INSTITUTIONS AND CONTRACT ENFORCEMENT*

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Abstract. We conduct laboratory experiments where the market rules mimic labor market institutions, and exogenously vary institutions to study the causal impact on subjects' behaviors. We focus on rules analogous to dismissal barrier institutions, such as employment protection legislation, and on institutions allowing bonus pay. We find that when constrained to fixed wage contracts, dismissal barriers reduce efficiency, but parties react by evolving rising compensation profiles. When the option to pay bonuses is introduced this completely offsets the negative effects of dismissal barriers. In the absence of dismissal barriers, bonus pay reduces frequency of repeated interactions, but leaves market efficiency unchanged.

1. Introduction

All countries have labor market institutions that constrain the incentive options available to firms, to varying degrees. Establishing the causal impact of such institutions on market performance, and on the types of incentive strategies that may emerge, is notoriously problematic due to the likely endogeneity of institutions (Falk and Huffman (2007)). This paper reports the results from laboratory experiments

*We are grateful for helpful comments from seminar participants at IZA Bonn, the University of Zurich, Columbia University, the NBER summer institute, the Wharton School of Business, the editor, Paul Oyer and the anonymous referees.

in the spirit of the gift exchange game (see Fehr et al., 1993Fehr et al. (1993)). We modify market rules to mimic features of important labor market institutions, and manipulate these to study the causal effects on behavior.

At one extreme we consider rules for our experimental markets that mimic *dismissal barrier* institutions, which may arise in real world labor markets due to employment protection legislation (Autor et al. (2007)),[1] and we also restrict contracts to involve binding, up-front compensation (fixed wages). At the other end of the spectrum we consider markets where there are no constraints on firing, and also introduce the additional flexibility to use *bonus pay*. Bonus pay is an increasingly important feature of labor market institutions (Oyer (2004); Lemieux, MacLeod and Parent (2009)), but implications for market functioning are not fully understood.

In our experiments we randomly assigned student subjects to roles, labeled neutrally in the instructions as *buyers* or *sellers*. In terms of the payoff functions and possible actions implemented in the experiments, the former are analogous to (single proprietor) "firms" buying "effort" for "wages", and the latter to "workers" selling effort; henceforth, we use these labels to indicate the roles and actions of subjects in our experiments. Subjects who were firms could make contract offers to workers. A firm's payoffs were increasing in an "effort number" chosen by an employed worker, and decreasing in the compensation they paid the worker. For workers, payoffs were increasing with wages, but decreasing with the choice of higher effort numbers. Effort was observable to the firm but not contractable, corresponding to non-verifiability to third parties.[2] Firms and workers had the possibility to endogenously engage in repeated interactions over the course of the 18 period experimental game.

In experimental markets with the dismissal barrier institution, a firm lost the option to "fire" a worker for the rest of the game, if at any point the firm chose to re-hire the same worker beyond an initial probation period. Wages were also downwardly rigid, to prevent *de facto* firing. The second institution, bonus pay, allowed firms the flexibility to pay performance contingent bonuses at the end of each period of the game, after observing worker effort choices. Like effort, bonuses were not enforceable.

[1]Barriers can also arise due to relationship-specific investments or due to relationship-specific investments (Mincer (1962))

[2]Non-verifiability is a pervasive feature of employment relationships. See Williamson, Wachter and Harris (1975) for a classic early study.

We find that in experimental markets where contracts are constrained to involve only fixed wages, dismissal barriers reduce efficiency, although parties react to the constraints by endogenously evolving incentives based on rising wage profiles. When the option to pay bonuses is introduced this completely offsets the negative effects of dismissal barriers. In the absence of dismissal barriers, bonus pay reduces frequency of repeated interactions, but leaves market efficiency unchanged.

The rest of the paper is organized as follows: Section 2 discusses the relationship of this work to the literature. Section 3 describes the design of the experiment, Sections 4 and 5 present the empirical analysis, and Section 6 concludes.

2. Previous Literature

For the class of games we explore existing theory provides limited guidance. If we suppose that individuals are expected income maximizers, then we know the equilibrium is highly inefficient. Kreps et al. (1982) introduced a game theoretic model with asymmetric information that was designed to produce equilibria involving non-minimal cooperation, despite a finite horizon. This type of model is very complex and there are an unlimited number of ways to generate this type of result. One thing we do know is that the introduction of bonus pay can have large effects upon the structure of market equilibria.[3] This literature suggests a need for more empirical evidence in order to understand behavior in these complex markets.[4]

It is a long-standing policy question how dismissal barrier institutions affect market performance. Lazear (1990) argued that there would be no consequence for match quality since starting wages could be adjusted to compensate for separation costs. Such a contract does not, however, deal with the potential adverse incentive effects in the case that work effort is non-verifiable. Our experiments speak to this latter issue by making some of the actions of the trading parties not contractually enforceable.

Previous laboratory experiments have found that bonus contracts outperform wage contracts (e.g., Fehr, Gachter and Kirchsteiger(1997),

[3]See, e.g., MacLeod and Malcomson (1998).

