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Morale, Relationships, and Wages: An Experimental Study

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Morale, Relationships, and Wages: An Experimental Study

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ABSTRACT:

Many labor relations are characterized by the possibility of repeated interaction without long term contracts and with discretionary pay components. We implement such a structure in the lab by allowing workers and firms to interact repeatedly for many periods absent a pre-announced final period. In this setting, persistently different human resource policies emerge endogenously: we find (long-term) relationships characterized by generous surplus sharing and spot-interactions with little to no rent for the workers. Efficiency, i.e. exerted effort, is comparable across these two institutions. Hence, spot-interactions are at least as profitable for firms engaging in such relationships. In control treatments, we show that neither limited firm commitment nor structural unemployment alone is sufficient to generate these patterns. Analyzing individual level data, we document that firm and worker behavior are individually rational and that individual histories play a significant role in explaining the observed behavior

Keywords: relational contracts, laboratory experiment, labor market segmentation

JEL Codes: C91, D21, M50

1) INTRODUCTION

Many labor relations are characterized by discretionary pay components and the possibility of repeated interaction without long term contracts, i.e. by relational contracts (see Bull (1987), MacLeod and Malcomson (1989), Baker et al. (1994), or Levin (2003)). Much of the literature on relational contracts has focused on partial equilibrium settings, i.e., one firm and one/many workers. In contrast, in this paper we investigate, experimentally, how this specific institutional setting affects market level outcomes. While there is some theory, see for example, MacLeod and Malcomson (1998), Board and Meyer-ter-Vehn (2014), we are not aware of any systematic empirical investigation of the topic. Whereas it is hard to test for the effects of different contractual agreements in field data, lab experiments lend themselves to this question as they allow us to observe not only market-level data but also the patterns of individual relationships.

We implemented the institutional relational contract structure in the lab by allowing workers and firms to interact repeatedly in a market for many periods absent a pre-announced final period. In our main Incomplete Contract (IC) treatment, workers, who are identical (with respect to their productivity), identifiable, and in excess supply, choose effort that is costly (to them) and productive (to the firm). In each stage-game, firms make private and public offers to the workers. However, part of the final wage payment is made up by a discretionary bonus, i.e., firms cannot commit to fully pay the wage they promised their workers once they observe the worker's effort choice. We interpret this discretionary bonus more general as firm promises – e.g., relating to work conditions or perks – being not enforceable and can be reneged on.¹

In the implemented setting, persistent labor market segmentation emerges endogenously. We document on the one hand long-term relationships characterized by generous surplus sharing between workers and firms and on the other hand spot-interactions and short-term relationships entailing very little surplus allocated to workers. While exerted effort, and hence efficiency, are more stable and higher (though not by much) in long-term relationships, this does not compensate for the substantially higher wage bill. Therefore, firms earn on average higher profits in spot-interactions and short-term relationships.

The paramount importance of implicit relationships and agreements as fostering efficiency via long-term relationships has been stressed by the recent experimental literature (see for example, Brown et al., 2004, Brown et al., 2012, Bartling et al., 2012, Linardi and Camerer, 2012, or Altmann et al., 2014) and by the management literature, see for example, Helper and Henderson (2014) who explain

¹ Examples closer to home for academics would be promises on the teaching (schedules, contents and loads), discretionary resources, or office allocation, which are significant parts of the negotiated academic contracts in Europe and sometimes in the US.

the vastly superior performance of Toyota over GM by the latter's superior management of worker and supplier relationships. Nevertheless, there seem to be successful companies that take a different path: Two prominent and hugely successful examples that were decried for indifference with regards to the employees' wellbeing were Amazon² and Walmart³. Our results demonstrate that this may be an at least as profitable strategy as in short-term relationships (or even spot interactions) when workers are abundant firms can earn high profits and thus a better treatment of workers may not be profitable.

We ran several control treatments – one allowing the firm to commit to the wage offer and one with the same number of firms and workers - to disentangle which aspects of our contractual and institutional environment are triggering the stable market segmentation result. Both the ability to commit and the absence of structural unemployment affect the outcomes in terms of surplus sharing and firm profits. We find that the mere fact that contracts are incomplete is not sufficient for the emergence of segmented labor markets with persistent and sustainable differences in human resources policies. Since it has been established in the literature (see for example, Brown et al. 2004) that complete contracts would not give rise (by themselves) to such heterogeneity (even with structural unemployment), we conclude that contractual incompleteness may be a necessary condition, but not a sufficient one. Our second control treatment indicates that even in the absence of structural unemployment, the contractual structure we implemented in which firms cannot commit to the wages they promise, labor market segmentation and firm heterogeneity in human resource policies emerges endogenously. This leads us to the conclusion that (structural) unemployment (by itself) is neither sufficient nor necessary for the emergence of persistently heterogeneous human resource policies. However, we do find that (structural) unemployment seems to lead to significantly higher profits for firms engaged in either spot market interactions or in short-term relationships.

Finally, we analyze the individual level data to explain these aggregate results and to shed light on the black-box of relationships. In doing so, we have two goals: First, to explain why workers, in our main treatment, chose at least as high effort levels as absent structural unemployment given that

² A recent article in the New York Times describes human resource policies in Amazon in which the company ensures through constant monitoring and the threat of dismissal high effort levels on the part of its workers – even transitory health shocks are being punished. Unlike other companies, Amazon seems to have no policies aimed at retaining workers (see, NYT Aug. 15, 2015).

³ Walmart has been continuously sued and found to violate employees' rights. While most of cases have been settled out of the courtroom, the settled lawsuits suggest that Walmart denied workers rest and meal breaks, overtime pay, and even paid less than the minimum wage (see, NY Times, Dec. 23, 2008, The Huffington Post Feb. 5, 2012, LA Times May 14, 2014). The interested reader can find a list of cases filed against Walmart at <http://www.wal-martlitigation.com/>.

they, according to the aggregate data, seem not to profit from doing so. Second, to explain why firms entered long-term relationships even though these entailed on average lower profits.

Starting with firms' behavior we see that what seems puzzling on the aggregate level makes much sense at the individual-firm level: in relationships, effort and profits are significantly and substantially less variable. Moreover, specifically those firms that had unprofitable matches in spot-interactions entered into relationships. These firms in fact individually did better in relationships than they did before. Similarly, workers' behavior is individually rational. Shirking is associated with lower earnings. Moreover, shirking reduces dramatically the likelihood of entering and, in particular, of maintaining long-term relationships (that entail lucrative surplus sharing).

We interpret the finding that workers comply with effort requests even though their earnings are relatively low to be consistent with a "lure of relationships" that induces workers in spot-interactions (and short relationships) to invest high effort and make these relationships profitable for the firm. Indeed, in a third control treatment in which we do not allow relationship to emerge, we find significantly lower effort levels and the likelihood of shirking by the workers is higher. Note that this argument is complementary to the classic efficiency wage argument that threat of firing (termination of the relationship) and an unattractive outside option (unemployment or inefficient spot market employment) serves to motivate employed workers (see for example, Shapiro and Stiglitz, 1984). A prominent historic example of a firm using exactly such a lure of relationships is the often described case of the German steel behemoth Krupp in the 19th century. A large chunk of the workforce was made up by workers on only very short-term contracts. Though they often worked for a long period of time for Krupp, they were by far not treated as well as Krupp's long-term workforce, proudly calling themselves the "Kruppianer". These had access to social insurance, were provided subsidized housing, and were granted job security. The short-term part of the workforce was strongly motivated to perform by the aspiration to be one day granted access to the group of Krupp's long-term workforce.⁴

The first main contribution of our paper is to document what contracts and outcomes emerge when the institution of relational contracts is part of a market. In a recent theoretical paper Board and Meyer-ter-Vehn (2014) study a large, anonymous labor market in which firms motivate their workers via relational contracts. Their results mirror our experimentally established patterns as they theoretically show that persistent and divergent human resource policies can emerge also absent structural unemployment. The mechanism in their model that causes this heterogeneity is on-the-job

⁴ Source: <http://www.zeit.de/2011/47/Firma-Krupp/komplettansicht>; Last Accessed: Nov 12, 2014

search, which is also present in our institutional structure as firms are allowed to make offers to all workers regardless of their employment status.⁵

As substantial part of the experimental literature studying repeated employment relationships in the laboratory follows Brown et al. (2004). In that paper, 8 firms and 6 workers interact for 15 (???) periods. Effort is not enforceable and firms can make private and public offers. And, dependent on the treatment, workers have fixed IDs, i.e. reputation can be built up and relationships can be formed. They find that, with fixed IDs, long-term relationships between trading parties emerge endogenously and the vast majority of trades are initiated with private offers and the parties share the gains from trade equally. Low effort or bad quality is penalized by termination of the relationship.

Our experimental setting shares the most similarities with the T-bonus treatment in Falk et al. (2015) that looks at an experimental labor market a la Brown et al. (2004) in which firms interact repeatedly and commit to a wage before observing workers' effort. In Falk et al. (2015), the authors introduce "job security" and the possibility to pay discretionary bonuses in addition to committing to a discretionary wage. In comparison to the treatment in which firms had only the option to commit to a discretionary wage, the authors document (similar to our finding) that bonus pay causes firms to rely less on long-term relationships and to rely less on past performance in their decision to form relationships. Moreover, they also find (as we do) that effort appears to be higher in spot interactions in this treatment. As the focus of that paper is the "job security" aspect of the contracts, the authors do not investigate other aspects of the bonus pay treatment. Moreover, they do not report what fraction and what kind of interactions actually used the bonus option (as opposed to the wage commitment) and how large is the bonus component in the final wage. Therefore, it is difficult to give a more detailed comparison between the papers.

The second main contribution of our paper is to the literature on the endogenous emergence of labor market segmentation and the existence of multiple sustainable human resource management strategies. "Classic" explanations for the emergence of market segmentation due to contract enforcement problems posited an exogenous difference of monitoring technologies across segments; see, e.g., Bulow and Summers (1986). Endogenous segmentation has been modelled to arise due to differences in setup and adjustment costs; see, e.g., Saint-Paul (1996). We document how labor market segmentation emerges endogenously although firms have access to homogeneous technologies and how contractual incompleteness can also affect aggregate-level market outcomes.

⁵ Note that previous experimental literature suggests that on-the-job search by itself is not sufficient to generate persistent diversity in human resources policies. A robust finding across various studies appears to be that in markets in which contracts are incomplete and firms can commit to workers' wages, relationships are the only form of sustainable interactions (see Brown et al. (2004, 212) or Bartling et al. (2012)).

More importantly, we document that while dual labor markets can emerge when contracts are incomplete, when there is structural unemployment, and when workers are allowed to conduct on-the-job-search, none of these conditions are sufficient in isolation.

Our study is not the first to document labor market segmentation. Both Altmann et al. (2014) and Bartling et al. (2012) show such segmentation, both papers rely on the Brown et al. (2004) paradigm in which firms commit to wages before seeing the workers' effort choice. In both papers, the authors add constraints on the technology and information. Altmann et al. (2014) allow the firms to employ more than a single worker, focusing on the case of diminishing returns to scale technologies. In Bartling et al. (2012), the authors allow the firms to restrict the effort levels the workers can choose at a cost to efficiency and allow firms to observe the workers' past effort choices. Our results show that labor market segmentation can emerge endogenously in a world in which firms cannot fully commit to bonus payments even without special constraints on technology or access to information.

Our results also suggest that histories matter. In particular, in our main treatment we find that firms rationally may choose to engage in the less profitable strategy of entering a long term relationship given what they can observe from their own history, e.g., by updating their beliefs regarding the fraction of trustworthy workers in the population). This is in line with the recent theoretical literature that emphasizes the role of history dependence of relational contracts (see, e.g. Chassang (2010), Li and Matouschek (2013), or Halac (2014)).

