
Wage	18.30	0.93	10.89	0.92
Desired Effort	0.78	0.16	1.25	0.16
Worker/Total Surplus	0.16	0.01	0.01	0.01
Contracts:				
Wage	25.28	1.10	16.27	1.01
Desired Effort	2.07	0.18	1.58	0.18
Worker/Total Surplus	0.18	0.02	0.05	0.02
Relationship Length	8.04	0.30	6.00	0.25
A.r.l	0.25	0.02	0.17	0.02
Actual:				
Delivered Effort	4.29	0.21	3.20	0.18
Suprise	1.02	0.19	0.36	0.15
Buyer Profit	17.65	1.31	15.72	1.39
Seller Profit	16.08	0.81	9.06	0.80
Worker/Total Surplus	-0.06	0.04	-0.20	0.06
Renewed Immediately	-0.61	0.03	-0.58	0.03

Table 9: Difference between private and public contracts are diminished in downturn.

	1.Firm: Pre-downturn		2. Worker: Interim		3. Firm: Post-downturn	
	Mean	S.E	Mean	S.E	Mean	S.E
Wage	41.81	2.20	33.84	1.51	41.00	1.99
Desired Effort	7.90	0.33	7.83	0.23	8.20	0.29
Offered Surplus	0.39	0.02	0.29	0.02	0.35	0.02
Fraction Private	0.80	0.05	0.67	0.04	0.78	0.05
Relationship Length	5.71	0.66	2.88	0.23	5.87	0.70
Delivered Effort	7.03	0.37	5.90	0.28	7.09	0.36
ExpectedEffort	7.16	0.35	6.23	0.24	7.41	0.31
Suprise	-0.13	0.17	-0.33	0.18	-0.32	0.16
Buyer Profit	28.47	2.25	25.14	1.84	29.87	2.29
Seller Profit	30.76	1.56	25.35	1.11	29.94	1.44
Actual Surplus	0.64	0.09	0.68	0.08	0.60	0.07
Renewed Immediately	0.61	0.06	0.46	0.05	0.57	0.06
	N=79		N=118		N=70	

Table 10: Contracts before, during, and after downturns.

7 Appendix: Proofs

Proposition 2.1

Proof: Selfish workers will always provide $e = 1$ in the one period game. Fair worker will shirk if a contract is unfair, hence firms are restricted to making fair offers $\hat{w}(e) = 5e - c(e)/2$. Firm's expected utility for making a fair offer for effort level e is $\pi(e) = p(10e - \hat{w}(e)) - (1-p)(10 - \hat{w}(e)) = 10pe - \hat{w}(e) + 10 - 10p$. Since there is an excess supply of labor and because firms do not have any information about individual workers' fairness, there is competition among workers for firms and no competition between firms for workers.[19] This allows firms to maximize their profit. Taking a derivative of $\pi(e)$ over $\hat{w}(e)$ and substituting $c(e)$ for $\hat{w}(e)$, we find that firm's profit is maximized when $c'(e) = 20p - 10$. Since $c'(e) = 1$ for $e = 2$,$c'(e) = 2$ for $3 \leq e \leq 8$, $c'(e) = 3$ for $e > 8$, we can solve for minimum and p that support each effort level and arrive at the PBE above.

Proposition 2.2

Proof: The steps of our proof are adapted from BFF2 for multiple firms and excess supply of labor. We prove this more generally for any $\tilde{e}_T$, $\tilde{e}_t$ for all $t < T$, $w = \hat{w}(\tilde{e})$ when $p = .6$, which includes $\tilde{e}_T = 8$,$\tilde{e}_t = 10$.
Step 1 (behavior of fair workers): All fair workers will always perform the desired effort since all wages will be fair.
Step 2 (behavior of selfish workers): In final period T, since there are no unmatched firms, value of unemployment $U_T = 5$. Since $V_T = \hat{w}(\tilde{e}_T) > U_T$, it is a uniquely best strategy of the selfish worker to accept the contract of the incumbent firm and then deliver $e = 1$. In any period $t < T$, since firms renew their private offers when workers deliver requested effort, expected future utility of not shirking is:

$$V_t = \hat{w}(\tilde{e}_t) - c(\tilde{e}_t) + V_{t+1} \tag{4}$$

and since firms who experienced shirking do not offer private contracts to workers who were previously matched and after $t = 1$ public offers are $[5, 1]$, expected future utility of not shirking is:

$$U_t = 5 + U_{t+1} \tag{5}$$

Since $V_{t+1} - U_{t+1} > c(\tilde{e}_t)$ for all $\tilde{e}_t$ above, it is therefore the best strategy for $e_t = \tilde{e}_t$.
Step 3 (firm behavior): Given the discussion in Prop 2.1 firms are not under competition for workers and can maximize profits at all periods. Since $p = .6$, firms' are indifferent between contracts of $c'(e) = 2$ at period T. At period T-1, firm offers $[\hat{w}(\tilde{e}_{T-1}), \tilde{e}_{T-1}]$ that corresponds to $\tilde{e}_T$ that was previously chosen (Table 2 Row 5). For $\tilde{e}_T > 4$, $\tilde{e}_{T-1} = 10$ can be supported, and hence $\tilde{e}_t = 10$ for all $t < T$. For $\tilde{e}_T \leq 4$, T-1 offers are $\tilde{e}_{T-1} = 9$ for $\tilde{e}_T = 4$ and $\tilde{e}_{T-1} = 7$ for $\tilde{e}_T = 3$. These two period T and T-1 can then support

