Pensions in the Laboratory: The Role of Commitment and Reputation for Deferred Compensation in Multi-Period Labor Contracts

Steffen Huck, University College London, ELSE, IZA
Andrew J. Seltzer, Royal Holloway, University of London
Brian Wallace, University College London, ELSE

We gratefully acknowledge a grant from the Nuffield Foundation. In addition, the first author acknowledges financial support from the Economic and Social Research Council (UK) via the Centre for Economic Learning and Social Evolution (ELSE). We have benefited from comments by Hans Normann and participants in seminars at Royal Holloway, Colby College, University of Vermont, UCL, IZA, and the Society of Labor Economists Conference.

Pensions in the Laboratory: The Role of Commitment and Reputation for Deferred Compensation in Multi-Period Labor Contracts

Abstract

This paper examines the relationship between firms' wage offers and workers' supply of effort in a multi-period environment. If firms are able to commit to a schedule of wage payments, in equilibrium they will offer deferred compensation: first-period productivity is positive and wages are zero, while last-period productivity is zero and wages are positive. Workers respond to deferred compensation by supplying sufficient effort to avoid dismissal. In the absence of commitment, firms pay zero wages and workers supply low effort. The experiment produces strong evidence of these predictions. With commitment, we frequently observe deferred compensation and relatively high worker effort. In the absence of commitment, we observe no deferred compensation, much lower wages, and little worker effort. A third treatment where commitment is not possible, but firms are able to build a reputation, produces an intermediate result. Finally, we also find some evidence of gift exchange, in particular in the absence of commitment when deferred compensation does not work.

Keywords: deferred compensation, pensions, experimental labor economics, personnel economics, gift exchange, incentives, shirking.

JEL class: C91, J31, J41, M51, M52.

Few questions in labor economics have been the subject of as much attention as the effect of workplace incentives on worker effort (Lazear, 2000 and Prendergast, 1999). While this literature has traditionally combined theory with the empirical analysis of observational data, the last decade has seen an ever-increasing number of experimental studies shedding light on the nexus between incentives and effort. Important contributions include Fehr, Kirchsteiger, and Riedl (1993) on the role of gift exchange and Fehr, Gachter, and Kirchsteiger (1997) on the role of reciprocity. More recently, this literature has focussed on the issue of dynamic, long-term 'relational' contracts. Specifically Brown, Falk, and Fehr (2004 and 2008) study repeated labor markets where agents are identifiable and workers and firms can endogenously match into long-term pairs. Such endogenous relations are shown to be substantially efficiency enhancing. However, while worker-firm relations are dynamic in these studies, contracts as such are always for one period only.

In this study we examine multi-period labor contracts in order to study the role of deferred compensation, as described by Lazear (1979). In a deferred compensation contract, the worker/employer relationship is expected to be long-term. Workers are underpaid during the early part of their career (that is pay is less than marginal revenue product) and overpaid during the later part of their career. This structure of compensation encourages higher effort. Future pay always exceeds future productivity, thus workers have an incentive not to undertake actions that will lead to dismissal.[1] An important issue concerning deferred compensation is that firms have an incentive to renege on late-career overpayment and dismiss older workers, who are paid more than their marginal product. This implies that in the absence of an effective commitment mechanism, deferred compensation can not be part of an equilibrium contract. The literature has focused on two such mechanisms: legally binding long-term contracts and reputation (i.e. a firm that dismisses older workers will face future recruiting difficulties).[2]

Because deferred compensation is an optimal contract only when there exist difficulties measuring short-term effort and output, there is an inherent problem in testing the theory directly. If the short-term performance were directly observable to the firm (and researcher) then the employer should be able to optimally tie wages to productivity in the short-run, for example through piece rates. So, unsurprisingly, we are not aware of any direct empirical evidence on the impact of deferred compensation on worker behavior. Instead the existing literature focuses on whether mandatory retirement and steep age earnings profiles are associated with jobs with monitoring difficulties (Hutchens, 1987); whether mergers or high bankruptcy probabilities are associated with flatter wage profiles (Gokhale et. al., 1995); and whether wages increase too much in later years of the career to be explained by productivity increases (Seltzer and Merrett, 2000).

---

[1] Deferred compensation contracts have also been shown to reduce quits and attract future-minded employees (Salop and Salop (1976)). We do not analyze these properties in this paper.

[2] A second issue is that older workers will have an incentive to remain on the job past the optimal retirement point because they are paid more than marginal revenue product. This problem can be solved by a policy of mandatory retirement.

This paper directly examines the relationship between deferred compensation and worker effort levels using experimental evidence. We create a simple three-period model in which positive worker effort is a socially optimal outcome. The model captures several of the important equilibrium features of the Lazear model: namely, assuming that firms are able to commit to wage offers in advance, there will be underpayment of young workers, overpayment of old workers, higher worker effort than in a spot labor market, and mandatory retirement. We test whether deferred compensation and positive worker effort actually emerge under different rules concerning contract enforceability and workers' information about firms' previous behavior. To the best of our knowledge, our study is the first to provide experimental evidence on the intertemporal allocation of wages.

The basic structure of the experiment is as follows. In the first stage, the firm player makes a wage offer for the three stages. In our first treatment (henceforth referred to as the Full Commitment Treatment, FCT), this offer is binding for all three stages. Upon receiving the wage offer, the worker player decides the level of effort to supply. If they supply low effort, the round ends with some probability; if they supply medium or high effort, the round continues to the second stage. The worker faces the same decision again in the second stage. The third stage corresponds to retirement, and, if it is reached, the firm player gives the worker player the pension promised at the start of the first stage.

We have two additional treatments in which the firm player makes an initial wage offer that is only binding for the current stage. In addition to the binding offer for the current stage, the firm player makes a non-binding wage promise for future stages. At the beginning of each stage, the firm player makes a new wage offer that is again binding for only one stage and (for the second stage) a new wage promise for future stages. In the second treatment (henceforth referred to as the Repeated Game Treatment, RGT), the worker player observes the history of the firm player's wage promises and offers in previous rounds and can see if they have previously been generous in the later stages of the game. The third treatment (henceforth referred to as the No Commitment Treatment, NCT) the wage offer beyond the current stage is non-binding and, unlike in the RGT, the worker player has no information on the firm player's history.

The experiment is designed such that higher effort increases productivity but has costs for the worker player. We ran the experiments with random matching of worker and firm players over 20 rounds in order to provide opportunities for learning while essentially keeping the strategic incentives of the one-shot game (FCT and NCT). In the FCT firms pay positive wages and workers supply effort in equilibrium. In the NCT firms pay zero wages and workers do not supply effort in equilibrium. The RGT is included to test whether in a (finitely) repeated game reputation can essentially replicate a binding contract.[3]

[3] In an incomplete information environment with some 'crazy' firms that actually always keep their promises and can, thus, effectively commit, equilibria can be constructed where 'standard' money-maximizing firms mimic the honest firms for a while such that high levels of cooperation can be achieved even with a finite time horizon.

It is shown that subjects behave largely in accordance with the predictions of the Lazear model. In the FCT, subjects supplied considerably higher levels of effort when offered deferred compensation than when compensation was front-loaded. Over time firm players learned this and paid ever increasing shares of the total wage in the last period. In the NCT, firm players repeatedly reneged on promised wage offers. Worker players learned this over time and refused to supply effort. After several rounds, the subjects behaved close to the theoretical equilibrium of zero wages and low effort. The outcomes of the RGT fall in between those of the FCT and NCT. Many firm players tried to build a reputation by consistently making generous wage offers in the second and third stages of the game. The total average wage over the three stages was only slightly lower than in the FCT, although there was considerably less deferred compensation. As a consequence, workers' efforts were considerably lower than in the FCT.

In all, the Lazear model explains subjects' behavior surprisingly well. We say surprisingly since in many experiments of similar complexity orthodox theoretical predictions fail, notably in experiments on one-period labor contracts such as Fehr, Kirchsteiger, and Riedl (1993, 1996) who have shown that gift exchange (Akerlof, 1982) can prevent labor markets where efforts are not enforceable from collapsing. Combining this direct experimental evidence with the indirect field evidence, we conclude that indeed what looks like deferred compensation in the field might actually be deferred compensation as modeled by Lazear.[4]

Despite the generally good performance of orthodox economic theory, we also find some evidence for gift exchange in our data. Worker players increased their effort levels in response to above-equilibrium wage offers in all treatments. This relation is strongest in treatments without explicit commitment, the NCT and RGT, illustrating the role of informal mechanisms such as gift exchange as a *substitute* for formal incentive mechanisms such as deferred compensation.

The remainder of the paper is organized as follows. The first section outlines a simple three-period model which captures the essential features of Lazear's deferred compensation model. The second section describes the design of our experiment. The third section presents the results from the experiment. The fourth section concludes.

I. The Model

Figure 1 shows a deferred compensation contract. In a competitive labor market, the contract offers lifetime wages that are equal in net present value to lifetime productivity; however, wages are less than productivity prior to T* and greater than productivity

[4] Conversely, negative experimental evidence would have suggested that the indirect field evidence is spurious. In many ways our experiment gives the theory its best shot so that it would have seemed doubtful whether something that it fails in our environment can work in much more complex real-life situations.

thereafter.[5] These contracts need two additional features to provide optimal incentives. In order for lifetime wages to be no greater than lifetime productivity, the worker must retire at or before T**. At the start of the contract, the worker is indifferent to the wage payments shown with retirement at T** and a contract with wage equal to MRP. However, since the wage is greater than the worker's value of leisure at T**, he will continue working unless the contract contains a mandatory retirement provision. It is also necessary to have provisions that make dismissal of older workers difficult in order to prevent firms from reneging on the implicit contract and dismissing the worker at T*. Lazear offers two mechanisms for this purpose: legally binding contracts such as "last hired, first fired" and informal means that depend on maintaining an honest reputation in order to recruit workers in the future.

Our experiments use a discretized version of Lazear's continuous time model with three periods reflecting the phases before T* (young worker – stage 1), between T* and T** (old worker – stage 2), and after T** (retired worker – stage 3).

At the start of each round, firm players have to decide about wages for the first two stages and about a pension for the third

$$(W_1, W_2, W_3) \in \boldsymbol{R}^3_{+0}\,.$$

We initially assume that these offers are binding for all three stages. Worker players then have to decide their effort level in stages 1 and 2, with each choice modeled as a triple decision (low, medium, high). High effort leads to output Z_H which is assumed to be greater than the output under medium effort, Z_M, and, likewise, output under medium effort is greater than output under low effort Z_L, such that

$$Z_H > Z_M > Z_L.$$

We assume that there is an increasing cost of effort, C, i.e.

$$C_H > C_M > C_L$$

where H, M, and L again indicate the effort choice. This holds in both stages. If (and only if) low effort is detected, the worker is either sacked (after stage 1) or loses his pension (after stage 2), although he is still paid his earnings for the current stage. For the sake of simplicity, the detection probability is exogenously determined to be *p*. We assume that the firm can make a full commitment not to renege and dismiss a worker who has supplied medium or high effort.