2. Experimental Settings

We utilize established experimental procedures and build on Brown et al. (2004) with the exemption that we allow firms to make non-binding wage offers, i.e. pay discretionary bonuses after they observe effort choices. In doing so, we follow the theoretically established set up of classic relational contracts models; see, e.g., MacLeod and Malcolmson (1989) or Baker et al. (1994). As we aim to strip the situation from any complications (such as individual differences in ability), we implement a lab experiment with chosen effort, i.e., effort is a number chosen with consequences for payment of the firms and the workers:

The firms' payoff is given by: $10 \times \text{effort} - \text{wage}$. The worker earnings by: $\text{wage} - C(e)$, where $C(e)$ is given in Figure 1 and follows the parametrization in Brown et al. (2004). Note that given this parameterization, full effort is socially efficient. The exchange rate from Experimental Points (EP) into EUR was given by $1\text{EP} = 0.05 \text{ EURO}$.

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

Figure 1: Cost of Effort

As implied by the payoff functions, all workers are identically productive. We abstract from any uncertainty regarding why the firm broke its promise and did not pay.⁶ This implies that our workers are fully aware that when the firm did not pay their promised bonus it did so after observing their actual effort level and without any constraints. Hence, receiving a lower than promised wage immediately implies having been taken advantage of by the employer. This gives the workers the highest incentives to punish in case it decides to renege.

Our main treatment included experimental labor markets in which 6 firms and 8 workers with fixed and observable identification numbers interact for “at least 20 periods” (in reality it was 23).⁷ In the stage-game, the firms can make private and/or public offers where an offer consists of a non-binding wage and a suggested effort level. If the worker accepted an offer, she decides on the (costly) effort level to supply. The firm then observes the effort level and decides on the wage it will pay. The firm can choose any wage as long as it pays at least the gross outside option that we exogenously set to 5. Note that workers could still make losses if they choose substantial effort, incurred corresponding effort costs but then were paid the minimum wage. In contrast, firms can ensure strictly positive earnings by adjusting ex-post wage payments downwards after observing actual effort choices. The instructions are in Appendix A. We ran 6 markets of this main treatment, which we refer to as [IC] for Incomplete Contracts.

To isolate the mechanisms we implemented 3 additional versions of the main treatment:

In the Implicit Contracts with Firm Commitment [ICFC] treatment we deviated from the main treatment only by enabling the firms to commit to binding wage offers, i.e. the firm could no longer renege on the initial wage after observing actual effort. We ran 4 markets of the ICFC treatment.

In the Implicit Contracts No Structural Unemployment [ICNSU] treatment we kept every facet of the above described main treatment, but as we have 6 firms and 6 workers, there is no structural unemployment in this treatment. We ran 5 markets of the ICNSU treatment.

In the Implicit Contracts No Relationships [ICNR] treatment we excluded the possibility of relationships by having no identification numbers and allowing firms to post public offers only. All other aspects of the treatment were the same as in the main IC treatment. We ran 4 markets of the ICNR treatment.

All experiments were run in Konstanz during the summer and fall of 2011. Each session lasted about 90 minutes, in total ??? subjects participated and were paid on average ??€.

⁶ Moreover, this follows the conventions in the literature that other than in recent theoretical work - e.g., Li and Matouschek (2013) or Engmaier and Segal (2012) – abstracts from any uncertainty regarding whether or why the firm did not pay.

⁷ We chose this procedure to mimick the theoretical relational contracting framework with infinite horizon.

3. Results

3.1 Labor Market Segmentation with Wage Dispersion

Throughout the experiment a large fraction of the interactions were spot-interactions, where spot-interactions are either isolated employment events or in case they were repeated events the firm showed no intent to engage in repeated interactions with the worker (i.e., it did not make repeated private offers to the worker that were accepted).⁸ Specifically, in all periods at least 30% of the interactions were spot-interactions such that spot-interactions comprised 45% of the interactions overall and 39.2% of the interactions after period 10. Thus, firms in our experiment engaged in two types of interactions: spot-interactions and relationships. These two types of interactions are different as far as workers' outcomes are concerned. In what follows, we examine the main outcomes of interest regarding firm and worker behaviors for each of these interaction types. Specifically, we examine worker earnings, firms' renegeing on promises, effort provision, worker shirking, and firm profits. The time series depiction of these outcomes in the experiment by interaction type is presented in Figure 1. Table 1 presents the corresponding regression results. These regressions serve as parametric tests that allow us to investigate whether relationships and spot-interaction regimes are comparable, taking into account that observations are not independent (we cluster at the firm level) and that there may be common time dependencies (to capture this we add period fixed effects to all the regressions). The coefficient of interest is the dummy "Spot" that equals one if worker and firm are not in a relationship. This dummy, represents the difference in the outcome of interest between the two regimes after we take into account common time trends.

Panel A of Figure 1 displays worker earnings (i.e., the earnings of participants who were hired by a firm) throughout the experiment. Panel A clearly demonstrates that firms that engaged in relationships offered higher earnings to their workers than their counterparts who were engaged in spot-interactions. Thus, on average workers' earnings in relationships were 28.4, while earnings of workers in spot-interactions were 18.3, i.e., more than a third below. Parametric and non-parametric tests confirm that these differences are significant; a Mann-Whitney test for the equality of the distributions yields a p-value below 0.001. Column 1 of Table 1 confirms that indeed workers hired by

⁸ We define a firm and a worker to be in a relationship of length N if in the first period of the relationship the worker accepted an offer from the firm and from the second period until the final period of the relationship (i.e., period N) the worker accepted a **private** offer made by the firm. This definition makes sure that the firm intended to engage in repeated interactions with the worker (who also agreed to this). It also ensures that the relationship length encompasses all the periods of consecutive interaction. Spot-interactions are employment events that are not part of a relationship and hence not covered by the definition above. Formally, we define spot-interaction as employment instances that were not immediately followed by another employment contract between the same parties initiated by a private offer and in case they were initiated by a private offer were also not immediately preceded by an employment contract initiated by a private offer between the same parties.

firms that engage in spot-interactions earn significantly less (10.87) than their counterparts that were hired by a firm engaged in relationships.

The different treatment of workers can also be observed by the surplus sharing behavior of firms. We divide all interactions in which effort was higher than 1 into three categories: high surplus sharing (which includes mainly equal surplus sharing), medium surplus sharing, and low surplus sharing (for which effort 10 entitled the workers to earnings of 22 and below).⁹ Panel B of Figure 1 suggests that firms offering relationships and those offering spot-interactions systematically vary in their treatment of their workers. Firms offering spot-interactions not only reduce their equal surplus sharing with their workers to practically nil after period 10, they also increase the fraction of low surplus sharing behavior to 71.6% of the interactions after period 10. In contrast, the modal sharing category for firms offering relationships is the medium surplus sharing (40.5% of interactions) with a large fraction of high sharing behavior (26.9% of the interactions).

Panel C of Figure 1 examines promise breaking behavior by firms, i.e. whether firms reneged ex-post on their initially promised wages. Here we restrict attention to interactions in which the workers did not shirk, because only in these interactions not paying the promised wage is a clear indication of promise breaking. We find that firms engaging in spot-interactions are more likely to break their promises, in particular after period 10, in which 20.6% of spot-interactions in which the worker complied with the firm's request featured promise breaking. Column 2 of Table 1 reports the corresponding regression results. We find that, when workers did not shirk, firms in spot-interactions are 10% more likely to renege on their promises than firms in relationships.

Panel D of Figure 1, documents that workers in relationships are more motivated: on average, the effort provided by workers in relationships is 9.7 and by workers in spot-interactions is 8.4. This difference in effort provision is significant as is indicated by a Mann-Whitney test that yields a p-value below 0.001 and by Column 3 of Table 1.¹⁰ Consistent with these results, column 4 of Table 1 documents that workers in spot-interactions are less likely to choose the maximum level of effort (i.e., effort = 10). Moreover, they are 24.2% more likely to shirk, i.e., to provide their firm with lower effort than it requested. In accordance with the high levels of effort we find in spot-interactions, we

⁹ We started to build this categories with the high surplus sharing category which was defined for firms in relationships and included firms that at least equally shared the surplus with their workers in at least 75% of the relationships' periods. Thus, the division is based on the data and not on theory. Firms in spot-interactions that shared with their workers at a level at least as high as the lowest of the "high surplus sharing" firms in relationships (which was 0.46667) were assigned to the highest surplus sharing category. The rest of the firms were divided into two groups as equal as possible, where the firms who allocate to their workers a surplus share of 0.268 (that corresponds to effort level 10 and worker earnings of 22 and firm profits of 60) and below were assigned to the lowest surplus sharing category.

¹⁰ In the table we report the result of a linear regression because we are interested in parametric tests of the means. The results reported below remain unchanged when we ran Tobit regressions instead.

find that in these interactions overall only 36.9% of workers shirked. As is clearly evident in Panel E of Figure 1, the likelihood that workers engaged in shirking (in both types of interactions) decreased over time. In particular, the fraction of workers shirking after period 10 is 7.4% in relationships and 28.4% in spot-interactions. Column 5 of Table 1 confirms these results in a regression analysis. Indeed, the likelihood that a firm in spot-interactions will experience shirking behavior by its worker is 24.2% higher than the one experienced by a firm engaged in relationships.

The results so far suggest that a human resource policy relying on spot contracts and little rent to the workers results in de-motivated workers. However, from the firm's perspective the relevant question is whether profits are negatively affected by the increase in shirking behavior and reduced motivation. Panel F of Figure 1 documents that the decrease in workers' motivation was not large enough to decrease firms' profits. Thus, firms in relationships earned on average 51.4 in the experiment and firms engaged in spot-interaction earned 51.7. Column 6 of Table 1, confirms that on average firms' earnings in relationships and in spot-interactions are very similar.

Thus, we find that the market and contractual structures we implemented, gave rise to endogenous labor market segmentation. Firm-worker interactions in the market segments varied in their human resource policies and resulting worker motivation: in one market segment workers have high earnings and are highly motivated (and in fact provide effort close to the efficient level). In the other, workers earn significantly less and are subjected to promise breaking from time to time. In consequence, in this segment, they shirk more and are less motivated on average.

3.2 What Feature of the Contractual Structure Leads to Endogenous Labor Market Segmentation?

The empirical/experimental literature on labor market segmentation (see, e.g., Altmann et al., 2014) suggests two possible reasons: contractual incompleteness and - following the literature on efficiency wages, i.e., Shapiro and Stiglitz (1984) - pressure from unemployed workers. We designed two control treatments to check whether each of these conditions is a necessary and/or sufficient condition for labor market segmentation in the relational contract environment. For both treatments we examine whether spot-interactions are prevalent, persistent, and sustainable, i.e., deliver the same profits to firms engaged in these two human resources policies. After establishing whether contractual incompleteness and structural unemployment are both necessary and sufficient for labor market segmentation, we examine whether the respective human resources policies differ on other dimensions besides the length of the interactions.

Contractual Incompleteness

In a world of complete contracts¹¹ and structural unemployment, standard reasoning suggests that the only prevailing human resource policy ascribes workers' wages that are close to the workers' outside option while still asking in return an effort level of 10. Furthermore, there is no need to engage in relationships and spot-interactions should dominate. This is broadly consistent with experimental results (see, e.g., Brown et al (2004) or the survey by Charness and Kuhn (2011)).

