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The discreet charm of the collective contract

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Abstract

We compare individual with collective contracts using variations of a repeated gift-exchange game. Firms consist of one employer and three workers. In the individual variation (I) different workers can receive separate wages. In the collective variation (C) workers receive the same wage. I and C are played altering the order across sessions resulting in four treatments: 1I, 1C, 2I, 2C. The wage offered in the first period of 1C is significantly higher than the wage offered in the first period of 1I. Average wage and effort become indistinguishable in phase 1 afterwards. Individual contracts resulted on higher average effort but undistinguishable wages when comparing 2I with 2C. In spite of an experimental design favourable to individual contracts, collective contracts fared unexpectedly well.

JEL classification: C92
Keywords: laboratory experiments, gift exchange, collective contracts

1. Introduction

Employment contracts suffer from the problem of moral hazard (Holmstrom, 1982). In employment relationships, the problem occurs because it is impossible and/or costly to observe all aspects of employees' work, in particular their effort. This means that employment contracts are incomplete and employees have the opportunity to shirk, leading to low firm output. This problem is intensified in a team setting, since it is difficult to reward individual performances and employees thus have an opportunity to free-ride.

Principal-Agent literature from the 1970s and 1980s recommends that principals expend resources on monitoring each worker and pay accordingly. However, this literature pre-dates economists' recent work on social preferences such as reciprocity and altruism. This literature suggests that there may be a more cost-effective method to reduce shirking - drawing upon workers' propensities to reciprocate the trust of an employer, to engage in mutual monitoring and social sanctioning of free riders, and emulation of others' efforts.

Governments also play an external role in the regulation of the employment relationship through economy wide workplace relations legislation. For instance in Australia government regulation has forced workplace arrangements to be highly collective. This has been a result of Australia's award[1] and enterprise bargaining systems, which are necessarily collective and place labour unions at the heart of wage negotiations.

Recent debate in Australia has centered on the productivity gains from the *decollectivisation* of employment agreements - that is, individualising employment contracts. Individual agreements were the centerpiece of reforms introduced by the Workplace Relations (Amendment) Act (2005) (More commonly known as WorkChoices). The rationale for these reforms was to 'further promote and facilitate the making of agreements at the workplace level', so that 'the full potential for productivity gains in the Australian economy (could be) realised' (John Howard, 2005 p.39[2]. Ellem et. al. (2005, p.13) argue that the case for the introduction of these reforms was never clearly articulated, stating, "…(it is not a simple matter) to theorise, explain and demonstrate the connections between industrial relations legislation and specific outcomes… Many of the arguments put for change - by the Government itself, employer associations and any number of editorialists and columnists - by-pass these difficulties".

With the election of a new government in 2007, these reforms were abolished and replaced with a new platform, dubbed "Forward with Fairness", which returns the focus of agreement-making to collectivist methods, and places restrictions on the use of individual agreements.

[1] A system whereby a central authority set employment standards known as `awards' which applied throughout entire industries.

[2] See King and Stilwell (2005), and Ellem et. al. (2005) for an overview of these reforms. Further discussion can also be found the December 2005 (Special Edition) of the Australian Journal of Political Economy.

The performance of individual vs. collective contracts is studied through the use of a variation of the Gift Exchange Game, which was first studied by Fehr et. al. (1993). In this game, employers pay wages to workers, who in response choose an effort level. In our experiment, participants play two within subject treatments - an individual treatment, and a collective treatment. An employer offers the same wage to all workers in the collective treatment and one wage per worker in the individual treatment. The most interesting feature of this framework is to study how the contracts evolve and whether or where they settle. Therefore ours is a partner design experiment based on a repeated game.

We designed two variations of a repeated gift exchange game with a 'firm' frame. Firms are composed by one subject taking the role of the employer and three other subjects acting as workers. The games are designed such that for any given wage there is an effort level that will generate the same payoff for both employer and worker. Maximum [minimum] wage and effort give an equal and maximum [minimum] payoff to employer and workers. The egalitarian (or fair) nature of the games was well known by subjects as they had to correctly answer a battery of control questions before each treatment started. In the individual variation (I) workers can receive separate wages, and in the collective (C) variation all workers in a firm receive the same wage. Games are played 10 times in each of the two variations maintaining constant the composition of firms. The order in which the variation of the game are played varies resulting in four treatments: 1I, 1C, 2I, 2C. The SPNE in any of the four repeated games is minimum wage/minimum effort.

We expected wages and efforts to be above the minimum in all four treatments. We hypothesise the individual treatments to be overall more efficient given that the employer can more easily coordinate with each of the three workers offering individual contracts than with three potentially heterogeneous workers offering collective contracts. That is, one free riding worker can push down the wages for the whole firm in the collective treatment.

We did observe average wages and efforts to be significantly above the minimum across all treatments. Average effort and wage do not differ between 1I and 1C. Average effort and wage jump up after subjects finished 1C and start 2I. Indeed average effort and in 2I is significantly different and higher than in any other treatment. Modal effort and wage in all treatments except 2I equals minimum effort. Modal effort and wage equals maximum effort in 2I for most but the very last periods. Unexpectedly, wage in the first period of 1C is significantly higher than in 1I.

