Equal and Unequal Profit Sharing in Highly Interdependent Work Groups: A Laboratory Experiment

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Abstract

We study the performance effects of two profit sharing schemes in a simplified representation of an organization with high task interdependence. The production process involves three stages such that output of earlier stages is the necessary input for subsequent stages. Work at earlier stages is easier than at later stages and the product is only final if it goes successfully through the highest stage. We compare the effects on the performance of the organization of a payment scheme in which profits are equally shared by all those involved in the production process with one where the participation in profits is strongly increasing in the production stage. The comparison is made for two ways of assigning individuals to the production stage: randomly or by merit. We also study the distinction between sharing schemes that are exogenously imposed and those that are chosen by the person at the top of the hierarchy. We find that overall the type of payment scheme has no effect on profits. We also find that profits increase over time and more so with the equal than with the unequal sharing scheme. The high interdependence in production that we study makes steep incentives ineffective and even counter-productive. These changes in profits over time can be explained by changes in production performance over time. We also find that merit-based assignment to positions in the hierarchy leads to significantly higher profits than random assignment.

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1. Introduction

As the use of teamwork in organizations continues to grow (Mathieu et al., 2008), the 2013 European Company Survey (Eurofound, 2015) shows that within the 62% of European establishments that use some form of variable pay, profit sharing (34%) and pay linked to group performance (25%) represent sizable components (pay linked to individual performance is now used in only 43% of establishments that have variable pay). There is a need for understanding the effects of such practices on performance. In this paper we present an experimental comparison of the effects of two profit sharing schemes in an organization with a hierarchical structure and high interdependence between different production levels. In one of the schemes profits are equally shared between all members of the organization, whereas in the other scheme the share is higher for those higher up the hierarchy.

In our experiment we study the behavior of a team, in the sense of a group of people who are brought together to interact with each other to perform a task with a common goal and who exhibit interdependencies with respect to workflow and outcomes. Kozlowski and Ilgen (2006) provide an overview of psychological research pertaining to the effectiveness of work groups and teams. Literature in economic theory also discusses the effects of incentives in the context of team production (Holmström, 1982; Alchian and Demsetz, 1972; Lazear and Oyer, 2009; Kremer, 1993; Adams, 2006). This literature, however, does not speak directly to how different ways of sharing profits affect performance when one considers interdependencies combined with different task complexity and heterogeneities in abilities, which are common production characteristics in many companies and other organizations (Encinosa et al. 2007).

In the presence of strong interdependencies one would expect the choice of sharing rules to be of most importance, since it is here that different units depend on each other the most, and thus any factor that may negatively impact the will to collaborate with others would be more detrimental to the final output, the outcome of the work group (Fisher, 1994). Moreover, in many interdependent tasks, like that of an industrial assembly line or a service such as delivering a marketing campaign, not all stages of a production line are of equal difficulty and this may need to be taken into account in the design of profit sharing schemes. IKEA has two profit sharing programs for all workers that exceed a minimum tenure in the company. One of them, *TACK!*, uses equal sharing and the other uses profit sharing allocation related to the individual wage, *One Ikea Bonus,* with differences in shares related to differences in jobs. Interestingly, in Spain in 2016 the amount dedicated to the unequal profit sharing scheme was much larger than the one allocated to equal profit sharing.[1]

In designing our experiment we follow a number of design principles to construct a production process involving a real-effort task. Participants work individually in order to deliver a final product to the market. They are part of a production line with three different stages. Each participant is assigned to one of the production stages. The difficulty of the task is increasing with the stage. The production process takes place sequentially and is such that higher levels of the hierarchy need the output of the preceding level as an input. The final product can only be sold if the task at the highest level has been completed satisfactorily. The higher the production stage, the fewer people work at that stage. This design is meant to represent functional departments (e.g. finance) in companies or generic administrative tasks in the public sector, where higher ability consists in being able to deal with tasks of higher complexity. The real-effort task that we use is multiplying numbers. Multiplication, as a task, is part of our participants' - university students - general knowledge and, hence, it should provide a level playing field regardless of area of study and academic performance. In addition, multiplications are easy to increase or decrease in difficulty.[2]

We study six treatments. In the first four treatments we exogenously vary the profit sharing rule, equal sharing vs. unequal sharing, and the way in which participants are assigned to the three production stages, randomly or merit-based on the results of a multiplications pre-test. In two additional treatments the sharing rule is endogenously chosen by the participant assigned to the top position in the hierarchy.

Our setting is related to the weakest-link game introduced by Van Huyck et al. (1990) and used in relation to organizational issues by Weber (2006) and Brandts and Cooper (2006), among others. In that

[1] El País. December, 5th, 2016.
[2] Dohmen and Falk (2011) state that multiplications is a task that requires no previous knowledge, is easily explainable, and guarantees a heterogeneity in skill. Further, Roth (2001) states that multiplications are a good proxy for general cognitive ability, and that the learning effects of this type of task are expected to be small.

game there is typically no real effort.[3] Effort levels are simply stated (i.e. participants make a choice of an effort number based on a payoff table) and imply a certain known monetary cost. Any common stated effort level constitutes an equilibrium of the weakest-link game, with higher common effort levels corresponding to higher payoffs to all players. In actual play of this game there are two main issues. First, will an equilibrium arise or will there be miscoordination. Second, if an equilibrium emerges which of the multiple ones will it be.

The design we use is more complex than the weakest-link game to better reflect the characteristics of the production environments that we are interested in studying. Due to the profit sharing character of the incentive scheme our production hierarchy setting can be seen as a both sequential and simultaneous coordination game. There is both an issue of coordination between the three levels of the hierarchy as well as of the participants at the lowest level among themselves and those at the middle level among themselves. It also involves more players than is now typical in weakest-link games (four or five) and a real-effort task which takes place in real time and, hence, introduces issues of different ability levels and effort levesl, both of which are unobservable.

These features of the game make it impossible to analyze it in terms of equilibria in the way in which the weakest-link game was studied. Given these limitations we have to limit ourselves to pointing out some benchmarks in term of feasibility. First, consider the configuration where all seven players choose to make zero multiplications. This configuration is feasible and stable, since no unilateral deviation by any of the four players in stage 1 is profitable. Second, there will be a highest possible profit level which will depend on the distribution of participants' abilities over the levels of the hierarchy. Any intermediate production between zero and this highest level is also feasible. With respect to coordination between players at the bottom and the middle levels there are again many different outcomes possible which depend on the abilities of the participants.

[3] For some exceptions see Bortolotti et al. (2016) and Afridi et al. (2020).