For markets where firms are able to commit to their wage offers before the workers invest (non-contractible) effort, there is experimental evidence (see, for example, Brown et al., 2004) that a second distinct human resource policy emerges: firms form relationships with workers and offer these workers high wages for high effort. As our design diverges on several dimension from the design in these papers - we have more workers than firms and an ambiguous end instead of an ex-ante known end date - we ran a control treatment using our specifications, the treatment Incomplete Contracts with Firm Commitment [ICFC]. For this treatment, in which firms can commit to wage promises, we find, consistent with the existing literature, that firms' profits are significantly higher when they engage in relationships. Thus, firms in relationships earn on average 40.9 while firms engaged in spot-interactions earned 22 and if anything over time the difference widens; after period 10, firms in relationships earn on average 41.5 while in spot-interactions they earn 16.7). Regression results (using the same specification employed for Column 6 of Table 1) indicate that indeed firms in spot-interactions earn significantly less: the spot-interaction dummy equals -18.8 with a standard error of 2.6.¹²

Consistent with firms making higher profits in the relationships regime, we find that overall only 26.4% of the interactions were spot-interactions, and after period 10 merely 15% were spot-interactions. This result is consistent with, e.g., Brown et al., 2004). However, it is in contrast to our main IC treatment in which 39.3% of interactions after period 10 were spot-interactions. The Mann-Whitney test rejects the equality of the distributions, yielding $p < 0.001$. Panel A of Figure 2, shows the fraction of spot-interactions in the two treatments. The figure suggests that while the two treatments start out similarly in the early periods, they diverge, in particular after period 10, and spot-interactions are clearly more prevalent in our main IC treatment in which firms cannot commit to the wage they offer to their workers. To confirm the patterns emerging in Panel A of Figure 2, we ran probit regressions in which the dependent variable was set to one if a firm and a worker were in a spot-interaction and standard errors were clustered at the firm level. Our main coefficient of interest is a dummy that equals one for observations belonging to the ICFC treatment. In regressions in which we add period dummies, we find that the likelihood of spot-interactions significantly

¹¹ It is important to note that to make contracts complete in our case, we have to allow both firms and workers to commit to the wage and effort request.

¹² Table A1 in the Appendix, reports the equivalents of the regressions reported in Table 1 for this treatment.

decreases (by 19.3% with a standard error of 8.1%) when the firm can commit to its wage promise. Next we allow for linear time trends that possibly vary between the treatments. While both treatments display a reduction in spot-interactions over time,¹³ the reduction is significantly larger for the ICFC treatment: in our main IC treatment the coefficient on its linear time trend is -0.012 (standard error of 0.004), while the coefficient on the linear time trend in the ICFC treatment is -0.026 (standard error 0.006). These two coefficient are significantly different from another with $p = 0.048$.

Thus, we find that the mere fact that contracts are incomplete is not sufficient for the emergence of segmented labor markets with persistent and sustainable differences in human resources policies. Since we know that complete contracts would not give rise (by themselves) to such heterogeneity, we conclude that contractual incompleteness may be a necessary, but not a sufficient condition.

Structural Unemployment

Next, we investigate the role of structural unemployment. Starting with Shapiro and Stiglitz (1984), efficiency-wage theory suggests that labor market slackness, i.e., an excess supply of workers as compared to jobs, leads to labor market segmentation. Note, however, that in Shapiro and Stiglitz (1984) no labor market segmentation among employed workers is predicted instead the theory predicts segmentation in terms of employment status (in a situation in which full employment is feasible). To test the effect of labor market slackness, in our contractual environment, we ran another treatment, denoted ICNSU, in which there was no structural unemployment as we set the number of workers to be equal to the number of firms, i.e., 6 each. Here, too, we find labor market segmentation. Specifically, we find that spot-interactions are prevalent throughout the experiment and that they are sustainable, i.e., firms earn the same in both market segments. Thus, we find that in ICNSU, too, firms in the two segments of the markets have the same profits: firms engaged in spot-interactions earn on average 41 and firms engaged in relationships earn 42.6. Table 2 repeats the regressions reported in Table 1 for this treatment. Column 6, in which profits of firms across the two regimes are compared, indicates that indeed these differences are insignificant: the spot-interaction dummy equals -1.2 with a standard error of 2.4.

Panel B of Figure 2, displays the likelihood of spot-interactions in the treatments in which firms cannot commit to wages, i.e., the IC and ICNSU treatments, by their labor market characteristics. There are no differences between the two treatments, and if anything spot-interactions are slightly more likely in the treatment in which there is no structural unemployment. Parametric and non-

¹³ The result for the IC treatment is not surprising, as it takes time for firms that want to engage in relationships to find workers. Moreover, as we will see in Section 3.4, it also takes time for firms to realize that they may want to enter relationships.

parametric tests confirm these results. The Mann-Whitney test for the equality of the distributions yield $p = 0.319$. Even though, both treatments display a declining trend in spot-interactions, this trend seems to have stabilized after period 10 with 39.3% and 41.3% of the interactions being spot-interactions for the structural and no-structural unemployment treatments, respectively. In a probit regression, in which the dependent variable was set to one if the interaction was a spot-interaction and standard errors were clustered at the firm level, we find no statistical differences between the treatments. Thus, there is no significant treatment effect when we use the period dummies specifications and there are no significant differences in time trends.

In a probit regression in which we allow for linear time trends that could vary between the treatments there are no differences across treatments. Thus, in our main IC treatment the coefficient on the linear time trend is -0.0131 (standard error of 0.004), while the coefficient on the linear time trend in the ICNSU treatment is -0.0129 (standard error 0.005). These two coefficients are not significantly different from each other ($p = 0.981$).¹⁴

A natural question to ask at this stage is whether we have different human resource policies in the treatment without structural unemployment, too. The answer is yes. As was the case when there was excess labor supply, workers in spot-interactions earn on average 20.8 while workers in relationships earn 35.4. Column 1 in Table 2, suggests that these differences are significant and large (the coefficient on the dummy for spot-interactions is -15.17) even after we take into account time trends and the possible interdependence of the observations. Furthermore, firms in the spot-interaction regime are more likely to renege on their promises. Thus, in 34% of the interactions in which workers provided the required effort, firms in spot-interactions reneged on their promise. In contrast, only 6.3% of firms in relationships did so. Column 2 of Table 2, indicates that these differences, too, are significant. As a result, workers in spot-interactions were less motivated (they invested on average 7.37), less likely to choose the maximum effort level (only in 39.6% of interactions), and more likely to shirk, i.e., to deliver less than the desired effort level, (in 46% of the interactions) than their counterparts engaged in relationships (who invested on average effort 9.47, invested effort 10 in 81.6% of the interactions, and shirked in only 9.3% of the interactions). These differences are significant as columns 3, 4, and 5 of Table 2 indicate.

Thus, we find that even absent structural unemployment, the contractual structure we implemented in which firms cannot commit to the wages they promise, labor market segmentation and firm heterogeneity in human resource policies emerge endogenously. These differences are persistent and sustainable because they give the corresponding firms the same profits. There is, however, a

¹⁴ If we repeat the analysis reported in the previous subsection and compare the treatment in which firms can commit to the two treatments without firm commitment, we find qualitatively and quantitatively the same results.

striking difference between the treatments with and without structural unemployment: when there is structural unemployment firms on average earn 51.5 while in the treatment without structural unemployment firms on average only earn 41.8. Meaning, structural unemployment appears to affect the *level* of profits in an expected way but does not change the *nature* of the market outcome.

3.3 Opening the Black-Box of Relationships

Heterogeneity in Outcomes of Firms in Relationships

So far we have treated all relationships in the same manner. However, there may be differences in human resources policies among firms in relationships, too. To examine these possible differences, we divide relationships into three categories by their length: short relationships of 2-10 periods in length, medium relationships of 11-19 periods in length, and very long relationships of 20-23 periods in length.¹⁵ Figure 3 depicts firm profits by its eventual relationship length. Panel A depicts results from our main IC treatment and Panel B depicts results from the treatment with no structural unemployment. The figure suggests that absent structural unemployment eventual relationship length is uncorrelated with firm profits. However, when there is structural unemployment, profits seem to *decrease* with relationship length. Moreover, it suggests that for all relationships but the very-long-term ones, firms' profits are higher when there is structural unemployment. In the next subsection we show how this behavior can be rationalized.

Figures 4 and 5 suggest that even within the group of firms engaged in relationships there are differences in human resource policies. Specifically, firms in longer relationships are more likely to share a larger fraction of the surplus with their workers (see Figure 4)¹⁶ and grant their workers higher earnings (see Figure 5).¹⁷ Both figures indicate that in the treatment without structural unemployment, firms' human resource policies were more generous in comparison to the treatment in which there was structural unemployment (compare Panel A in the figures to the respective Panel B). Within each of the treatments, Figure 6 indicates that a more generous human resource policy is associated with higher worker motivation. However, when we compare the treatment with structural unemployment (Panel A) to the one without (Panel B), we find that even though human resource

¹⁵ Of course, the length of relationships is endogenous and is being determined by the behavior of both workers and firms. However, there is no other obvious way to divide the data using an exogenous variable. We chose relationship length to contrast our results with that of the literature. Another way to divide the data is by firms' sharing behavior. These two ways of cutting the data, as we discuss below are, not surprisingly, highly related to one another. The division described in the text is based on the data and not on theory. We bundle together relationships' lengths that appear to give similar aggregate outcomes.

¹⁶ When constructing Figure 4, we excluded observations in which workers provided effort less than 2 because the firm could not allocate to its worker less than 50% of the profits in this case.

¹⁷ The drop in worker earnings in period 20 for relationships length 11-19 is coming from two firms who gave their workers, who invested effort level 10, the minimum wage (5). In the treatment with structural unemployment it was in the 17th period of the relationships and in the treatment without structural unemployment it was in the 18th period. There were three such incidents for relationships that lasted 2 periods, 2 in the treatment with structural unemployment and one in the treatment without.

policies were more generous in the latter, workers provided higher effort in the former treatment. We investigate this in the next subsection.

The different panels of Figures 3-6 also depict the respective information for spot-interactions. The data suggest that for workers and firms engaged in relationships the outcomes of interest did not change significantly over the course of the experiment. However, we document that the human resource policy of firms engaged in spot-interactions changed dramatically between the first 10 periods and the later periods. Figure 4 suggests that in both treatments firms in spot-interactions reduced the likelihood of sharing the surplus with their workers. Specifically, in the treatment with (without) structural unemployment in the first 10 periods on average workers received 29.4% (37.2%) of the surplus, in the later periods they got only 20.9% (26.7%) of the surplus (Mann-Whitney tests yield $p < 0.001$ for both treatments).¹⁸ Consistent with this, Figure 5 documents that the earnings of workers engaged in spot-interactions decreased between the early and late periods in both treatments. However, Panel A of Figure 6 suggests that effort of the workers in the main IC treatment, if anything, increased over time. As a result, we find that profits of firms engaged in spot-interaction in the IC treatment (see Panel A of Figure 3) increased and in the later periods are equal to the profits of firms engaged in short-term interactions and higher than that of firms engaged in medium- and long-term relationships. This is not the case for the treatment without structural unemployment. Thus, Panel B of Figure 6 suggests that workers' effort certainly did not increase. Consistently, Panel B of Figure 3 suggests that firm profits in the ICNSU treatment are not higher in the later periods.

Table 3 presents the respective regression results. As before, these regressions serve as parametric tests that allow us to control for common time trends and to account for dependency of the observations. We keep the division of relationship lengths to the 3 categories discussed above (i.e., short-, medium-, and long-term). To allow for differences between the early and the later phase, we added a dummy that equals one if the spot-interactions were conducted in or before period 10 for the main treatment IC and for treatment ICNSU when examining workers' earnings.¹⁹ To examine the differences between the treatments we added dummies for the different relationship lengths categories for the ICNSU treatment. Significant coefficients on these variables imply that the outcomes vary between the two treatments for that relationship length category. The omitted

¹⁸ In the treatment with structural unemployment in the first 10 periods in 11.9% of the interactions firms at least shared their surplus with their workers, this did not happen at all in the later periods (Fisher exact test yields $p < 0.01$). The differences are less dramatic (and insignificant) in the treatment without structural unemployment. There, in the first 10 periods in 19.2% of the interactions firms at least shared their surplus with their workers and in the later periods this happened in 12.6% of the interactions (Fisher exact test yields $p = 0.151$).

