Vertically Splitting a Firm:

Promotion and Relegation in a Team Production Experiment*

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Abstract

We report an experimental study that examines the effect on voluntary contributions of vertically splitting a larger group of collaborators into two equally-sized divisions, to which we refer to as the *major* and the *minor* league. The best collaborator in the minor league promotes to the major league, and the worst collaborator in the major league relegates to the minor league. In the experiment, this mechanism leads to a self-sorting of subjects according to their cooperation. Against the theoretical predictions under the convention of rationality, our experimental results reveal a significant increase of cooperation levels relative to the benchmark of the standard voluntary contribution mechanism in the minor league, and the major league elicits significantly higher contribution levels than the minor league. We argue that the higher contributions can be explained if players are myopic. Finally, conditional cooperation seems to play a crucial role for the dynamics of the repeated game.

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1. Introduction

The group incentive problem remains a core challenge to incentive design in organizations. In business operations where emphasis on teamwork, cooperation, and alignment of employees' with stockholders' interest is increasingly the norm, the practice to use group measures to determine individual payouts has become virtually instinctive (Prendergast 1999; Che and Yoo 2001). Empirical evidence has shown that group incentive schemes may increase average productivity (e.g, Kruse 1992, 2002; Knez & Simester 2001; Hamilton et al. 2003; Delarue et al. 2008), but has also suggested that it may discourage high effort levels of the more productive workers (Prendergast 1999, p. 41). Evidence indicating that a group compensation scheme may raise employee performance is puzzling under the conventional wisdom of the free-rider paradigm in team production (Alchian and Demsetz, 1972).

While the behavior of people in team production has not been understood in all its complexity, Nalbantian and Schotter (1997, p. 314) suggest that the free-rider problem may be significantly mitigated if the compensation scheme is not vulnerable to the mistakes of one's colleagues. They conclude that carefully crafted group incentive schemes which are in the described sense robust may decisively help to induce workers to work both harder and smarter even with the same technologies. On this account, the incentive structure has the potential to create value within the firm. As a promising incentive structure, Nalbantian & Schotter propose a split of the work-force into two competing (horizontal) divisions.[1] In terms of average productivity levels, this incentive structure outperformed their other examined rewarding systems including piece rates. However, more recent results have revealed (Croson et al. 2006a) that the dynamics in the horizontal competition system may still suffer from mistakes by one's colleagues; even the most collaborative people may opt out of the team-competition plan and play it safe if their proper colleagues try to free-ride on them.

One way of mitigating the free-riding on and discouragement of the workers with the highest collaborative abilities is to let workers sort themselves into a team (Hamilton et al. 2003). Relevant experimental research on sorting in group decision making has convincingly

[1] Previous literature has analyzed the horizontal split of the work-force in competing teams. It has been observed that between-teams competition significantly increases productivity (Nalbantian & Schotter 1997; van Dijk et al 2001; Bornstein et al 2002; Croson et al. 2006a).

demonstrated the existence of a significant source for higher cooperation levels (e.g., Page et al. 2005; Gächter and Thöni 2005; Ahn et al. 2006; Gunnthorsdottir et al. 2007a, b).[2] For instance, Gächter and Thöni report that cooperation among like-minded people leads to an increase in average contributions and Gunnthorsdottir et al. (2007 b) find that highly cooperative subjects maintain their contribution levels if they never or sufficiently infrequently fall prey to free-riding. Further empirical results reinforce the view that the motivation for high performance and also the implied productivity correlate positively to the beliefs about one's coworkers' behavior (Kim 2003).

In this paper, we report an experimental study that examines the behavioral dimensions of a vertical split of the work-force into two equally-sized divisions, to which we refer to as the *major* and the *minor* league.[3] The best collaborator in the minor league promotes to the major league, and the worst collaborator in the major league relegates to the minor league. Within this incentive structure we examine the sorting of subjects in groups under controlled laboratory conditions. Most of our results are quite intuitive but may be astonishing from the conventional game theoretic point-of-view. First, we find that the contribution levels of the major league exceed those of the minor league, which again significantly exceed those of the standard voluntary contribution mechanism treatment. Particularly the second result shows the power of our approach to overcome the free-riding problem.[4] Second, subjects sort themselves into groups according to their contribution levels; highly cooperative subjects stay in the major league thus move away from the less cooperative subjects who use to stay in the minor league. This result shows that sorting is not an issue of exogenous enforcement by authority as the above mentioned literature may evoke, but that it may also evolve as a voluntary action. Finally, we find that conditional cooperation is driving behavior in our experiment.

[2] Conversely, Ockenfels and Weimann (1999) found no significant increase of contributions due to sorting. In contrast to the other cited studies which start the sorting procedure right from the start, their design involved a surprise restart of the repeated game in which subjects were sorted on the basis of their cooperation levels exerted in the originally repeated game.

[3] Examples for leagues can be found in sports; most geographically limited team sports contests are organized in leagues. In these leagues, teams compete with another and a forced performance ranking leads to promotion of the best and relegation of the worst teams.

[4] We contribute to the literature on the mechanisms to overcome the free-riding problem. Surveys of the theoretical and experimental literature have been provided by Laffont (1986) and Kosmann and Riedl (2004), respectively.