Our focus is on the comparative statics with respect to changes in the different treatment variables; Schotter (2015) discusses in detail the comparative-statics approach to studying behavior in experiments. There are some empirical studies that compare the effects of different payment schemes under complementarities. They compare individual incentives with equal profit sharing and consider teams with identical tasks for team members and pooled interdependence, as in van Dijk et al (2001), Hamilton et al. (2003), or Bortolotti et al (2016). Goerg et al. (2010) conduct an experiment to test the theory model of Winter (2004) which shows that asymmetric compensation can be part of an optimal mechanism even when agents are identical, based on the externalities of effort. The argument is that when everybody is needed to complete production, unequal compensation will make highly compensated individuals choose high effort no matter what other workers do. Given this, other workers will find it optimal to exert effort for a lower compensation, and so on. The experimental results are in line with the theoretical prediction of Winter (2004).

Some managerial literature introduces interdependencies closer to our setting while comparing different compensation systems, but does not deal with the specific issues we study. Guymon et al. (2006) analyze group performance under a group piece-rate incentive contract and group performance under a group budget-based incentive contract, with homogeneous task in two production settings, a dependent production setting and an interdependent production setting. The authors find that in a context where opportunism is not possible because of interdependence, a group budget-based incentive contract leads to higher levels of performance. More relevant to our study, Libby & Thorne (2009) study the effects of individual, group, and mixed incentive structures on group performance in two types of groups. One type is teams with identical tasks which allow for cooperation, like in Guymon et al. (2006), and the other type is assembly lines. They find that performance is higher under group incentives (equal sharing) for teams, however, they find no difference in group performance for assembly lines regardless of the large payment structure differences. These studies, however, assume equal sharing under their profit sharing schemes, and do not inform us on how the very common unequal profit sharing scheme affects group performance in interdependent settings. Furthermore, they do not introduce the natural step of non-homogeneous tasks, a key component in our design, through which unequal profit sharing is often justified in the field. This naturally means that they also cannot distinguish how perceived fairness, due to the allocation method, affects performance.

Furthermore, being able to differentiate between settings in which the sharing rule was exogenously or endogenously imposed is important for disentangling potential differences in group performance between the profit sharing rules. Any potential differences in team performance under equal and unequal sharing rules likely depend on members' perceptions of fairness and responsibility. Experimental findings have shown that most individuals hold others responsible for things that are in their realm of control, but not for certain things which are outside it (see Cappelen et al., 2010). In addition, both Cappelen et al. (2010) and Luhan et al. (2013) find that meritocratic positions are much more common that egalitarian ones, which implies that the perception of how merited differences in pay under unequal sharing may play a crucial role in group performance.

2. Experimental Design

2.1 General Design Features

There is previous work in which technologies with strong complementarities are considered as for example in the O-ring technology of Kremer (1993) and Adams (2006) and in the experiments with asymmetric weakest-link games of Brandts et al. (2007, 2016). For our purposes we designed a completely new experimental production process. We wanted this production process to have a number of characteristics, which we believe to be natural in our context. In particular, in designing our environment we used the following design principles:

- First, there are different production stages that involve a sequential order in the sense that output of earlier stages is the necessary input for the subsequent stages.
- Second, different stages represent a production hierarchy in the sense that work at an earlier stage is simpler than at a subsequent stage.

- Third, the higher a production stage the fewer people work at that level.[4]
- Fourth, the product (or service) is only ready for the market if it goes successfully through the highest stage.
- Fifth, mistakes in the production process are costly, and more so the higher up in production process they are made.

With multiplications being the task, we can structure an experimental environment that satisfies the five principles presented above. In our production process, there are three sequential stages in which individuals do multiplications. Each subsequent stage consists of harder multiplications than the previous one. In particular, at stage 1 participants have to multiply two-digit numbers, at stage 2 three-digit numbers and at stage 3 four-digit numbers. Participants at a higher stage are only given a multiplication problem to solve if two multiplications have been done correctly at the previous stage. At stage 1 there will be four individuals working in parallel, at stage 2 there will be two individuals working in parallel and at stage 3 there will be only one participant. The group as a whole will only receive payment for their work if a multiplication is done correctly at stage 3.

We will use the first treatment as a baseline for describing the experimental design more in detail and then explain the differences of the other 5 treatments (7 conditions) in comparison to the first.[5]

2.1.1 Treatment 1 – Random Allocation and Equal Pay

An experimental session begins with the random assignment of participants to groups of seven. A session consists of four periods, one "pre-experimental" practice period and three proper experimental (paying periods). In the "pre-experimental" period participants practice solving multiplications of two numbers of 2, 3, and 4 digits. They are provided with paper and pencil in order to solve the multiplications, but have to input the answer on the screen and press an "OK" button. On all pieces of paper provided to the participants on to initially solve the multiplications, we had already printed one correctly solved 4x4 digit

[4] We think that this models what happens in many real organizations, even those that have a sequential conveyor-belt type of task interdependence. Even the most extreme sequential task, the conveyor belt, uses multiple workers at one stage of the belt doing the same task. It is only the most difficult tasks, which require highly specialized skills, that cannot be supported by other workers' efforts in a particular stage of production.

[5] The instructions for the experiment can be found in Appendix A.

multiplication as an example. At the bottom of the screen there was a counter telling participants how many correct answers they had so far. It is important to note that in the practice period participants know which of the treatments they are in. As we will discuss below this opens the door to possible interaction effects between pre-experimental points and the treatments.

Table 1: Representation of the Production Process

Stage 1

Position	1	2	3	4
Inputs	x=two digit integer numbers randomly selected from [18, 31]			
Tasks (2')	Individual multiplication of two numbers x.			
Outcomes	y: correct multiplications, $y \in [324{,}961]$ and y^I=incorrect answers			

Stage 2

Position	5	6
Inputs	Pool of Correct y's from 1 and 2	Pool of correct y's from 3 and 4
Tasks (6')	Individual multiplication of two numbers y in this pool.	Individual multiplication of two numbers y in this pool.
Outcomes	z= correct multiplications, $z \in [103041{,}923521]$ and z^I= incorrect answers	z= correct multiplications, $z \in [103041{,}923521]$, and z^I= incorrect answers

Stage 3

Position	7
Inputs	z^a =Pool of z by agents 5 and 6 divided by 100 and rounded to closest integer $z^a \in [1030{,}9235]$
Tasks (8')	Multiplication of two numbers z^a in this pool
Outcomes	w=correct answers and w^I=incorrect answers
Profit:	$\Pi_t = 8 \cdot \#w - 0.15 \cdot \#y^I - 0{,}3 \cdot \#z^I - 0.6 \cdot \#w^I$

Once the practice period starts, each participant receives a different and random 2x2 digit multiplication. After introducing a possible solution into the computer, participants receive a random 3x3 digit multiplication; after it is solved, they receive a random 4x4 digit multiplication, and then the screen goes back to a random 2x2 digit multiplication. This process goes on for 6 minutes, after which all participants are given feedback on their results of the practice periods, separately for each of the three levels of difficulty (2, 3 and 4 digits). However, they do not receive any feedback about how the others in the group performed during this period.