¹⁹ In additional specifications we confirmed that indeed there are no differences between the early and the late periods for any other relationship category and that for the ICNSU treatment there are no differences for outcomes other than workers' earnings.

category in the regressions is the spot-interactions conducted after period 10 in the main treatment (i.e., IC treatment). Table 3, also includes our last treatment in which firms could not commit to paying the promised bonus and relationships were not possible by construction, denoted ICNR. We discuss the coefficients relating to this treatment below.

Column 1 confirms that in comparison to spot-interactions in the first 10 periods and to worker earnings in relationships indeed worker earnings are the lowest in spot-interactions after period 10 in both treatments (the F test for $\beta_{\text{Spot} \times \text{ICNSU}} + \beta_{\text{Spot} (t > 10) \times \text{ICNSU}} = 0$ yields $p = 0.603$). The only other relationship length category in which worker earnings in both treatments are equal is long-term relationships (note that the indicator on that interaction term is insignificant). In a series of F-tests we confirmed that for each treatment separately worker earnings increased significantly with the relationship length category. The only exception is that worker earnings in the treatment without structural unemployment do not differ between medium and long-term relationships, as it is clear from Figure 5 and implied by Figure 4.

Columns 2-4 of Table 3 examine the effort provided by the workers. As in Table 2, we use three outcome variables: effort provided (Column 2),²⁰ the likelihood that a worker provided effort 10 (Column 3), and the likelihood that a worker shirked (Column 4).²¹ Consistent with Figure 6, we find no differences between the treatments when workers are in relationships (all the interaction coefficients are insignificant) even though worker earnings are higher in the treatment without structural unemployment. However, we do find that after period 10 workers in spot-interactions in the treatment with structural unemployment were significantly more motivated. On average they invested 1.3 more units of effort, were 17.3% more likely to invest the maximal effort level, and 9.6% less likely to shirk than their counterparts engaged in spot-interactions in the ICNSU treatment. Within each of the treatments, we find that worker motivation (regardless of how we measure it) is lowest in spot-interactions. Moreover, worker motivation does not significantly differ between the long- and medium-term relationships, but it is significantly lower in the short-term relationships.

Column 5 of Table 3 depicts firm profits and shows a picture that is consistent with these results. The coefficients on the different ICNSU treatment dummies are negative and significant (besides the one on the long-term relationships) indicating that firms in the main IC treatment earn significantly more than firms in the treatment without structural unemployment as long as they were not engaged in

²⁰ As before, this is an OLS regression. We also ran a Tobit regression and the results are qualitatively and quantitatively similar.

²¹ Since workers never shirked (in both treatments) when engaged in long-term relationships, these observations were dropped from the analysis.

long-term relationships (that were characterized by equal surplus sharing in the IC treatment).²² This is not surprising since the workers of these firms in the ICNSU treatment provided the same or even lower effort but had at least as high earnings. A series of F-tests confirm that (consistent with Panel B of Figure 3) profits did not vary with relationship length in ICNSU. This is not the case for our main treatment IC. For treatment IC, firms that engaged in short-term relationships or those that engaged in spot-interactions after period 10 had significantly higher profits than firms engaged in longer relationships. We also find that firms engaged in medium-term relationships earned significantly more than firms engaged in long-term ones. Thus, we find that the set of human resource policies implemented by firms engaged in medium- and long-term relationships are less profitable in a market with structural unemployment.

The results above suggest that in the treatment without structural unemployment, firms profits were the same regardless of the human resources policy they employed. This explains why the heterogeneity in human resources policies can persist. This is not the case, however, for the treatment with structural unemployment, i.e., our main IC treatment. In that treatment, HR policies that call for generous sharing with workers are less profitable. Moreover, when we compare the behavior of workers between the treatments it seems puzzling why workers in our main IC treatment chose at least as high levels of effort as in the ICNSU treatment given that their payment was not higher and often even lower. In the next subsection we show that both these behaviors can be rationalized.

3.4 Can the Behavior of the Participants be Rationalized?

In this section we provide evidence that our participants (both firms and workers) behaved in a manner that can be rationalized. We start by investigating the behavior of firms and then discuss the behavior of workers.

Firms' Behavior

We have seen that in our main treatment IC the aggregate results indicate that entering relationships (unless they are short-term ones) leads to, on average, lower profits for firms. However, it is possible that given individual firms' histories, relationships may seem attractive. To investigate this possibility we ask: is a firm's longest relationship at least as profitable as its previous interactions, i.e. do firms that move into relationships make the ex-post rational choice? To answer this question, we assigned for each firm its (first) longest relationship and compared the profits before and during this longest relationship. There are 27 firms that did not start their longest relationship in the first period and were engaged in any relationship. Out of those, 24 have, on average, higher earnings in their longest

²² Even in the first 10 periods firms in spot interaction in the IC treatment earned significantly more than firms in the ICNSU treatment as the p -value of the F test for $\beta_{\text{Spot} (t \leq 10) \times \text{IC}} = \beta_{\text{Spot} \times \text{ICNSU}}$ is 0.012.

relationships than in the preceding periods.²³ Firm fixed-effects regressions (in which standard errors are clustered at the firm level) are reported in columns 1 and 2 of Table 4 and confirm this result. Since the individuals may not be aware of the general time trends (of somewhat increased profits over time) we first report the results without time trends (in column 1) and then add these in column 2. Indeed, the regression results confirm that firms engaged in their longest relationship are making significantly higher profits than they made before. Thus, the coefficient “In Longest Relationship,” which is a dummy that equals 1 if the firm is in its first longest relationship, is positive, large, and highly significant in both specifications.

To investigate the issue further we calculated for each of these 27 firms the mean of its profits in the periods before its longest relationships. We find that (after controlling for whether the worker shirked and whether the firm reneged on its promises) firms who had lower earnings on average in the periods preceding their longest relationships tend to allocate higher earnings to their workers (see Column 3 of Table 4). Moreover, we find that the likelihood that a firm in its longest relationship will offer an equal surplus split to its worker is decreasing in its realized profits before its longest relationship (Column 4 of Table 4).²⁴ The simple means already tell the story: of the 18 firms whose profits before their longest relationships exceed 41 (i.e., profits of equal surplus split given the maximum effort level 10 had been chosen) only one (5.6%) had offered to split surplus with its worker. Of the 9 firms whose profits before their longest relationships were at most 41, 4 (44.4%) had offered to split surplus with their workers. These differences are significant (Fisher exact test for the equality of the distributions yields $p = 0.03$). Column 5 of Table 4 shows the respective regression results in which the decision to split surplus in each period of the firm’s first longest relationship is the dependent variable.²⁵ Thus, firms whose mean profits before their longest relationship was at most 41, were 71.2% more likely to split surplus with their workers in their first longest relationship. A second candidate explanation why firms engage in relationships is risk aversion (over effort or profits). We find that the variation in effort and in profits is lower when firms are in relationships (even short ones). Thus, the standard deviation of the provided effort for firms not in relationships is 2.58 and for firms in relationships it is 1.06 (Levine’s robust test for the equality of the variances yield $P < 0.001$). Similarly, the standard deviation of profits for firms not in relationships is 19.4 while for firms in relationships it is 12.01 (Levine’s robust test for the equality of the variances yield $P < 0.001$). If we split the group of firms in relationships we find that the standard deviation in the effort provided (profits) is decreasing in relationship length. Thus, it equals 1.35 (12.40) for short-term

²³ The three firms that did not increase their profits in relationships include a firm that from the second period engaged in relationship length 22 in which it shared profits with the worker. The other two firms longest relationships lasted for 2 and 5 periods and both engaged before in spot-interactions.

²⁴ We get similar results when we employ the probability of revenue split as the dependent variable.

²⁵ Note that all of these results are present for treatment ICNSU (i.e., same number of firms and workers), too.

relationships (i.e., 2-10 periods), 0.4 (6.90) for medium relationships (i.e., 11-19 periods) and 0.148 (0.45) for long relationships (i.e., 20-23 periods). While the standard deviations do not differ significantly for the last two groups, firms engaged in short relationships experience significantly larger variations in the effort their workers provide relative to firms engaged in longer relationships (Levine's robust test for the equality of the variances yields $P < 0.001$). This suggests that if firms behave as if they were risk averse,²⁶ they would prefer to enter relationships in order to maintain a high and constant level of effort and profits.

Another way to see that relationships are a way for firms to reduce their risk is to examine period 20, which was, given our "at least 20 periods" announcement, the first period in which the experiment could have ended. In this period all workers who were at least in the second period of a relationship complied with their firm's effort request while 28.6% of workers engaged in spot relationships or in their first period of relationships did not comply (Fisher-exact test for the equality of the distributions yield $p = 0.006$).

Of course, a last reason to engage in long-term relationship is preferences for equality. In the IC treatment there are 4 firms engaged in very long term relationships in our data (22 and 23 periods). There are another 7 firms engaged in medium turn relationships. Out of these 7, only one has shared surplus with its workers whenever it was possible. Hence, for a total of five firms out of 36, it is possible that their behavior is driven by a preference for equality.

Workers' Behavior

We have already seen (in Figure 2 and Table 3) that workers ensure the highest earnings if they manage to engage in long-term relationships and that the longer the relationships the higher those earnings are; in particular, after period 10. Moreover, we have seen that workers tend to comply with the firm's request. Therefore, we asked: has shirking adverse consequences for workers? We investigate this question in Table 5. We first examine whether shirking affects the likelihood that a firm will make the worker a private offer in the next period, i.e., will initiate a new relationship or continue an existing one. Here, we also take into account private offers that were not accepted by the worker. Thus, the dependent variable in Column 1 of Table 5 is a dummy variable that equals 1 if the firm made a private offer to the worker in the next period. Our variable of interest is a dummy ("Worker Shirked") that equals one if the worker shirked, i.e. provided less than the requested effort level. Column 1 indicates that a worker's likelihood of receiving a private offer in the next period is significantly reduced (by 38.8%) after shirking (the likelihood of receiving an offer after complying with the firm's request is 63.3%). Since it may matter whether the shirking event happened while the parties were already engaged in a relationship, we also added a dummy that equals one if the parties

²⁶ One reason (outside the realms of our experiment) that actual firms may care about effort levels is that those may translate to quality of product or services, and could have long-term effects on profitability.

were at least in the second period of their relationship and the interaction between this variable and shirking.²⁷ The results reported in Column 2 of Table 5 confirm this notion. Shirking (instead of complying) is costly even before the start of a relationship: it reduces the likelihood of a private offer from the firm in the next period by 20.4%. But, shirking while engaged in a relationship is significantly more costly and reduces the likelihood of receiving a private offer from the firm in the next period by an *additional* 31.8%. Not surprisingly, complying with the firm's requests while the parties are already engaged in a relationship increases the likelihood of a private offer in the next period by 66.2%. Thus, shirking clearly affects negatively the likelihood of entering and maintaining a relationship.

The rest of the columns in Table 5 investigate the question whether for individual workers (given their own history) shirking is a costly. To answer this question we restrict attention to the 35 workers who both complied and shirked in the course of the experiment.²⁸ Only four out of these 35 workers, experienced on average higher profits when they shirked, the rest saw on average higher profits when they complied with their firms' requests. Indeed, worker-FE regressions (clustered at the worker level) confirm this result. Columns 3 and 4 of Table 5 report the results of such regressions without and with period dummies, respectively. Thus, workers who shirked experience that their earnings in that period are reduced by 9.4 (or by 10.8 if they take time trends into account).