This game can be solved through backward induction. The equilibrium is as follows. First, note that in a one-shot game it is off the equilibrium path for the worker

[5] The competitive labor market assumption is not necessary to capture the main points of Lazear model. Our model does not assume competitive labor markets, and in equilibrium lifetime wages are less than lifetime productivity. One consequence of assuming a non-competitive labor market is that our experiments do not have an obvious focal point whereby the subjects split the earnings for the round.

ever to supply high effort, even if that is the socially optimal outcome, because the cost to the worker is increasing in effort level and he cannot be dismissed for supplying medium effort.[6] The subgame perfect equilibrium solution is found by observing that if:

$$(Z_M - C_M) > (Z_L - C_L)$$

the joint surplus is higher if the worker supplies medium effort in both periods than if he supplies low effort. Thus the firm will be willing to compensate the worker for the cost of extra effort. Analyzing the worker's second period choice of whether to supply medium effort, we find he does so whenever:

$$(1) \qquad (1 - p)W_3 - C_L \leq W_3 - C_M$$

His first period choice depends on what he expects to do in the second period. If condition (1) is fulfilled, i.e. that the pension is sufficiently high to deter low effort in the second period, then medium effort in stage 1 pays only if:

$$(2) \qquad (1 - p)(W_2 + W_3 - C_M) - C_L \leq W_2 + W_3 - 2C_M$$

Profit maximization implies that W_2 and W_3 are chosen such that (1) and (2) hold with equality. Notice that there is no restriction on W_1, which does not influence the worker's behavior and can be viewed as a windfall or gift, and thus is zero in equilibrium. From (1) we obtain the equilibrium pension:

$$W_3 = (C_M - C_L)/p.$$

Substituting this in (2) we obtain:

$$W_2 = C_M.$$

Thus, the equilibrium prediction is that firms will offer the wage profile[7] $(0, C_M, (C_M - C_L)/p)$; workers will supply effort levels (MEDIUM, MEDIUM); and net productivity will be $(Z_M - C_M, Z_M - C_M, 0)$. The resulting payoffs over the three stages are $(-C_M, 0, (C_M - C_L)/p)$ for the worker and $(Z_M, Z_M - C_M, -(C_M - C_L)/p)$ for the firm.

Now consider the case where the firm cannot commit in advance to its wage offer and only decides on the wage at the start of each stage. Solving by backward induction, in stage 3 the firm always chooses W_3=0, as the worker no longer produces any output. The worker anticipates this and therefore chooses to supply low effort in stage 2. The firm anticipates this and thus understands that they can not motivate effort in stage 2. Therefore they offer the worker W_2=0, and similarly for stage 1. The equilibrium

[6] This is consistent with Lazear (2000), who argues that firms need to use additional mechanisms (such as promotion tournaments) to motivate workers to supply effort above a threshold level.

[7] Note that in the model the worker has a zero discount rate and thus their effort in stage 1 will respond the same way to payments in stage 2 or stage 3. Thus the equilibrium can be characterized as (0, X, Y) where $0 \leq X \leq C_M$ and $Y=(C_M-C_L)/p+(C_M-X)$. In the presence of some small discount rate, the equilibrium described above is unique.

prediction is that the firm will offer the wage profile (0, 0, 0); workers will supply effort levels (LOW, LOW), and net productivity will be (Z_L–C_L, p(Z_L–C_L), 0). The resulting payoffs over the three stages are (–C_L, –C_L, 0) for the worker and (Z_L–C_L, p(Z_L–C_L), 0) for the firm. Because the firm cannot commit to its offers, the end result is the pareto inferior low wage, low effort equilibrium.

II. Experimental Design

We ran three treatments in our experiment to distinguish between optimal responses to incentives, gift exchange, and genuine mistakes. In all treatments, the Full Commitment Treatment (FCT), the No Commitment Treatment (NCT), and Repeated Game Treatment (RGT), ten subjects (5 workers and 5 firms) participated in each session. Subjects were assigned the role of firm or worker at the beginning of the experiment and kept their role throughout the session. Each session consisted of 20 rounds, with random matching of workers and firms in order to approximate a one-shot game in each round of the NCT and FCT. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). We ran 6 sessions for each of the treatments, and thus there are observations for 30 worker players and 30 firm players over 20 rounds for each treatment. The subjects were students at Royal Holloway, University of London and UCL. Sessions lasted approximately 100 minutes. The mean earnings were £20.20, £22.77 and £21.32 for firm players in the FCT, NCT, and RGT, respectively and £21.30, £16.89, £19.09 for worker players (including a £4 show-up fee).

The parameters of the model were set as follows: p = 0.5, C_L = 0, C_M = 20, C_H = 40, Z_L = 50, Z_M = 100, Z_H = 140. Wage offers could range between 0 and 120 pence. The firm player earns (Z_L-w = 50) in the second stage if the game ends during the first stage. Thus in the FCT the worker players' optimal strategies are:

Stage 1: Effort = MEDIUM if $W_2 \geq 40$ or $(W_2 + W_3) \geq 60$;
Effort = LOW otherwise
Stage 2: Effort = MEDIUM if $W_3 \geq 40$;
Effort = LOW otherwise

In the NCT the worker players' optimal strategies induce low effort in both stages independent of wage offers and history.

In the RGT workers and firms are also randomly matched in each period. However, firms carry labels and are, thus, identifiable. Moreover, worker players have access to firm players' history. Specifically, the worker player observes the firm player's wage promises and offers in all previous rounds (and the responses to the offers by the workers players with whom that firm had been matched), and so can see if they have previously reneged on promised wages. The First Appendix shows a sample screen used by a worker player from the RGT.

In this setup, the unique subgame perfect equilibrium prescribes the repetition of the NCT equilibrium with zero wages and low effort all the time. However, if there is some uncertainty about players' types (say, if subjects deem it possible that there are some "crazy" honest firm players who will not renege on their promises), one can construct equilibria where standard players also build a reputation for their honesty in the usual way. In other words, in the RGT there are multiple equilibria, including some where firms and workers cooperate for some length of time. For all practical purposes, the worker players' optimal strategy then depends on their beliefs about the veracity of the firm players' wage promise.

Sample instructions can be found in the second appendix to this paper.

III. Results

III.1 Workers

Let us first focus on the behavior of worker players. We examine effort levels across the different treatments. Our analysis focuses on the extent to which worker players supplied optimal effort, given the wage offers in the FCT and NCT. We also examine the determinants of suboptimal effort levels and the effect of wage offers in the current stage on effort levels in order to distinguish between mistakes and gift giving. Finally, we examine the importance of firm players' wage offers in previous rounds in the RGT. The evidence shows that subjects typically supplied the optimal effort (given the wage offers), thus contract design has a strong influence on effort levels.

We begin with some descriptive statistics on worker behavior across the three treatments. We examine behavior in rounds 6-19, in order to allow subjects time to learn the game, eliminate any last-period effects, and ensure a reasonable sample size.[8] Table 1 shows the percentage of worker players playing low, medium, and high and the resulting average social surplus generated in both stages of the three treatments. There are several observations that can be made from the table. First, in each treatment, effort is higher in the first stage than the second stage. This is particularly true for the NCT. Second, the underlying rules regarding commitment appear to have substantial effects on the efficiency of outcomes. Subjects exerted considerably more effort in the FCT than in the RGT and slightly more in the RGT than the NCT.

The results from Table 1 address the social efficiency of subject behavior, not the optimality of worker player actions, given wage offers. In the FCT and NCT, subjects supplied optimal effort levels 71.5 and 73.5 percent of the time, respectively.[9] The extent

[8] Subjects' behavior changed dramatically during the first few rounds in each treatment. The average wage offers and effort levels were considerably higher during the first 5 rounds than the remainder of the session. After the first five rounds, the choice of of which rounds to include in the analysis is somewhat arbitrary, and the qualitative results do not depend on whether we take the last two thirds or the last half or any similar subset.

[9] We ignore the RGT in this discussion as, due to the multiplicity of equilibria, the optimal choice of effort is less clear.

of optimal play varied slightly depending on which effort would have been optimal. Specifically, in the FCT worker players played optimally low 77.3 percent of the time and optimally medium 63.9 percent of the time. This supports the prediction of the Lazear model that deferred compensation can be used to elicit increased effort. A breakdown of the optimality of effort supplied in FCT and NCT is shown in Figure 2. There is considerable similarity between the treatments. Another similarity is that in each treatment there are learning effects. The proportion of players providing optimal effort increases over time, particularly during the early rounds. Moreover, in all treatments, a higher proportion of players supplied excess effort than deficient effort. This is trivially true for the NCT (in which the optimum effort is always low), but also for the FCT, particularly during the second stage.

Several questions remain open. To what extent can the differences between the RGT and NCT be explained by worker players' responses to the firm players' reputations (based on previous behavior)? To what extent are deviations from optimal outcomes due to fairness considerations? To examine these questions, we further analyze worker behavior using a series of regressions on worker players' actions in the first and second stages of the three treatments. We use two sets of dependent variables in the analysis: first, ACTION_1 and ACTION_2 (0 = low, 1 = medium, 2 = high), and, second, TOO LOW_1, TOO LOW_2, TOO HIGH_1, and TOO HIGH_2 (1 = effort is suboptimally low or high in the first or second stage, and 0 otherwise). As with the previous analysis, we use data from rounds 6-19.

The first set of regressions examines the determinants of ACTION_1 and ACTION_2, estimated using multinomial logit.[10] To provide a sensitivity analysis for our results, we report two specifications for the RGT. The main independent variables are the wage offers (W_{11}, W_{12}, and W_{13} in the FCT and W_{11}, W_{22}, and W_{33} in the NCT and RGT) and non-binding wage promises (W_{12}, W_{13}, and W_{23} in the NCT and RGT). The regression also includes independent variables that capture the effect of subjects' understanding of the experiment and personal characteristics. The measures of understanding are ROUND – the number of times that the subject has played the game, a measure of learning by doing; and TEST SCORE – the score that the subject attained on a pre-experimental quiz.[11] If players intended to maximize their earnings (i.e. behave in accordance with the Lazear model) but made mistakes in their calculations, one would expect that more knowledgeable players would be less likely to play high. Thus the coefficients on both ROUND and TEST SCORE are expected to be negative in the regression for ACTION = high. As medium effort may be either an optimal or suboptimal action, depending on the wage offer, we do not have any prior expectations for the sign of these coefficients in the

[10] Because each subject plays 20 rounds there is a repeated measurement problem, with the consequence that standard methods will underestimate the variance of the coefficient. To accommodate repeated measurement, we ran the multinomial logit regressions clustering on individual subjects. See White (1980) for details.

[11] Subjects took a quiz with 13 questions based on the instructions shown in the Appendix prior to the experiment commencing. Their computer screen indicated incorrect answers and subjects were required to resubmit answers to these questions. The experiment did not begin until each subject had correctly answered each of the questions. The variable TEST SCORE reflects the number of correct answers on the first time the subject submitted the quiz. The quiz is available from the authors upon request.

regression for ACTION = medium. The regression controls for personal characteristics (obtained from a post-experimental questionnaire) are SEX, AGE, STUDY YEAR (undergraduate =1, 2, 3; masters = 4; PhD = 5, 6, 7), ECONOMICS (1 if majoring in economics), and session dummies. We do not have strong prior expectations on the signs of the coefficients on these variables.

The additional specification for the RGT is included to capture the importance of reputation in the repeated game framework. We add reputation variables showing the average of actual wage offers made in previous rounds (X's average W_{11}, X's average W_{22}, X's average W_{33}), which were available to the worker players at the time they had to decide on effort levels.[12]

Our main interest is in the wage variables, and, in the case of the RGT, the reputation variables. In the FCT, the Lazear model predicts that W_1 will have no effect on effort and that W_2 and W_3 will have an equal positive effect on first period effort levels. The model also predicts that only W_3 will have a positive effect on second period effort levels. High effort is always off the equilibrium path (as is medium effort in the NCT) and thus wages offers should have no effect on the probability that effort is high (or medium in the NCT). The Lazear model also predicts that workers will supply more effort if firms have a reputation for treating older and retired workers well. Thus the coefficients on the reputation variables for later stages of the game are predicted to be positive (e.g. a worker player is likely to supply more effort in stage 1 if the firm player has a history of making good wage offers in stages 2 and 3). The gift exchange model implies that worker players will consider the overall fairness of the wage offers and will supply effort in response to high wage offers, even when it is off the equilibrium path. For example, a worker player concerned with fairness may supply effort in the first period in response to a high first period wage.