While the latter finding confirms earlier experimental results in team production (Montmarquette et al. 2004), it proves again that the team dynamics observed under controlled laboratory conditions must not always be in line with the standard agency framework in which behavior is guided by rational profit maximization. The established theoretical result in which promotions serve as prizes given to the winners, as the "up-or-stay" promotion rule, is that promotion will fail in providing incentives to work harder if the wage differential is not large enough. As Gibbons (1998, p. 126) puts it: "if the two jobs in question are really just two job titles sharing the same underlying technology, then an up-or-stay rule cannot simultaneously provide an incentive for the worker to invest and an incentive for the firm to reward investment." Since in our environment no fixed payoff differentials apply, no behavioral effect would be expected in the perfect Bayesian world. Just as in the voluntary contribution mechanism, collective free-riding is also the unique equilibrium when promotion and relegation are involved.[5] In fact, this theoretical result relies on the assumption that people hold sequentially rational beliefs. If players are myopic and their beliefs about the behavior of players in the other league are not sequentially rational, positive Bayesian-Nash equilibrium contributions are possible. We conclude from the theoretical discussion and also from the analysis of the experimental data that subjects may expect a higher continuation payoff when affiliated to the major league than when affiliated to the minor league.

The paper is organized as follows. The following section describes the design and alludes to the theoretical predictions. In the third section we report on the data of our study and the fourth section provides some concluding remarks.

2. Experimental design & theoretical considerations

The Control Treatment – the VCM

The experimental design employed a repeated standard voluntary contribution mechanism (hereafter VCM) in a partner's setting. Work efforts and free-riding activities were framed as contributions to a group project and contributions to an individual project, respectively.

[5] Since our design leaves the perfect Bayesian-Nash equilibrium of the game unchanged, our experimental results appear more challenging than those on the horizontal split of the work-force (Nalbantian and Schotter 1997).

Subjects participated in groups of four and were endowed with 50 Eurocent per round, which they privately divided between the "group project" and the "individual project". The unit per capita return of a contribution to the group project was one half; each two Eurocent contributed in group interest generated a payoff of one Eurocent for every group member. The individual project returned contributions one to one. More formally, the individual payoff function writes as follows:

$$\pi_i(x_i,x_{-i}) = 50 - x_i + (x_i + x_{-i})/2 \qquad (1)$$

where $x_i \in [0;50]$ denotes individual i's contribution to the group project, $i = \{1,2,3,4\}$, and x_{-i} denotes the contribution of the other players. The individual maximizes her payoff by choosing $x_i = 0$, while the group's payoff is maximized if every individual chooses $x_i = 50$; hence, individual rationality pits against collective rationality. By backward induction the result of collective free-riding extends to the finitely repeated game. As extensive experimental research on voluntary contribution mechanism has revealed, neither full contribution nor collective free-riding are perfectly supported in the laboratory.[6]

The Leagues Treatment

In the Leagues treatment, each independent observation involved eight subjects initially assigned to two groups of four with equal probability. The two groups were named "Group 1" (the major league) and "Group 2" (the minor league) according to the group's contribution in the first round of the experiment; the group that had contributed more [less] in the first round represented the major [minor] league.[7] After each round, including the first one, the individual who submitted the highest contribution to the group project in the minor league "moved" (promoted) to participate in the major league in the following round; and the individual who submitted the lowest contribution to the group project in the major league moved (relegated) to participate in the minor league in the following round. Ties were resolved randomly.[8]

[6] Two stylized facts are that subjects contribute between 40% and 60% of their endowment to the group project in the first round of the finitely repeated game and that contributions decline in the sequel (surveys are provided in Hey (1999), Davis and Holt (1993), Ledyard (1995) and Keser (2002)).

[7] This initial group assignment rule was common information to participants.

[8] While the tie-breaking rule in sports leagues involves usually a "K.O. round", sometimes, e.g. in earlier world-cup football competitions, a random draw procedure has been applied.

The payoff function of individuals from both, the minor league and the major league obeys to equation (1); promoting or relegating subjects are paid according to the league to which they submitted their contribution to. For identical contributions, the payoffs in the major league would thus be identical to both, the payoffs in the minor league and the payoffs in the VCM. In principle, a subject in the major league has therefore no different incentives (monetary or other) to contribute than subjects in the other conditions; free-riding is the dominant strategy for individual behavior in the one-shot game and is the unique equilibrium strategy in the finitely repeated game. Since the partial equilibrium in the major league involves collective free-riding, no subject in the minor league has any incentive to promote to the major league. Hence, both leagues produce zero contribution levels in the unique equilibrium. Under the assumption of identical players we thus can write down the following comparative hypothesis.

Hypothesis 1. Contribution levels are treatment-independent; the VCM, the major league and minor league elicit the same zero contribution.