[4]There is a rich theoretical literature showing that a number of strategies can be used to enhance performance with incomplete employment contracts, including rising wage profiles (Lazear (1979)), efficiency wages (Shapiro and Stiglitz (1984)), subjective bonus pay (MacLeod and Malcomson (1998)) and contractible bonuses (Baker, Gibbons and Murphy(1994)). A key question is: which strategy will actually emerge, and under what conditions? This paper focuses on the potential determining role of institutions.

Gneezy (2006), and Fehr, Klein and Schmidt(2007)), but have mainly been restricted to one-shot settings. In our repeated-interaction setting, where wages can be complemented with firing threat, we find that wage contracts perform about as well as contracts involving bonus pay. At the same time, bonus pay leads to less reliance on relational contracting and shorter employment duration, qualifying previous laboratory findings that non-verifiable effort necessarily leads to long relationships (Brown, Falk and Fehr(2004)). Huck et al. (2011) show that rising wage incentives work better when firms can commit to a given profile. Our study differs by investigating how the prevalence of rising wage profiles depends on the presence of dismissal barriers, and comparing their performance relative to other incentive strategies.

There is a literature showing that bonus pay is associated with longer employment relationships. Weitzman (1983) explicitly argues that bonus pay in the form of profit sharing can extend the duration of relationships. Oyer (2004) and more recently Lemieux, MacLeod and Parent (2012) find that bonus pay is associated with fewer layoffs. An open question, however, is whether or not bonus pay *causes* a reduction in layoff rates. There can be a number of reasons why jobs with bonus pay have lower layoff rates, including the possibility that such incentives are adopted endogenously in matches that are long-lasting due to more relationship specific investments.[5] The results of our laboratory experiments illustrate how the causal impact of bonus pay could actually be to reduce relationship length.

As we discuss in the conclusion of the paper, the empirical literature on the impact of employment protection legislation has found mixed or weak evidence. Our experiments help shed light on some potential reasons why, showing how, in the spirit of Coase, it may take only a small degree of additional contractual flexibility for market participants to contract around the distortions caused by institutions.

3. The Experiment

3.1. **Basic setup.** The experimental game involved 18 trading periods. Subjects were randomly assigned to the role of a firm or worker. In each period a firm could hire at most one worker, and a worker could have at most one job. A period involved two or three main phases, depending on the treatment.

A period began with the *Market Phase*, in which firms made contract offers and workers could only accept or reject. Firms could make as many contract offers as they wanted during the time limit of three

[5]See, e.g., (Lemieux et al. (2009)).

minutes; if one of a firm's contracts was accepted, all of the other offers by that firm were immediately removed from the market.[6] Contract offers consisted of a wage, w, a desired effort level, $\tilde{e}$, and in some treatments an offered bonus, $\tilde{b}$. The offer also included the firm's ID number.

Firms could make two types of contract offers during the market phase. "Public offers" were observed by all workers, and thus could be accepted by any worker. "Private offers" were observed only by a worker specified by the firm, and thus were available only to that particular worker. In the case that a firm made a private offer, the firm specified a worker's ID number, in addition to the contract terms. Worker and firm ID numbers remained constant over the entire 18 periods. This design made it possible for a firm and worker to endogenously form a long-term relationship, by choosing to repeatedly engage in private-offer contracts with each other. Public offers were a way for firms to engage in a spot market for labor. During the market phase, firms were kept constantly informed about which workers had already accepted a contract, so as to avoid having firms make a private offer to a worker that was no longer available.

A second phase, the *Effort Phase*, was entered by firms and workers that agreed on a contract at the conclusion of the market phase. In this phase the worker could decide how much effort, e to exert, where effort was a number from 1 to 10 as described in more detail below. Importantly, the desired effort in the contract was not binding, to mimic a setting in which effort is non-verifiable to third parties (e.g., third parties being legal courts).

In treatments where the contract offer could include an offered bonus, there was a third phase, the *Bonus Phase*, in which the firm was informed about the worker's effort choice and could decide how much of a bonus, b, to pay. Importantly, neither the worker's effort level or the firm's bonus payment were restricted by the initial contract agreement, whereas a wage specified in the agreement was binding. After the second (third) phase, the firm and worker were informed about their profits and earnings, respectively, and then a new period began.

The experiment used neutral framing (e.g., "buyers", "sellers", and "quality") to help ensure that if subjects act like workers and firms, it is due to the implemented incentives, rather than a perception that the

[6]The market phase was designed to end automatically after three minutes, or after the last firm had a contract offer accepted, whichever came first.

experimenter expects them to act like workers and firms.[7] Representative instructions are provided in an online appendix.

3.2. **Treatments and the dismissal barrier institution.** In total we have four treatments: The treatment T-Baseline provides a benchmark, of a wage contract setting without dismissal barriers;[8] contracts consisted of a binding wage, w, and a desired effort level, $\tilde{e}$. In T-Barrier the contract options were the same, consisting of w and $\tilde{e}$, but there was also a dismissal barrier institution, described in more detail below. In the treatment T-Barrier-Bonus, the dismissal barrier institution was in effect, but firms had the option to offer a (non-enforceable) bonus, $\tilde{b}$, in addition to a wage and desired effort. Finally, we had T-Bonus, which included the bonus option but no dismissal barriers, with contracts consisting of w, $\tilde{e}$, and $\tilde{b}$.