The regression results for the first and second stages are shown in Tables 2 and 3, respectively. Overall the regressions have considerable explanatory power, with each specification being significant at a .01 percent level. The regressions generally confirm the predictions of the Lazear model. In the FCT, the wage offers for future periods have the expected incentive effects. In each specification W_{12} and W_{13} have a positive, statistically significant influence on the probability that subjects play medium effort in the first period; and W_{13} has a positive, statistically significant influence on the probability that subjects play medium in the second period. The magnitudes of these effects are large. We have calculated the probabilities that a worker player plays low, medium, or high in the FCT given several hypothetical values of W_{11}, W_{12}, W_{13} using the results from Tables 2 and 3. The estimated probability of making the optimal decision is well over 50 percent for most values of W_1, W_2, and W_3, though there is a slight bias to playing low. In the NCT and RGT the non-binding wage promises for future periods have little effect on effort. The coefficients on non-binding wage promises are significant in a

[12] We have run the regressions using other reputation variables including the proportion of previous rounds in which nonbinding wage promises were equal to wage offers, the average difference between nonbinding promises and offers in previous rounds, and various interactions of the reputation variables and non-binding promises. The qualitative results are similar to those presented in the paper.

couple of specifications; however, the sign is sometimes negative and the size of the coefficients is small in every regression. We conclude that non-binding wage promises were not treated as being credible and that worker players expected the firm players to renege.

A second important result concerns the effects of the reputation variables. Worker players supplied more effort when matched with firm players who had a history of higher wage payments in the later stages of the game. In the post-experiment questionnaire, several of the worker players noted that they considered this. In stage 1, worker players increased their effort in response to increases in the firm player's average stage 2 wage offers in previous rounds. Similarly, in stage 2 worker players increased their effort in response to increases in the firm player's average stage 3 wage offers in previous rounds.

The coefficients on the knowledge variables are generally in accordance with the view that subjects intended to maximize earnings, but were computationally limited.[13] TEST SCORE (and sometimes ROUND) has a significantly negative effect on the probability that the subject supplied high effort, suggesting that the relatively infrequent examples of high effort were typically mistakes made by players with limited understanding of the game.

The results also provide some evidence for gift exchange. We focus on two types of responses as gifts: first, increased effort in response to high wage offers in the current period and, second, high levels of effort. In both cases the behavior is off the equilibrium path; in the first case, because current period offers have no incentive effects and, in the second case, because high effort is always strictly dominated by medium effort. Current period wage offers (stage 1: W_{11} for all treatments, and stage 2: W_{12} in the FCT and W_{22} in the NCT and RGT) have a positive, statistically significant influence on effort levels in the FCT, NCT, and RGT. In the RGT and NCT *only* wage offers in the current period have an effect on effort. This behavior can be interpreted as gift-exchange whereby worker players supply higher than equilibrium effort in response to having received an above equilibrium wage offer. In the FCT, W_{11} has a positive, statistically significant influence on subject effort in the first period and W_{12} has a positive, statistically significant influence on subject effort in the second period. Though this is consistent with gift exchange, the effort response to current period wage offers is of considerably smaller magnitude than the response to future period offers (which effect incentives). For example, the predicted effort levels of Worker players for the FCT show that the estimated effort supplied in response to (20, 0, 0) is virtually identically to that supplied in response to (0, 0, 0) and similarly with (20, 20, 40) and (0, 20, 40). Notice also that our results indicate that the intertemporal allocation of wages matters for gift exchange. It is

[13] Anecdotally, this coincides with evidence from the post-experimental questionnaires. A few subjects indicated that they did not completely understand the game initially and improved their performance through trial and error. Another more formal test of bounded rationality is to look at the relationship between whether a subject played optimally in the first stage of a round and whether they played optimally in the second stage. We have run a logistic regression and find that playing optimally in the first stage increases the probability of playing optimally in the second stage by about 70 percent. This is statistically significant at a 5 percent level and is robust to the inclusion of control variables (W_1, W_2, W_3, TEST SCORE, ROUND).

not the entire rent left to the worker that triggers workers' generosity but specifically the first-period wage where it is, from a theoretical viewpoint, unambiguously clear that non-zero offers are gifts.

The second source of evidence on gift giving comes from workers supplying high effort, which is always off the equilibrium path. Consistent with a model of gift exchange, in each treatment higher wage offers increased the probability of high effort. However, the results also suggest that high effort was more likely to be due to subject error than to fairness considerations. As shown in Table 1, high effort occurred relatively rarely after the first few rounds. Moreover, Tables 2 and 3 show that the subjects with a good understanding of the game (i.e. those getting quiz scores of 11 or higher) almost never played high, regardless of the wage offer.

To further test whether actions off the equilibrium path were mistakes or gift giving, we have run a series of logit regressions on the determinants of suboptimal effort. The dependent variables are TOO LOW (1 if effort = low, optimal effort = medium) and TOO HIGH (1 if effort = high or effort = medium, optimal effort = low) and the independent variables in the regressions are the wage offers, TEST SCORE, ROUND, and personal characteristics.[14] We interpret positive coefficients on the wage offers in the regressions on TOO HIGH as evidence of gift exchange, whereas we interpret positive coefficients on TEST SCORE and ROUND as evidence of mistakes.

The regression results are presented in Tables 4 and 5 (for stage 1 and stage 2 of the experiment). There is some evidence of gift exchange in the tables. The coefficient on current stage wage offer in the regression on TOO HIGH is significantly positive in the FCT. The coefficient on current stage wage offer has an even stronger effect on the probability that the subject supplies too much effort in the NCT. This is broadly consistent with the findings of Fehr, Kirchsteiger, and Riedl (1993), who in a one stage set-up find that subjects engage in non-enforceable cooperation to bring about socially superior outcomes. However, the much smaller coefficients in the FCT along with the importance of future wages shown in tables 3 and 4, suggests that gift exchange may play a much smaller role when it is possible to write legally enforcing contracts over multiple periods. In other words, formal and informal mechanisms that improve social efficiency appear to work as substitutes.

We conclude this section by briefly examining how workers differ in their behavior. For each subject we compute how often, on average, they choose optimal effort given the wage offers. Figure 3 plots the distribution over these optimality rates across subjects in the FCT and NCT. In both treatments between 67% around 75% of all worker subjects choose optimally in at least two thirds of all their choices. The median behavior is 76.5% and 82.2%, of optimal effort choices in the FCT and NCT, respectively. In both treatments there is a small minority of worker subjects who systematically fail to optimize. Regressing the percentage of optimal choices on test score, we find strong

[14]We also ran the regressions with ROUND and TEST SCORE but without personal characteristics. The results were very similar to those of the regressions with personal characteristics and are thus not reported in this paper.

support (p < .01) for the hypothesis that bounded rationality influenced off-equilibrium behavior.

We summarize our findings for worker players in the following:

Result 1 *Despite some heterogeneity, worker player behavior is predicted well by the Lazear model. Subjects respond well to the monetary incentives provided. There is strong evidence that worker players increase their supply of effort in response to binding higher future period wage offers. There is little evidence that worker players increase their supply of effort in response to non-binding higher future period wage promises. There is also evidence that with repeated play worker players supply higher effort if the firm player has a history of making high wage offers to older or retired workers. There is, however, also evidence for gift giving. Worker players provide higher effort when offered higher wages, in particular when the wage offers have no incentive effect on effort. Finally, we find evidence for bounded rationality. There is considerable subject heterogeneity and worker players were more likely to play optimally if they had a good understanding of the rules of the game.*

III.2 Firms

The behavior of firm players is more complex. Unlike the worker players whose decisions map directly into payoffs, the firm players must anticipate the worker players' response to their wage offer. To the extent that worker players' actual strategies deviate from equilibrium and these deviations change over time, firm players must also update their offers.

The expected payoff to the firm player can be calculated under the assumptions that i) worker players always provide the equilibrium response to their wage offer and ii) worker players respond probabilistically in the manner estimated from tables 2 and 3.[15] Under equilibrium response, the firm player's expected payoff is (W_1, W_2, and W_3 denote actual wage offers):

$$200 - W_1 - W_2 - W_3 \quad \text{if } (W_2+W_3) \geq 60 \text{ and } W_3 \geq 40$$
$$150 - W_1 - W_2 - pW_3 \quad \text{if } W_2 \geq 40 \text{ and } W_3 < 40$$
$$100 - W_1 - pW_2 - p^2W_3 \quad \text{otherwise}$$

Under probabilistic response, the firm player's expected payoff is (we denote e=0 if the round ends prior to a stage being reached):

$\sum_{e,t} \pi_{e,t} Z_{e,t} - W_t p_{e_{t-1,t-2}}$ where e = 0, L, M, H; t = 1, 2, 3; $\sum_{t=2,3;e=0} Z_{e,t} W_t = 50$; $p_{e_{t-1,t-2}}$ is the probability that the round has ended given the worker player's effort in previous rounds; and $\pi_{e,t}$ is the probability that the worker player chooses effort e in stage t, estimated using the regression coefficients from Tables 2 and 3.

[15] We estimate these probabilities using a "representative" worker player, who takes on the mean values of the continuous variables and the modal values of the discrete variables.

We calculated the expected payoffs for all possible combinations of W_1, W_2, and W_3 in the FCT, using the probabilities estimated from Tables 2 and 3 (using a representative subject). As might be expected from what we have seen in the previous subsection on workers, the optimal strategy in the FCT is to offer deferred compensation. The firm players' optimal strategy in the FCT is (0, 20, 41), very close to the equilibrium wage offer, (0, 20, 40). The expected payoff is 110.93. For the NCT, using all possible combinations of W_{11}, W_{12}, W_{13}, W_{22}, W_{23} and again using the probabilities estimated in table 2 and 3, the optimal strategy is (0, 120, 0) at stage 1 and (0, 120) at stage 2, with an expected payoff of 115.83. In each treatment, using either rounds 1-20 or rounds 6-19, both equilibrium strategies yield an expected payoff of at least 98 percent of the maximum across all possible strategies. These figures provide further evidence that the Lazear model does an excellent job of predicting worker behavior.

Figure 4 shows the average total offer made by firm players over 20 rounds and the percentage of the offer made in stages 1 and 3 for all three treatments. It can be seen from this figure that there is considerable learning by firm players over the course of the experiment. Firm players in all three treatments offered wages well above the equilibrium level in the early rounds and reduced their total offers sharply over the course of the game. In addition, Figure 4 shows that the distribution of offers across stages changed over the experiment, particularly in the FCT, where subjects learned to defer compensation. In the FCT the stage-1 wage offer averaged 34.3 in rounds 1-5, but only 13.7 in rounds 14-19. Over half of the firm players (51.1 percent) made zero wage offers (the theoretical equilibrium) in rounds 14-19, compared to only 12 percent in the first 5 rounds.

Figure 5 shows the expected payoff of the firm players over each round in the FCT and NCT, given that worker players' responded either optimally in accordance with the theoretical model or probabilistically as described above. It is evident that there was considerable learning over the course of the experiment, resulting in a near monotonic increase in expected payoff.

It is also evident from Figure 4 that there are large differences in the firm players' strategies across treatments. These differences are consistent with the theoretical predictions of the model, namely that total pay should be higher in the FCT than in the NCT and that compensation should be deferred in the FCT, but not the NCT. From the first panel of Figure 4 it can be seen that the total offer is highest in the FCT and lowest in the NCT. The gaps between the treatments are fairly small; however, this largely reflects sample selection bias, as we only have observations for the NCT and RGT when the round proceeded to stage 3 (which was disproportionately in cases with high wage offers). To correct for this bias, we consider only rounds where both coin tosses were heads, and thus the round proceeded to stage 3 regardless of the wage offers. Combining stages 14-19, we observe that the average total wage offer was 57.48, 37.32, and 23.02 in the FCT, RGT, and NCT, respectively (this compares to figures of 59.97, 54.15, and 30.86 when we consider all rounds that proceeded to stage 3).