The Lure of Relationships

The results depicted in Table 5 suggest that indeed complying with their firm's requests is a strategy that increases worker earnings by increasing the likelihood of workers entering and maintaining relationships. Thus, we expect that the possibility of entering relationships will make workers who are not engaged in a relationship more likely to comply with their firm's requests and provide higher levels of effort. To investigate this possibility we ran a treatment in which we excluded the possibility of relationships by having no identification numbers and allowing only public offers.²⁹ We denote this treatment Incomplete Contracts No Relationships (ICNR). Figure 7 displays the average effort provided (Panel A) and the fraction of workers shirking (Panel B) per period across the IC treatments. The picture is clear; after period 10, workers in spot-interaction in our main IC treatment invest higher effort on average and are less likely to shirk than their counterparts in the ICNR treatment. Panels C and D of Figure 7 depict worker earnings and firm profits. They confirm that the higher effort invested in our main treatment IC is *not* the result of higher worker earnings and lead (not surprisingly) to higher firm profits. Thus, it is the possibility to enter relationships that motivates

²⁷ The omitted category in the regression is complying workers in either spot-interactions or in the first period of the relationships.

²⁸ Of the remaining workers, 3 always shirked and 10 always complied.

²⁹ Note, in this treatment, it is impossible for a firm to avoid interacting with a worker to whom it broke a past promise. Therefore, this may serve as a disciplining device for firms' behavior.

workers to exert high effort even in spot-interactions and to comply with their firm's effort request. To us, the most plausible explanation is that workers try to demonstrate to the firm that they are willing to exert high effort and therefore they should be hired into a relationship.

Table 3 includes also the coefficients for the ICNR treatment. There are two dummies: ICNR that equals one if the observation belongs to the ICNR treatment and ICNR ($t > 10$), which equals one if the in addition the observation occurred after period 10. The sum of these two dummies variables corresponds to the effect of the ICNR treatment after period 10. Column 1 examines worker earnings. It indicates that workers in the INCR treatment have as low earnings as the workers engaged in spot interactions in our main IC treatment. In series of F-tests we confirm that there are no significant differences between the two treatments before or after period 10. Interestingly, while workers engaged in spot interactions in both treatments experienced a reduction in their earnings after period 10 to various degrees, we confirm in a series of F-tests that their earnings after period 10 are not significantly different from one another.

Worker motivation, however, is a different story. After period 10, workers who are engaged in spot interaction in our main IC treatment are more motivated than they counterparts in the ICNR treatment. They invest significantly higher levels of effort, are more likely to invest the highest level of effort, and less likely to shirk (as is evident by the signs and p-values on the F-test for the sum of the coefficients on the ICNR variables). As a result, we find that, after period 10, firms who engage in spot interactions in our main IC treatment have significantly higher profits than their counterparts in the ICNR treatment.

The difference between the IC and ICNR treatment is that workers in the former has a chance to engage in relationships while worker in the latter cannot. Given that workers in relationships have significantly higher earnings and that complying with the firm's request is (almost) the only way to entice the firm to engage in a relationship, it makes sense for the workers in the IC treatment to exert high levels of effort. This is not the case in the ICNR treatment. Thus, the possibility of relationships (possibly combined with the unemployment pressure) lures the workers to invest more effort even though their earnings are higher.

Equilibrium Behavior – Promise Breaking and Punishment

In the contractual structure we implemented, promise breaking, i.e., renege on the ex-ante wage promise, is feasible and is happening. We have already noted that firms in spot-interactions are more likely to renege on their promises, though the aggregate data suggested that this does not hurt their profits. In this subsection we examine the individual-level data and investigate whether renege has adverse consequences for the firm's future. To this end, we calculated for each firm for each period its per-period stream of earnings starting in that period and its per-period future stream of earnings.

We have 16 firms (44.5%) in our main IC treatment that renege on their promises and 62 instances of renegeing.³⁰ Column 1 of Table 6A describes the relationships between the per-period continuation values and promise-breaking experienced by these firms. Because we are interested in knowing whether the firms themselves would observe a reduction in their future profits, we added firm fixed-effects to all the regressions reported in Table 6A. It is clear that the per-period future earnings of firms that did not keep their promises are lowered after the promise breaking. In column 2 we add a dummy that equals one if the firm reneged on its wage promise and moreover assigned a wage to its worker that caused the worker's earnings, net of effort costs, to be lower than the outside option (i.e., lower than 5).³¹ We find that only after a firm reneged on its promise while assigning its worker lower earnings than the outside option it experienced lower per-period continuation values. Thus, it seems that firms that badly misbehaved (i.e., broke their promises and assigned their workers very low earnings) may learn not to do that. However, in the contemporaneous period promise breaking (and in particular, one that assigns very low earnings to the worker) is profitable. Therefore, Columns 3 and 4 of Table 6A examine the effects of promise breaking on the per-period earnings starting with the current period. We find that overall it is profitable for the firms to break ex-ante promises (see the positive and significant coefficient in column 3). In cases where below-outside-option-earnings were assigned to the worker, the increase in contemporaneous firm profit is enough to offset the future decline in earnings (see the positive and insignificant coefficient on the interaction term in Column 4).

The results presented in Table 6A suggest that workers are either not engaged in punishment activities or are not given the chance to do so. We investigate this issue next. Out of the 59 incidents of promise breaking that occurred before period 23,³² 34 (57.6%) did not happen in the last period in which the worker and the firm ever interacted. In 7 out of these 34 events (20.6%), the workers' earnings were lower than their outside option.³³ Thus, some of the workers that were hurt by "their" firm's promise breaking behavior could have had the option to punish the misbehaving firm. Moreover, in principle, workers could have punished their firm by choosing very low effort levels (in particular, by choosing effort level 1 the worker can guarantee that the firm's profits will be 5).³⁴ It turned out that only in 15 (44.1%) out of the 34 cases in which the workers could punish the firm for

³⁰ The modal number of renegeing events per firm is 2 (6 firms did that), 3 firms broke their promises only once and one firm broke its promise 14 times.

³¹ Of the 62 renegeing events, 29 (46.8%) are events in which worker earnings were lower than the outside option.

³² 3 renegeing events occurred in period 23.

³³ Of the 25 renegeing events that occurred before period 23 and in the last period of interaction between a worker and the firm, 21 (84%) involved worker earnings below the outside option. A Fisher exact test for the equality of the distributions yields $p < 0.001$.

³⁴ As long as the worker chose effort level 4 and below she can guarantee that the firm will get less than 41, which is what it can get by sharing surplus with a worker that put the maximal effort level.

promise breaking they actually punished the firm by shirking. Moreover, only in 6 cases the workers chose effort level 1 (and in another 2 cases, they choose effort level 4). Overall, workers who decided to punish their firm and shirk in their next interaction period exerted on average effort of 4.3 and earned on average 9.13. Workers who “let it go” in the next interaction period, put on average effort 9.84 and earned on average 15.9. The results are similar if we focus on what happens after a firm assigned its worker earnings less than the outside option. The main difference is that the likelihood of workers shirking after the firm both reneged and assigned them low earnings is significantly higher (85.7% vs. 33.3%): the Fisher exact test for the equality of the distributions yields $p = 0.028$. Such workers are also significantly more likely to invest effort level 1 (57.1% vs. 7.4%): the Fisher exact test for the equality of the distributions yields $p = 0.010$. But, it is still the case that the workers that shirked earned less. Thus, consistent with the results of Table 5, punishment in this environment is costly for the worker.

Table 6B reports the regression results for the workers. Column 1 documents that after a firm reneged on its promise, the workers are more likely to shirk and significantly more so if the firm assigned earnings below their outside option. Column 2 documents that only workers with such low earnings are more likely to choose effort level 1. When it comes to worker earnings in the next interaction periods, workers who interacted again with a firm that reneged on its promises earned less than their counter parts who interacted with firms who kept their promises (see column 3). Moreover, column 4 indicates that workers who choose to punish their misbehaving firm and shirked in the following period earn significantly less than workers who did not do so. This confirms that punishment is indeed costly in our environment and could explain why it is only rarely used.³⁵ This latter finding is consistent with Anderson and Putterman (2006) and Carpenter (2007) who also document that punishment is used less when it is costly.

4. Conclusions

In our experimental labor market with excess labor supply and the possibility to pay contingent discretionary bonuses, we observe endogenous labor market segmentation with wage dispersion. While the long-term relationships are characterized by generous surplus sharing, the spot-interactions and short-term relationships entail significantly lower rents for workers. However, efficiency, i.e. exerted effort, is only marginally lower in these spot-interactions and short-term relationships. Given that either regime entails close to efficient effort, in fact spot-interactions and short-term relationships deliver higher profits for firms.

³⁵ If we add to the regression in Column 4 a dummy indicating whether as result of the conflict worker earnings were below the outside option and its interaction with whether the worker shirked in the next period, these two variables are insignificant.

We conduct several control treatments to show that two features of our experimental labor market are crucial for these results: limited firm commitment – i.e., firms may renege on their initial wage promises – and structural unemployment. The former seems necessary to create segmented labor markets, while the latter seems to deliver the profitable outcomes for firms engaging in spot- and short-term interactions.

Analyzing individual level data, we document that the persistence of both regimes and firm and worker behavior are individually rationalizable given observed patterns in the data. Outside long-term relationships, firms can renege on promises and are not punished for this as workers cannot afford to do so. Those firms that enter into relationships, which on average entail lower profits, had experienced bad outcomes in their preceding (spot or short-run) interactions and did better in (longer) relationships. Moreover, payoffs within relationships are substantially less volatile than outside of long-term relationships.

For workers outside of long-term relationships it still is optimal to deliver the requested effort levels, even though firms often renege on them. On average, the continuation value of complying with the effort request is higher than the continuation value of shirking; largely because only fulfilling the effort request entails the chance to enter into a long-term relationship with surplus sharing. This also holds for contemporaneous payoffs as firms renege less when the worker has not shirked.

Our analysis suggests a lure of relationships that induces the workers in the spot-interactions (and short relationships) to invest high effort and make these relationships profitable for the firm. Hence, the mere presence of attractive labor relationships makes spot markets more efficient; an argument that neatly complements the standard efficiency wages argument.

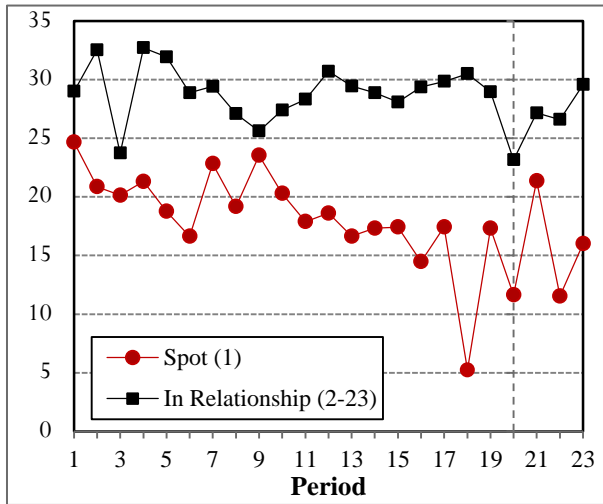
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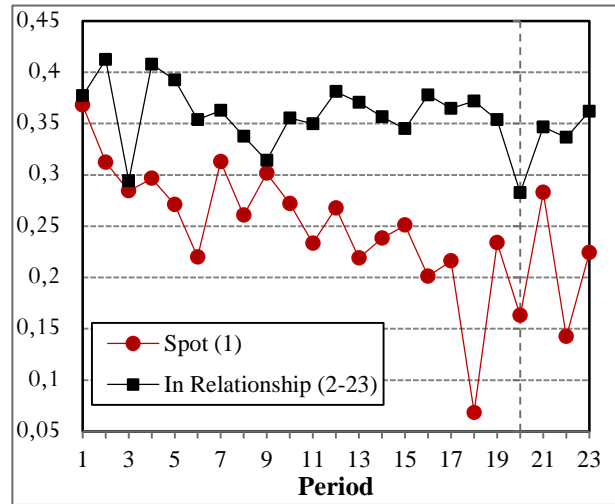
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APPENDIX A: Instructions