[19] Suppose Firm A and B make an offer to the same person, who rejects A for B. Firm B and the worker are then matched, and Firm A can make another offer to the remaining $n > 1$ workers as a monopolist. Since time is not costly, there is no loss of utility here for Firm A for losing its initial worker to Firm B.

$\tilde{e}_t = 10$ for all $t < T-1$. All firms are matched initially at $t = 1$ through identical public offers of $[59, 10]$, in equilibrium all following offers are private renewals to previous trading partner. Hence $n-2$ workers remain unemployed for all t.

Proposition 2.3

Proof: As before, let $j_t = \hat{w}(\tilde{e}_t) - c(\tilde{e}_t)$. Without downturn, job rents are equal to difference in earnings from current period and expected job rents from future periods.

$$V_t - U_t = j_t + V_{t+1} - 5 - U_{t+1} = j_t - 5 + (V_{t+1} - U_{t+1})$$

where $V_T - U_T = w_T$ for selfish types and $w_T - c(e_T)$ for fair types.
With downturn, job rents are

$$V_t^\delta - U_t^\delta = (1-\delta)(j_t + V_{t+1}^\delta) + \delta\mu(j_t + V_{t+1}^\delta) + \delta(1-\mu)(5 + j_{t+1} + V_{t+2}^\delta) - \mu(j_t + V_{t+1}^\delta) - (1-\mu)(5 + U_{t+1}^\delta)$$

Simplifying we arrive at

$$= (1-\mu)\left[(1-\delta)(j_t - 5) + (\delta - \mu)(j_{t+1} + V_{t+2}^\delta) - (1-\mu)(5 + U_{t+2}^\delta)\right]$$

$$= (1-\mu)\left[(1-\delta)(j_t - 5) - \mu(j_{t+1} - 5 + (V_{t+2}^\delta - U_{t+2}^\delta) + \delta j_{t+1} - 5 + \delta V_{t+2}^\delta - U_{t+2}^\delta\right]$$

$$= (1-\mu)\left[(1-\delta)(j_t - 5) - \mu(\delta V_{t+1} - U_{t+1})\right]$$

where $V_T^\delta - U_T^\delta = (1-\mu)(1-\delta)(V_T - U_T)$.
(i) Since $j_t > 5$ for all $e_T > 1$ and $V_{t+1} > U_{t+1}$, job rents are always positive.
(ii) Since current period job rent $j_t - 5$ is discounted by $(1-\mu)(1-\delta)$ and future period rents are also discounted, job rents are lower in the downturn.

Proposition 2.4

Proof: The strategy profile describes a very strong reconnection norm ($\mu = 1$). We prove that this reconnection norm is a Perfect Bayesian Equilibrium with the following steps:
Step 1 (behavior of fair workers): All fair workers will always perform the desired effort since all wages will be fair.
Step 2 (behavior of selfish workers): As in the baseline case, it is a unique best strategy of the selfish worker to accept the contract of the incumbent firm at T and perform $e_T = 1$. It is also best response to not shirk, since no firms make private offers to previously employed workers, driving the outside option to 5.
Step 3 (firm not hit by downturn at $t = 1$): Proof follows the baseline case. We now show that if a worker shirks, the firm's best response is to extend a private offer to never employed workers or to make a public offer of $[5, 1]$. Given out of equilibrium belief that only selfish workers shirk, when no firms are hit by a downturn, all previously employed workers are selfish. When the other firm is in downturn, his previously employed worker enters the pool of unemployed workers for one period. If the firm can identify this worker, the best strategy is to privately offer him the single period contract of $[46, 8]$, since the

worker will return to his employer after the downturn.[20] However, since firms only observe which workers are employed but do not observe pairings between workers and firms, it cannot perfectly identify this worker. Because the population has $n-1$ selfish workers and one worker with probability .6 of being fair, the firm cannot do better than to offer $[5, 1]$.

Step 4 (firm hit by downturn at $t = 1$): If the firm competes with an incumbent firm for his worker, he will earn 0 profit, which is lower than the profit of 5 from public offer of $[5, 1]$. Hence a firm unable to make offers at the first period make offers to never employed workers. Given out of equilibrium belief that only selfish workers shirk and the inability to perfectly identify workers left by downturn in Step 3, firms cannot do better than to make a public offer of $[5, 1]$.

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[20] Trying to prevent this worker from returning to his employer will result in a profit of 0 for the firms, which is lower than the profit of 5 from public offer of $[5, 1]$.