Dismissal barrier institution: In experimental markets with dismissal barriers, a firm lost the ability to fire a worker in the case that in two consecutive periods the worker had accepted a private offer from that firm.[9] The fact that the dismissal barrier was activated only with the second consecutive contract has an analogue in situations where relationship-specific investments are made only after some time has elapsed, or in the case of employment protection legislation, which often specifies an initial probation period.

Once the dismissal barrier took effect the firm had to make an offer to that same worker at the beginning of each subsequent period until the end of the game or until the worker decided to reject the firm's offer. Firms chose the terms of these offers in a special phase before the market phase. The wage offer always had to be at least as high as in the previous period. Some rigidity of the wage is required for a dismissal protection institution to work, otherwise a firm could effectively fire a worker by reducing the wage to zero.[10] After firms had determined their offers required by the dismissal barrier institution, the market period began and workers protected by the dismissal barrier could see the standing offer from their own firm, in addition to the other market

[7]This framing was also used by, e.g., Brown et al. (2004). Across the literature there is no strong evidence that choice of framing matters for this class of games.

[8]The ICF treatment in Brown et al. (2004) was similar, except that it lasted only 15 periods. Our T-Baseline extends the market game to 18 periods.

[9]Disallowing firing, as opposed to introducing an additional parameter capturing a finite cost of firing, has the advantage of simplifying an already complex choice situation. It also provides a particularly tough test of the ability of bonus pay to overcome the effects of dismissal barriers.

[10]This is known as *constructive dismissal,* and is considered illegal in any jurisdiction with employment protection. See Black's Law Dictionary.

activity. At any time, the worker could accept the standing offer, in which case the firm was informed. Alternatively, the worker could accept another contract in the market. As soon as the worker rejected the standing offer, the firm was informed, and allowed to make offers during the remainder of the market phase.

3.3. **Parameters, Information Conditions, Procedure, and Subject Pool.** All market sessions lasted 18 periods, and had 7 firms and 10 workers. The material payoff to a firm was given by the function

$$\pi_f = \begin{cases} 10 \cdot e - w - b & \textit{if a contract offer was accepted} \\ 0 & \textit{if no contract offer was accepted} \end{cases} \tag{3.1}$$

and the payoff function for a worker was given by

$$\pi_w = \begin{cases} w + b - c(e) & \textit{if a contract offer was accepted} \\ 5 & \textit{if no contract offer was accepted} \end{cases} \tag{3.2}$$

where $c(e)$ was a cost of effort function, and 5 was the unemployment benefit in the case that a worker did not engage in a trade. The wage, the offered bonus, and the bonus actually paid, b, could each take on an integer value $0, 1, 2, ...100$. The desired effort level and the actual effort level chosen by the worker, e, could take on integer values $1, 2, ..., 10$. The effort cost function (Table 1) is increasing and convex. Because the marginal cost of effort is at most 3, while the marginal benefit is always 10, the efficient effort level is 10.[11]

Table 1: Effort cost schedule

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

The length of the game, and all payoff functions, including the effort cost function, were common knowledge. Firms learned about the effort choices only of workers that they traded with, and workers learned about the bonus decisions only of firms that they personally encountered, reflecting non-verifiability to third parties. Firms observed all

[11]Using numerical rather than "real effort" allows holding effort costs constant across workers. One could have an optimal effort at the interior, but then it would not be possible to disentangle empirically incentives to reduce effort from errors in setting effort.

public offers on the market during the market phase. Workers were informed not only about private offers they had received, but also about all public offers on the market.

At the end of each period, a subject's period profits were summarized, along with the profits of the trading partner in the case of a trade. Subjects were also reminded of the partner's ID number, the terms of the initial contract, the actual effort choice, and the actual bonus paid. Subjects recorded this information on a separate sheet of paper, ensuring that subjects were fully informed about their own trading history over the course of the experiment.[12]

The experiment was computerized using Z-Tree software (Fischbacher (2007)). There were 408 participants in the experiment. We conducted six market sessions for each of the four treatments. Subjects were students at the University of Bonn, from various fields of study. Recruiting was done using ORSEE (Greiner (2003)). No subject participated in more than one session. On average, a session lasted roughly 100 minutes, and a subject earned 25 Euros (approximately 32 USD).