In a seminal paper, Aklerof (1982) introduces the notion of 'gift exchange' as an explanation for workers providing input levels above the minimum required in firms. In his argument, workers give a 'gift' to the firm in excess of their minimum work required, while firms give a gift to their workers of a wage above the minimum. Underpinning this idea of gift exchange is a reciprocal relationship between workers and the firm. This relationship can be both positive and negative - if one side does not live up to expectations of gift giving, the other side lowers its level of gifts in response. Worker reciprocity is based on a workplace norm or standard, represented by intrinsic work rules and workers' notions of fairness. Workers expect to be treated 'fairly' by the firm, a conception that is based on relative, rather than absolute comparisons of one's own situation with that of others. Where workers feel they are

being treated well and justly, they engage in positive reciprocity by giving gifts above that predicted by self-interested models. If they feel they are being treated unfairly however, they may engage in negative reciprocity, 'punishing' for what they believe to be unfair behaviour.

Economists have utilised the notion of gift exchange and reciprocity to explain observed empirical regularities which are inconsistent with the predictions made by main stream economic theory. Akerlof and Yellen (1980), Akerlof (1982) and Bewley (1999) advance reciprocity as an explanation of the prevalence of efficiency wages and associated phenomenon of voluntary unemployment. Due to the existence of reciprocity, employers may be willing to offer wages higher than the minimum because of the effect on this has on the workers' reciprocal gift.

Subsequently, economists have empirically and experimentally analysed the robustness and impact of reciprocity and related social preference on the labour market. The bulk of this literature is largely experimental. This is justified by the difficulty in empirically separating reciprocity from strategic cooperation, reputation building and retaliation in repeated games (Fehr and Gächter, 2000b). Ernst Fehr and a series of collaborators [Fehr et. al., 1993, 1998a, 1998b; Fehr and Falk, 1999], have conducted experiments with the gift exchange game - a two stage game where a principal offers a wage to an agent, who in turn chooses an effort level. In these experiments, a positive relationship between wage and effort is observed, providing evidence for the fair wage hypothesis of involuntary unemployment suggested by Akerlof and Yellen (1980). Further studies have found that reciprocity can mitigate the contract enforcement problem (Fehr et. al., 1997), leading to a substantial increase in the set of enforceable actions and thus large efficiency gains. Maximiano (2007) finds that reciprocity is robust even in a one shot gift exchange game with one-employer, many worker firms, where employers have the opportunity to earn much higher payoffs than their workers.

Gneezy and List (2006), and Kube et. al. (2006) test reciprocal actions in labour market field experiments. In these field experiments, subjects were recruited to perform simple, measurable tasks at an advertised rate. When subjects arrived to perform the task, they learnt they would be paid wages above those advertised. The productivity of the workers with the surprise increase in wages were then compared to workers who worked only for the advertised rate. Gneezy and List (2006) claim that positive reciprocity does not have persistent effects on outcomes. Workers contributed high effort levels for a short period of time, but their productivity then returned to normal levels. This finding contradicts the research of Fehr and collaborators, who consistently find that reciprocity has a persistent effect on labour market outcomes. Extending Gneezy's and List's (2006) field experiment to include negative reciprocity, Kube et. al. (2006) find that negative reciprocity has much stronger effects, with a significant and lasting impact. These results suggest that there is asymmetry to reciprocity - negative reciprocity seems to be a much more powerful and robust phenomenon.

This experimental literature confirming the importance of negative reciprocity has been complemented by empirical studies. Katz et. al. (1983), Kleiner et. al. (2002), Krueger and Mas (2004), and Mas (2006), analyse the effect of poor labour relations (for example long, protracted wage negotiations and strikes etc.) on productivity

levels. They find that poor labour relations have an unambiguous negative effect on productivity. For example, Mas (2006) found that wage rises below a reference point has strong negative effects on productivity. The further the wage from the demanded wage, the larger the decline in performance. Utilising a different approach to the aforementioned papers, which focus on individual firms, Chen (2005) uses data from the 1995 Australian Workplace Industrial Relations Survey, a large, economy-wide, Australian linked survey of workers and workplaces, to examine workplace reciprocity. Consistent with other empirical papers, Chen finds support for negative reciprocity, however this evidence is not strong.

The impact of reciprocity and conceptions of fairness on effort levels in firms have also been studied in coordination games and public goods games. The incentive structure faced by agents in these games is similar to that faced by agents in the collective treatment in the experiment studied in this paper. Brandts and Cooper (2004, 2005, 2006) consider methods of overcoming moral hazard in teams using a coordination game. In their `weak link' game for example, the firm's output is determined by the worker with the lowest output - workers must therefore coordinate at a high level. They find that in the absence of managerial intervention, subjects slip into coordination failure, consistent with Holmstrom (1979). Further, communication by managers is a more effective tool in overcoming coordination failure than monetary incentives. The most effective messages simply request high effort levels from workers, point out the mutual benefits from high output, and imply that workers are being paid well. These results provide support to the notion that monetary incentives may be less effective than appealing to workers' notions of fairness as a method of raising effort input. Similarly, Gächter and Fehr (1999), studying a public goods game, show that social interaction and agents' anticipation of social sanctions affects the level of voluntary contribution to public goods. It is also well established in public goods literature (e.g. Fehr and Gächter (2000a)) that agents are willing to ‘punish’ free riders even at a cost to themselves. These results suggest that worker effort levels may be affected by their desire to `fit in', and are shaped by social norms.

There is now little disagreement amongst researchers that reciprocal behaviour exists, and there is an emerging consensus that negative reciprocity has larger and longer lasting effects than positive reciprocity. However, opinion remains divided on the sources and the conditions for sustainability of reciprocal behaviour.