As a matter of fact, hypothesis 1 is the standard game theoretic prediction if all beliefs are consistently in equilibrium but we are not completely intrigued by it. In our opinion, it is rather likely that players in the game believe that the major league produces higher contributions than the minor league. Let us elaborate on this idea a bit further. For the ease of the presentation, assume that players are myopic payoff maximizers who only look one round ahead and expect a *continuation payoff* by affiliating to the major or minor league in the next round. Let the continuation payoff be denoted by α_{Mi} and α_{mi}, respectively. Hence, players perceive the payoff received in one round of the game as two payoffs, the payoff from the current round and the continuation payoff according to their affiliation of the following round. This assumption seems to be unadventurous since present contributions only determine the affiliation of subjects in the next round. More formally, given player *i* is in the major league (M), her perceived payoff is as follows.

$$\tilde{\pi}_i(x_i, x_{-i}; \alpha_{Mi}, \alpha_{mi}) = \pi_i(x_i, x_{-i}) + \begin{cases} \alpha_{Mi} & if\ x_{i,M} > \min x_{j,M},\ j \neq i \\ (\alpha_{Mi}(n_M - 1) + \alpha_{mi})/n_M & if\ x_{i,M} = \min x_{j,M},\ j \neq i \\ \alpha_{mi} & if\ x_{i,M} < \min x_{j,M},\ j \neq i \end{cases} \quad (2)$$

where $\pi_i(x_i,x_{-i})$ is *i*'s payoff according to (1) and n_M denotes the number of tied minimum contributions in the major league. On the other hand, given *i* is in the minor league in the current round her perceived payoff is described as follows.

$$\tilde{\pi}_i(x_i, x_{-i}; \alpha_{Mi}, \alpha_{mi}) = \pi_i(x_i; x_{-i}) + \begin{cases} \alpha_{Mi} & if\ x_{i,m} > \max x_{j,m},\ j \neq i \\ (\alpha_{mi}(n_m - 1) + \alpha_{Mi})/n_m & if\ x_{i,m} = \max x_{j,m},\ j \neq i \\ \alpha_{mi} & if\ x_{i,m} < \max x_{j,m},\ j \neq i \end{cases} \quad (3)$$

where n_m denotes the number of tied maximum contributions in the minor league.

The beliefs about the continuation payoff differential for affiliating with the major and the minor league ($\alpha_{Mi} - \alpha_{mi}$) determine the Nash equilibrium contributions.[9] The unique equilibrium allocation for which beliefs are accurate is the one proposed by hypothesis 1, and involves zero continuation payoffs. To see that the symmetric zero contribution equilibrium is the only defensible rational expectation equilibrium of the game, consider any symmetric contribution profile in the minor league and assume that being in the major league is advantageous ($\alpha_{Mi} - \alpha_{mi}$) > 0.[10] Since the probability of being promoted is $1/n_m$ = ¼, the increase of one's contribution by less than ¾ × ($\alpha_{Mi} - \alpha_{mi}$) is beneficial, given that the deviant is being promoted with probability one.[11] Only on the boundary, if all players in both leagues contribute their endowment, contributions cannot be increased further. But if all players contribute their endowment being in the major league cannot be advantageous anymore ($\alpha_{Mi} - \alpha_{mi}$) = 0, and players in the major league would then do better by contributing nothing. Hence, if and only if contributions in both leagues are zero, such that ($\alpha_{Mi} - \alpha_{mi}$) = 0, beliefs are consistently in equilibrium; thus, zero contribution results in the unique perfect Bayesian Nash equilibrium.

[9] The differential is bounded between $0 \leq (\alpha_{Mi} - \alpha_{mi}) \leq 75$ since the continuation payoffs depend on the others' contributions. At best, for the player in the major league, the others contribute everything and, at worst, for the player in the minor league, the others contribute nothing. Thus, the advantage of being in the major league in the next round can not exceed 75. On the other hand, if players do not care about their future location the expected advantage of being in the major league is zero.

[10] An asymmetric contribution profile cannot be part of a perfect Bayesian Nash equilibrium since some players can always do better by lowering their contributions.

[11] Note that the line of reasoning is the same for mixed strategies as the increment in the probability corresponds to a higher probability of being promoted and a higher expected payoff.

However, we know from previous experimental studies that beliefs about the contributions of the others' usually vary among human subjects and differ from the contributions of the others (e.g., Fischbacher and Gächter 2006; Croson 2007; Neugebauer et al 2008).[12] If we allow players to hold non-sequentially rational beliefs, (non-perfect) Bayesian-Nash contribution profiles exist which support greater contributions in the major league. Assume, e.g., that players in the minor league believe that $\alpha_{Mi} = \alpha_{mi} = 0$, so that they all contribute zero, and players in the major league believe also that $\alpha_{mi} = 0$. There are two pure-strategy Bayesian Nash equilibria in the major league associated with major league players holding correct beliefs, $\alpha_{Mi} = 0$ and $\alpha_{Mi} = 75$. The latter case implies that contributions are equal to the endowment. In that case, beliefs of the players in the minor league would be wrong. However, we can construct other Bayesian Nash equilibria where only some players in the minor league have erroneous beliefs about the major league. Assume two players in the minor league believe that $\alpha_{Mj} = \alpha_{mj} = 50$ and contribute nothing while all other players in the minor and major league believe that $\alpha_{Mi} = 75$ and $\alpha_{mi} = 25$; while the former players do best by contributing nothing given their beliefs, all other players do best by contributing their endowment.[13] Since for various beliefs the contributions in the minor and the major league may be strictly positive, the following hypothesis can be written down.

Hypothesis 2. Contribution levels are likely to be greater in the major league than in the minor league and in the minor league greater than in the control treatment.[14]

In the literature on voluntary contributions it has been observed that beliefs about others' contributions are positively correlated with one's own contribution level (see e.g., Croson 2007, Fischbacher and Gächter 2006, Neugebauer et al. 2008). Due to the positive correlation, one possible implication of hypothesis 2 could be that the more cooperative players sort themselves

[12] There is more experimental evidence of heterogeneous, non-equilibrium beliefs; e.g., see the literature on the beauty-contest experiment (Nagel 1995).