We can use the second and third panels to compare the extent of deferred compensation across the three treatments. The Lazear model predicts that in the FCT there will be a high share of total compensation in the third stage and low (zero) share in the first stage. The Lazear model predicts 0 total compensation in the NCT, thus the shares by stage are undefined. A model of gift exchange predicts that compensation should be offered early in the round so that the worker player has time to respond to gifts. A key difference between the NCT and RGT in this respect is that in the RGT worker players in subsequent rounds can observe payments in stage 3, and may supply more effort as a result. The second and third panels of Figure 4 show outcomes in accordance with these predictions. The share of compensation in the first period is much lower and the share in the third period is much higher in the FCT than in the NCT. The RGT falls in between the FCT and NCT for both stages.

We can also examine whether there are noteworthy differences between firm subjects. Figure 6 plots the distribution of total wage offers during rounds 14-19 of the experiment. The figure reveals substantial heterogeneity, and there emerges a sharp distinction between two groups of firm players. One group of players attempts to persuade the worker players to supply effort by making positive wage offers, while another basically decides to exit the game by offering (0,0,0). Offering zero wages comes close to exit since it guarantees a minimum payout of £1 per round, but it also very rarely leads to higher profits. In the FCT the wage offers of those making positive offers cluster around the theoretical equilibrium of 60, whereas in the NCT and RGT the distribution is fairly uniform. Not surprisingly (0, 0, 0) is far more common in the NCT, where it is the theoretical equilibrium.

Firm players also differ substantially in how much they learn to defer compensation. Figures 7 and 8 plot the distribution over the shares of first- and final-period wages — again both for rounds 1-5 and 14-19. For both figures, we have excluded all (0,0,0) wage offers since the shares are not defined in this case. Both figures show considerable subject heterogeneity, even in the latter rounds of the experiment. Both figures also show striking evidence of learning. In the FCT wage offers are much more end-loaded in the later rounds. Initially, less than 10% of subjects choose first-period wages close to zero, but towards the end this figure was over 40%. The figure also shows that a small minority of firm subjects relies on pure gift exchange by offering all wages in the first period. In addition, by the latter rounds a growing minority of subjects paid the majority of their wage offer in the third stage. By contrast, in the NCT compensation was heavily frontloaded even in the early rounds. By the latter rounds virtually all subjects chose to pay nothing or very little in the third stage.

Finally, we examine gift giving by firm players in the NCT and RGT by examining the determinants of wage offers in stages 2 and 3 using OLS regressions, with fixed effects to control for individual heterogeneity. The independent variables in the regressions are their wage promises and the worker player's effort level, both from earlier stages of the same round. The regression results are shown in Table 6. The results show that firm players ignored their prior promises when deciding on actual wage offers, which is consistent with the results shown in Tables 2 and 3 that the worker players did not believe the promises. However, the most striking result from Table 6 is that firm players strongly rewarded worker effort in the previous stage, in some specifications fully offsetting the cost of their effort. This is consistent with the findings of previous experiments, showing that gift exchange leads to socially improved outcomes. The results also show that the response to effort in the RGT is somewhat higher than in the NCT. One explanation for this is that in the RGT higher wage offers enabled the firm player to improve their reputation for future rounds as well giving a gift to a worker who had supplied effort.

We summarize our findings for firm players in the following:

Result 2 *Firm player behavior is predicted reasonably well by the Lazear model. However the model does not predict firm behavior as well as worker player behavior, probably because of strategic uncertainties faced by firm players. In addition, there is greater evidence of bounded rationality and subject heterogeneity. In early rounds subjects offered excessively high wages. Few subjects deferred compensation, though wage offers in the NCT were more front-loaded than in the FCT. Over time, subjects in all three treatments learned to reduce their wage offerings, and increased their own earnings as a result. Subjects in the FCT drastically reduced their offers for the first stage, and some subjects learned to defer compensation. By contrast, subjects in the NCT made their offers even more frontloaded. As with the worker players, the strategies played by the firm players in the RGT were in between the other two treatments. Finally, we find strong evidence of gift giving by the firm players in the NCT and RGT. Firm players responded to previous effort by the worker player with generous wage offers.*

IV. Conclusions

There exists a sizeable theoretical literature showing that deferred compensation can be used by firms to elicit higher effort from their employees. The effect of deferred compensation on worker effort has thus far eluded direct empirical testing, as this sort of compensation structure is most likely to be used if it is impossible to measure all of the dimensions of short-term output and effort. However, there has been indirect evidence for the relevance of deferred compensation. This paper supplements this indirect evidence by directly testing the relationship between the time structure of wages and worker effort in an experiment. It is the first experiment to investigate the role of the intertemporal allocation of wages for incentivizing workers.

The experiment begins with a firm player making a wage offer for three periods. In one treatment, the wage offer is binding for all three periods. In a second treatment, the firm player is allowed to change their offer at the start of each period. In a third treatment, the firm player is also allowed to change their offer at the start of each period, but the worker player observes the history of the firm payer's binding and nonbinding wage offers. If the firm player is able to commit to its wage offer in advance, in equilibrium, it offers a wage below marginal revenue product in the first period and above marginal revenue product in the third period and the worker player supplies effort levels above what they would supply in a spot labor market in the first two periods. In the absence of commitment, in equilibrium, the firm player pays zero wages and the worker player supplies low effort in all three periods.

We find that the worker players play according to the equilibrium over 70 percent of the time, thus it is possible for the firm player who is able to commit to wage offers in advance to induce higher effort using deferred compensation. We also find some evidence that gift exchange influences the supply of effort. However, when firm players were able to commit to wage offers, the effects of incentives on worker effort dominate the effects of gift exchange. In the two treatments where firm players were not able to commit to wage offers in advance, we find a stronger role for gift exchange, showing how formal and informal mechanisms to increase social efficiency serve as substitutes. Worker players responded to high wage offers in the current period with increased effort and firm players responded to increased effort in the current period with higher wage offers in the next period. However, the amount of effort supplied (and thus the social surplus) was considerably higher in the treatment where firms could commit to wage offers and incentivize their workers.

We also find that the ability of firm players to build a reputation for high wages matters for social surplus. Worker players supplied higher effort when they could observe that they were paired with a firm player with a history of high wages in future stages. This is in line with experimental evidence from the industrial organization and the social capital literature that shows how feedback information can enable reputation building and, thus, improve outcomes in trust games or markets for experience goods. Similar to our results, reputation building in trust games achieves higher but not full efficiency (see, for example, Bohnet *et al.*, 2005).

Finally, we found considerable evidence of bounded rationality and learning during the experiment. Subjects with a better understanding of the experiment (as measured by a pre-experiment quiz) consistently made choices that were closer to the equilibrium strategy. In addition, subjects played closer to the equilibrium after they played several rounds of the experiment.

Our results strongly support the relevance of intertemporal wage allocation for worker and, ultimately, firm performance. A crucial role for intertemporal wage allocation — its shape and effect — is assumed by the strength of commitment. With full commitment we observe the strongest effect but, crucially, not all is lost if there is only weak (endogenous) commitment through reputation building.

Figure 1
A Deferred Compensation Contract

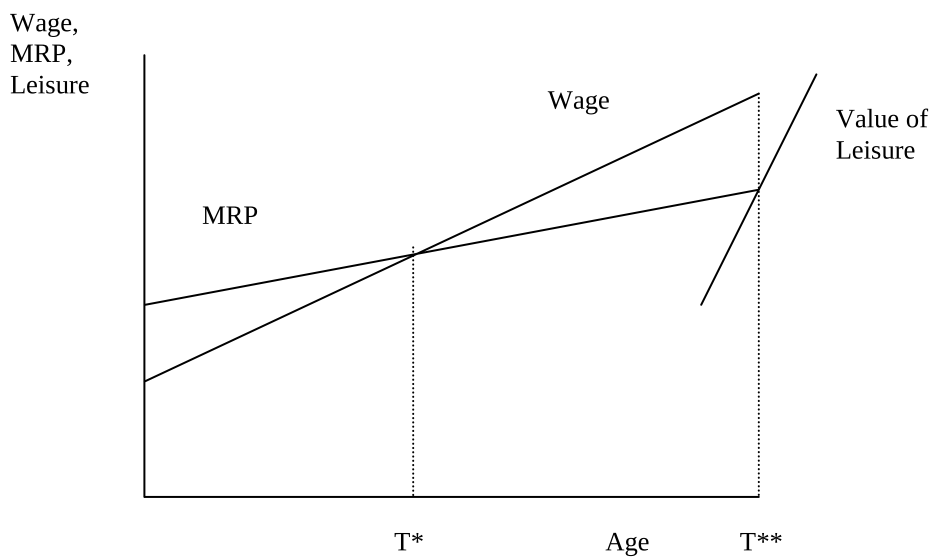
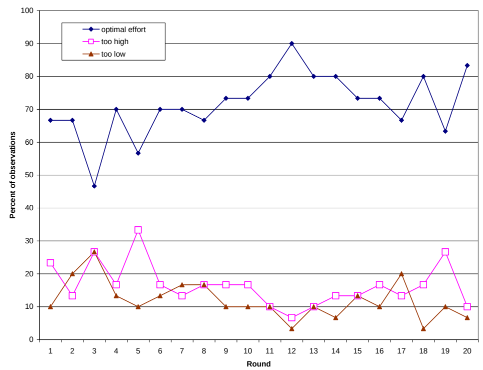
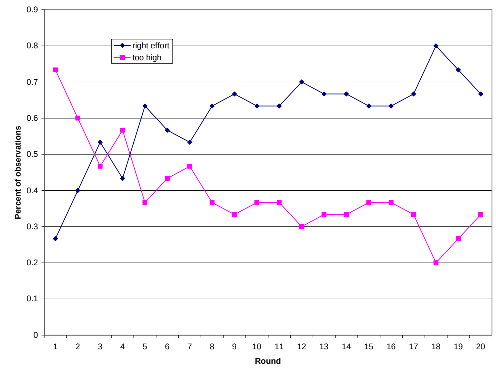


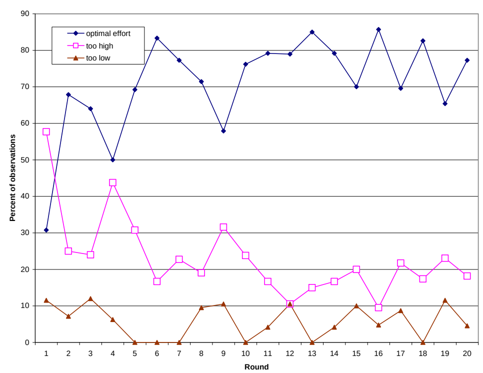
Figure 2 – Percent of Subjects Providing Optimal, Too Much, and Too Little Effort Given W_1, W_2, W_3



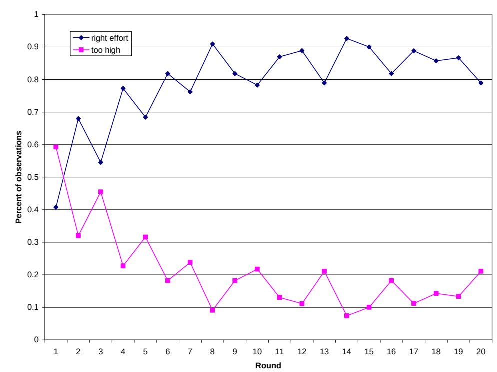
FCT (stage 1)



NCT (stage 1)



FCT (stage 2)



NCT (stage 2)