After this, participants are randomly assigned to one of the seven positions in the group, in one of the three different stages of the production line. Four participants are allocated to a position in the first stage of the production process, two are allocated to a position in the second stage and one is allocated to the final, third stage. They are told to which of the three stages of the production they have been randomly assigned to, and the exact number of their position (see Table 1). Importantly, participants know at the beginning of the practice period that assignment to the positions will be random.

The production process we study combines pooled and sequential task interdependence (Thompson, 1967). Under pooled interdependence group performance is simply the sum of all individual performances (Saavedra at al., 1993). An example of pooled interdependence is salesmen in a firm, who work independently of each other, but all contribute towards the same goal of their firm. Under sequential interdependence at least one stage of the overall production produces an output which is necessary for the production of the next stage's output. This type of interdependence requires that units perform different parts of a task in a clearly arranged, one-way, order (e.g. an assembly line, in which the output of a worker on the line is heavily dependent on the workers in the earlier parts of that very same assembly line).

An experimental period starts off with the work of the four group members allocated to stage 1. They are given four minutes to individually solve as many two-digit, two number multiplications (ex. 25*30=?) as they can. The input and generation of new multiplications works in the same way as in the practice period explained above, but now only two digit numbers are generated. Every correct answer goes into one of two "pools". The correct answers of participants at positions 1 and 2 (P1 and P2) go into the pool of P5, and the correct answers of P3 and P4 go into the pool of P6. Even though bad performance at any stage can be detrimental to the entire work-group, there is a small cushion in the form of pooling. P1 and P2, P3 and P4, and P5 and P6 pool their answers, thus bad performance (deliberate or not) from one player can, to some extent, be compensated by a great performance by his/her "pooling partner."[6]

[6] For broad overviews of the workings of hierarchies see Anderson and Brown (2010) and Greer et al. (2018).

All numbers in the 2x2 digit multiplications consist of two random numbers between 18 and 31, the reason for this being that any combination of these numbers when multiplied gives rise to a 3 digit number. The correct results are stored by the program into one of the two pools for the next stage of the production.

Once the four minutes are over, stage 1 participants stop working and stage 2 participants begin their task. The two participants in the second stage have six minutes to solve 3x3 digit multiplications. However, they do not solve multiplications of random three-digit numbers, but multiplications of the correct answers given in stage 1. P5 multiplies correct answers of P1 and P2, and P6 uses the correct multiplications of P3 and P4. The correct answers of P1 and P2 are combined into one pool so it does not matter if P5 gets to multiply two correct answers of P1, two correct answers of P2, or one of each. Each correct answer from the first stage gets used only once in a 3x3 digit multiplication in stage two. For example: If P1 solves 14 multiplications correctly and P2 solves 4 multiplications correctly, P5 will only be given 9 multiplications to solve (14+4 =18, 18/2=9). The period ends for both participants of the stage when the six minutes are over, or for each of them when he/she runs out of multiplications to solve. All the correct answers given by P5 and P6 are divided by 100 and rounded, in order to produce a four digit number, and then pooled together in yet another pool and passed off to stage 3.

As soon as stage 2 finishes, stage 3 starts. The sole participant in stage 3 of the production process now has 8 minutes to solve 4x4 digit multiplications, which were pooled from the correctly answered multiplication questions by P5 and P6. The stage finishes when the 8 minutes run out or when P7 runs out of possible multiplications to solve.

With this, the first experimental period ends, and all participants learn in detail about the performance of their production group and how much they have earned in the period. They are shown the number of correct answers and incorrect answers at each stage of the production, but cannot see the performance of any individual participant (except for P7 who is the sole participant in stage 3). The total profit of the period depends solely on the correct number of 4x4 digit multiplications minus the amount for all wrong inputs in all three stages of production.[7] This profit is then, in this treatment, split evenly among all seven members of the group, which results 14.29% for each participant. Specifically:

Profit for the work group = (Number of Correct w's * 8 euros) - [(Number of incorrect y's * 0.15 euros) + (Number of incorrect z's * 0.30 euros + (Number of incorrect w's * 0.60 euros)]

The production process is repeated for a total of three periods, after which participants are shown a final table with the earnings of each period, and the sum of the earnings for the three experimental periods. If the total earning of a participant after the three periods had been negative, the program would have told them that their total income was 0, since we cannot have participants pay money to us. However, this never happens, though many groups did get a negative income (loss) for at least one of the three experimental periods, in which case this loss is subtracted from the periods with positive profit. With this the experiment ends and all participants are paid the total amount earned for the three periods plus the 4 euros show-up fee. In Table 1 we present the production process in detail.

During the production process the information feedback is the following. Participants see their own performance while they make decisions. There is a ticker that informs them of their total correct and incorrect multiplications of the current period in real-time (until their time runs out). Participants do not learn the individual performance of the other six participants while they are producing. Participants at stages 2 and 3 only know if those at the previous stage have supplied enough correct multiplications so that they can proceed with their multiplication. At the end of each complete period of three stages they are informed about the total numbers of correct and incorrect multiplications at each stage. This information including incorrect multiplications is necessary for the profit calculation.

[7] As in many real life situations, a company only makes profit on a final good on their production line and not on a semi-completed good, which is why a profit is only generate when a group manages to complete a good correctly though all three stages of production. Companies have a cost for all mistakes made throughout all stages of production, with the mistakes generally being more costly the closer the product is to completion.

2.1.2 Treatment 2 – Random Allocation and Unequal Pay

Treatment 2 is identical to treatment 1, except for the way in which a work-group splits the final profit between its members. In this treatment participants in stage 1 receive a percentage of the profit that is a fourth of what they receive in treatment 1 and participants in stage 3 receive a percentage that is four times what they receive in treatment 1. This amounts to the participants of the first stage receiving 3.57% of the total profit each, participants in stage 2 receiving 14.29% of the total profit each (the same percentage as in treatment 1), and the participant in stage 3 receiving 57.14% of the total profit, or sixteen times the percentage that the participants in stage 1 obtain. The participants know the way the profit is split from the very beginning and that allocation to the positions will be random. Observe that for stage 2 the fraction of profits that participants receive is the same as in the equal sharing scheme.