[13] It is noteworthy that in contrast to the former example, this second example allows time consistent beliefs in the repeated setting since the two players who hold wrong beliefs about the major league have no opportunity to update them given that they are in the minor league always.

[14] Hypothesis 2 relies on the assumption that the non-perfect Bayesian-Nash equilibria are selected with positive probability. As pointed out above, a necessary condition for this assumption is that players' beliefs are inconsistent in equilibrium, a fact that has been corroborated in diverse experimental settings on beliefs elicitation (e.g., Croson 2007).

into the major league if they expect that the more cooperative players will participate in that league. In fact, this possible implication is one major research question addressed in the present paper.

Procedures

The experimental design used a partner's setting implemented in the computer software zTree (Fischbacher 2007). The sessions were run at the laboratory for experimental research LINEEX at the University of Valencia. The distinguishing feature in the experimental setting of the VCM was the feedback information. Subjects received feedback information on individual contributions ordered from the maximum to the minimum; however, individual contributions could not be traced to the contributor. This information (and private information on round payoffs) was displayed in a table for all previous rounds during and after each round on the subject's computer screen. In the Leagues treatment, subjects received additional information on the "Group" (1 or 2) to which they contributed and they were informed when they moved from one league to the other; members in the major league received no information on the contributions in the minor league and vice versa. Before the experiment, subjects completed a quiz to make sure they had fully understood the logic of the game (see the Appendix for the questionnaire).

3. Experimental Results

The control treatment to the present study is the VCM with the described parameters; the sample consists of 24 subjects (6 groups $\times$ 4 subjects) inducing six independent observations.[15] The Leagues treatment involved 80 subjects in a partner's setting, i.e., 10 independent observations (10 groups $\times$ 8 subjects). By participating to the experiment a subject earned on average 16 Euro.[16] The experiment was completed within an hour.

[15] Croson et al (2005, 2006 a, b, c) use identical data for the VCM. It is analogous to the "information" treatment used in Andreoni and Petrie (2004) and Fatas et al. (2008).

[16] In the reported ten rounds of the Leagues treatment, subjects earned on average 8 Euro. In the experiment, subjects faced thereafter a surprise restart of the game and earned another 8 Euro. We observed a restart effect

Treatment Effect

Table 1 represents the average contributions toward group interest in each round of the experiment (see also Figure A1 in the appendix). The contributions in the minor and the major leagues are recorded as well as the treatment averages. Test results are presented in the last two rows of the table. Based on these results, we write down our first observation which supports hypothesis 2 and rejects hypothesis 1.

Observation 1.

a) Contributions in the minor league are significantly greater than in the VCM for the whole experiment and for each round.
b) Contributions in the major league are significantly greater than in the minor league for the whole experiment and for all but the last round.

Support

As recorded in the second column of the table, the first round average contribution in group interest was 81 Eurocent in the VCM (about 40% of the endowment) and 128 Eurocent in the Leagues treatment (about 64% of the endowment); 152 Eurocent in the major league and 104 Eurocent in the minor league. According to the Mann-Whitney test, the results of which are recorded in the second last row of Table 1, the contributions in the minor league were significantly greater than in the VCM; the exact p-value being 0.021 for the first round. The last row reports the outcomes of the Wilcoxon signed-ranks test on the within-sample differences between the minor and the major league. By definition we have that the contributions in each major league cannot be smaller than in the minor league in the first round. However, for completeness we report the resulting asymptotic p-value 0.003 for the first round. The test results reported in the following columns confirm observation 1 at the 10% significance level.

(Andreoni 1988; Croson 1996; Croson et al. 2005); contributions were the same as in the first round of the reported game followed by similar dynamics. The data are available from the authors upon request.

Table 1: Average contributions to the group project (group total ≤ 200)

	Round										Overall
	1	2	3	4	5	6	7	8	9	10	
VCM	81	79	78	82	83	63	50	47	39	36	64
League	128	138	137	137	127	118	128	121	103	74	121
Major L.	152	162	161	153	144	131	146	131	129	82	139
Minor L.	104	115	114	121	111	105	109	111	77	66	103
Test results:											
VCM vs. Minor L.[a)]	0.021	0.036	0.021	0.036	0.047	0.028	0.016	0.008	0.028	0.074	0.011
Major L. vs. Minor L.[b)]	0.003	0.003	0.008	0.063	0.018	0.077	0.026	0.030	0.003	0.101	0.003

a) p-value of the one-tailed Mann-Whitney test (six observations VCM; 10 observations minor league). b) p-value of the one-tailed Wilcoxon signed-ranks test (10 observations).

Overall, the average group contributions were 103 Eurocent in the minor league and 139 Eurocent in the major league. The data thus indicates that in the experiment real incentives existed to be promoted to and to stay in the major league.