The rest of the paper is organised as follows. Section 2 summarises the experimental design and procedures. Section 3 presents the results of the experiment, and Section 4 discusses the main results and recommends directions for further research. Two appendices contain an example of the experimental instructions and control questions (Appendix A) and data analysis omitted in the paper (Appendix B).

2. Experimental Design and Procedures

The experiment is a variation on the bilateral gift exchange game introduced Fehr et. al (1993), and creates a small representation of employer-worker relations in the workplace. The use of a gift exchange game allows the experiment to be characterised by contractual incompleteness.

The experiment takes the following form. There is a firm consisting of one employer and *k* workers. The employer moves first and chooses wages w_i for his *i = 1,2,3,...,k* workers. Subsequently, workers simultaneously decide their level of effort, e_i. Workers cannot reject the wage offer made. This effort costs the workers $c(e_i)$ where $c(e_i) = e_i$.

The payoff function π_{w_i} of worker *i* is given by:

$$\pi_{w_i} = -e_i + w_i \qquad \text{for } i = 1, 2, ., k. \qquad (1)$$

The payoff function π_e of the employer is given by:

$$\pi_e = v\sum_{i=1}^{k} e_i - \sum_{i=1}^{k} w_i \qquad (2)$$

where *v* is the marginal product of effort, and is fixed. This stage game is repeated for ten periods.

We considered two variations of the basic game explained above. In the individual variation (I), the employer chooses *k* wages, one for each worker. These wages can be the same or different. Conversely, in the collective variation (C), the employer is restricted to offering only one wage (that is, the same wage) to all *k* workers.

In the actual experiment, agent's choices were restricted by the following parameters. For the employer, the wage had to be an integer between 200 and 400. The effort choice of each worker had to be an integer between 50 and 100. The value of *v* is set to 5. Further, while the game is characterised by incomplete contracts, these parameters ensure that it is Pareto optimal for employers and workers to co-operate. That is, if the employers and workers cooperate with wages 400 and effort level 100, this yields the highest payoff for employer and worker such that no agent can be made better off without the other being made worse off.

The upper and lower limits of the wage and effort levels were carefully chosen to create a symmetric payoff structure between employers and workers. For example, if an employer offers the minimum wage of 200 to all three workers, and all three workers provide the minimum effort level of 50, all agents gain a payoff of 150. Similarly, if an employer offers the maximum wage of 400 to all workers, who provide the maximum effort level of 100, all agents gain a payoff of 300. More generally, for every wage, there exists an effort level which will equilibrate the

payoffs of employer and workers. This was reinforced through a battery of control questions[3].

It is still possible, however, for the employer to make a loss. It was therefore stressed in the instructions to the experiment that the agents *could always make decisions which avoided losses*, and this was reinforced through control questions which all subjects were required to complete. To negate the possibility of negative payoffs, all subjects were provided with a sufficiently high initial endowment of 600 ECU. These measures were to ensure that vertical fairness concerns i.e., the employer having the opportunity to earn a greater payoff than the workers, did not affect the agents'.

The experiment used a partner design. This was to take into account the fact that most employment relationships are long-term relations. That is reputation building and repeated interactions are a feature of employment relation in the real world, and are potentially of great economic significance. Each basic stage game in the experiment was therefore repeated for 10 periods. The main purpose of 10-fold repetition was to allow subjects to become acquainted with the strategic environment, and to allow differences in the strategic interaction between the two treatments to emerge which would not necessarily emerge in one-shot play.

Subjects play both the I and C treatments. Hence we refer to treatments as 1I, 1C, 2I and 2C where the number represents the order in which I or C is played. Overall, four sessions were conducted, which for 1 hour and 30 minutes each. Two sessions were conducted each day over two consecutive days. Sessions 1, 2 and 4 had 24 subjects, while session 3 had 20 subjects. In total, there were 92 subjects. In sessions 1 and 4, subjects played firstly the collective treatment, followed by the individual treatment (CI). In sessions 2 and 3, this order was reversed; subjects played the individual treatment followed by the collective treatment (IC). In any case firm composition remained the same during a particular session.

At the start of the experiment instructions[4] were distributed and read publicly after subjects had enough time to review them, with the opportunity for subjects to ask questions. Subjects had to provide answers to the control questions. Then they learned their roles as employer or worker. Subjects were then matched into firms of one employer to three workers, which remained the same throughout the experiment. This matching was random and anonymous i.e., the subjects never learned the identities of the other players. The experiment then ran as follows: first, the employers set the wage without knowing the effort choices made by their workers. In the collective treatment, the employer set one wage for all three workers, while in the individual treatment, the employer set individual wages for each worker. Recall that the wage offer was restricted to integers between 200 and 400. The workers were then informed of the wage set by their employer and chose their effort level, which was restricted to integers between 50 and 100. When all workers had made their decision, the employer was informed of the effort level provided by their workers, and both employers and workers learned of their payoffs. Then, the next period began and the same process was repeated. This first treatment ran for a total of 10 periods.

[3] See Appendix A
[4] See Appendix A.

At the conclusion of the 10 periods, the instructions for the new treatment were distributed. Subjects who played the individual treatment in the first phase were given the instructions for the collective treatment and vice versa. Subjects were given a new endowment of 600 ECU to negate the possibility of negative payoffs in this new treatment. The new treatment was then conducted in exactly the same manner as the first treatment. Again, subjects were given time to read the new instructions individually, then instructions were read aloud, with the opportunity for subjects to ask questions publicly. This was again followed by control questions relating to the new treatment which subjects were required to correctly answer before moving on to the experiment. After this, subjects completed 10 rounds of the new treatment, in the same roles and same firms as in the first treatment. At the completion of the second treatment played, subjects filled out a short questionnaire.