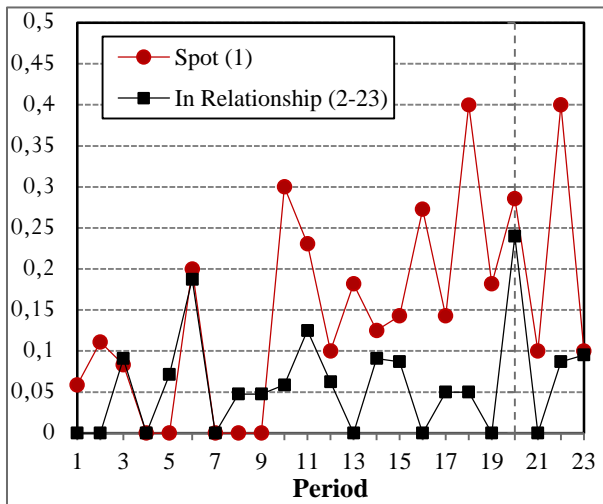
APPENDIX B: Figures & Tables



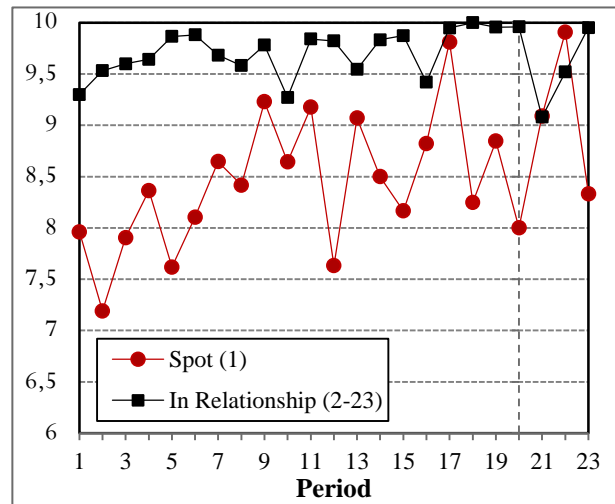
Panel A: Earnings All Workers



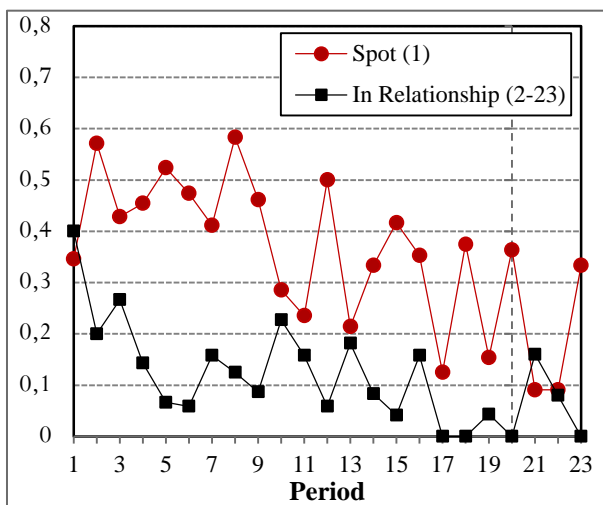
Panel B: % Surplus Workers Earned



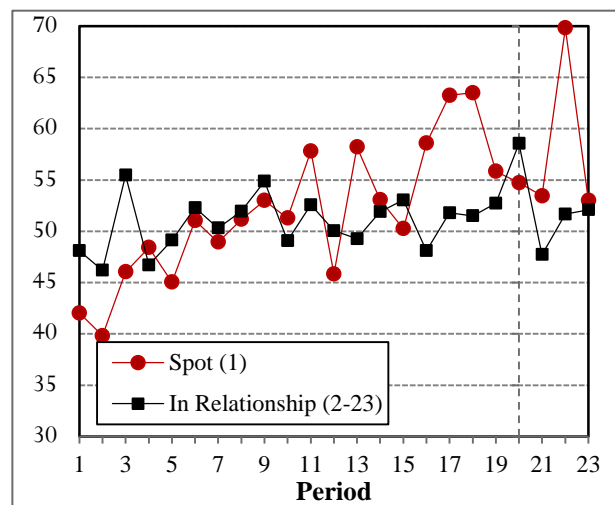
Panel C: Fraction Broken Promises



Panel D: Effort Provided



Panel E: Fraction Workers Shirking



Panel F: Firm Profits

Figure 1: Aggregate Outcomes by Period and Relationship Status

Table 1: Aggregate Outcomes by Relationship Status

Dependent Variable:	(1) Worker Earnings	(2) Probability of Firm Reneging	(3) Effort Level	(4) Probability of Effort = 10	(5) Probability a Worker Shirked	(6) Firm Profits
Spot	-10.901*** [2.434]	0.104* [0.558]	-1.194*** [0.273]	-0.254*** [0.0565]	0.244*** [0.048]	1.711 [2.001]
Period Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	828	592	828	828	828	828
R ²	0.167		0.129			0.066

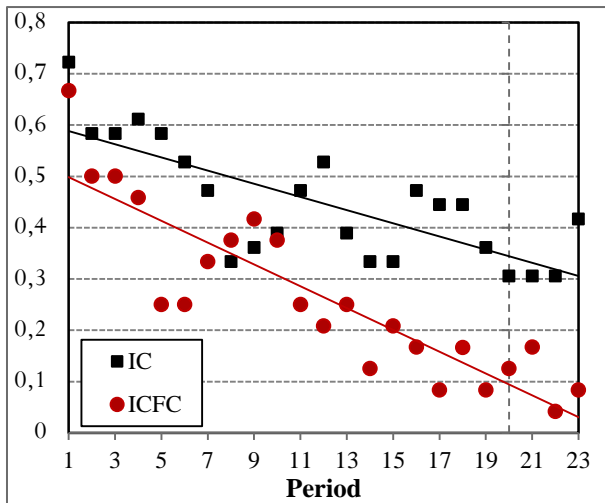
Notes: Robust standard errors clustered at the firm level in brackets. *** p<0.01, ** p<0.05, * p<0.1

In Columns 2, 4 and 5 we report the marginal effects (calculated at the sample means) after probit regressions.

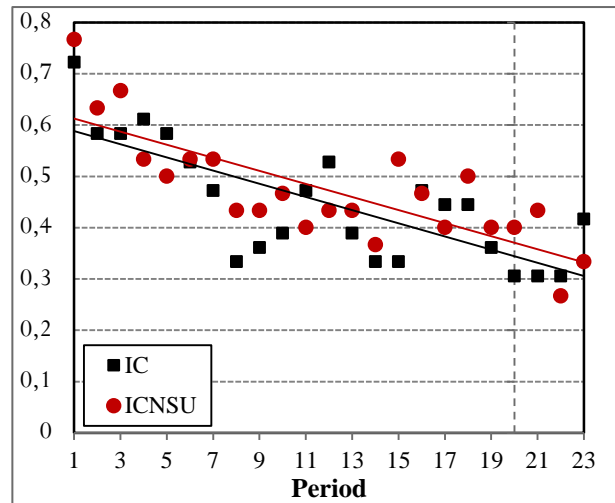
Table 2: Aggregate Outcomes by Relationship Status for the Control Treatment without Structural Unemployment [ICNSU]

Dependent Variable:	(1) Worker Earnings	(2) Probability of Firm Reneging	(3) Effort Level	(4) Probability of Effort = 10	(5) Probability a Worker Shirked	(6) Firm Profits
Spot	-15.171*** [1.926]	0.300*** [0.077]	-2.118*** [0.307]	-0.403*** [0.078]	0.360*** [0.054]	-1.238 [2.398]
Period Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	690	484	690	690	690	690
R ²	0.286		0.171			0.031

Notes: see notes to Table 1.

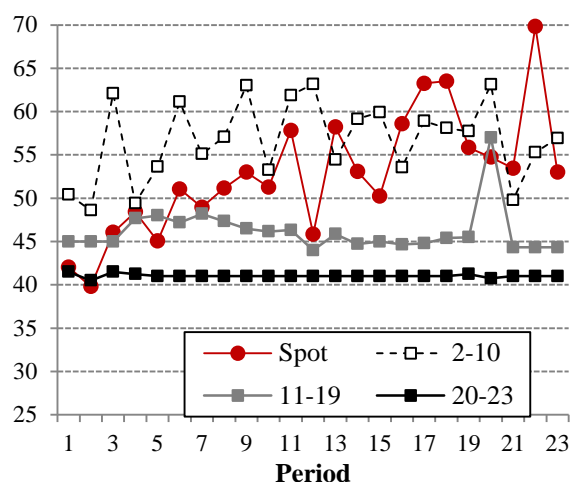


Panel A: Fraction of Spot Interactions by Firm Ability to Commit

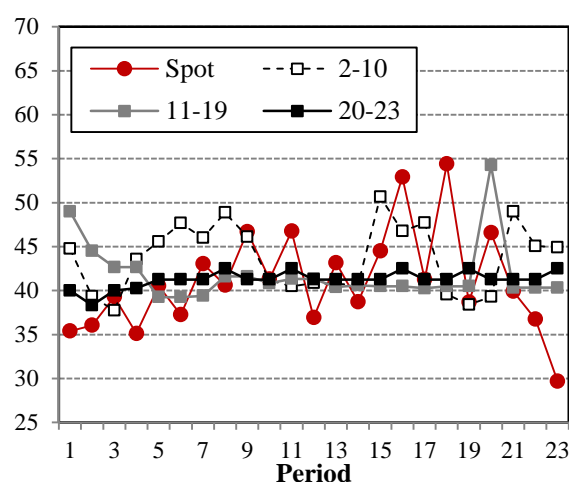


Panel B: Fraction of Spot Interactions by Structural Unemployment and No Firm Commitment