The profit sharing scheme that we use here may seem extreme in the distribution of profits, but we believe that a strongly unequal sharing scheme is the right starting point for a comparison with the equal sharing scheme. The effects of more moderate inequality could be studied in future work. Also, we think that multiplications of two numbers with four digits are much harder than those of two numbers of two digits, so that much higher participation in profits seems appropriate.[8]

2.1.3 Treatment 3 – Ranked Allocation and Equal Pay

Treatment 3 is different from the previous two treatments in the way that the participants are allocated to one of the seven positions in the production line. In this treatment the allocation depends on the performance in the "pre-experimental" period, which is now not only used as a practice period. Participants are informed before the practice period begins that allocation to the different positions will be

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[8] The large differences in the difficulty of the multiplications at the different stages is also the reason for assigning different numbers of minutes to the tasks at different stages. Changing the profit sharing scheme implies changing both the relative and the absolute payoff of participants at the top and at the bottom of the hierarchy, which is unavoidable.

done based on performance in the practice period. This “pre-experimental” period is in all other ways exactly the same as in the first two treatments. After the “pre-experimental” period finishes the program ranks the seven participants in terms of performance. It does this by awarding 1 point for each correctly solved 2x2 digit multiplication, 2 points for each correctly solved 3x3 digit multiplication, and 4 points for each correctly solved 4x4 digit multiplication. It also subtracts 0.1 point for each incorrectly solved 2x2 digit multiplication, 0.2 points for each incorrectly solved 3x3 digit multiplication, and 0.4 points for each incorrectly solved 4x4 digit multiplication. The participant with the most points is allocated to P7 in stage three of the production line, the 2nd and 3rd highest scoring participants are randomly placed into positions P5 and P6 in the second stage of the production line, and the four lowest scoring participants get randomly allocated to one of the four positions in stage 1 of the production line. Ties are resolved by randomization. All participants are made aware of this from the beginning of the experiment and are informed about their position at the end of the pre-experimental period. Participants in this treatment split the final income equally, just as in treatment 1.

2.1.4 Treatment 4 – Ranked Allocation and Unequal Pay

Treatment 4 combines the changes introduced in treatments 2 and 3. With everything else being the same as in all treatments, this treatment employs ranked allocation based on the pre-experimental period, just as in treatment 3, and the unequal pay used in treatment 2. Again, as in treatments 1, 2 and 3, participants know all of the information about the allocation as well as the profit sharing scheme from the very beginning of the experiment.

2.1.5 Treatments 5 and 6 – Random and Ranked Allocation with Endogenously Selected Payment Scheme

These two treatments differ between themselves through the allocation method, one treatment has random allocation while the other ranked. Participants know from the start – like in treatments 1-4 – whether allocation to the positions will be done on the basis of performance in the practice period. However, they do not know, while in the practice period, which payment scheme will be chosen, since this choice will be made by the participant at P7 once the allocation to positions will have been done.

2.2 Procedures

We conducted multiple sessions for each of the six treatments. The average running time of all six treatments was one hour and 40 minutes, which includes the time for reading the instructions out loud before the session as well as the time for paying all of the participants at the end of the session. Particpants are paid a 4 euro show up fee plus whatever they end up making during the experiment. The experiment was conducted at the computer lab of the Universitat Autonoma de Barcelona and participants were undergraduate students from the university. The z-tree software was used to run the experiment (Fischbacher, 2007).

We have a total of 637 participants in 91 work-groups: 15 in treatment 1, 11 in treatment 2, 13 in treatment 3, 15 in treatment 4, 16 in treatment 5 (9 Unequal, 7 Equal) and 21 in treatment 6 (6 Equal, 15 Unequal).

3. Background and Research Questions

As mentioned in the introduction, our production hierarchy setting can be seen as a both sequential and simultaneous coordination game with a real-effort task for which ability varies among the participants. There is both an issue of coordination between the three levels of the hierarchy, which move sequentially, as well as of the participants at the lowest level, who move simultaneous, among themselves and of those at the middle level, who also move sequentially, among themselves. In the sequential dimension of the coordination game between production stages the position of the three production levels is asymmetric. The bottom level has to act based solely on the expectations of what participants at the middle and top level will do. By contrast, participants at the top make their decisions knowing what the production has been at the middle level and, hence, how much intermediate input there is. Participants at the middle level are in an intermediate position: they base their decisions on what they know has happened for sure at the bottom level and their expectations of what will happen at the top.

In the simultaneous dimension of the coordination game at the bottom and middle levels the coordination issue is that all players at the corresponding level are interested in there being enough production for the subsequent level of the hierarchy but all would prefer the other players at their level to incur the effort cost of production. At the bottom level things are made slightly more complex by the fact that the four players at the bottom produce for two different (sub)pools: P1 and P2 for P5, and P3 and P4 for P6. There is now a coordination game both between, on one hand, P1 and P2, and, on the other hand, P· and P4 and also between the team of P1 and P2 vs. P3 and P4. However, these features of of our setting do not alter the fundamental coordination game character of the situation at the bottom level.

Our production-hierarchy setting is not directly based on a theoretical model. It bears some relation to the weakest-link game introduced by Van Huyck et al. (1990), but is more complex on several dimensions to better represent the production environments that we are interested in studying. In particular, it involves real effort and real time and also a particular kind of feeback information. Given these features we can not refer to the equilibria of the game in any rigorous way. In Appendix B we explain in detail why our design can not be looked at through the standard game-theoretic lense.

Up to now the discussion has referred to the case without any issues of distribution and efficiency, parallel to the standard symmetric weakest-link game. In terms of our treatments this is the case in treatment 1 with random assignment to positions and equal pay. Treatment 2 brings the issue of distribution into the picture. With unequal pay the game is still a coordination game, but now issues of relative payoffs between levels may affect players' behavior at the different levels. In particular players at the bottom could prefer not to work or even decide to sabotage production, since in any case they will only receive a small share of the profit.

In Treatment 3 we introduce the issue of efficient allocation to positions, given the existence of different abilities for the real-effort task. Again, the fundamental coordination game character of the situation is not changed, but now the players at the bottom may be prevented by their own low ability in coordinating with the others at a high production level, despite equal pay. For completeness, in Treatment 4 we study the joint effects of unequal pay and ranked allocation. Finally, the endogenous treatments bring in yet another issue: the possible reaction of participants and the bottom and middle levels to the fact that the participant at the top chooses a particular payment scheme out of the possible ones.[9]

We now come to our research questions. We study the comparative statics with respect to changes in the different treatment variables. Our main focus is the comparison of the effects on total profit of comparing the equal and the unequal profit sharing schemes. The main tension here is that the unequal scheme gives very good monetary incentives to people in the top position, but may have a demotivating effect on people at stage 1, perhaps being neutral for stage 2. There is much evidence that cooperation and efficiency may be affected by fairness considerations related to the payment scheme. Even in one-shot situations agents repay the principals' decisions, giving higher wages, by subsequently increasing efforts (e.g., Fehr et al. 1997, Fehr and Falk 2002). Workers may be unwilling to exert full effort when they realize that they are not being paid fairly (Akerlof and Yellen, 1990).[10] Additionally, it has been found that what employees see as fair payment, heavily depends on the wages paid to their co-employees (e.g. Frank, 1984; Lazear, 1989, Abeler et al. 2010). While this may be the reason that many firms pay equal wages to employees at the same horizontal level (Baker et al., 1988), equal payment at the same horizontal level may not necessarily imply fairness (e.g. Abeler et al., 2010; Holmström, 1982). We think that, given the high interdependency of the different production stages in our design, previous results are not directly applicable. Hence, it is a priori not clear which profit sharing scheme will lead to higher profits and better performance.