The experiment was conducted at the Experimental Economics Laboratory at the University of Melbourne (E^2 MU). Subjects were recruited using E^2 MU's web-based recruitment system. Email invitations were sent to randomly selected students who had registered an interest in participating in experiments via E^2 MU's website. To register, subjects were required to click a link in the email invitation they received and places were allocated on a first come, first serve basis. Recruitment was performed in accordance with the guidelines stipulated by the University of Sydney's Human Ethics Committee. All subjects were students of the University of Melbourne, and the subject pool consisted mainly of undergraduate students. The sessions were overbooked in anticipation of a proportion of subjects failing to attend booked sessions, and excess subjects were paid a $5 AUD turn-away fee. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007).

In the experiment, subjects were given the opportunity to earn `Experimental Currency Units' (ECUs), which were exchanged into Australian Dollars (AUD) at a rate of 150 ECU = $1 AUD. The average earnings were $35.60 AUD.

3. Results

In this section, the results of the experiment are presented. Some descriptive evidence on wage and effort choices over time are presented first, followed by tests for treatment influences.

3.1. Wage and Effort

Table 1 contains summary statistics. Average wage and effort levels over all periods are significantly above the minimum levels. The average wages over all periods were 267.15 and 269.83, for the 1C and 2C treatments respectively, increasing to 270.96 and 306.78 for the 1I and 2I treatments. The average effort over all periods was 63.25 and 66.07 for the 1C and 2C treatments, and 67.82 and 76.85 for the 1I and 2I treatments. These clearly exceed the SPNE levels ($w^* = 200$, $e^* = 50$).

	Treatment			
	1C	2C	1I	2I
Mean Wage	267.15	269.83	270.96	306.78
Wage Variance	78.11	71.54	65.49	89.01
Mean Effort	63.25	66.07	67.82	76.85
Effort Variance	18.52	18.49	18.41	22.12

Table 1. Descriptive statistics

Result 1*: Average wages and efforts are significantly above the SPNE in all treatments.*

More detailed information about the relationship between wage and effort is provided in Figure 1. Graph (a) displays the average effort conditional on wage for all four treatments. Graph (b) displays the average conditional wage on average effort in period t-1 (collective treatment), versus effort in t-1 (individual treatment). For both workers and employers, a clear pattern emerges in all treatments - workers choose, on average, a higher effort level when the wage is higher, and employers choose, on average a higher wage level when effort offered in the previous period is higher.

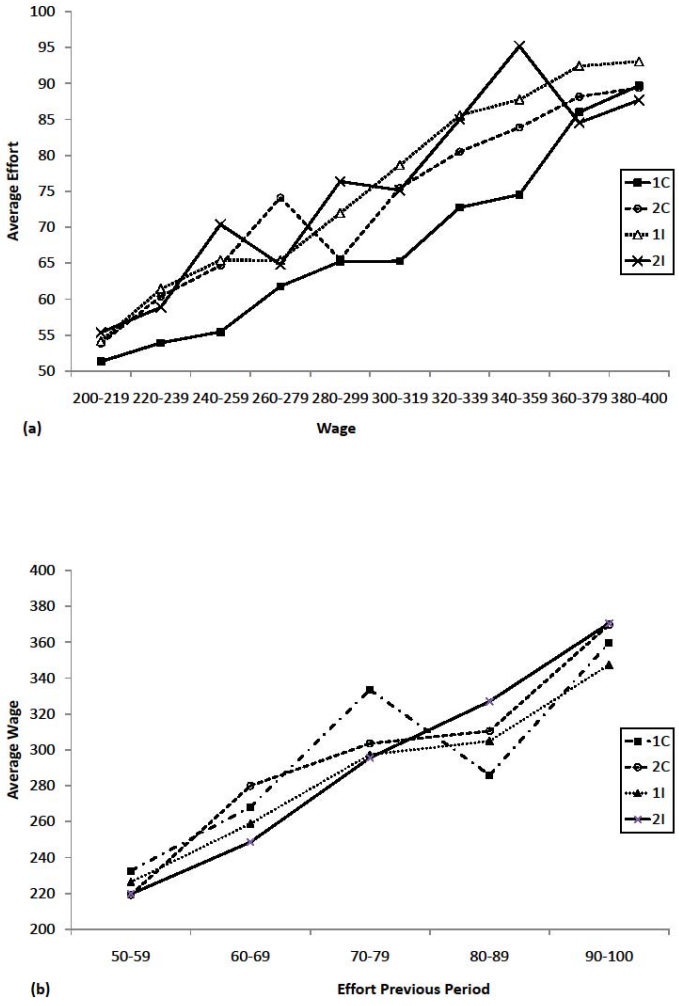

Figure 1. Relationship between wage and effort.

3.2. Treatment Effects

Our attention now turns to the differences between treatments. Figure 2 shows the average wage and effort levels across 10 periods for each treatment. In particular Figure 2(a) indicates that the aggregate average effort levels provided in the individual treatments are greater than their collective counterparts in both phases. It is also observable that the average aggregate effort in treatment 2I is higher than the average effort in all other treatments. In order to test whether these differences are statistically significant, we used a Mann-Whitney-U test[5]. The Mann-Whitney test is a non-parametric test with the null hypothesis that the two samples come from the same distribution.