Figure 2: Fraction of Spot Interaction by Treatment and Period

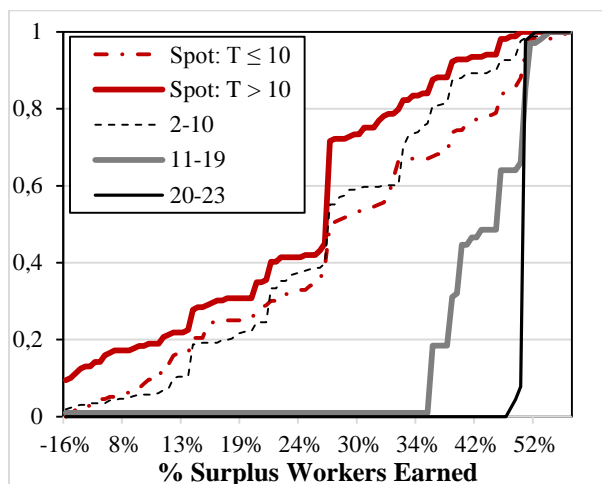


Panel A: Structural Unemployment

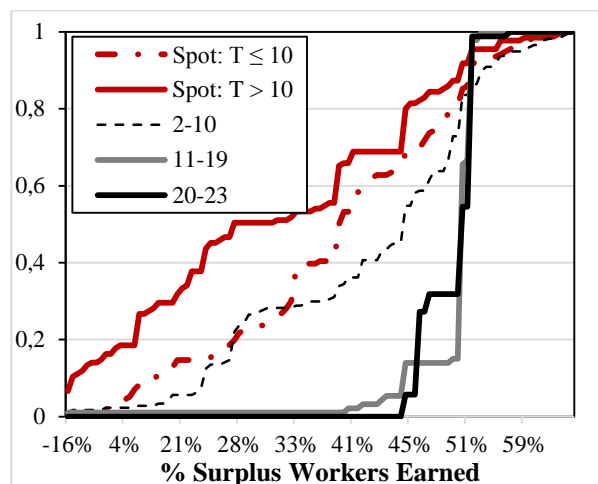


Panel B: No Structural Unemployment

Figure 3: Firm Profits by Period, Relationship Length, and Treatment

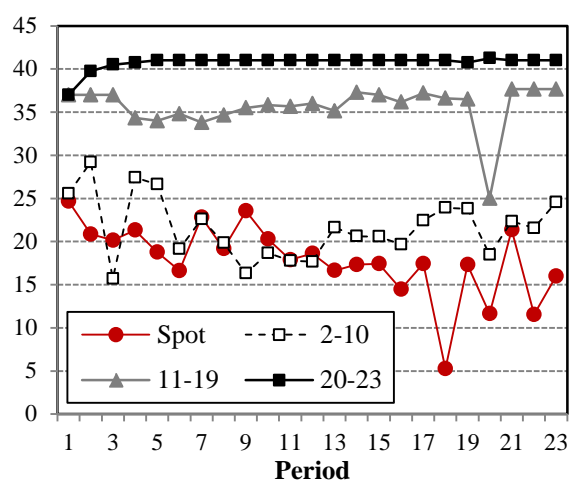


Panel A: Structural Unemployment

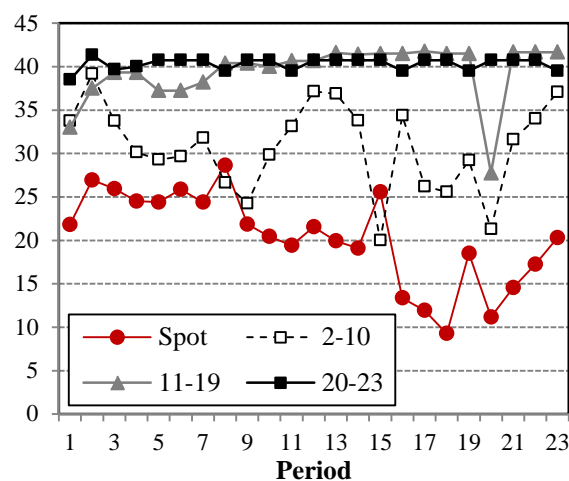


Panel B: No Structural Unemployment

Figure 4: CDF of % Surplus Workers Earned by Relationship Length and Treatment

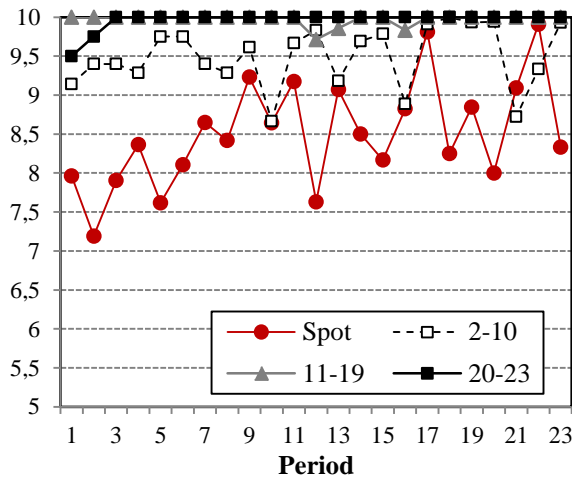


Panel A: Structural Unemployment

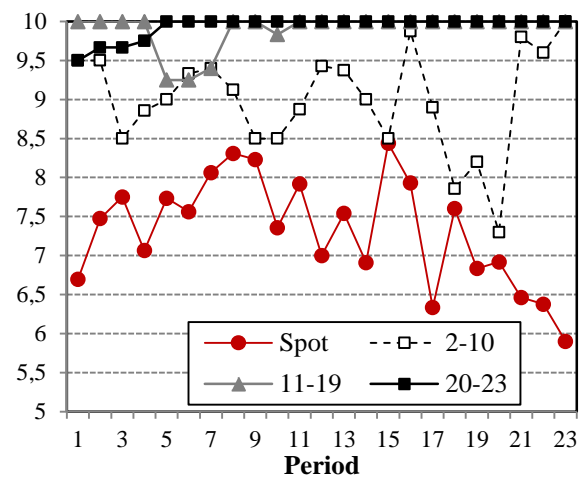


Panel B: No Structural Unemployment

Figure 5: Worker Earnings by Period, Relationship Length, and Treatment



Panel A: Structural Unemployment



Panel B: No Structural Unemployment

Figure 6: Effort Provided by Period, Relationship Length, and Treatment

Table 3: The Effects of Structural Unemployment and Relationships Formation

Dependent Variable:	(1) Worker Earnings	(2) Effort Level	(3) Effort = 10	(4) Worker Shirked	(5) Firm Profits
Spot ($t \leq 10$) \times IC	5.530*** [2.045]	-0.549 [0.357]	0.019 [0.069]	0.023 [0.063]	-7.460*** [2.420]
Spot \times ICNSU	9.152*** [2.483]	-1.321*** [0.454]	-0.173** [0.088]	0.096* [0.060]	-14.521*** [3.017]
Spot ($t > 10$) \times ICNSU	-7.491** [2.847]				
Relationship Length 2-10	6.187** [2.366]	0.782** [0.327]	0.157*** [0.057]	-0.149*** [0.046]	0.767 [2.087]
Relationship Length 11-19	20.258*** [2.793]	1.204*** [0.343]	0.382*** [0.038]	-0.338*** [0.026]	-10.269*** [2.497]
Relationship Length 20-23	25.507*** [2.020]	1.253*** [0.345]	0.404*** [0.034]		-14.990*** [1.727]
Relationship Length 2-10 \times ICNSU	9.282*** [2.332]	-0.480 [0.314]	-0.109 [0.121]	0.006 [0.073]	-13.052*** [2.775]
Relationship Length 11-19 \times ICNSU	4.243** [1.989]	-0.054 [0.088]	-0.039 [0.173]	-0.012 [0.160]	-4.535** [2.224]
Relationship Length 20-23 \times ICNSU	-0.452 [0.928]	-0.030 [0.039]	-0.145 [0.220]		0.212 [0.716]
ICNR	1.324 [3.203]	-1.278*** [0.460]	-0.159* [0.084]	0.021 [0.065]	-8.914*** [3.157]
ICNR ($t > 10$)	-2.685* [1.382]	-0.282 [0.387]	-0.138** [0.067]	0.149** [0.067]	-1.859 [2.925]
Prob > F: ($\beta_{\text{Spot} \times \text{ICNSU}} + \beta_{\text{Spot} (t > 10) \times \text{ICNSU}} = 0$)	0.603				
Prob > F: ($\beta_{\text{Spot} \times \text{ICNR}} + \beta_{\text{Spot} (t > 10) \times \text{ICNR}} = 0$)	0.636	0.001	< 0.001	< 0.001	< 0.001
Period Dummies	Yes	Yes	Yes	Yes	Yes
Observations	2,070	2,070	2,070	1,892	2,070
R-squared	0.348	0.169			0.109

Notes: Robust standard errors clustered at the firm level in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Firm Behavior – Entering Relationships

Dependent Variable:	(1) Profit Firms	(2) Profit Firms	(3) Worker Earnings	(4) Probability of Equal Surplus Split	(5) Probability of Equal Surplus Split
In Longest Relationship	8.363** *	7.063** *			
	[1.652]	[1.993]			
Mean Profits Before Longest Relationship			-0.450*** [0.158]	-0.040** [0.016]	
Mean Profits Before Longest Relationship Is At Most 41. Worker Shirked					0.712*** [0.170]
Firm Reneged on Promises			-13.425*** [4.278]		
			-18.626*** [3.020]		
Long-Term Relationships			14.549*** [3.715]	0.929*** [0.048]	0.905*** [0.061]
Period Dummies	No	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	No	No
Observations	461	461	237	217	217
R-squared	0.313	0.358	0.608		

Notes: Robust standard errors clustered at the firm level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

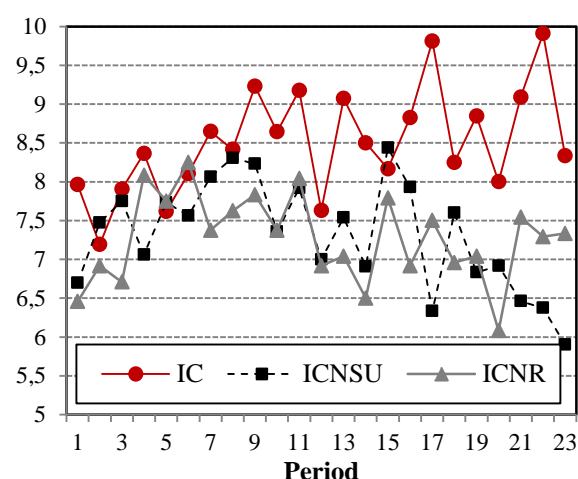
In columns 3-5, the sample is restricted to include firms in their first longest relationships. The sample is extended to include also firms before their first longest relationships (provided that those started after the first period) in columns 1 and 2. Since firm renegeing or worker shirking always led to firms not sharing surplus with their workers, such observations were excluded from the sample in columns 4 and 5.

Table 5: Worker Behavior - Shirking

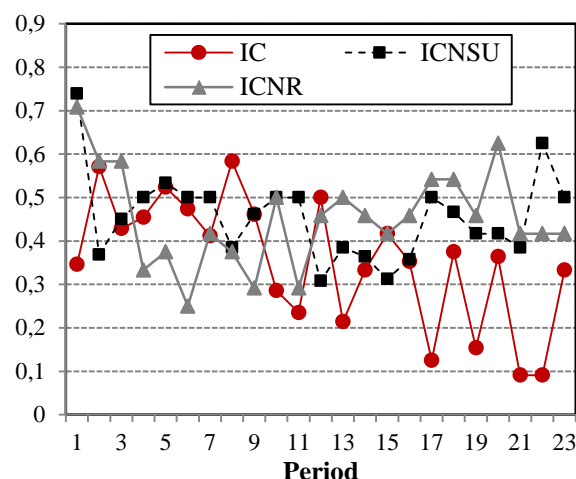
Dependent Variable:	(1) Private Offer was Made in the Next Period	(2) Private Offer was Made in the Next Period	(3) Worker Earnings	(4) Worker Earnings
Worker Shirked	-0.388*** [0.066]	-0.204*** [0.075]	-9.377*** [1.416]	10.783*** [1.464]
At Least in Second Period of Relationships		0.662*** [0.057]		
Worker Shirked × At Least in Second Period of Relationships		-0.318*** [0.105]		
Period Dummies	Yes	Yes	No	Yes
Worker FE	No	No	Yes	Yes
Clusters	Firm	Firm	Worker	Worker
Observations	791	791	598	598
R-squared			0.378	0.430

Notes: Robust standard errors clustered at the firm/worker level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

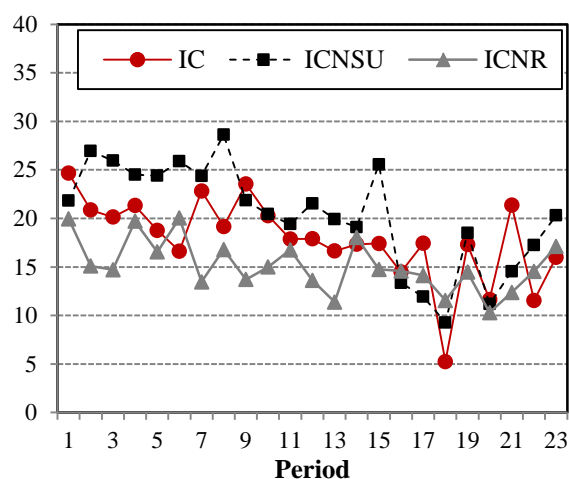
In columns 3 - 4, the sample is restricted to include workers who both complied and shirked throughout the experiment.