[9] See Sen (1997) on menu-dependence.

[10] Charness and Kuhn (2007) argue that the previous might not be the case, as most findings on worker effort and perceived fairness come from experiments of gift exchange (e.g. Fehr et al., 1998; Fehr and Falk, 1999). They find, experimentally, that workers' effort decisions are highly sensitive to their own wages, but largely unresponsive to co-workers' wages. They also argue that wage compression can be harmful and lead to paying equal wages to workers of unequal productivity, which is far from profit maximizing.

Second, we are also interested in the comparison between ranked and random assignment to the positions in the production line. Ranked allocation implies assigning those better at the task to the top position and those that perform weakest in the task to the bottom, in line with Kremer (1993) and Winter (2004) providing higher incentives at the top. Again, given the high interdependency of the different production stages it is not obvious which assignment scheme will be better for total performance of the organization. For a given level of input that reaches the top level, profit can be expected to be higher under ranked than under random assignment, since those at the top will be faster and will make fewer mistakes. However, since now those at the bottom level are less skilled it is possible that not enough input reaches the top and, hence, profits might be hurt.

Finally, we have the comparison between exogenous and endogenous determination of the payment scheme. Endogenous choice does not alter the coordination-game character of our setting. In this case the comparative statics depends on the interaction of the exogenous/endogenous variation with that of equal/unequal split. Like for the other cases, it is not possible to make an a priori prediction of the comparative statics.

4. Results

The results section consists of three parts. In section 4.1 we look at the results from the pre-experiment. In section 4.2 we present our findings about the "bottom line", the profits of the groups for each of the treatments. In the final section 4.3 we look at performance at each stage in each of the treatments.

4.1. Results – Pre-Experimental Period

Table 2 shows descriptive statistics for the numbers of points obtained in the pre-experiment multiplications for all six treatments. Recall that in the first four treatments participants know, when doing the pre-experiment multiplications, both the payment scheme and the procedure (Random or Ranked) that will be used for allocating them to the positions in the production process. In the last two treatments, they only know the allocation procedure but not the payment scheme, since that will be chosen by the participant at P7 after allocation to the positions in the production process has taken place.

As explained above, in the pre-experimental period participants have six minutes to solve as many multiplication problems as they can. The sequence of problems starts with a 2x2 digit multiplication to solve, followed by 3x3, then 4x4, before starting again with 2x2 etc.

Table 2: Average Pre-experimental Points Earned per Player

	Mean	Std. Dev.	Freq.
Equal Split – Random	4,783	4,265	105
Unequal Split – Random	4,445	4,282	77
Equal Split – Ranked	4,736	4,216	91
Unequal Split – Ranked	5,995	5,079	105
Endogenous - Random	4,744	4,031	112
Endogenous - Ranked	4,950	4,577	147

As can be seen from Table 2 the one treatment which stands out in pre-experimental performance is the Unequal Split-Ranked treatment. Using a two-tailed t-test one can see in Table 3 that we find significant difference between the Unequal Split-Ranked treatment and all other five treatments. This difference in performance comes mainly from the difference in correctly solved 4x4 digit multiplications.[11] In the Unequal Split-Ranked treatment participants have a stronger incentive to perform better in the pre-experimental period than in the other three exogenous treatments; the best performing participant will receive the stage 3 position and earn the highest amount among the seven teammates. Note also that there are no significant differences between any of the other treatments.

At first sight it may be surprising that participants in the Unequal Split-Ranked treatment perform significantly better than those in the Endogenous Split-Ranked treatment, since these two treatments seem to have the same incentive structure in the pre-experimental period. As can be seen from Table 3, we find a significant difference in the pre-experimental performance between these two treatments (p= 0.003 using a 2-tailed bootstrapped t-test), with participants in the Endogenous-Ranked treatment performing worse. It

[11] See Table A in Appendix C for more information.

is true that in the treatment with performance-based assignments and endogenous profit sharing. the best performer in the pre-experimental test will have the possibility to choose the unequal sharing scheme, but this does not mean that all potential top-performers will want to choose the unequal scheme; indeed some do not choose it, perhaps due to some aversion to inequality. Others may even prefer not to be at the top, to avoid the responsibility of having to choose or because they fear low performance or sabotage from their teammates if they opt to do so.[12]

Table 3: Bootstrapped T-test on Treatment Differences of Pre-Experimental Points

	Equal Split - Random	Unequal Split - Random	Equal Split - Ranked	Unequal Split – Ranked	Endo. - Random	Endo. – Ranked
Equal Split - Random		0.915 (0.992)	0.133 (1.014)	**-3.254***** **(1.035)**	0.120 (1.028)	-0.511 (0. 968)
Unequal Split - Random			-0.769 (1.014)	**-3.773***** **(0.949)**	-0.847 (0. 981)	-1.392 (0.946)
Equal Split - Ranked				**-3.252***** **(0.960)**	-0.022 (1.039)	-0.627 (0. 925)
Unequal Split - Ranked					**3.503***** **(0. 979)**	**2.963***** **(0.967)**
Endo. - Random						-0.658 (1.019)
Endo. - Ranked						

Note: Bootstrap method using 9,999 bootstrap samples, with standard errors in brackets; *p*-values: *<0.1, **<0.05, ***<0.01

4.2 Results – Profits

Table 4 allows us to get a first impression of profit differences between treatments. It shows the mean values of per period profits in the different conditions, as well as the totals over all three experimental

[12] An additional issue of interest is whether there is a difference in pre-experimental points between participants at stage 3 who choose the equal sharing scheme and those who choose the unequal one. For the Endogenous-Ranked treatment we find no statistical difference in the number of pre-experimental points. Indeed, the average numbers of points are very similar: 12.64 for those who chose unequal and 11.93 for those who chose equal. This is not surprising and simply due to the fact that those participants with the highest number of pre-experimental points in a group all have a similar number of points. By contrast, for the endogenous-random treatment there is a sizeable difference in the average number of points between those who chose one or the other sharing scheme (7.000 for unequal and 3.0066 for equal). Although in this case we only have sixteen data points in this treatment we find a statistical significant difference (p=0.088) using a two-tailed bootstrapped t-test. Our interpretation is that those participants who were randomly chosen to be at the top of the hierarchy are more likely to feel entitled to choose a sharing scheme that favors them if they did well in the pre-experimental test.

periods. Looking at the totals one can see that the average is always higher for ranked than for the corresponding randomly allocated case. The average for unequal sharing is higher than for equal except for the Endogenous-Ranked case. Over time there seems to be a general upward tendency, but with exceptions. Importantly, observe that in period 3 equal sharing has a higher average than unequal sharing in all relevant comparisons.