Figure 3
Distribution of Optimality Rates Across Subjects and Treatments

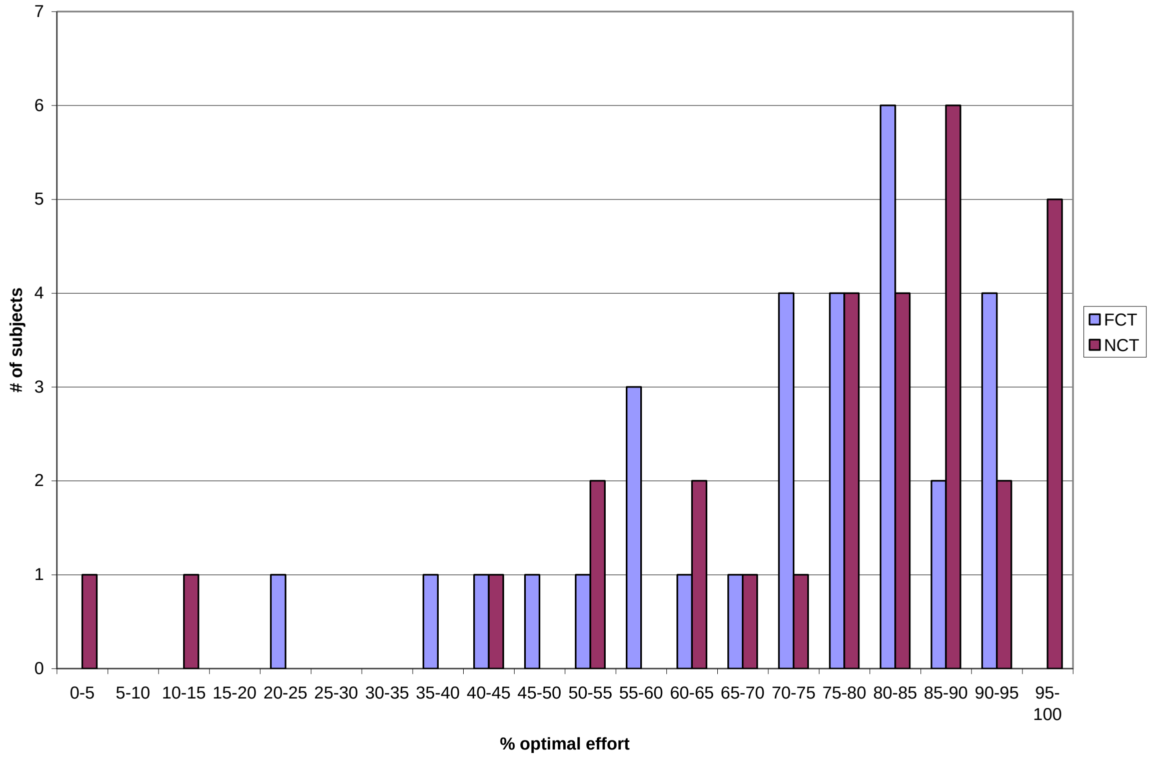
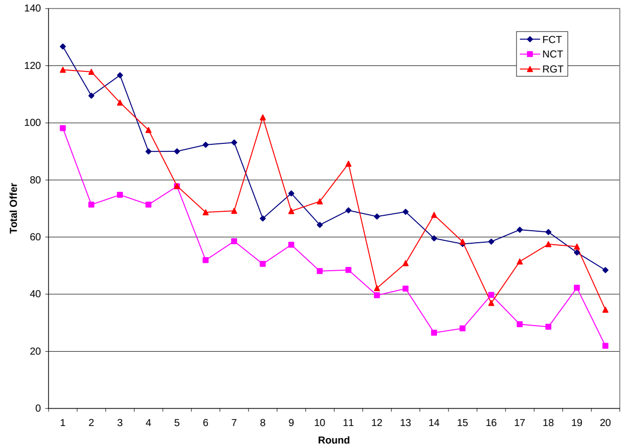
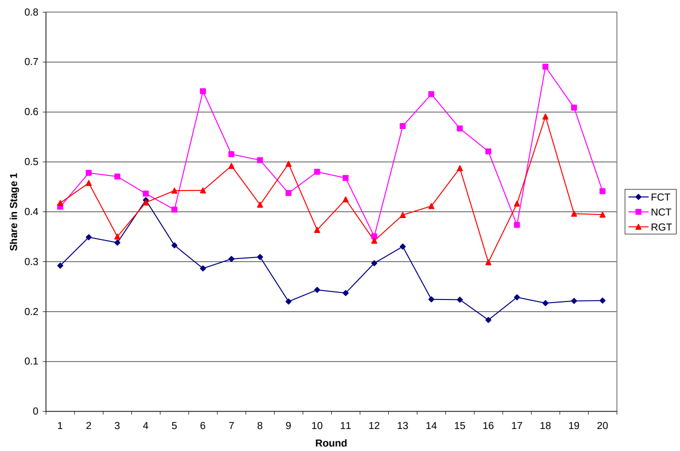


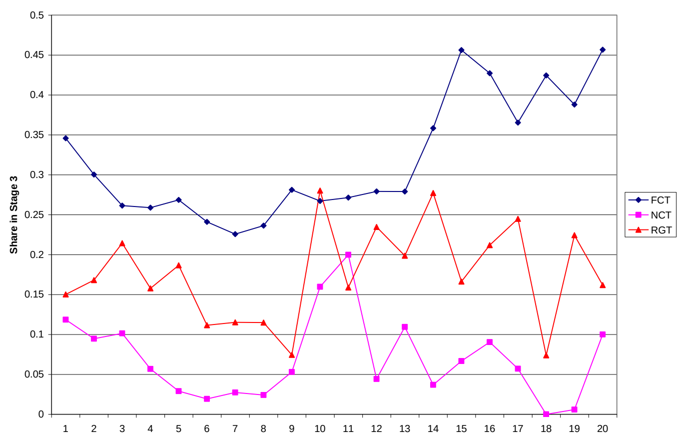
Figure 4
Wage offers by Round



Total Wage Offer



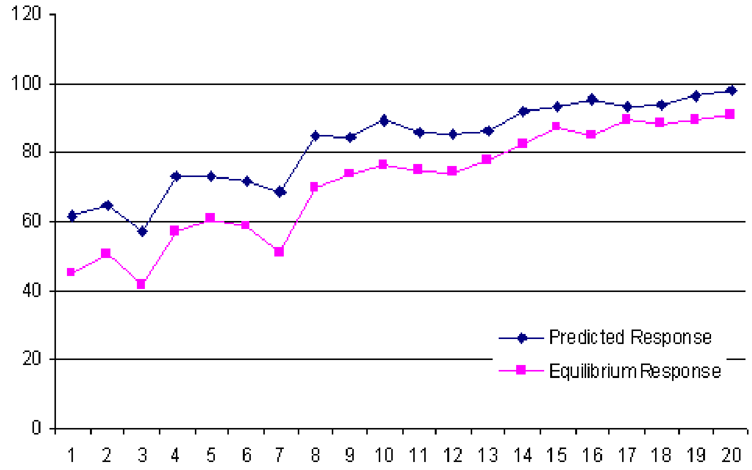
Percent in Stage 1



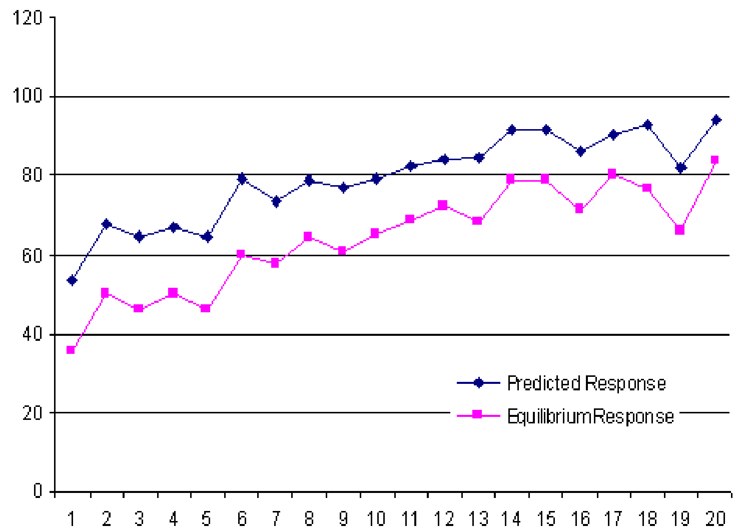
Percent in Stage 3

Figure 5
Average Expected Returns for Firm Players by Round in FCT & NCT

FCT

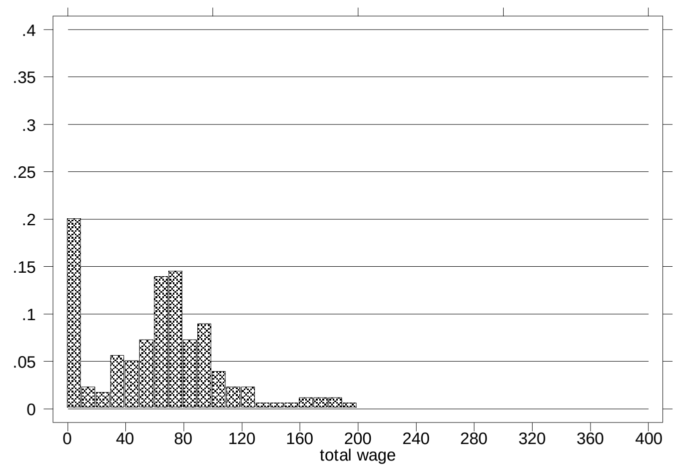


NCT

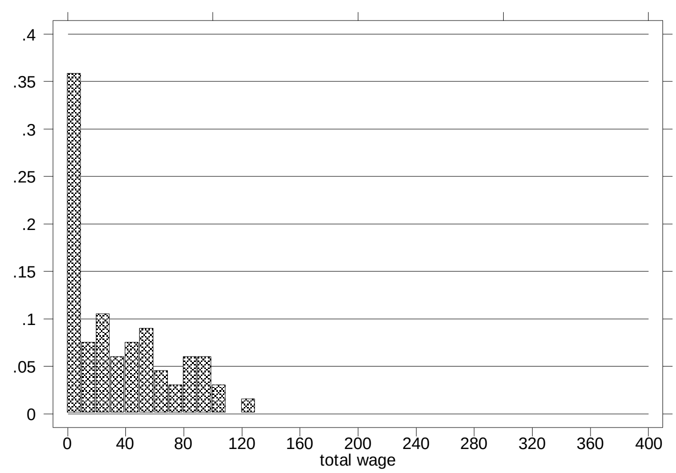


Note: Equilibrium response assumes that worker players always behave in accordance with the model described on pages 4-7. Predicted response assumes that workers behave probabilistically as estimated in tables 2 and 3.

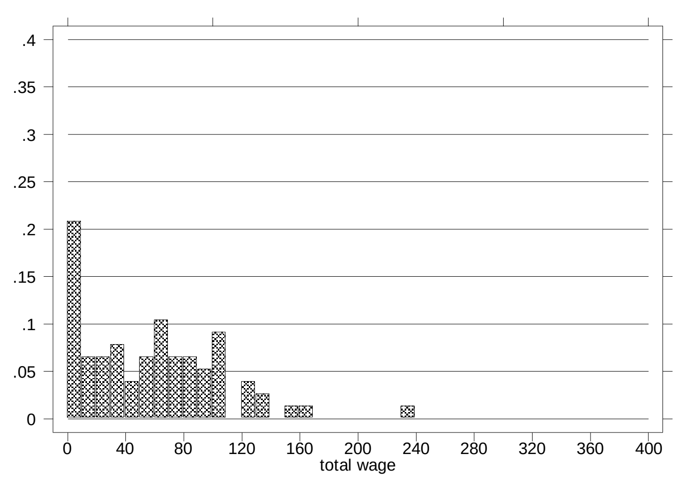
Figure 6
Distribution of Wage Offers in Rounds 14-19