[5] This test is chosen for use over the more powerful t-test as the t-test is sensitive to departures from normality, especially when the sample sizes are different. In the present case, sample sizes are small vary between treatments due to different show up rates in the experimental sessions.

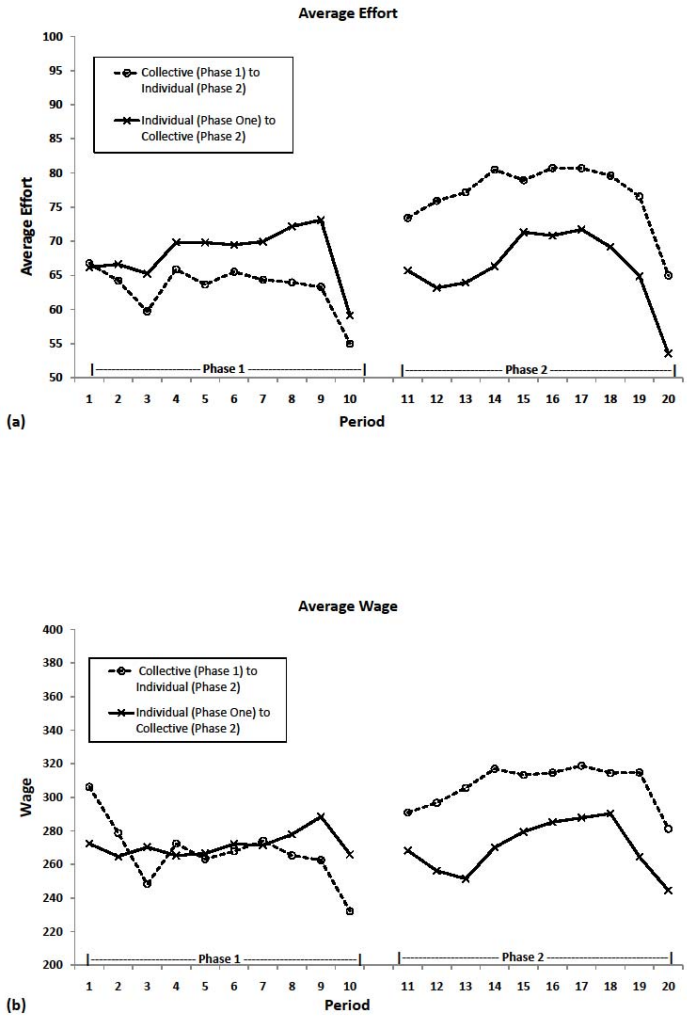

Figure 2. Average effort and wage.

Figure 2 shows that the average effort levels provided in the individual treatments are higher than the collective treatments in both phases. Using individual averages of over all periods as independent observations, we find the that the difference between 2I and IC treatments is statistically significant at the 5% level of significance (two-sided Mann-Whitney test, $p = 0.02$), and difference between the 2I and 2C treatments is statistically significant at the 10% level of significance (two-sided Mann-Whitney test, $p = 0.068$). No other differences between any two treatments are statistically significant at any standard degree.

Result 2*: Effort contributions of workers in the 2I treatment are, on average, significantly higher than in either of the collective treatments.*

Figure 2(b) shows less clear differences in wage than in effort. Average wages are not noticeably different for treatments played in phase 1. This is confirmed by a two-sided Mann-Whitney test ($p = 0.73$). Conversely, average wages for the individual

treatments played in phase two are observably higher than for collective treatments. However, Mann-Whitney testing suggests that this difference is insignificant at the (two-sided Mann-Whitney test, $p = 0.19$). There is in fact insufficient evidence to suggest any differences between the average wages paid in each.

Result 3*: Average wage is slightly higher in the 2I treatment than all other treatments, but the difference is not statistically significant.*

Note that, against our hypothesis average wage and effort are not higher in 1I than in 1C.

Result 4*: Both average wage and effort are insignificantly higher in 1I than in 1C.*

A closer inspection of the actions of employers and workers in specific periods is helpful to gain an insight into how players perceive the different treatments. Figure 2(b) suggests that in period 1 of phase 1, the average wage for the collective treatment is much higher than the average wage for the individual treatment (306.25 compared to 272.42). Regression analysis using OLS with robust standard errors supports this conclusion - on average, the wages offered in period 1 of phase one collective treatments, are 33.825 ECUs higher, ceteris paribus[6]. This is statistically significant at the 5% level. At least initially, employers pay higher wages to attempt to foster cooperation in the collective treatment, or believe that workers in the collective treatment are more willing to cooperate.

Result 5*: in contrast with results 2 and 3 the wage offered in the first period of 1C is significantly higher than the average wage offered in the first period of 1I.*

This faith however, is unrewarded - as the average effort levels in 1I and 1C are nearly identical afterwards. Regression analysis using OLS with robust standard errors finds that although workers contributed on average 4.78 units less effort in the collective treatment than the individual treatment, ceteris paribus, this difference is not significant.

In phase two of the experiment, the situation is reversed - employers in the individual treatment offer an average wage of 290.97, which is higher than the average wage of 268.27 in the collective treatment. As we already know this effect lasted afterwards.