Table 4 - Firm Profits

	Exogenous Pay				Endogenous Pay			
	Random		Ranked		Ranked		Random	
	Equal	Unequal	Equal	Unequal	Equal	Unequal	Equal	Unequal
Period 1	10.31	12.90	17.61	23.28	23.19	18.29	10.01	12.35
Period 2	13.48	23.54	25.28	22.51	25.35	19.54	13.12	11.27
Period 3	23.23	14.46	23.13	22.51	26.76	20.72	15.61	15.40
Total	47.01	50.90	66.02	68.29	75.30	58.54	38.74	39.02

In our regression analysis we need to take into account that in treatments 1 to 4, the payment scheme is exogenously imposed by the experimenters, whereas in treatments 5 and 6 it is chosen by one of the participants. For this reason we analyze the treatments separately. Table 5 shows the results of random effects panel regressions for the exogenous treatments, using group level clustering. In Model 1 the independent variables are only the two treatment variables plus periods 2 and 3, with period 1 being the baseline. One can see that allocating the best "talents" to the right positions increases group profits. By contrast, the way in which the profit is split between group members does, as such, not make a significant difference. There are also significant period effects both for periods 2 and 3.[13]

In Model 2 we incorporate interaction terms between the equal-split variable and periods 2 and 3. We do this motivated by the inspection of the left panel of Table 4 where one can see that profits seem to increase in equal and not in unequal sharing treatments. The results of Model 2 show that there is indeed a

[13] In Appendix C we now show figures for period per period group profits. In the plots for the exogenous treatments one can see that the increasing trend is freqüent, so that the significant effects of period 2 and period 3 are not due to a few groups with a very strong upward trend in profits

significant interaction between equal sharing and time, but only for period 3 and not for period 2 and that effect of the period variables as such is not significant anymore.

Table 5 - Random effects panel regression on group profit – exogenous treatments only

	Model 1	Model 2	Model 3	Model 4
Ranked	6.079**	6.079**	12.556*	1.944
	(2.631)	(2.631)	(6.740)	(3.040)
Equal Split	-1.013	-4.505	-9.599	-2.490
	(2.631)	(3.415)	(6.556)	(3.040)
Pre-Exp. Points			0.344*	0.313***
			(0.202)	(0.088)
Equal* Pre-Exp.			0.266	
			(0.181)	
Ranked* Pre-Exp.			-0.220	
			(0.194)	
Equal*Ranked* Pre-Exp.				0.151
				(0.111)
Period 2	4.677**	4.053	4.677**	4.677**
	(1.930)	(2.716)	(1.930)	(1.930)
Period 3	5.019***	0.212	5.019***	5.019***
	(1.930)	(2.716)	(1.930)	(1.930)
Equal*Period 2		1.204		
		(3.771)		
Equal*Period 3		9.271**		
		(3.771)		
N	162	162	162	162

Note: 162 observations clustered at the group level; 54 groups; *p*-values - *<0.1, **< 0.05, *** < 0.01; Standard error in parentheses.

In Model 3 we add pre-experimental points to the regression, as well as its interactions with the treatment variables. One can see that pre-experimental points have a significantly positive effect on group profit. Pre-experimental points do not qualitatively alter the effect of the treatment variables and have the expected positive effect on profits; the higher the overall level of 'talent' in a group, the higher the group's profit, everything else equal. In Model 4 we have replaced the separate interactions of pre-experimental points with ranked allocation and equal sharing by a three-way interaction between the three variables motivated by the results in Table 4. Pre-experimental points have again a strongly significant effect, but the interaction term is not statistically significant.

Table 6 - Random effects panel regression on group profit – endogenous treatments only

	Model 1	Model 2	Model 3	Model 4
Ranked	8.951***	8.951***	1.507	4.931
	(2.896)	(2.896)	(12.307)	(3.684)
Equal Split	2.867	1.406	-4.384	-2.656
	(2.923)	(3.896)	(12.391)	(4.361)
Pre-Exp. Points			-0.250	-0.128
			(0.370)	(0.172)
Equal* Pre-Exp.			0.202	
			(0.353)	
Ranked* Pre-Exp.			0.212	
			(0.352)	
Equal*Ranked* Pre-Exp.				0.288*
				(0.167)
Period 2	1.408	0.507	1.408	1.408
	(2.165)	(4.462)	(2.165)	(2.165)
Period 3	3.500	2.625	3.500	3.500
	(2.165)	(4.462)	(2.165)	(2.165)
Equal*Period 2		2.224		
		(4.462)		
Equal*Period 3		2.159		
		(4.462)		
N	111	111	111	111

Note: 111 observations clustered at the group level; 37 groups; *p*-values - *<0.1, **< 0.05, *** < 0.01; Standard error in parentheses.

The lack of significance of the interaction terms in Models 3 and 4 may be surprising in the light of the fact that Unequal-Ranked leads to higher pre-experimental points, as shown in Table 3. The lack of significance in model 3 of the interaction term with equal simply says that the fact that the equal variable itself is not significant does not hide a positive effect for high (low) pre-experimental points and a negative effect for low (high) pre-experimental points. The lack of significance of the interaction with ranked allocation in Model 3 shows that the fact that in ranked the allocation of talent to hierarchy levels is better is not affected by the level of talent in a group; the gain from allocating people on the basis of ability instead of randomly is independent of the overall level of ability. The lack of significance of the three-way interaction in Model 4 can be seen as a double check on possible interactions and confirms the results of Model 3.

Table 6 shows regressions with the same specifications as in Table 5, but for the treatments where the payment scheme is chosen endogenously. In Models 1 and 2 the effects of the two treatment variables are similar to those in Table 5. There are now no significant period effects, however, as already suggested by inspection of Table 4. The addition of pre-experimental points in Model 3 shows that now higher pre-experimental points do not lead to higher profits separately from the effects of Ranked. Model 4 does show a significant effect of the three-way interaction.

Result 1*: (Profits)*

- *Averaged over time, the unequal profit sharing scheme yields the same total profit than the equal sharing scheme.*[14]
- *Averaged over time, ranked allocation yields higher profit than the random assignment.*
- *All the above holds for both the exogenous and the endogenous treatments.*[15]
- *In the exogenous treatment over time the unequal profit sharing scheme leads to a smaller increase in profits than the equal sharing scheme.*

[14] We did an ex-post MDE analysis, adopting a 5% significance level and an 80% power level, Model 1 of Table 5 would require a minimum detectible effect size of 7.367, and Model 1 of Table 6 would require a minimum detectible effect size of 8.184. Given the large MDE, we cannot with certainty confirm the null-hypothesis. However our results indicate a particularly small effect between the payment schemes (on average): the mean profit differences between the payment schemes are less than 3% in the exogenous conditions and less than 1% in the endogenous ones. The one case where we feel that the small sample size likely prevented us from finding a highly significant result is for the Endogenous-Ranked groups where our data indicates that equal-sharing groups largely outperform the unequal-sharing groups (equal-payment was chosen less often in the endogenous conditions).