Full Commitment

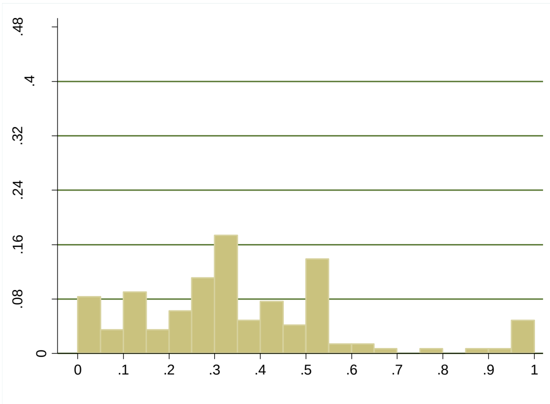


No Commitment

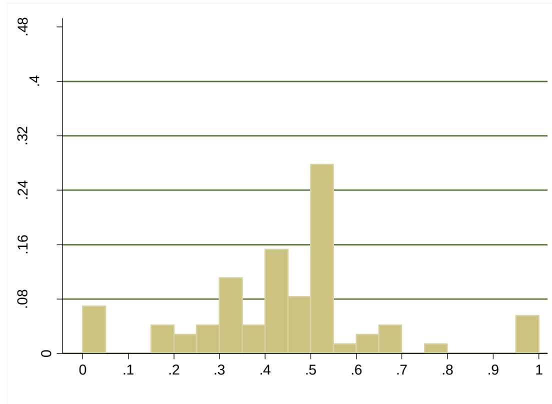


Repeated Game

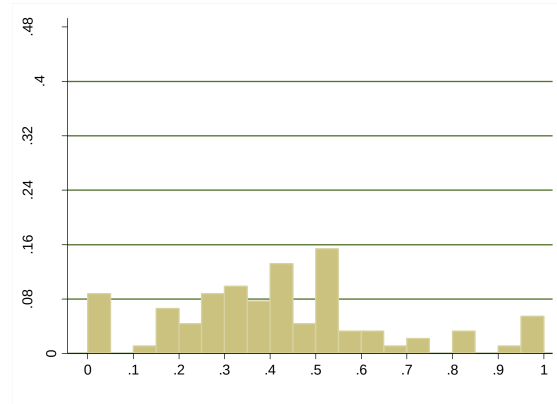
Figure 7
Distribution of Share of Wage offers in Stage 1, Rounds 1-5 and Rounds 14-19



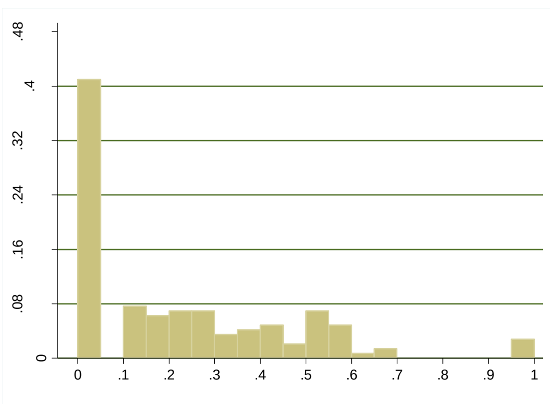
FCT, Rounds 1-5
(Mean = .3468, Median = .3333)



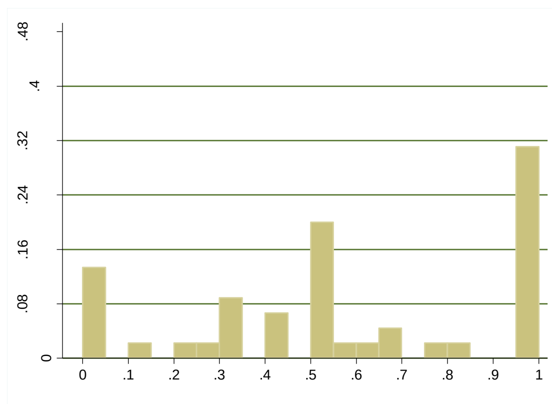
NCT, Rounds 1-5
(Mean =.4422, Median = 4545)



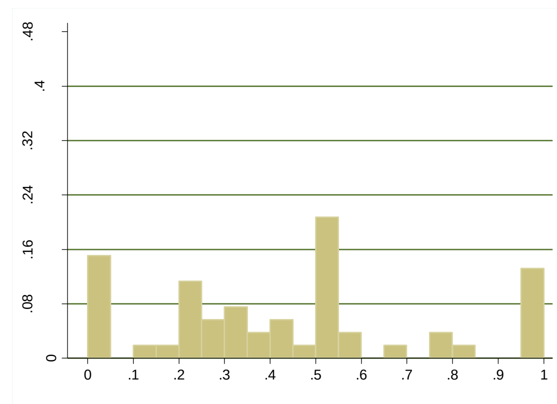
RGT, Rounds 1-5
(Mean = .4125, Median = .4000)



FCT, Rounds 14-19
(Mean = .2163, Median = .1538)

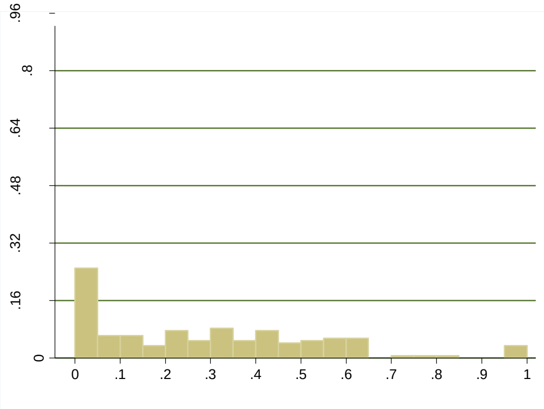


NCT, Rounds 14-19
(Mean = .5712, Median = .5000)

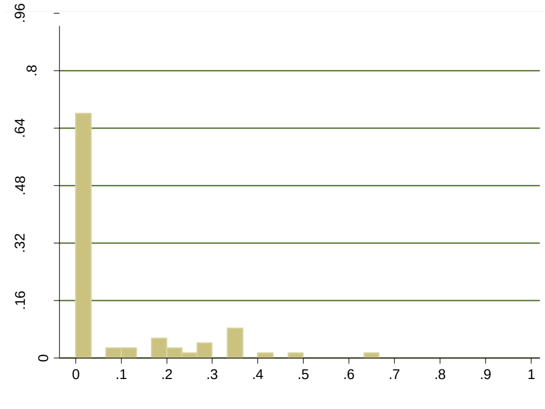


RGT, Rounds 14-19
(Mean = .4251, Median = 4286)

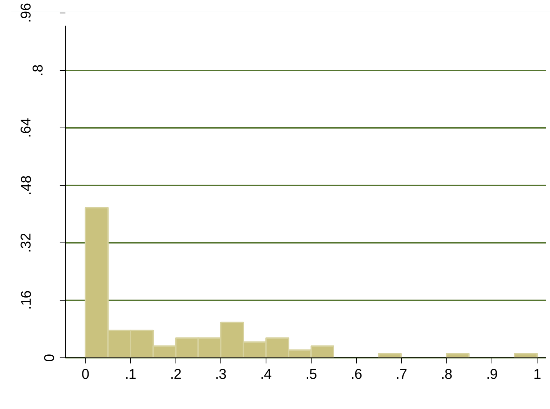
Figure 8
Distribution of Share of Wage offers in Stage 3, Rounds 1-5 and Rounds 14-19



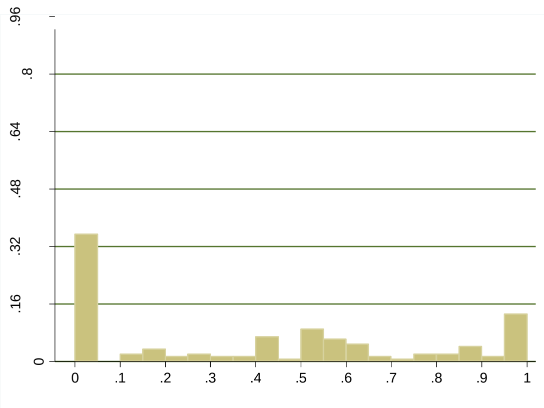
FCT, Rounds 1-5
(Mean = .2876, Median = .2500)



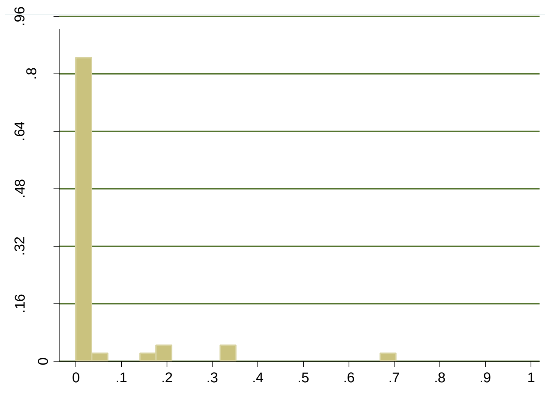
NCT, Rounds 1-5
(Mean =.0887, Median = .0000)



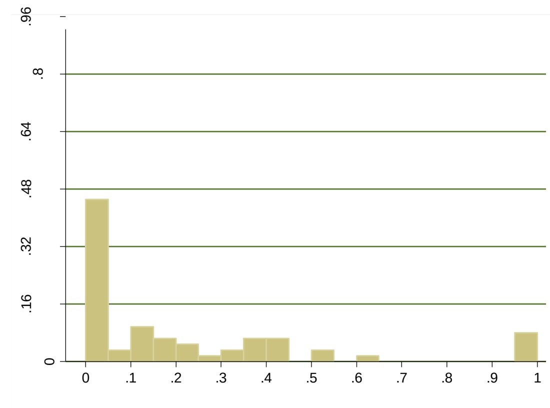
RGT, Rounds 1-5
(Mean = .1753, Median = .2103)



FCT, Rounds 14-19
(Mean = .4033, Median = .4211)



NCT, Rounds 14-19
(Mean = .0436, Median = .0000)



RGT, Rounds 14-19
(Mean = .2103, Median = .1000)

Table 1
Distribution of Actions and Social Surplus in the 3 Treatments

	Stage	Low	Medium	High	Social Surplus	N
FCT	1	51.90	42.38	5.71	65.57	420
FCT	2	60.91	34.53	4.56	59.24	307
NCT	1	65.48	29.76	4.76	61.31	420
NCT	2	84.93	9.93	5.14	53.86	292
RGT	1	62.14	31.19	6.67	62.69	420
RGT	2	73.78	21.68	4.55	55.98	286

Notes: Actions expressed as a percent of observations. The social surplus in each stage is 50 if low or stage 2 is not reached, 80 if medium, 100 if high.

Table 2
Multinomial Logit Regressions on Player Y's Actions in Stage 1 Rounds 6-19

		FCT	NCT	RGT	RGT
$ACTION_1$ = medium	W_{11}	.0141 (1.59)	.0484** (4.30)	.0357** (3.78)	.0409** (3.18)
	W_{12}	.0599** (6.19)	.0106** (2.87)	.0028 (0.48)	.0053 (0.83)
	W_{13}	.0222** (3.54)	-.0062 (1.62)	.0028 (0.55)	-.0003 (0.08)
	Test Score	-.0245 (0.38)	-.0335 (0.26)	-.0444 (0.43)	-.0177 (0.17)
	X's average W_{11}				-.0278 (1.90)
	X's average W_{22}				.0228 (1.50)
	X's average W_{33}				.0121 (0.91)
	Constant	-4.200* (2.26)	-2.026 (1.24)	-0.374 (0.21)	-0.4347 (0.23)
$ACTION_1$ = high	W_{11}	.0286* (2.46)	.1110** (5.14)	.0685** (4.58)	.0932** (3.50)
	W_{12}	.0538** (4.56)	-.0053 (0.41)	.0237 (1.94)	.0174 (1.40)
	W_{13}	.0360** (6.01)	.0248 (1.66)	-.0216 (1.51)	-.0261* (2.26)
	Test Score	-.0099 (0.08)	-1.5548* (2.37)	-.5734** (2.99)	-.5796** (2.58)
	X's average W_{11}				-.0919** (3.57)
	X's average W_{22}				.0746** (3.59)
	X's average W_{33}				-.0031 (0.11)
	Constant	-12.586** (3.18)	4.651 (0.70)	0.6308 (0.21)	.3403 (0.11)
	Observations	420	420	420	419
	Pseudo R^2	.2874	.1364	.1825	.2147

Notes: Absolute value of t-statistic in parentheses.
$ACTION_1$ = low is the comparison group.
* and ** indicate significance at the 5 and 1 percent level, respectively.
The control variables are: SEX, AGE, YEAR, ECONOMICS, and ROUND.
To accommodate the repeated measurement of individual subjects, the "robust cluster" option was used.