A clear restart effect between treatments 1C and 2I can also be seen from Figure 2 - the mean effort in period 10 of treatment 1C is 55 and period 1 of 2C is 73.42; and 232.35 and 281.28 for wage respectively. This is confirmed to be significantly different by a two-tailed Mann-Whitney test ($p = 0.003$ for effort; $p = 0.04$ for wage). Conversely, there appears to be no restart effect in wage between 1I and 2C (266.03 versus 268.27), and little difference in effort 59.12 versus 65.73). Mann-Whitney testing confirms that these are not significantly different ($p = 0.23$ for effort; $p = 0.87$ for wage).

[6] Full details of this regression analysis can be found in Appendix B

We regressed effort on several different explanatory variables. The results of these regressions are presented in Table 2. To account for the panel structure of the experimental data (there are 20 time points per subject), the estimation method used is fixed effects OLS with robust standard errors clustered on groups as the independent units of observation. The data package used for this estimation was STATA.

Model 1 tests for reciprocity and includes the variable "Wage". The result of model 1 confirms that effort increases with wage, but wage alone accounts for only 70% of effort contributions. Model 2 tests the significance of lagged variables - effort from the previous period and wage from the previous period, with a dummy variable for those observations in period one. These lagged variables are found to be highly significant. Model 3 includes period dummies for periods 2 to 10, and confirms the impression from Figure 2(a) that effort increases over time then declines sharply in period 10 - subjects recognise that they cannot benefit by providing above minimum effort levels in period 10, and therefore act selfishly. The results from models 1 to 3 suggest that both reciprocity repeated interaction play a role in determining worker's productive efforts.

Model 4 tests for treatment effects through the introduction of dummy variables. The dummy variable "TreatC" is equal to 1 if the treatment in question for that observation is the collective treatment, and the dummy variable "Phase1" is equal to 1 if the treatment was played in phase 1 for the individual in question. Model 4 finds that TreatC and Phase1 are highly significant - in the collective treatment, workers provided, on average, an effort level of 3.933 less than in the individual treatment, ceteris paribus. Similarly, in the first treatment played by each subject, workers provided an effort level of 2.387 less than in the second treatment played, ceteris paribus.

In model 5, we look for differences in the slope between treatments. This is done by adding 2 interaction terms - the interaction of wage and the collective treatment (TreatC*Wage), and the interaction of wage and phase one treatments (Phase1*Wage). This addition renders all treatment effects insignificant, most likely due to correlation between the interaction terms and wage. I therefore tested the joint significance of the explanatory variables TreatC, Phase1, TreatC*W and Phase1*Wage, with the null hypothesis that the coefficients of these explanatory variables are jointly zero, and was able to reject this hypothesis at the 5% level of significance (F_c = 12.54 (2 d.p.) $\geq$ F* $\approx$ 2.106). There is therefore insufficient evidence to determine if there are differences in slope between the two treatments. However, models 4 and 5 provide further evidence that both the treatment type, and phase in which a treatment is played, matters.

Dependent Variable: Effort					
	1	2	3	4	5
Constant	14.328	12.077	68.123	20.450	16.862
	(2.900)***	(2.438)***	(1.281)***	(3.084)***	(3.387)***
Wage	0.194	0.193		0.184	0.196
	(0.010)***	(0.011)***		(0.104)***	(0.012)***
$Wage_{t-1}$		-0.067			
	(0.010)***				
$Effort_{t-1}$		0.312			
		(-0.046)***			
dLagged		0.953			
		(-1.853)			
Period2			-0.884		
			(1.293)		
Period3			-1.318		
			(1.712)		
Period4			1.862		
			(1.639)		
Period5			3.123		
			(1.700)*		
Period6			3.528		
			(1.928)*		
Period7			3.471		
			(2.032)		
Period8			2.768		
			(1.760)		
Period9			1.362		
			(2.068)		
Period10			-9.507		
			(2.321)***		
TreatC				-3.933	-0.978
				(0.767)***	(2.682)
Phase1				-2.387	1.800
				(0.777)***	(2.700)
TreatC*Wage					-0.010
					(0.012)
Phase1*Wage					-0.015
					(0.012)
R^2	0.699	0.773	0.034	0.707	0.710

Robust Standard Errors in Parentheses
***significant at 1%; **significant at 5%; *significant at 10%

Table 2. Determinants of effort.

Separate regression analysis was conducted on the determinants of wage in the collective and individual treatments. The estimation method used was random effects OLS with robust standard errors clustered on groups. These results are presented in Table 3 and Table 4. In order to determine how employers choose the wage in the collective treatments, we regressed wages offered in the collective treatments on the minimum, maximum and average efforts in the previous period. We found that average effort was statistically significant at the 10% level, while minimum and maximum effort were not significant. This suggests that employers take into account all three effort levels of their workers, rather than only the lowest or highest.

In model 2, we introduce dummy variables for periods 2-10, and find that wages are highest in the first period, on average. This suggests that employers pay high wages in period 1 to try to encourage cooperation. Wages decline in periods thereafter - declining by 20.087 in period 2 and a further 18.174 in period 3, before again trending upwards. However, wages drop significantly in period 10, indicating that employers anticipate that their workers will contribute low levels of effort in the last period.

In model 3, we introduce a dummy variable, for the phase in which the treatment was played. We find that on average, employers offer higher wages in the treatments played in phase one, however this difference is not statistically significant.