Continuation Payoff Estimate

Since subjects cannot expect a further interaction beyond round 10, the expected continuation payoff in that round of the game is zero. Therefore, it seems not surprising that the corresponding difference between the contributions in the major and the minor league is not significant in that round as recorded in Table 1. To estimate the expected continuation payoff for the other nine rounds we must make assumptions about players' beliefs. For simplicity let us assume that subjects expect the others to exert the same effort in one round as in the previous one.[17] Thus, a player who stays in the major [minor] league for two subsequent rounds is assumed to expect a major [minor] league continuation payoff equal to the sum of present

[17] Note that players are assumed to anticipate the others' contributions as they make their continuation payoff expectations at a time, when they have not observed the others' contributions. The assumption that experimental subjects actually base their continuation payoff expectations on these anticipated contributions is, admittedly, quite demanding. Yet, it seems less demanding than alternative assumptions as, for instance, perfect foresight. Under the perfect foresight assumption, one arguably biased estimate of the continuation payoffs differential between the leagues would be the difference of the average contributions in the two leagues during the last nine rounds (see Table 1) which is 34 Eurocents.

contributions of the other two staying members and of the contributor that is going to enter the league from the minor [major] league in the following round. If the player moves from the major [minor] league to the minor [major] league, because her contribution is the smallest [greatest] one, we compute her expected continuation payoff by considering that she would stay in the league and instead of her the player who submitted the second smallest [greatest] contribution would leave. Finally, the expected continuation payoff from the minor [major] league of a major [minor] league player is assumed to be the repetition of the contributions from the staying members in the minor [major] league. The thus estimated average expected continuation payoff over the first nine rounds is $\hat{\alpha}_M = 62$ [$\hat{\alpha}_m = 31$] for the major [minor] league.[18]

Payoff and Sorting Effect

Despite the difference in the continuation payoff between leagues, payoff is not increasing in the frequency of playing the major league. The average round payoff of the four subjects who stayed most frequently in the major league is 0.80 €, while the average payoff of the other four subjects who stayed most frequently in the minor league is 0.81 €. The payoffs of these groups are not significantly different,[19] thus proposing a "law of one price" in terms of expected payoff.[20] Figure 1 illustrates the relationship between participation in the major league and the round payoff. According to this chart, subjects who participated only once in the major league achieved the highest average payoff.[21]

Figure 1 reports also the frequency distribution of participants in the major league, e.g., two of the eighty subjects (2.5%) participated exactly once in the major league. If all subjects

[18] We reach at a very similar estimation, i.e., $\hat{\alpha}_M = 62$ [$\hat{\alpha}_m = 32$], if we neglect the assumed expectations of the subjects who are moving from one league to the other.

[19] The p-value of the two-tailed Wilcoxon signed ranks test is 0.767.

[20] We observe that some subjects moved regularly between the leagues, submitting high contributions in the minor league and almost free-riding in the major league. Given the additional incentives to collaboration of both cooperators and free-riders to get into the team with more cooperative types the existence of such "arbitrageurial" behaviour might not be surprising. Ultimately the mentioned "law of one price" in terms of average payoff might have succeeded due to the behavior of these subjects.

[21] Compared to the VCM treatment, the payoffs in the Leagues treatment were significantly greater. Only two of the eighty participants in the Leagues treatment ended up earning less than the average round payoff of 0.66 € the most cooperative group in the VCM achieved. Similarly, only seven subjects of the eighty participants in the Leagues treatment contributed less than the average contribution in the VCM which was 0.32 of the endowment (as in the scaling of Figure 1).

contributed the same amount, as suggested by the perfect Bayesian Nash equilibrium, they would be expected to participate five times in the major league and five times in the minor league. In relation to this suggestion, we state the second main observation resulting from our data analysis.

Observation 2.

Subjects self-sort according to their willingness to cooperate; i.e., the frequency of major league participation is positively correlated with contribution levels.

Support

Assuming a random allocation of subjects to leagues, only one in one thousand subjects would be expected to participate zero times or ten times in the major league. Yet, as shown in Figure 1, nine of the 80 subjects (11.25%) participate never and seven subjects (8.75%) participate always in the major league. In fact, the realized distribution looks rather uniform across all possible participation frequencies. From this observed distribution, it already follows that contributions are not equal across subjects, but that subjects who participate more frequently in the major league are also those who are more cooperative. The average contribution of the four subjects who participated most frequently in the major league of their group is 1.5 times the contribution of the remaining four subjects, in money terms a contribution of 0.36 Euro versus 0.24 Euro per round. The difference in contribution levels between these subgroups is positive for each of the 10 independent groups of the Leagues treatment. The likelihood that this extreme result is due to chance is 0.001. Also, if we order the contributions according to the frequency of major league participation in each group, we find that contributions and major league participation are significantly correlated. According to the Page test of ordered alternatives the probability of the observed correlation or an extremer one is 0.000. Figure 1 illustrates this positive correlation as the average contribution increases from 12.5 Eurocent, i.e., 0.250 of the endowment, for the nine subjects who participated never in the major league to 41 Eurocent (0.82 of the endowment) for the seven subjects who participated always.