Table 3
Multinomial Logit Regressions on Player Y's Actions in Stage 2 Rounds 6-19

		FCT	NCT	RGT	RGT
$ACTION_1$ = medium	W_{11}	-.0029 (0.44)	.0229* (2.45)	.0010 (0.10)	.0172 (1.36)
	W_{12}	.0142 (1.95)	-.0054 (0.91)	-.0121 (1.57)	-.0054 (0.73)
	W_{13}	.0531** (5.16)	-.0227* (2.53)	.0119 (1.41)	.0037 (0.50)
	W_{22}		.0619** (3.12)	.0369** (3.05)	.0321** (2.77)
	W_{23}		.0101 (1.20)	.0033 (0.75)	.0097 (1.87)
	Test Score	-.0217 (0.73)	-.9210 (3.33)	-.0373 (0.28)	.0004 (0.00)
	X's average W_{11}				-.0664 (0.84)
	X's average W_{22}				-.0068 (0.32)
	X's average W_{33}				.0472** (2.85)
	Constant	-8.722** (4.14)	8.459 (1.93)	-0.7582 (0.37)	-2.647 (1.36)
$ACTION_1$ = high	W_{11}	.0076 (0.52)	-.0932** (4.59)	-.0100 (0.77)	-.0219 (1.24)
	W_{12}	.0246* (2.00)	.0183 (0.82)	-.0190 (1.03)	-.0031 (0.21)
	W_{13}	.0663** (4.61)	.0057 (0.37)	-.0041 (0.44)	-.0125 (1.44)
	W_{22}		.1409** (3.36)	.0487** (2.85)	.0414* (2.21)
	W_{23}		-.0059 (0.49)	.0113 (1.93)	.0158** (2.68)
	Test Score	.275 (1.45)	-3.445** (3.84)	-.0533 (0.14)	-.0000 (0.00)
	X's average W_{11}				.0303 (1.13)
	X's average W_{22}				-.0223 (0.63)
	X's average W_{33}				.0462* (2.17)
	Constant	-20.507** (3.15)	55.063** (2.73)	-3.516 (0.85)	-5.063 (1.19)
	Observations	307	292	286	285
	Pseudo R^2	.2971	.5881	.1540	.2009

Notes: See Table 2.

Table 4
Logit Regressions on the Determinants of Suboptimal Actions, Stage 1

	TOO LOW	TOO HIGH	
	FCT	FCT	NCT
W_{11}	-.0102 (1.41)	.0153** (2.86)	.0305** (4.82)
W_{12}	-.0482** (4.38)	-.0022 (0.38)	.0088* (2.12)
W_{13}	-.0230** (3.27)	-.0006 (0.12)	-.0021 (0.58)
Test Score	.0042 (0.06)	-.1023† (1.87)	-.1636** (3.18)
Round	-.0836* (1.98)	.0414 (1.16)	.0483 (1.60)
Constant	3.002* (2.43)	-1.4236† (1.88)	-1.058 (1.56)
Observations	224	420	420
LR χ^2	33.60**	11.21*	41.59**
Pseudo R^2	.2637	.0313	.0889

Notes: Absolute values of the t-statistics in parentheses.
** indicates significance at the 1 percent level.
* indicates significance at the 5 percent level.
† indicates significance at the 10% level.
Regressions on Too Low only include observations where $W_2 \geq 40$ or $W_2+W_3 \geq 60$.

Table 5
Logit Regressions on the Determinants of Suboptimal Actions, Stage 2

	TOO LOW	TOO HIGH	
	FCT	FCT	NCT
W_{11}	-.0296 (1.38)	-.0085 (1.26)	.0365** (2.94)
W_{12}	-.0037 (0.28)	.0193** (3.27)	-.0069 (0.77)
W_{13}	-.0195 (1.27)	-.0033 (0.66)	-.0025 (0.30)
W_{22}			.0416** (4.04)
W_{23}			.0066 (0.78)
Test Score	-.1917* (2.03)	-.0454 (0.68)	-.6964** (6.47)
Round	-.0052 (0.07)	.0188 (0.49)	.0388 (0.66)
Constant	2.285 (1.26)	-1.6675† (1.90)	2.458* (2.00)
Observations	89	307	292
LR χ^2	12.68*	11.44*	104.24**
Pseudo R^2	.1373	.0385	.4211

Notes: Regressions on Too Low only include observations where $W_3 \geq 40$.
Other notes as in table 4.

Table 6
Regression Results for Stage 2 and 3 Wage Offers, Rounds 6-19

	NCT	NCT	RGT	RGT
Stage	2	3	2	3
W_{12}	.0042 (0.12)		.0633 (1.59)	
W_{13}		.0200 (0.70)		.0050 (0.10)
W_{23}		-.0341 (1.34)		-.0069 (0.15)
$MEDIUM_1$	12.96* (4.47)	2.06 (0.97)	23.18* (8.61)	5.21 (1.40)
$MEDIUM_2$		10.36* (3.40)		14.05* (3.75)
$HIGH_1$	39.29* (4.36)	-1.95 (0.38)	36.45* (7.92)	-3.15 (0.57)
$HIGH_2$		22.54* (4.78)		27.29* (4.20)
Constant	23.36* (5.25)	-1.55 (0.48)	4.57 (0.94)	-2.13 (0.31)
Observations	292	170	286	171
Adjusted R^2	.2109	.1544	.3549	.1920
F	13.30*	4.18*	31.02*	4.12*

Notes: Absolute value of t-statistic in parentheses.
* indicates significance at a 1% level.
The regressions control for ROUND.

References

George Akerlof, 1982, "Labor Contracts as a Partial Gift Exchange", Quarterly Journal of Economics, 97: 543 – 569.

George Akerlof and Janet Yellen, 1990, "The Fair Wage-Effort Hypothesis and Unemployment", Quarterly Journal of Economics, 105: 255-83.

Iris Bohnet, Bruno S. Frey, and Steffen Huck, 2001, "More Order With Less Law: On Contract Enforcement, Trust, and Crowding", American Political Science Review, 95: 131-144.

Iris Bohnet, Heike Harmgart, Steffen Huck, Jean-Robert Tyran, 2005. "Learning Trust", Journal of the European Economic Association, 3, 2-3: 322-329.

Martin Brown, Armin Falk and Ernst Fehr, 2004, "Relational Contracts and the Nature of Market Interactions", Econometrica, 72: 747-780.

Martin Brown, Armin Falk and Ernst Fehr, 2008, "Competition and Relational Contracts: The Role of Unemployment as a Disciplinary Device", IZA Discussion Paper 3345.

Ernst Fehr and Armin Falk, 1999, "Wage Rigidity in a Competitive Incomplete Contract Market", Journal of Political Economy, 107: 106-134.

Ernst Fehr, Simon Gachter, and Georg Kirchsteiger, 1997, "Reciprocity as a Contract Enforcement Device: Experimental Evidence", Econometrica, 65: 833-860.

Ernst Fehr, Georg Kirchsteiger, and Arno Riedl, 1993, "Does Fairness Prevent Market Clearing?", Quarterly Journal of Economics, 108: 437-460.

Ernst Fehr, Georg Kirchstieger, and Arno Riedl, 1996, "Involuntary Unemployment and Non-Compensating Wage Differentials in an Experimental Labour Market", Economic Journal, 106: 106 – 121.

Ernst Fehr, Alexander Klein, and Klaus M. Schmidt, 2001, "Fairness, Incentives, and Contractual Incompleteness", University of Zurich, Working Paper No. 72.

Urs Fischbacher, 1999, "z-Tree - Zurich Toolbox for Readymade Economic Experiments - Experimenter's Manual", Working Paper No. 21, Institute for Empirical Research in Economics, University of Zurich.

Jagadeesh Gokhale, Erica Groshen, and David Neumark, 1995, "Do Hostile Takeovers Reduce Extramarginal Salary Payments?" Review of Economics and Statistics, 77, 3: 470-85.

Robert Hutchens, 1987, "A Test of Lazear's Theory of Delayed Payment Contracts", Journal of Labor Economics, 5: S153-S170.

Edward Lazear, 1979, "Why is there Mandatory Retirement?", Journal of Political Economy, 87: 1261-64.

Edward Lazear, 2000, "Performance Pay and Productivity", American Economic Review, 90: 1346-1361.

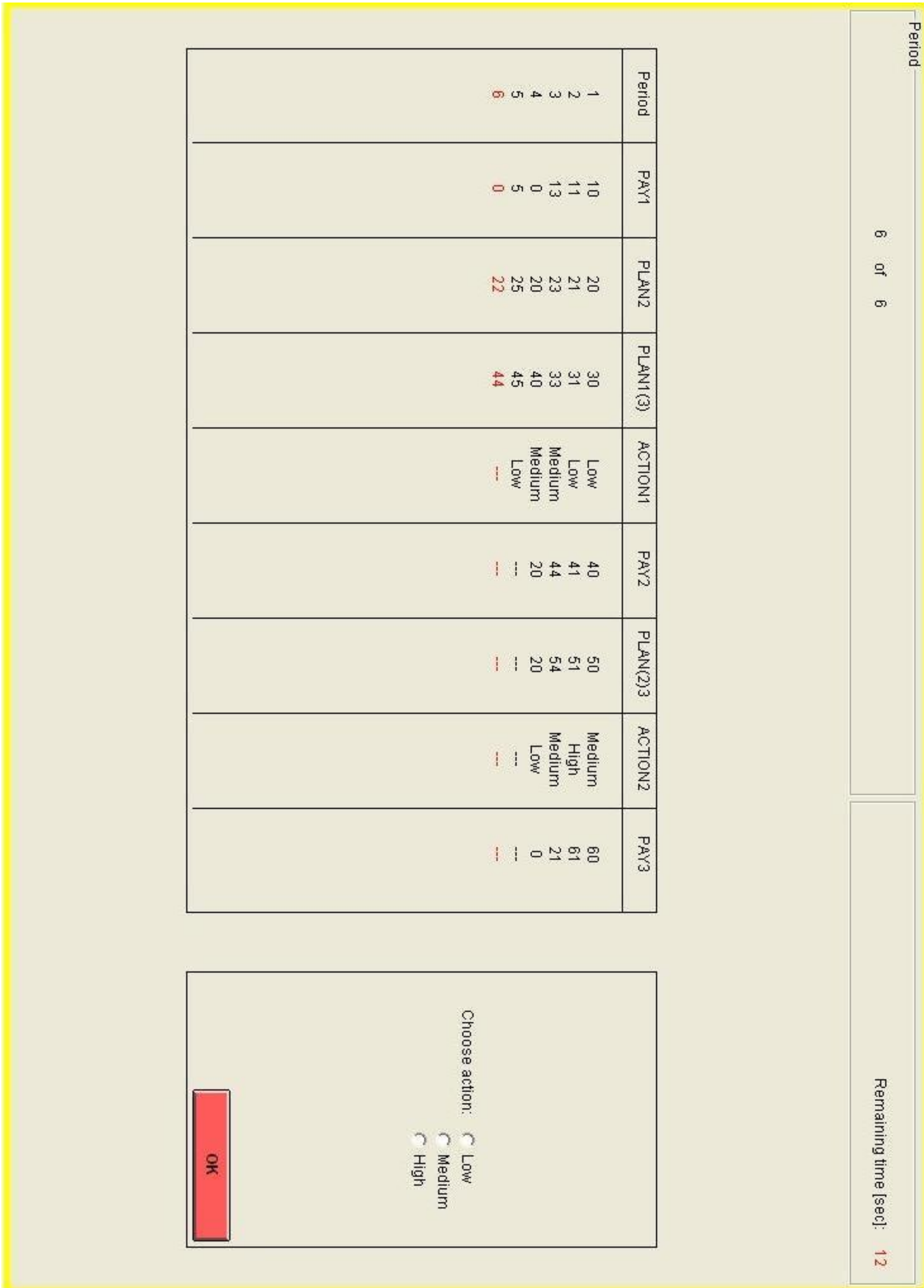
Canice Prendergast, 1999, "The Provision of Incentives in Firms", Journal of Economic Literature, 37, 1: 7-63.