Dependent Variable: Wage in Collective Treatment			
	1	2	3
Constant	32.23556	288.087	41.26011
	(18.9546)**	(15.621)***	(0.006)***
Minimum Effort$_{t-1}$	0.213244		
	(1.350)		
Maximum Effort$_{t-1}$	-0.6637966		
	(1.247)		
Average Effort$_{t-1}$	4.100186		3.391023
	(2.384)*		(0.244)***
Phase1			3.965293
			(7.891)
Period2		-20.087	
		(12.367)	
Period3		-38.261	
		(16.087)	
Period4		-16.696	
		(16.492)	
Period5		-17.000	
		(18.928)	
Period6		-11.869	
		(18.729)	
Period7		-7.391	
		(17.347)	
Period8		-10.739	
		(18.919)	
Period9		-24.565	
		(20.390)	
Period10		-49.957	
		(17.320)***	
R^2	0.587	0.035	0.581

Robust Standard Errors in Parentheses
***significant at 1%; **significant at 5%; *significant at 10%

Table 3. Determinants of wage, collective treatments

For wages in the individual treatments, we regressed wage on the effort offered by workers in the previous period, and found effort in the last period to be highly significant, confirming earlier results. For every unit increase in effort, wage increased by 2.991 units on average, ceteris paribus. In contrast to the collective treatment, where wages paid were higher in the treatment played in phase 1, we found that wages were lower, on average, in phase 1. However, this was also statistically insignificant. Finally, it seems that the level of wages trends upwards over time in the individual treatment, in contrast to the collective treatment.

Dependent Variable: Wage in Individual Treatment			
	1	2	3
Constant	70.087	78.260	282.101
	(12.562)***	(14.422)***	(15.196)***
$Effort_{t-1}$	2.991	2.946	
	(0.181)***	(0.1751)***	
Phase1		-10.115	
		(7.286)	
Period2			-0.667
			(8.392)
Period3			9.783
			(10.650)
Period4			9.507
			(13.344)
Period5			6.986
			(10.476)
Period6			10.319
			(10.878)
Period7			12.638
			12.703)
Period8			14.913
			(13.173)
Period9			20.116
			(12.886)
Period10			-8.116
			(11.022)
R^2	0.768	0.768	0.0096

Robust Standard Errors in Parentheses
***significant at 1%; **significant at 5%; *significant at 10%

Table 4. Determinants of wage, individual treatments

3.3. Individual Behaviour

The analysis up until now has been based on mean conditional effort and wage levels per treatment. This may conceal large individual heterogeneity between subjects within treatments. In Figure 3, the effort levels in each period are plotted in a bubble graph. In these graphs, the size of the bubble represents the number of observations at that data point, allowing us to clearly see the variations in contributions between periods and treatments. Treatments 1C, 2C and 1I have the minimum effort of 200 as the unique mode. 2I however, has two effort levels with high frequencies - 200 and 400. This is evidence that the greater aggregate levels of effort in treatment 2I shown in Figure 2 and in Table 1, are not due to across-the-board increases in effort levels - but greater co-operation amongst a sub-set of workers. Figure 3 thus provides a powerful result - only the individual agreement is effective in garnering high levels of co-operation and only after the collective treatment has already been played.

Another difference in cooperation between treatments can be seen in Table 5. In treatments 1C, 2C and 1I, a greater proportion of workers provide ‘always minimum’ or ‘mostly minimum’ effort levels than employers pay ‘always minimum’ or ‘mostly minimum’ wages. In treatment 1C, 58.4% of workers provided minimum effort most

or all of the time, compared to only 50% of employers paying minimum wage. In treatment 2C, 39.8% of workers provided minimum effort all or most of the time, compared to only 18.2% of employers doing the same. In treatment 1I, 39.4% of workers provided minimum effort all or most of the time, compared to 24.2% of employers doing likewise. Finally, 22.2% of workers in the 2I treatment provide minimum effort most or all of the time, compared to 27.2% of employers paying minimum wages most or all of the time. Workers therefore seem more willing to cooperate in the 2I treatment than in the other treatments.