A notable feature of our experimental setting is the finite horizon. If material selfishness is common knowledge, standard backwards induction arguments imply low effort and compensation levels in all periods in all treatments. Thus, the variation in institutions should have no impact on market outcomes. It is well established based on experimental evidence, however, that material selfishness does not fully describe the motivations of all agents, and that there is typically a substantial fraction who are motivated by fairness concerns (see, e.g., Fehr et al. (2007)). As is well known, the presence of a sufficient number of fair individuals can in principle lead to greater cooperation than the subgame perfect prediction (e.g., Kreps et al. (1982)). For example, in T-Barrier and T-Baseline, workers are the final movers; if some workers will exert non-minimal effort even in the final period of the game, in response to generous fixed wages, this could facilitate establishing incentives for selfish workers in earlier periods, because firms can offer the possibility of a final-period rent.[13] In the other treatments, T-Barrier-Bonus and T-Bonus, fairness concerns on the part of firms can make bonus payments credible in the final period, providing a rent to motivate workers. Given that incentives may be possible, the variation in institutions across treatments could affect market performance,

[12]There was an unpaid practice period before the experiment began, which consisted only of a market phase but not the subsequent effort or bonus phases, to give subjects experience with the process of making and accepting offers.

[13]See also MacLeod (2007) for a discussion of how final period rents allow obtaining performance that is close to the first best in earlier periods.

because they constrain the incentive strategies available to firms to varying degrees.

4. Results on Aggregate Outcomes

We begin our analysis by studying the impact of varying market rules on several aspects of aggregate performance in our experimental markets. We calculate efficiency of a trade as the ratio of the surplus generated relative to the maximum possible surplus, and study the impact of institutions on average efficiency per trade.[14] Firm profits and worker earnings are both normalized by maximum possible profits, and earnings in a trade, respectively. Length is the ultimate length of a relationship, where public offers are coded as having a length of 1.

Table 2 has three panels, where the regression results in each panel have a different treatment as the omitted category.[15] Panel A shows that efficiency and firm profits in T-Barrier are both significantly lower than in T-Baseline, by 12 and 9 percentage points, respectively. Dismissal barriers have no significant impact on worker payoffs, or relationship length, relative to T-Baseline.

Result 1: *Introducing dismissal barriers into a wage contract setting reduces efficiency and firm profits, without improving payoffs for workers or changing average relationship length.*

In Column (1) of Panel B we see that efficiency in T-Barrier-Bonus is 10 percentage points higher than in T-Barrier, as are firm profits. By contrast, efficiency and firm profits in T-Barrier-Bonus are both within 1 percentage point of the corresponding outcomes in T-Baseline (Columns 1 and 2 of Panel A). Worker outcomes, and average relationship length, are unchanged with respect to T-Barrier and T-Baseline.

Result 2: *Adding bonus pay to a setting with dismissal barriers almost eliminates the losses in efficiency and profits, and does not affect worker payoffs or relationship lengths.*

[14]The maximum possible surplus in a trade is generated by an effort level of 10. Maximum surplus equals: $10 * 10 - 18 - 5 = 77$.

[15]Estimates account for individual differences (random effects), and standard errors are adjusted to allow for correlation of the error term across observations from the same market session. Results are similar if we instead use session averages, instead of clustering, or simply use OLS without random effects and clustering. Subsequent regressions in the rest of the paper use a similar adjustment.

Table 3: Aggregate treatment effects

	Panel A: T-Baseline Omitted				Panel B: T-Barrier Omitted			
	Efficiency	Firm profits	Worker payoffs	Length	Efficiency	Firm profits	Worker payoffs	Length
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
T-Barrier	-0.12**	-0.09**	-0.03	0.18				
	(0.06)	(0.04)	(0.04)	(1.54)				
T-Barrier-Bonus	-0.01	0.01	-0.02	-0.87	0.10**	0.10**	0.01	-1.05
	(0.05)	(0.03)	(0.03)	(0.54)	(0.05)	(0.04)	(0.02)	(1.23)
T-Baseline					0.12**	0.09**	0.03	-0.18
					(0.06)	(0.04)	(0.04)	(1.54)
T-Bonus	0.05	0.10***	-0.05	-3.03**	0.17***	0.18***	-0.02	-3.20***
	(0.04)	(0.03)	(0.04)	(1.25)	(0.05)	(0.04)	(0.03)	(1.03)
Constant	0.64***	0.32***	0.32***	6.19***	0.52***	0.23***	0.30***	6.37***
	(0.04)	(0.02)	(0.03)	(1.20)	(0.04)	(0.04)	(0.02)	(0.96)
Obs.	3015	3015	3015	3015	3015	3015	3015	3015

	Panel C: T-Barrier-Bonus Omitted			
	Efficiency	Firm profits	Worker payoffs	Length
	(1)	(2)	(3)	(4)
T-Barrier	-0.10**	-0.10**	-0.01	1.05
	(0.05)	(0.04)	(0.02)	(1.23)
T-Barrier-Bonus				
T-Baseline	0.01	-0.01	0.02	0.87
	(0.05)	(0.03)	(0.03)	(1.42)
T-Bonus	0.06**	0.09***	-0.02	-2.16***
	(0.02)	(0.03)	(0.02)	(0.85)
Constant	0.63***	0.33***	0.30***	5.32***
	(0.02)	(0.02)	(0.01)	(0.76)
Obs.	3015	3015	3015	3015

Notes: Random effects estimates at the firm level, robust standard errors in brackets adjusted for clustering on sessions. ***, **, and *indicate significance at the 1-, 5-, and 10-percent level, respectively.