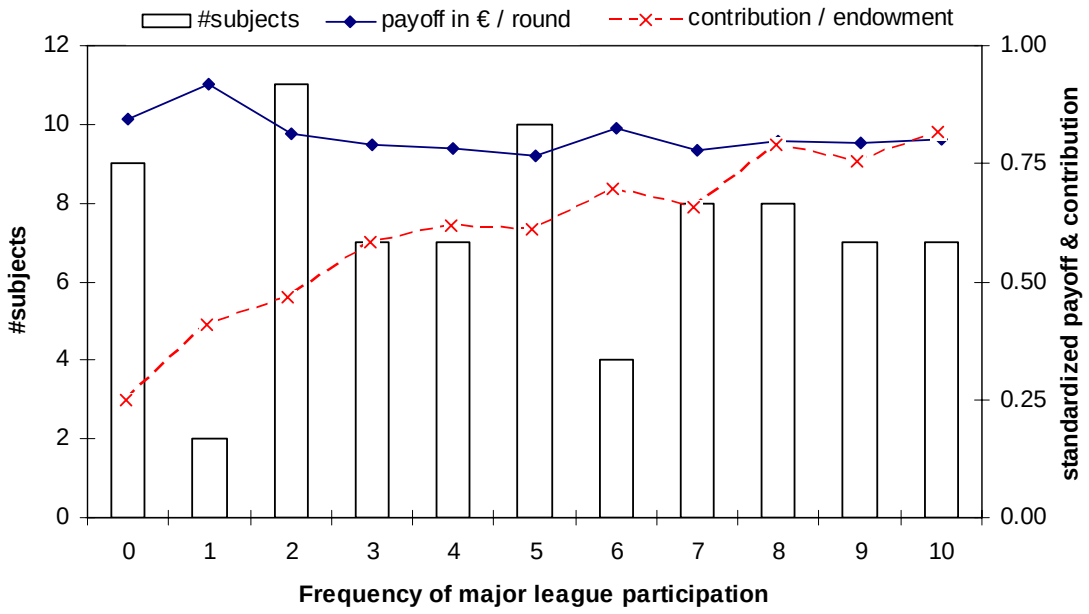

Figure 1. Average payoff (in Euro), contribution (relative to endowment) and number of subjects by frequency of major league participation

Although the forced relegation-promotion mechanism precludes a perfect sorting,[22] observation 2 shows that the incentives of the experimental design were sufficient to implement a self-sorting process of subjects. The result shows that a sorting of more cooperative subjects may be achieved on a voluntary basis by simply providing an appropriate organizational structure. In other experiments, the sorting of the most cooperative subjects is imposed by the experimenter (Gächter and Thöni 2005; Gunnthorsdottir et al. 2007a, b).[23] In our experiment, affiliation with any league exclusively depends on subjects' decisions.

Repetition Effect

Although contributions are greater in the Leagues treatment than in the VCM, Figure A1 suggests that contributions may decline over the rounds of the experiment in both treatments.

[22] For instance, if all four players in the major league contribute all their endowment and those in the minor league contributed nothing, one of the high contributors will be relegated and one of the defectors will be promoted.

[23] The "meritocracy mechanism" used in Gunnthorsdottir et al. (2007b) is closest to our Leagues treatment; subjects are sorted 100% in equally-sized groups according to their contribution levels. This procedure is used in each round of the game and payoffs are allocated accordingly in the same round. While their experimental results are similar to ours, their game structure induces multiple-equilibria.

To test the significance of the contribution decline, we run a random effects model regression including a treatment variable which we interact on the intercept and on the slope. The treatment variable, L_i, takes the value one if *i* is a subject in the Leagues experiment and zero otherwise. The regression results which are shown in the left column of Table 2 confirm that the decline is significant for both treatments. Though the decline is less pronounced in the Leagues treatment than in the VCM treatment, the slopes are not significantly different from each other. Since we observe a significant decline of the contributions in the Leagues treatment, an analysis of the dynamics suggests itself. As the recent literature on voluntary contributions has insinuated, the downward spiral of contributions may be caused by selfish-biased conditional cooperation and the successive adaptation of beliefs (Neugebauer et al. 2008). Therefore, we estimate the correlation of contributions with the average contribution of the others by the generalized method of moments to ensure the consistency of the corresponding panel data structure. In particular we use the Arellano-Bond estimator implemented in the STATA software package.[24] The results, as reported in the right column of Table 2, support the following observation.

Observation 3.

> The dynamics of contributions seem to be treatment-independent. Contribution changes move towards the lagged average contribution of the others in both treatments.

[24] A similar approach was used in Neugebauer et al. (2008). In particular, we use here the one-step least squares approach which employs the lagged variables as instruments (Arellano and Bond, 1991). The p-values of the Sargan test of over-identifying restrictions and the m_1 and m_2 statistics are 0.000, 0.000 and 0.516, respectively. Thus the validity of the instruments and the absence of misspecified dynamic structures are verified.