[15] We have checked the results of Tables 5 and 6 with corrections for multiple testing. The results of the correction are shown in Table B in Appendix C. We use the Benjamini-Hochberg False Discovery Rate method, which is the recommended one for the case of many comparisons. As can be seen in Table B, for the results shown in Table 5 the correction does not change the significances of Models 1 and 2. That is, the main results that (1) averaged over time, the unequal profit sharing scheme yields the same total profit then the equal sharing scheme, (2) in the exogenous treatment over time the unequal profit sharing scheme leads to a smaller increase in profits than the equal sharing scheme and (3) averaged over time, ranked allocation yields higher profit than the random assignment, are not affected by the corrections. By contrast, all the coefficients that are significant in Model 3 of Table 5 are no longer significant in the corresponding regression with the correction shown in Table B. This implies that the discussion in the fifth paragraph of section 4.2 of the paper is weakened. For the results in Table 6, the correction does away with the significance of the three-way interaction Equal*Ranked*Pre-Exp. We feel that this change is of minor importance. At the same time, in this case the correction makes the variable for period 3 in Model 1 significant at the 10% level, indicating that for the endogenous case there is some evidence in favor of profits going up over time.

4.3 Results – Performance at each Stage

We now move to looking at what is behind the profit differences by analyzing performance at each of the production stages. Table 7 shows averages of the number of correctly solved multiplications, attempted number of multiplications, and percentage of correctly solved multiplications for all three stages of the production line. Observe that for stage 1 the averages for both the number and the percentage of correct multiplications are higher for equal than for unequal sharing for all comparisons. Similarly, the same averages are higher for random than for ranked assignments in all comparisons. We interpret that participants at the lowest stage of the production line are demotivated when they receive a very small share of profits and that, ceteris paribus, in ranked treatments less able participants are assigned to stage 1.

Table 7: Descriptives of Correctly Solved Multiplications by Period

	Stage 1 (2x2)			Stage 2 (3x3)			Stage 3 (4x4)		
	Correct	Attempted	%	Correct	Attempted	%	Correct	Attempted	%
Equal Split – Random	11,378	12,572	90,50%	4,778	6,844	69,81%	2,311	3,756	61,54%
Unequal Split – Random	10,652	11,917	89,38%	4,591	6,076	75,56%	2,424	3,727	65,04%
Equal Split – Ranked	11,295	12,846	87,92%	5,744	6,936	82,81%	3,077	4,692	65,57%
Unequal Split – Ranked	9,950	11,639	85,49%	5,844	7,322	79,82%	3,222	5,089	63,32%
Endo. Equal Random	10,556	11,806	89,41%	5,222	6,519	80,11%	1,963	4,074	48,18%
Endo. Unequal Random	10,417	14,976	69,55%	4,905	6,548	74,91%	2,190	3,524	62,16%
Endo. Equal Ranked	10,208	11,972	85,27%	5,139	6,417	80,09%	3,444	4,500	76,54%
Endo. Unequal Ranked	9,233	13,033	70,84%	5,033	6,489	77,57%	2,933	4,267	68,75%

In stage 2 there is no such clear pattern, but for stage 3 there is an interesting pattern for the cases of endogenous choice of payment scheme by the participant at the top of the hierarchy. For the case of random assignment to the top unequal pay is associated with higher numbers and percentages of correct multiplications. By contrast, for the case of ranked assignment to the top position equal pay is associated with higher numbers and percentages of correct multiplications than unequal pay. A possible interpretation is that participants who have chosen an equal pay scheme feel highly motivated (perhaps out of a sense of responsibility).[16]

[16] The information shown in Table 7 shows that there is over-provision of effort at stage 1. Workers in stage 3 attempt about 4 multiplications, which requires each worker in stage 2 to solve at least 4 multiplications. That would require each worker in stage 1 to solve about 4 2-digit multiplications (or about 6 multiplications to account for mistakes in

Table 8 shows the results of random-effects panel regressions for the multiplications at the three production stages parallel to model 2 in table 5. To get a complete picture, we show results for the number of correct, the percentage of correct and the number of incorrect multiplications. In these regressions we do not include the variable for pre-experimental points, as in the profit regressions above. The reason is that for stages 2 and 3 it is highly correlated with Ranked. For better comparison we have also left it out for stage 1.

Focusing first on the regressions without interaction terms we can see that 'Ranked' has a significantly negative effect on stage 1 performance; it significantly increases the number of incorrect multiplications and decrease the percentage of correct multiplications. This negative effect can be explained by the fact that under ranked allocation to positions participants assigned to the stage 1 positions are typically less able than those assigned under 'Random'.

For stage 2 one can see that it affects all three measures in a way that increases performance. Ranked allocation significantly increases the number and percentage of correct multiplications and significantly reduces the number of incorrect ones. For stage 3 ranked allocation has a significantly positive effect on the number of correct multiplications. In summary, we can see how ranked allocation affects production levels at all three stages. The variable 'Equal Split' has a positive significant effect in stage 1, but no effects on stages 2 and 3. By contrast, equal sharing has no effects in stages 2 and 3, consistent with the absence of a significant effect on profits. Observe also the significantly positive period effects at all stages. Table 9 shows the corresponding results for the endogenous treatments. Focusing again on the regressions without interactions observe the positive effects of ranked allocation in stages 3 and, the somewhat weaker negative ones, in stage 1. Interestingly, we observe a positive effect of equal sharing in stage 1, but not in stages 2 and 3, consistent with what we saw in Table 8 for the exogenous treatments.

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stage 2). While time constraints is for sure binding for stage 3, and most likely for stage 2, workers in stage 1 are not under a lot of pressure. If they correctly anticipate that the number of solved tasks in stage 3 will be pretty low, they could reduce their effort levels without reducing group profit. With more experience this over-provision might have disappeared over time.

Table 8 - Random-effects Panel Regressions on Number of Correct Multiplications, Number of Incorrect Multiplications, and Percentage of Correctly Solved Multiplications in Exogenous Treatments