To identify the impact of bonus pay per se, we need T-Bonus. Column (1) of Panel A shows that bonus pay leads to a 5 percentage point increase in efficiency, relative to T-Baseline, but the difference is not statistically significant. Columns (1) and (2) of Panel C show that efficiency and firm profits are significantly higher in T-Bonus compared to

T-Barrier-Bonus. Thus, dismissal barriers do harm efficiency even with bonus pay, relative to the benchmark of bonus pay and no barriers, but only by about 6 percentage points. Firm profits are 9 percentage points higher in T-Bonus than in T-Barrier-Bonus. We also see in Column (4) of Panels A, B, and C that average relationship length is substantially lower in T-Bonus than in T-Baseline, T-Barrier, or T-Barrier-Bonus, although the magnitude is greater in the former comparison.

Result 3: *Bonus pay per se, in the absence of dismissal barriers, has little impact on efficiency. The highest firm profits, and also the shortest relationship lengths, are observed in a market with bonus pay but no barriers.*

5. Contract Enforcement strategies at the micro level

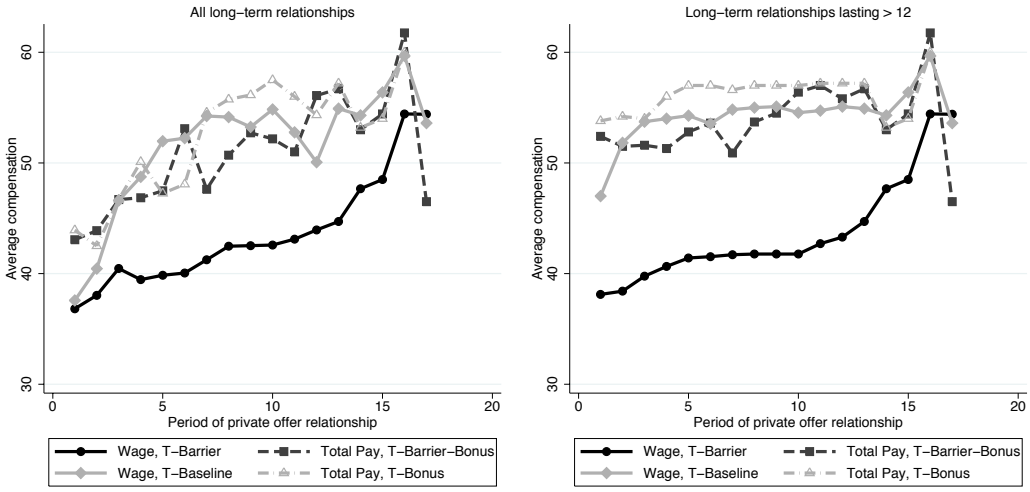
In this section we discuss how variation in market rules affected micro-level behavior of subjects in the role of firms, which in turn sheds light on mechanism underlying differences in aggregate outcomes. We do not provide detailed analysis of worker effort choices, for the sake of brevity and because average effort levels are already largely captured by aggregate market efficiency.[16] We organize the analysis by type of contract enforcement strategy.

5.1. **Incentives based on rising compensation profiles.**

Figure 1 shows compensation profiles over the course of long-term relationships in all treatments. Looking at T-Barrier, we see that firms tend to implement an increasing wage profile on average, with the largest increases saved till the last few periods. This is true in the left-hand panel of the figure, which includes all contracts in long-term relationships; the total increase in the average wage is 43 percent, from the second period when barriers become active, to the final period. We also see a similar pattern in the right-hand panel, which focuses only on the 50 percent or more of relationships that were truly long-lasting,

[16]In our experimental setup effort is essentially a sufficient statistic for efficiency. The only discrepancy arises in the rare case that a firm does not find a worker to accept a contract, in which case effort is not defined.

Figure 1: Compensation profiles in long-term relationships



Notes: Total compensation includes wage, plus actual bonus if applicable. Long term relationships refers to private offer contracts that are part of an on-going relationship.

in that they continued for at least 12 periods.[17] The profile is essentially unchanged by exclusion of short-lived relationships, with a wage increase of about 42 percent.

Turning to the other three treatments, Figure 1 shows that compensation levels are substantially higher than in T-Barrier throughout long-term relationships. The lower levels of compensation in T-Barrier explain why workers in long-term relationships are not better off than in other treatments, despite being protected from firing. While there is a positive slope for T-Barrier-Bonus, T-Baseline, and T-Bonus in the left-hand panel, this upward sloping relationship is misleading because short-lived relationships tend to have lower compensation levels in these treatments. In the right-hand panel, where this composition effect is eliminated, we see that compensation profiles are actually constant.[18]

Regression analysis shows that compensation levels are significantly lower in T-Barrier than T-Baseline for all long-term relationships ($p < 0.01$), and considering only relationships lasting at least 12 periods

[17]We see 82.6 percent of longterm relationships lasting longer than 12 periods in T-Barrier, and about 50 percent of long-term relationships achieving this length in each of the other three treatments.