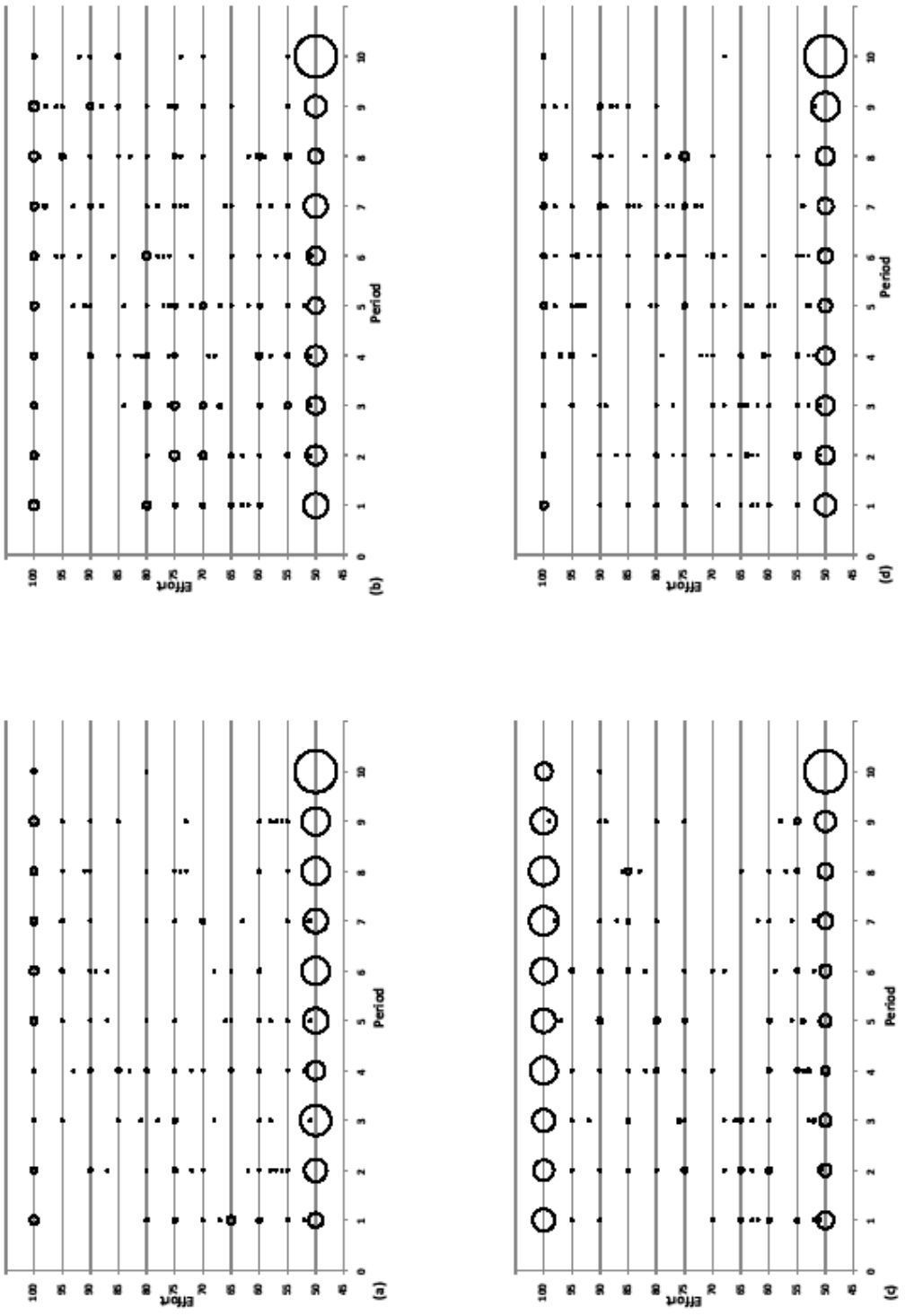

Figure 3. Effort per treatment: 1I (a), 1C (b), 2I (c), 2C (d).

Percentage of Subjects Contributing[1]:					
		Wage (23 Subjects in Total):			
Treaments	Observations	Always Minimum	Mostly[2] Minimum	Always Maximum	Mostly Maximum
1C	12	0	50% (6)	0	8.3% (1)
2C	11	9.1% (1)	9.1% (1)	0	0
1I	33	9.1% (3)	15.1% (5)	6.1% (2)	0
2I	36	5.6% (2)	22.2% (8)	27.8% (10)	16.7% (6)
		Effort (69 Subjects in Total):			
		Always Minimum	Mostly Minimum	Always Maximum	Mostly Maximum
1C	36	5.6% (2)	52.8% (19)	0	8.3% (3)
2C	33	18.2% (6)	21.2% (7)	0	12.1% (4)
1I	33	6.1% (2)	33.3% (10)	3% (1)	12.1% (4)
2I	36	8.3% (3)	13.9% (5)	16.7% (6)	27.8% (10)

[1] Only includes subjects who can be classified as per column headings; number of subjects in parentheses

[2] In 5 or more periods, but not all periods

Table 5. Individual behaviour.

Result 5*: Maximum effort and wage are modal in most of the periods of the 2I treatment.*

4. Conclusion and discussion

The aim of this study was to compare effectiveness of individual and collective employment contracts as a tool for managing the moral hazard problem. This research was conducted by studying a repeated version of the Gift Exchange Game. Firms play two treatments - an individual treatment in which they can offer a separate wage to each worker, and a collective treatment, in which they must offer the same wage to all their workers.

It was found that in all treatments, workers provided average effort levels above the minimum, and employers offered average wages above the minimum. In phase 1 of the experiment average wage and effort does not differ across treatments. Further than that the wage offered in period 1 of 1C is significantly higher than the average wage offered in period 1 of 1I. In phase 2 of the experiment effort is significantly higher in the individual treatment. Although a small minority of subjects managed to cooperate in all treatments, maximum effort and wage are only modal in the 2I treatment.

Our results suggest a couple of interesting conjectures:

- Subjects acting as employers seem to show an *ex-ante* preference for collective contracts as they start 1C offering higher wages than in 1I. On average subjects acting as workers did not manage to respond effectively enough to keep a high wage/high effort combination in 1C.
- Employers and workers seemed to have learned to coordinate effectively in 2I after a not so good experience in 1C.

Several extensions are natural to our basic framework. We can start varying the amount of information available to workers, for example allowing workers perfect information with regard to others' efforts. The work of Brandts and Cooper (2006) suggests that full feedback improves subjects' ability to overcome coordination failure. Modifying the experiment studied in this paper by allowing full feedback could thus yield different results.

Before any policy recommendations can be made, further research comparing individual and collective agreements when factors such as social approval come into play is necessary, since these may change the reciprocal tendencies of workers and yield contrasting results. It is fair however to stress out the unexpected attraction of the collective contract. Even in a context in all favourable to individual contracts, collective contracts in phase I work as well, if not better, than individual contracts.

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