Table 2. Panel data regression

Individual contribution (0; 50)

Independent variable	Random effects $t \in \{1,..,10\}$	Arellano-Bond $t \in \{2,.10\}$
Constant	23.886 ***	-1,29 **
	(2.730)	(0.205)
L_i	13.504 ***	(dropped)
	(3.113)	
Round	-1.445 ***	
	(0.293)	
$L_i \times$ *Round*	0.152	
	(0.334)	
Lagged own contribution		0.081
		(0.054)
Others' lagged average contribution		0.483 **
		(0.232)
$L_i \times$ *others' lagged average contribution*		-0.287
		(0.238)
Observations	1040	832
Number of groups	104	104
Wald Chi-squared	121.65	13.12

Note: *** significant at 1%; ** significant at 5%; (std. error in parenthesis)
Treatment dummy $L_i = 1$ for Leagues treatment; $L_i = 0$ for VCM

Support

The observation shows that the dynamics in the Leagues treatment are similar to the ones in the VCM, but contribution levels are absolutely higher. According to the random effects regression result reported in the left column of Table 2, this difference in contribution levels seem to be unchanging over the rounds (see also Figure A1). Given the fact that within our theoretical framework only the beliefs about the continuation

payoffs change when moving from the VCM to the Leagues treatment, these observed constantly higher contribution levels might indicate that subjects' beliefs about the continuation payoff differential between the minor and the major league may also have been unchanging during the experiment. Actually we find evidence for this indication if we consider the differences in round-ahead contributions during the experiment.[25] This would suggest that the assumption of myopic behavior in the experiment is not too far-fetched.

4. Concluding Remarks

In this paper we have discussed how an 'up-or-stay' promotion and a 'down-or-stay' relegation between two equally-sized but vertically segregated groups (the "major" and the "minor league") may affect voluntary contributions and sorting in a team incentive experiment. While we have not theoretically addressed the issue of positive contributions which usually occur in the standard voluntary contribution mechanism we have argued that we should expect higher contribution levels from the game structure of the Leagues treatment under the assumption that players' hold different beliefs about the continuation payoff to be earned in the major and minor league in the following round. Thus, we explain the observed higher contribution levels in the Leagues treatment, which represent an increase of about 90% relative to the VCM, on the basis of the indicated unchanging continuation payoffs differential between the major and the minor league. The estimated continuation payoff in the major league doubles the one in the minor league. Moreover, in line with other experimental studies on voluntary contributions, our experimental results indicate that subjects do cooperate more if they expect the others to

[25] If we consider the differences of contributions in the minor and major league over the rounds 2 to 9, thus taking the difference of the contributions towards the two leagues as a rough measure of the continuation payoff estimate of subjects (see above), we find that the slope of the pooled regression is not significantly different from zero. The p-value is 0.202.

cooperate more, too (Keser and van Winden 2000; Fischbacher et al. 2001; Brandts and Schram 2001; Fischbacher and Gächter 2006; Croson 2007; Neugebauer et al. 2008).

In the real world, promotion is the most prominent incentive in hierarchical work environments; by promotion a worker usually receives a greater base salary and more power. In the theoretical literature (Prendergast 1999), it has been generally assumed that the main problem for firms which motivate their workers by promotion prospects is to determine a wage differential large enough to induce workers to work harder and smarter. As our experimental data suggest, the structure of the organization, even without implementing additional explicit differentials in wage or power, may lead to a better performance in terms of collaboration. Promotion and relegation may thus represent incentives in a profit sharing environment per se as they allow more cooperative subjects to select themselves into a group of like-minded (Gächter & Thöni 2005). In this sense, hierarchical levels may introduce salient incentives even for equal jobs and equal abilities workers, if more collaborative workers can choose their team and thus mitigate their vulnerability against the mistakes of their colleagues. The fact that free-riders in the major league are immediately relegated has supported the constructive self-sorting process which led to an almost perfect sorting of experimental subjects according to their revealed willingness to cooperate in our experiment. Additional incentives, for instance, in form of a lump sum payment would surely increase the competition for promotion and lead to higher contribution levels. Our aim has been to show that even without such fixed wage differentials organizational structure matters.