[18]We find similar results using other natural relationship-length cut-offs, for example, considering all relationships lasting at least 9 periods, i.e., half of the market game.

($p < 0.01$). Also, there is a positive relationship between relationship period and compensation level in T-Barrier, which is significantly larger than in T-Baseline both for all long-term ($p < 0.01$), and long-lasting long-term relationships ($p < 0.01$).[19] Profiles in T-Barrier-Bonus and T-Bonus are not significantly different than in T-Baseline, and the correlation between relationship period and compensation level is no longer statistically significant for these treatments considering truly long-lasting relationships. Thus, a rising wage profile during long-term relationships is mainly observed in a setting with wage contracts and dismissal barriers.

For the rising wage profile in T-Barrier to provide incentives, wage increases must be conditioned on good performance. A Probit regression shows that good worker performance in the previous period has a significant positive impact on the likelihood of a wage increase ($p < 0.01$) in T-Barrier, controlling for the wage level and desired effort in the previous period. By contrast, there is not a positive and significant relationship for the other three treatments.

Notably, the motivating power of rising wage profiles in T-Barrier appears to be relatively weak, compared to the alternative strategies used in other treatments; lower aggregate effort levels in T-Barrier are driven entirely by lower effort levels within long-term relationships, and we observe a large, *within-worker* drop in effort in T-Barrier once dismissal barriers are triggered and prevent firing; this large drop is not present in other treatments.[20]

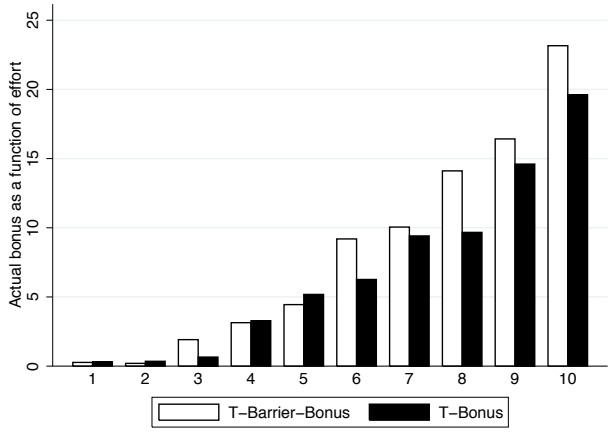
5.2. **Incentives based on bonus pay.** In T-Barrier-Bonus we see that 98 percent of all contracts involve a positive offered bonus, and as shown in Figure 2, firms use the bonus to reward high effort. A regression of actual bonus on worker effort, controlling for wage and

[19]The independent variables in this regression include: treatment dummies, relationship period, and interactions of treatments with relationship period. The coefficient on *Relationship period* shows a weaker correlation between relationship period and compensation level in T-Baseline, while the interaction terms *T-Barrier-Bonus*Relationship period* and *T-Bonus*Relationship period* are not statistically significant. We confirm robustness to including previous effort as a control as this is likely to be an important determinant of current compensation level, particularly in T-Barrier. Below, we discuss in detail the conditioning of wage increases on performance in the various treatments. Results are also robust to controlling for contract terms, and a dummy for final market period.

[20]Probit regressions show that the probability of an effort drop going from the first to second relationship period is significantly higher in T-Barrier than in T-Baseline, by 30 percent ($p < 0.01$). The results are robust to controlling for contract terms in the previous (first) relationship period, and for market period. There is no significant difference for T-Barrier-Bonus and T-Bonus with respect to T-Baseline.

desired effort, shows that this positive relationship is highly significant ($p < 0.01$).[21] Notably, average bonus payments are sufficient to cover worker effort costs, for a given effort level. We now see that firms in T-Barrier-Bonus used an alternative incentive strategy to rising compensation profiles, namely bonus reductions to discipline shirkers, with better results in terms of aggregate effort and efficiency (Table 2).

Figure 2: Actual bonus as a function of effort

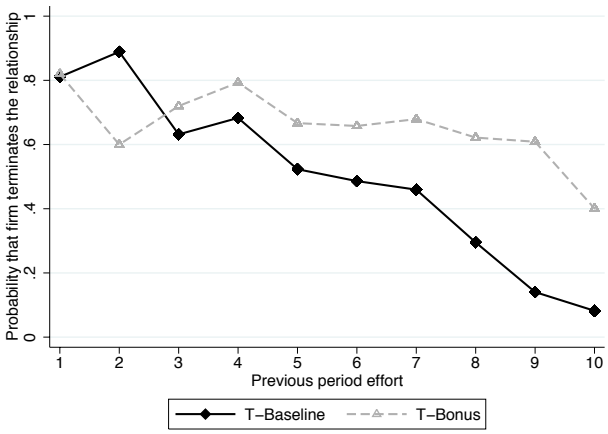


In T-Bonus 97 percent of contracts involve a positive offered bonus, and as shown in Figure 2 firms reward high effort with high bonuses ($p < 0.01$). We also see in Figure 2, however, that firms are able to pay a *lower level* of actual bonus in T-Bonus than T-Barrier-Bonus, while achieving just as good performance by workers. We explore this pattern in more detail using regressions, pooling data from T-Barrier-Bonus, and T-Bonus. Considering only contracts that were part of long-term relationships, we find that *offered* bonuses are significantly lower in T-Bonus than T-Barrier ($p < 0.01$), while for initial/one-shot interactions the treatment difference is actually negative and far from significant.[22] The fact that the difference is restricted to long-term relationships suggests that it reflects the ability to also rely on firing