Steven Salop and Joanne Salop, 1976, "Self-Selection and Turnover in the Labor Market," Quarterly Journal of Economics, 90, 4: 619-27.

Andrew Seltzer and David Merrett, 2000, "Personnel Practices at the Union Bank of Australia: Panel Evidence from the 1887-1900 Entry Cohorts", Journal of Labor Economics, 18: 573-613.

Halbert White, 1980, "A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity", Econometrica, 48: 817-838.

Appendix 1
A Worker Player's Computer Screen from the RGT



Appendix 2: Instructions to Subjects

FCT Instructions

Welcome to our experiment!

Please be quiet during the entire experiment. Do not talk to your neighbours and do not try to look at their screens. Simply concentrate on what you have to do. If you have any questions, please raise your hand. We will come to you and answer it privately.

You are participating in an economics experiment in which you interact with other participants for twenty rounds. Depending on your choices, the other participants' choices and luck you can earn a considerable amount of money. The amount of money you will receive depends on how well you understand these instructions, so read carefully. You will receive the money immediately after the experiment.

In each round you will interact with one other participant who is chosen at random. Once a round is over, you will be matched with a new participant, again at random.

At the beginning of the experiment each participant is assigned one of two roles, either X or Y. Everybody keeps their role during the entire experiment.

Let us now describe what happens in each of the 20 rounds. At the beginning of the round X has to offer Y some money. More specifically, he has to decide about three different amounts that will be paid to Y at stages 1, 2, 3 of the round. Depending on the actions of Y, the round may end before stage 2 or 3, in which case the amount offered by X will NOT be paid for those stages. After X has made the offer of some money, Y has to take up to two decisions that determine the total earnings of both X and Y.

Sounds complicated? Don't worry. Here is a detailed description of the entire round.

At the start of each round X decides about three different amounts that he is willing to pay to Y. Let's call these amounts W1, W2, and W3. The value of each W1, W2, and W3 can be any amount between £0.00 and £1.20. This is the only decision that X will make during the round, but the cash payoff of that decision depends on the process described below, so everyone should read on carefully.

1st stage: Y is informed about W1, W2, and W3. Then he faces his own choice: He has to pick one of three different actions, which we call LOW, MEDIUM, and HIGH. Each of these three actions cause some costs for Y and some benefits for X. Let's call these amounts COST1 and BENEFIT1.

If Y chooses LOW, he faces COST1 of £0.00, while X earns BENEFIT1 of £0.50.
If Y chooses MEDIUM, he faces COST1 of £0.20, while X earns BENEFIT1 of £1.00.
If Y chooses HIGH, he faces COST1 of £0.40, while X earns BENEFIT1 of £1.40.

If Y chooses MEDIUM or HIGH he receives (£0.40 + W1 – COST1). The round then continues with stage 2. If Y has chosen LOW, chance decides whether the round continues or not. More specifically, the computer will flip a coin. If it lands on heads, the round continues to stage 2. If the coin lands on tails, the round is over. The final payoffs received by the two players for the round are as follows:

X receives (£1.00 - W1)

Y receives (£0.40 + W1 - COST1)

Both participants are informed about what happened so far and their earnings for the round.

2nd stage: Stage 2 is the same as stage 1., i.e., again Y decides whether to choose LOW, MEDIUM, or HIGH. This has the same payoff consequences as in stage 1 (i.e. COST2 and BENEFIT2 are the same as COST1 and BENEFIT1).

If Y chooses MEDIUM or HIGH he receives (W2 – COST2) in addition to his earnings from stage 1. The round then continues with stage 3. If Y has chosen LOW, the computer will flip a coin. If it lands on heads, the round continues to stage 3.

If the coin lands on tails, the round is over. The final payoffs received by the two players for the round are as follows:

X receives (BENEFIT1 + BENEFIT2 – W1 – W2)
Y receives (£0.40 + W1 + W2 – COST1 – COST2)

Both participants are informed about what happened so far and their earnings for the round.

3rd stage: There is no choice in stage 3 and what happens is very simple. X pays the amount W3 (which he has chosen in the very first stage) to Y. That is, if round 3 is reached, we will subtract W3 from X's total earnings in this round and will add W3 to Y's total earnings in this round.

The final payoffs received by the two players for the round are as follows:

X receives (BENEFIT1 + BENEFIT2 – W1 – W2 – W3)
Y receives (£0.40 + W1 + W2 + W3 – COST1 – COST2)

At the end of the 3rd stage both X and Y will be reminded of what happened in this round, i.e., they will see X's choice of W1, W2, and W3 as well as Y's choices between LOW, MEDIUM, and HIGH. They will also see the final payoff for both X and Y in the round. Finally, you will see your total earnings so far, over all previous rounds.

At the end of the experiment you will be paid your total earnings over all 20 rounds in cash and be asked to sign a receipt.

This procedure may sound more complicated than it is. Take your time to read through the instructions again. And if you have any questions raise your hand. In a couple of minutes we will distribute an online questionnaire that we ask you to fill out. The purpose of this is simply to make sure that everybody fully understands the rules of the experiment before we actually start. You will need to answer each question correctly before beginning.

RGT Instructions

Welcome to our experiment!

Please be quiet during the entire experiment. Do not talk to your neighbours and do not try to look at their screens. Simply concentrate on what you have to do. If you have any questions, please raise your hand. We will come to you and answer it privately.

You are participating in an economics experiment in which you interact with other participants for twenty rounds. Depending on your choices, the other participants' choices, and luck you can earn a considerable amount of money. The amount of money you will receive depends on how well you understand these instructions, so read carefully. You will receive the money immediately after the experiment.

In each round you will interact with one other participant who is chosen at random. Once a round is over, you will be matched with a new participant, again at random.

At the beginning of the experiment each participant is assigned one of two roles, either X or Y. Everybody keeps their role during the entire experiment.

Let us now describe what happens in each of the 20 rounds. At the beginning of the round X has to offer Y some money. More specifically, he has to decide about an amount that will be paid to Y at stage 1 of the round. He also has to inform Y about the amount that he plans to pay in stages 2 and 3. Depending on the actions of Y in stage 1, the round may end before stage 2 or 3, in which case the amount offered by X will NOT be paid for those stages. After X has made the offer of some money, Y has to take a decision that determines the total earnings of both X and Y. In the second stage X makes an offer of some money to Y and informs Y about his plans for an amount to be paid in stage 3. These amounts need not necessarily be the same as X's initial planned amounts in stage 1. After X makes the offer, Y has to take a decision that determines the total earnings of both X and Y and whether the round will proceed to stage 3. In the third stage X makes an offer of some money to Y. This amount need not necessarily be the same as X's planned amounts in stages 1 and 2. Y has no further actions to take in this round.

Sounds complicated? Don't worry. Here is a detailed description of the entire round.

1st stage: At the start of this stage X decides about three different amounts that he is willing to pay to Y. Let's call these amounts PAY1, PLAN2, and PLAN3a. The value of each PAY1, PLAN2, and PLAN3a can be any amount between £0.00 and £1.20. X must pay Y PAY1, but he can later change his mind about PLAN2, and PLAN3a.

Y is informed about PAY1, PLAN2, and PLAN3a. These values will appear in red on the next screen. The screen will also show X's history throughout this session, that is all past values of PAY1, PLAN2, and PLAN3a offered by this particular X. Additionally, it will contain information about how the Y's responded to these offers (ACTION1 and ACTION2). This information will be in black. Y will not be able to determine the identity of the other Y players in previous rounds. The last page of this handout contains a picture of this screen.

Then Y faces his own choice: He has to pick one of three different actions, which we call LOW, MEDIUM, and HIGH. Each of these three actions cause some costs for Y and some benefits for X. Let's call these amounts COST1 and BENEFIT1.

If Y chooses LOW, he faces COST1 of £0.00, while X earns BENEFIT1 of £0.50.
If Y chooses MEDIUM, he faces COST1 of £0.20, while X earns BENEFIT1 of £1.00.
If Y chooses HIGH, he faces COST1 of £0.40, while X earns BENEFIT1 of £1.40.

If Y chooses MEDIUM or HIGH he receives (£0.40 + PAY1 – COST1). The round then continues with stage 2. If Y has chosen LOW, chance decides whether the round continues or not. More specifically, the computer will flip a coin. If it lands on heads, the round continues to stage 2.

If the coin lands on tails, the round is over. The final payoffs received by the two participants for the round are as follows:

X receives (£1.00 - PAY1)
Y receives (£0.40 + PAY1 - COST1) where COST1 is zero because Y chose LOW at stage 1

Both participants are informed about what happened so far and their earnings for the round.

2nd stage: At the start of this stage X decides about two different amounts that he is willing to pay to Y. Let's call these amounts PAY2 and PLAN3b. The value of each PAY2 and PLAN3b can be any amount between £0.00 and £1.20. X must pay Y PAY2, but he can later change his mind about PLAN3b.

After X decides on PAY2 and PLAN3b Y is informed about these amounts on the screen described in stage 1 and shown on the back page of the instructions.

He then decides whether to choose LOW, MEDIUM, or HIGH. This has the same payoff consequences as in stage 1 (i.e. COST2 and BENEFIT2 depend on Y's choice in the same way as COST1 and BENEFIT1).

If Y chooses MEDIUM or HIGH he receives (PAY2 – COST2) in addition to his earnings from stage 1. The round then continues with stage 3. If Y has chosen LOW, the computer will flip a coin. If it lands on heads, the round continues to stage 3.

If the coin lands on tails, the round is over. The final payoffs received by the two participants for the round are as follows:

X receives (BENEFIT1 + BENEFIT2 – PAY1 – PAY2)
Y receives (£0.40 + PAY1 + PAY2 – COST1 – COST2) where COST2 is zero because Y chose LOW at stage 2

Both participants are informed about what happened so far and their earnings for the round.

3rd stage: X's actions in the third stage are similar to his actions in the second stage. At the beginning of the stage he must decide on the amount of money he is willing to pay to Y, PAY3. The value of PAY3 can be any amount between £0.00 and £1.20.

Y does not make any choices in stage 3 and what happens is very simple. X pays the amount PAY3 to Y. That is, if stage 3 is reached, we will subtract PAY3 from X's total earnings in this round and will add PAY3 to Y's total earnings in this round.

The final payoffs received by the two players for the round are as follows:

X receives (BENEFIT1 + BENEFIT2 – PAY1 – PAY2 – PAY3)
Y receives (£0.40 + PAY1 + PAY2 + PAY3 – COST1 – COST2)

At the end of the 3rd stage both X and Y will be reminded of what happened in this round, i.e., they will see X's choice of PAY1, PLAN2, PLAN3a, PAY2, PLAN3b, and PAY3 as well as Y's choices between LOW, MEDIUM, and HIGH. They will also see the final payoff for both X and Y in the round.

Finally, you will see your total earnings so far, over all previous rounds.

At the end of the experiment you will be paid your total earnings over all 20 rounds in cash and be asked to sign a receipt.

Below is the screen that the Y participant sees after X has made the offer of some money (i.e in stages 1 or 2). [The values chosen have been smudged out]

This procedure may sound more complicated than it is. Take your time to read through the instructions again. And if you have any questions raise your hand. In a couple of minutes we will distribute an online questionnaire that we ask you to fill out. The purpose of this is simply to make sure that everybody fully understands the rules of the experiment before we actually start. You will need to answer each question correctly before beginning. We will also distribute another questionnaire at the end of the experiment. This will ask some basic information about yourself and the approach you took during the experiment.

Below is the screen that the Y participant sees after X has made the offer of some money (i.e in stages 1 or 2). [The values chosen have been smudged out]