Appendix 1

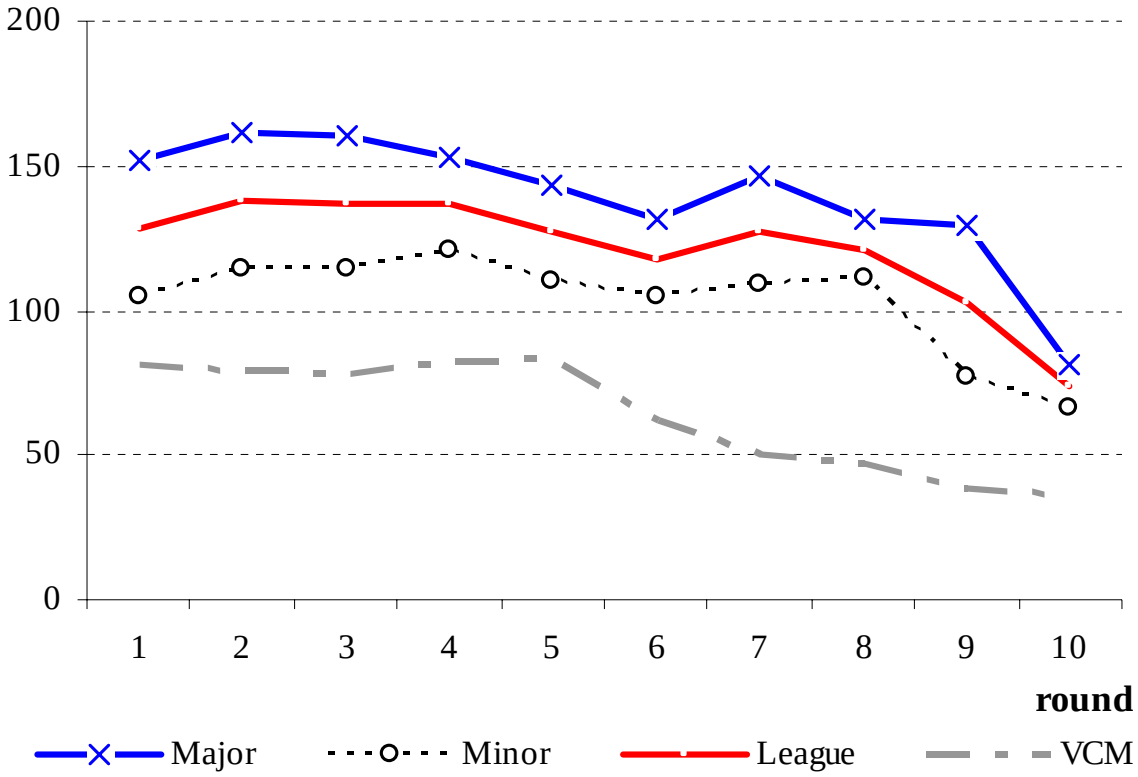

Figure A1: Average contributions to group project

Appendix 2: Instructions

The following instructions were originally written in Spanish. We document the instructions we used in the leagues treatment. The instructions for the VCM treatment did not involve features 2, 7, 8, 9f, and referred to a group of four participants in feature 1.

The aim of this experiment is to study how individuals take decisions in certain contexts. The instructions are simple and if you follow them carefully you will earn a considerable amount of money confidentially paid to you at the end of the experiment; nobody will be told the amount of money other participants earned in the experiment. Should you have any questions please raise your hand first and wait till asked. It is prohibited to communicate with the other participants during the experiment. If you violate this rule, we must exclude you from the experiment.

1 The experiment consists of 10 rounds. At the beginning of the experiment you will be assigned to a section of 8 participants. You will never get to know the identity of the members of each section.

2 Each section of 8 participants will consist in 2 groups of 4 participants, Group 1 and Group 2.

3 At the beginning of each round, each participant receives a lump sum payment of 50 EUROCENT. You only have to decide how much of it to assign to the group project. The remaining part will automatically be assigned to the individual project.

4 The payoff from the individual project is equal to your assignment to this project and does not depend on the others' decisions.

5 The size of the payoff from the group project is determined by the total amount of money assigned to the group project by the four group members (that is, the sum of your assignment to the group project and the assignments of the other three members of your group to the group project). This sum will be multiplied by two and then split into four equal parts among the group members.

6 Therefore, your payoff in one round will be computed as follows:
Payoff from individual project + payoff from group project = individual payoff

$$\textit{(50 Eurocent –your assignment to the group project)} + \left(\frac{2}{4}\ \textit{sum of the assignments of the group members to the group project}\right)$$

7 The composition of the groups in the first round will be randomly determined at the beginning of the experiment. The group with the highest total assignment to the group project in round 1 will be named Group 1, and the other group will, therefore, be named Group 2. If both groups assign the same amount, the names will be randomly determined.

8 The composition of the groups will change according to the following mechanism:
   a. The member with the lowest assignment to the group project in Group 1 will move to Group 2 in the following round.

b. The member with the highest assignment to the group project in Group 2 will move to the Group 1 in the following round.
c. If two or more subjects have the lowest assignments in the Group 1 (the highest assignments in the Group 2), the mover will be randomly determined among them.

9 After each round and during each round, you will receive the following information on your computer screen, for all previous rounds.

d. The assignment of each members of your group to the group project, ordered from the maximum to the minimum one. Note, the assignment is NOT ordered by the member of the group.
e. Your individual round payoff, detailing the payoff from the group project and the one from the individual project.
f. The name of the group you have been assigned to in each of the previous rounds. Furthermore, you will be informed when you move from one group to the other group.

10 At the end of the experiment the sum of your round payoffs will be privately paid to you cash.

Questionnaire

Choose 4 numbers between 0 and 50 and write them down:

N° 1 _____ N° 2 _____

N° 3 _____ N° 4 _____

Suppose these numbers are the assignments to your group project (all the amounts are in EUROCENT).
Taking into account these assignments to the group project, you have to calculate the earnings of each member, by following the next steps:
Step 1: Write the sum of the assignments to the group project: _____
Step 2: As mentioned in the instructions, each member will receive an equal part of the double of the group project. Write the result of doubling the group project and dividing into 4 parts:
Payoff from the group project = (2 x group project) / 4 : _____
Step 3: The assignment to the individual project is equal to the difference between the 50 EUROCENT and the individual assignment to the group project. In order to calculate it, firstly, copy the assignments to the group project of each member in the first column of the table below. Secondly, subtract the assignment to the group project from the initial endowment of 50 EUROCENT and write the result in the second column of the same table.
Step 4: Copy the assignments to the individual project (the payoff from the individual project) in the third column.
Step 5: Copy the payoff from the group project (the same payoff for each group member, calculated in the step 2) in the fourth column. The individual payoff is the sum of the payoff from the group project (4º column) and the payoff from the individual project (3º column). Write this sum for each member in the fifth column.

Assignment to the group project	Assignment to the individual project	Payoff from the individual project	Payoff from the group project	Individual Payoff
1				
2				
3				
4				

Suppose you belong to Group 1: Who would move to Group 2? _____

Suppose you belong to Group 2: Who would move to Group 1? _____

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