[21]This credibility breaks down somewhat in the final market period: In the final period 54 percent of firms pay a zero bonus, despite a positive offered bonus and the worker choosing the requested effort level, whereas this fraction is 5 percent taking all pre-final periods together. However, the remaining 46 percent of firms do pay a bonus in the final period, consistent with some firms having fairness concerns.

[22]The results are robust to controlling for wage and desired effort, as well as a dummy for final market period. Similar regressions, with actual bonus as the dependent variable, and effort included as an independent variable, show that actual bonuses were also significantly lower in T-Bonus than T-Barrier-Bonus. Including offered bonuses, the treatment dummy becomes significant, indicating that the

Figure 3: Probability of Termination as a Function of Effort



Notes: Sample includes private offer contracts in period t. Termination occurs if a firm does not make a private offer to the worker in $t+1$. Final market period is excluded.

threat in such cases, which is not possible in T-Barrier-Bonus. We show below that firms in T-Bonus do, indeed, use both bonus incentives and firing threat, explaining how they can offer lower bonus payments in long-term relationships, and yet achieve the same or higher effort levels compared to in T-Barrier-Bonus.

5.3. **Incentives based on firing threat.** In T-Baseline and T-Bonus, firms can use firing threat as an incentive device. Figure 3 reveals that firms in T-Baseline condition relationship continuation strongly on past performance of the worker. A Probit regression also shows that the probability of termination decreases significantly with higher previous period effort by the worker ($p < 0.01$).

For firing threat to provide incentives, it is also necessary that workers earn a rent by staying employed. This is the case in T-Baseline, as workers in renewed private offer contracts earn 48.28 on average, compared to 29.25 in public offer contracts, or 5 from being unemployed, so that even taking into account effort costs workers are much better off receiving a private offer.[23] Thus, firing imposes a cost on workers

difference in actual bonuses was reflected in the initial contract offer. Thus, firms had to offer, and pay, higher bonuses for a given effort level in T-Barrier-Bonus, but only in long-term relationships where firing threat was eliminated.

[23]A similar picture emerges when one considers the *expected* total future rents, conditional on being hired with a private offer in a given market period. For each period t we calculate a proxy for total rents by summing up current and future

in the form of foregone rents. Notably, relationships that start with high wages initially in T-Baseline are significantly more likely to have high effort, and to be long-lived.[24] This suggests the importance, in a wage contract setting, of offering high wages already at the beginning of relationships, for a successful relationship.

Figure 3 shows that firms in T-Bonus also use firing threat as an incentive device, in addition to bonus pay. Workers who are hired with a private offer earn rents relative to the case of being unemployed (or having a public offer contract), making firing a meaningful punishment.[25] It is apparent from Figure 3, however, that the conditioning of firing on performance is weaker in T-Bonus than in T-Baseline. A Probit regression shows that the negative relationship between effort and probability of termination is statistically significant in T-Bonus ($p < 0.01$), but that the slope is significantly flatter than in T-Baseline ($p < 0.01$). Not only are relational incentives weaker in T-Bonus, in the sense that termination is less closely linked to performance, but termination is generally more likely in T-Bonus, by about 23 percentage points on average across all effort levels ($p < 0.01$).[26] Thus, shorter relationships in T-Bonus are due to a change in incentive strategy.

5.4. **Incentives based on cutting wages.** In principle firms in T-Baseline and T-Bonus could provide incentives by re-hiring workers who shirked but penalizing them with a temporary reduction in wages in the next period. This strategy is essentially never used, however. Out of all cases in T-Baseline and T-Bonus where a worker is in a long-term relationship and shirks, firms use a strategy of re-hiring the worker and reducing offered wages in only 6 percent of cases, and 3

earnings, from t to $T = 18$, for all workers who are in a private offer contract in period t. We compare the average of this value for a given period, denoted V_{priv}, to the average current and future earnings of workers who are in a public offer contract in the same period, and workers who are unemployed, denoted V_{pub} and V_u, respectively. The differences $V_{priv} - V_{pub}$ and $V_{priv} - V_u$ are positive in every market period.

[24]The difference is apparent even in the very first period of relationships: regressing effort on initial wage level shows that a 10 unit increase in the wage increases average effort over the course of the relationship by more than 1 unit (random effects; robust s.e., clustering on session; $p < 0.01$).

[25]Similar to T-Baseline, expected future rents, conditional on being employed in a given period with a private offer, always exceeded workers' outside option in every period.