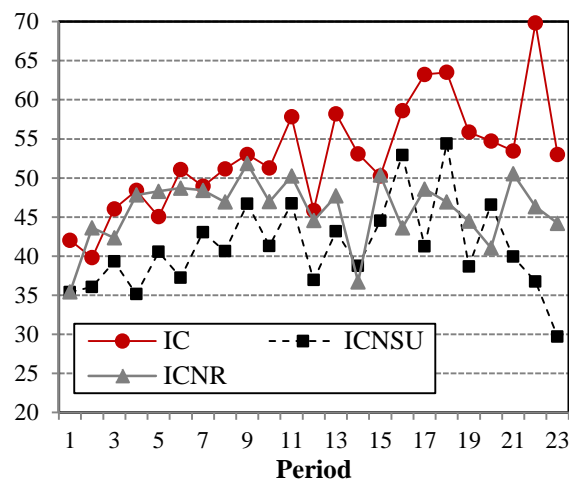
Panel A: Effort



Panel B: Fraction of Workers Shirking



Panel C: Worker Earnings



Panel D: Firm Profits

Figure 7: Effort Provision, Earnings, and Profits in Spot Interaction across Treatments

Table 6A: Firm Behavior – Promise Breaking

Dependent Variable:	(1)	(2)	(3)	(4)
	Continuation Value Per Period		Contemporaneous and Future Firm Profits Per Period	
Firm Reneged on Promises	-4.018** [1.565]	-0.245 [1.175]	3.842*** [1.107]	3.153** [1.378]
Firm Reneged on Promises × Firm Assigned Worker Earnings Less than 5EU		-7.407** [3.181]		1.345 [2.243]
Period Dummies	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	352	352	368	368
R-squared	0.645	0.669	0.644	0.644

Notes: Robust standard errors clustered at the firm level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 6B: Worker Behavior after Promise Breaking

Dependent Variable	(1)	(2)	(3)	(4)
	Worker Shirked	In the Next Interaction Period Worker Put Effort level 1	Worker Earnings	
Firm Reneged on Promises	0.225** [0.094]	0.080 [0.067]	-13.523*** [2.466]	-11.175*** [2.944]
Firm Reneged on Promises × Firm Assigned Worker Earnings Less than 5EU	0.618*** [0.181]	0.459* [0.279]	-2.311 [4.741]	
Firm Reneged on Promises × Worker Shirked Next Interaction				-6.383* [3.386]
Period Dummies	Yes	Yes	Yes	Yes
Observations	602	485	655	655
R-squared			0.073	0.075

Notes: Robust standard errors clustered at the worker level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Columns 1 and 2 report the marginal effects after probit regressions at the sample means. The lower number of observations is a result of not observing worker shirking or effort level 1 in several of the periods. The results without period dummies or the linear regression results are quantitatively and qualitatively similar.

APPENDIX C: Supplementary Material

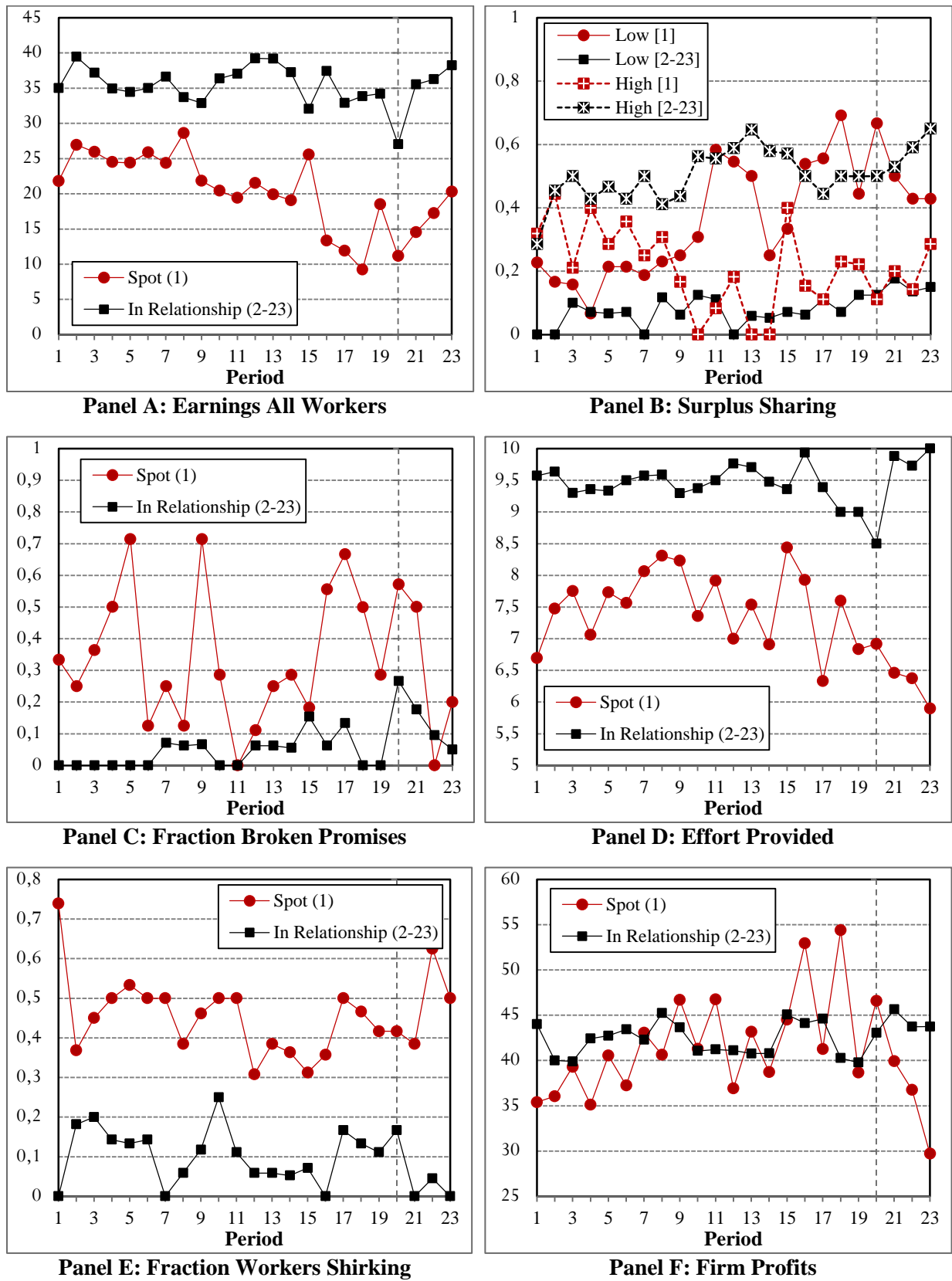
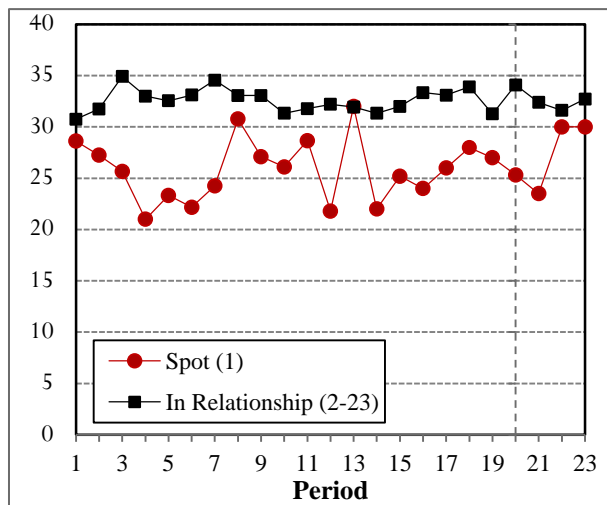
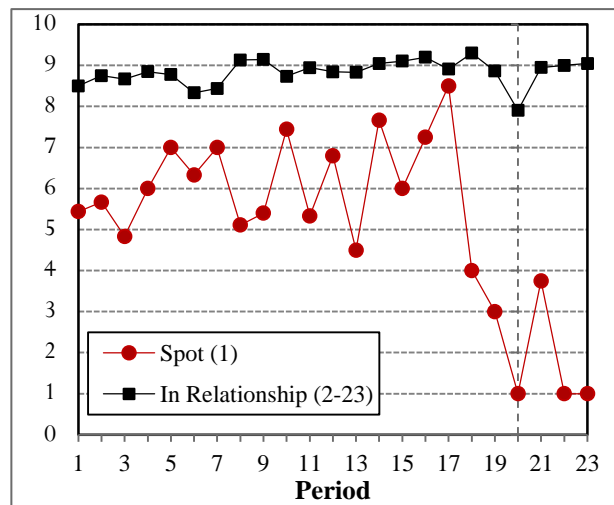


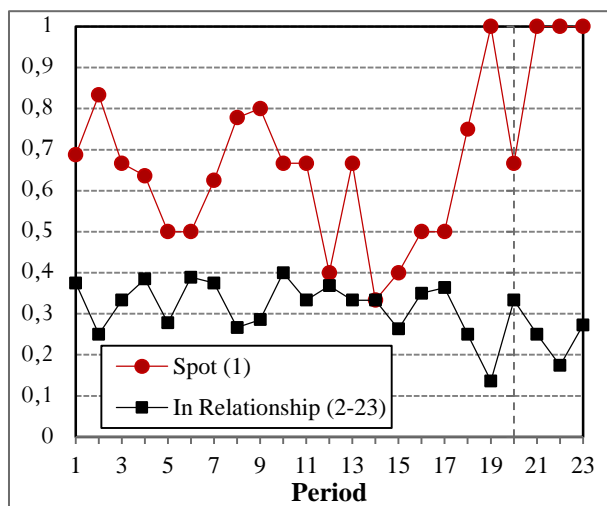
Figure C-1: No Structural Unemployment Treatment: Aggregate Outcomes by Period and Relationship Status



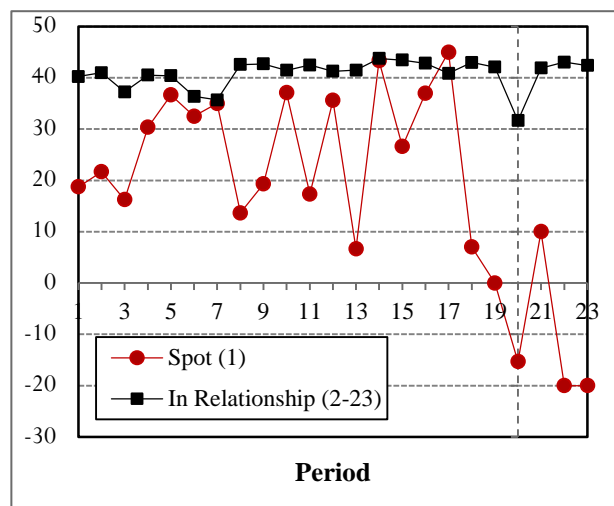
Panel A: Earnings All Workers



Panel B: Effort Provided



Panel C: Fraction Workers Shirking



Panel D: Firm Profits

Figure C-2: IC with Firm Commitment: Aggregate Outcomes by Period and Relationship Status

Table C-1: Aggregate Outcomes by Relationship Status for the Control Treatment IC with Firm Commitment [ICFC]

	(1) Worker Earnings	Firms cannot Renegé	(3) Effort Level	(4) Probability of Effort = 10	(5) Probability a Worker Shirked	(6) Firm Profits
Spot	-6.701*** [1.941]		-3.262*** [0.377]	-0.473*** [0.098]	0.345*** [0.093]	-18.782*** [2.585]
Period Fixed-Effects	Yes		Yes	Yes	Yes	Yes
Observations	552		552	552	552	552
R ²	0.116		0.347			0.247

Notes: see notes to Table 1.