[26]These results are from a Probit regression. Independent variables include effort, a treatment dummy for T-Bonus, and an interaction term between T-Bonus and effort. The significance of firing threat incentives is shown by a joint test of the significance of treatment dummy and interaction term.

percent of cases, respectively. Interestingly, there is some evidence that cutting wages compensation even has a deleterious effect on subsequent worker performance, which could explain why firms seldom use this strategy. Probit regressions show that a drop in offered wages is associated with a significantly *higher* probability of worker shirking, in both treatments($p < 0.01$; $p < 0.01$). This is true controlling for current offered wages, so it is the unfavorable relative comparison to previous compensation that is associated with an increased likelihood to shirk.[27]

Result 4: *Rising wage incentives are observed primarily when firms face dismissal barriers and no bonus option; with firing threat or bonus pay as options, these are used instead. Bonus pay causes firms to dismiss workers more frequently and condition re-hiring less strongly on performance.*

5.5. **Discussion.** One question raised by our results is: Why are rising wage incentives not more effective? Part of the answer may be the lower compensation over long-term relationships, observed in T-Barrier (see Figure 2).[28] Low levels of compensation may lead to low

[27]The regressions also control for desired effort in the previous and current period, and current and previous offered bonus in the case of T-Bonus. Similar results are obtained using a drop in the level of effort, rather than shirking, as the dependent variable.

[28]From a game theoretic viewpoint, it is understandable why firms pay relatively low compensation in T-Barrier. Going into the final period, firms have no incentive motive to actually raise the wage, so the only credible wage increase would be if firms are increasing the wage to a level that they would pay anyway in the final period, absent incentive motives. We observe in the data that firms do pay non-minimal, compensation in the final period, but at a modest level, presumably reflecting pooling of worker types and a tradeoff for the firm between the value of appealing to worker fairness motives and the need to protect against shirking by selfish types. This particular final period wage puts an upper bound on the credible wage increase going into the final period, and workers thus cannot expect a very large wage increase at the end of the relationship. In earlier periods, firms must pay even lower wages, so as to have room for gradual wage increases in response to good performance by workers. In other treatments, the final period rent allows firms to pay even higher wages in the pre-final period, thereby eliciting effort from fair types (and imitating selfish types); in T-Barrier paying higher wages in the second-to-last period does not work, because it will trigger immediate shirking; workers know that the wage will not be increased, it cannot be lowered, and they cannot be fired. In

effort from fair workers in pre-final periods, and may also be a negative signal for materially selfish agents about the likelihood of high compensation in the future (see MacLeod and Malcomson (1998)). In other treatments, firms are able to reward good performance by paying high wages or bonuses from the outset, and we have seen empirically that relationships beginning with higher compensation are more successful in these treatments. While rising wage incentives are relatively ineffective in the settings we consider, it is an interesting open question how adding additional communication or reputation possibilities might affect credibility of firms, and the relative performance of different incentive strategies.[29]

Another finding is that the option to pay bonuses causes firms to be more "footloose". The optimal degree of experimentation might be greater with bonus pay, compared to settings where maintaining a long-term relationship is more crucial for incentives. Looking at worker effort choices, performance in one-shot interactions is better in T-Bonus than in any of the other treatments, and the difference is statistically significant. In this sense, it does appear that costs of experimentation are lower with bonus pay.

The relative scarcity of occasions when firms re-hire a poorly performing worker for a reduced wage, is consistent with much field evidence that firms seldom cut worker wages, and that wage cuts may lead to poor morale or even sabotage (Krueger and Mas (2004)). One explanation may be that the level of previously offered compensation forms a salient reference point, so that a reduction relative to this level is viewed as a "loss". Indeed, we observe that it is the relative comparison to previous compensation that matters for shirking.

6. Conclusion

We use laboratory experiments to study the causal impact of different market rules, which mimic institutional regimes observed in labor markets, including dismissal barrier institutions and bonus pay. Our results are consistent with a "Coasian" perspective, showing how a single additional degree of contractual flexibility can be sufficient to allow trading parties to largely avoid incentive problems caused by firing

summary, while the presence of fair agents could help make rising wages a credible incentive device in T-Barrier, this would not be expected to generate very strong incentives, or high enough compensation to elicit high effort from fair types.

[29]As long as settings involve effort being non-verifiable to third-parties, however, it may be difficult for firms to establish reputations for following-through on effort-contingent promises, as these are also by definition non-verifiable.

costs. This point may be relevant for explaining why existing field evidence on the impact of dismissal barriers is mixed (see, e.g., Ichino and Riphan (2005); Autor, Kerr and Kugler (2007) ; and others). Our findings may also have some useful implications for discussion of the regulation of European labor markets. Bentolila et al. (2012) highlight the costs associated with having labor contracts that are restricted to be either of short or long duration. The behavior in our experiments suggests that discussion of regulation should include allowing economic actors to experiment with contract forms that go beyond the simple wage agreement.[30]

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[30]See also the recent work by Charness et al. (2013) who find that having workers propose a desired effort level can enhance performance.

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