	Correct Multiplications		**Incorrect Multiplications**		**% of Correct Multiplications**	
n=648			**Stage 1**			
Ranked	-0.378	-0.378	0.389***	0.389***	-0.034**	-0.034**
	(0.531)	(0.532)	(0.144)	(0.144)	(0.015)	(0.015)
Equal Split	1.050**	0.740	-0.106	0.0225	0.018	0.017
	(0.530)	(0.554)	(0.146)	(0.189)	(0.015)	(0.022)
Period 2	1.454***	1.308***	-0.009	-0.0865	0.019*	0.030**
	(0.240)	(0.325)	(0.103)	(0.140)	(0.011)	(0.013)
Period 3	1.903***	1.567***	0.069	0.346*	0.015	-0.006
	(0.272)	(0.360)	(0.120)	(0.178)	(0.012)	(0.020)
Equal*Period 2		0.282		0.149		-0.022
		(0.478)		(0.204)		(0.021)
Equal*Period 3		0.647		-0.534**		0.040
		(0.536)		(0.230)		(0.025)
n=324			**Stage 2**			
Ranked	1.103***	1.103***	-0.461**	-0.461**	0.085***	0.085***
	(0.328)	(0.329)	(0.192)	(0.193)	(0.026)	(0.027)
Equal Split	0.036	-0.107	0.128	0.147	-0.019	-0.013
	(0.334)	(0.400)	(0.188)	(0.233)	(0.026)	(0.035)
Period 2	0.481**	0.404	0.083	0.0769	0.008	0.018
	(0.189)	(0.277)	(0.129)	(0.225)	(0.020)	(0.033)
Period 3	0.741***	0.596*	-0.056	-0.0192	0.042*	0.041
	(0.216)	(0.305)	(0.141)	(0.205)	(0.023)	(0.035)
Equal*Period 2		0.150		0.0124		-0.020
		(0.378)		(0.263)		(0.040)
Equal*Period 3		0.279		-0.0701		0.002
		(0.432)		(0.283)		(0.046)
n=162			**Stage 3**			
Ranked	0.781**	0.781**	0.358	0.358	0.028	0.028
	(0.325)	(0.327)	(0.242)	(0.243)	(-0.054)	(0.054)
Equal Split	-0.130	-0.354	-0.064	0.288	-0.033	-0.109
	(0.321)	(0.423)	(0.249)	(0.324)	(0.054)	(0.087)
Period 2	0.481**	0.500	-0.241	-0.0769	0.113**	0.083
	(0.210)	(0.332)	(0.185)	(0.216)	(0.049)	(0.065)
Period 3	0.444*	0.0769	-0.037	0.346	0.081	-0.008
	(0.237)	(0.316)	(0.177)	(0.250)	(0.050)	(0.063)
Equal*Period 2		-0.0357		-0.316		0.059
		(0.426)		(0.366)		(0.098)
Equal*Period 3		0.709		-0.739**		0.172*
		(0.466)		(0.343)		(0.096)

Note: Clustered at group level (54 groups); *p*-values: * < 0.1, ** < 0.05, ** < 0.01; Standard deviation in parentheses

Table 9 - Random-effects Panel Regressions on Number of Correct Multiplications, Number of Incorrect Multiplications, and Percentage of Correctly Solved Multiplications in Endogenous Treatments

	Correct Multiplications		**Incorrect Multiplications**		**% of Correct Multiplications**	
n=444			**Stage 1**			
Ranked	-0.824	-0.824	-0.212	-0.212	-0.052*	-0.052*
	(0.593)	(0.595)	(1.562)	(1.565)	(0.031)	(0.031)
Equal Split	0.575	0.0262	-2.646**	-1.518**	0.052*	0.052*
	(0.642)	(0.652)	(1.337)	(0.770)	(0.029)	(0.031)
Period 2	0.507	0.284	1.068*	1.420	-0.0215	-0.021
	(0.314)	(0.456)	(0.592)	(0.982)	(0.016)	(0.025)
Period 3	1.615***	1.170**	1.811	2.830	0.006	0.005
	(0.323)	(0.476)	(1.339)	(2.227)	(0.020)	(0.031)
Equal*Period 2		0.549		-0.870		-0.002
		(0.592)		(1.000)		(0.030)
Equal*Period 3		1.096*		-2.513		0.003
		(0.572)		(2.234)		(0.036)
n=222			**Stage 2**			
Ranked	0.038	0.038	-0.115	-0.115	0.017	0.018
	(0.413)	(0.415)	(0.231)	(0.232)	(0.041)	(0.042)
Equal Split	0.207	-0.199	-0.259	-0.257	0.029	-0.026
	(0.417)	(0.515)	(0.234)	(0.326)	(0.043)	(0.068)
Period 2	0.986***	0.841**	-0.189	-0.250	0.074**	0.052
	(0.261)	(0.379)	(0.162)	(0.226)	(0.032)	(0.042)
Period 3	1.257***	0.909***	-0.041	0.0227	0.076**	0.032
	(0.197)	(0.242)	(0.156)	(0.220)	(0.031)	(0.037)
Equal*Period 2		0.359		0.150		0.053
		(0.499)		(0.317)		(0.064)
Equal*Period 3		0.858**		-0.156		0.110*
		(0.375)		(0.303)		(0.060)
n=111			**Stage 3**			
Ranked	1.060***	1.060***	-0.454**	-0.454**	0.145**	0.145**
	(0.361)	(0.364)	(0.211)	(0.213)	(0.057)	(0.057)
Equal Split	0.157	0.0443	0.228	0.0236	-0.048	-0.054
	(0.393)	(0.460)	(0.206)	(0.362)	(0.058)	(0.105)
Period 2	0.270	0.182	0.378	0.409	-0.071	-0.093
	(0.272)	(0.359)	(0.238)	(0.274)	(0.068)	(0.086)
Period 3	0.595**	0.545*	0.324*	0.0455	-0.025	-0.011
	(0.251)	(0.326)	(0.190)	(0.237)	(0.054)	(0.072)
Equal*Period 2		0.218		-0.0758		0.054
		(0.557)		(0.515)		(0.142)
Equal*Period 3		0.121		0.688*		-0.035

Note: Clustered at group level (37 groups); *p*-values: * < 0.1, ** < 0.05, ** < 0.01; Standard deviation in parentheses

Tables 8 and 9 also show the results of regressions with interaction terms that are parallel to those of Model 2 in Tables 5 and 6. In Table 8 we can see that 'Ranked' has a positive effect on production in stage 3, as measured by all three indicators, with no effect at the other two stages.

The interaction of the equal-split variable with the periods shows a positive interaction with period 3 in stages 1 and 3 in the sense of reducing incorrect multiplications. For the regressions in Table 9 corresponding regressions to the endogenous treatments we see some positive period effects and some indications that the equal-split variable interacts positively, in the sense of being production enhancing, with period 3.

***Result 2**: (Production performance)*

- *Averaged over time, the unequal profit sharing scheme has some negative effects on production performance at the lowest production stage.*
- *Over time the unequal profit sharing scheme leads to a decrease production at all three production stages.*
- *Averaged over time, the ranked assignment yields higher profit than the random assignment.*
- *All the above holds for both the exogenous and the endogenous treatments.*[17]

6. Summary and Concluding Remarks

We present a new experimental design to study the workings of highly interdependent work groups, a common situation in many organizations. In designing our production process we followed a number of basic design principles: a sequential order of production stages, the difficulty of the task increasing in the production stage, fewer people the higher the production stage, the product only being marketable if work

[17] We have checked the results of Tables 8 and 9 with corrections for multiple testing. The results of the correction are shown in Table C in Appendix C. We use the Benjamini-Hochberg False Discovery Rate method; the recommended method for the case of many comparisons. Note first that in Table C we have left out the percentages of correct multiplications that do appear in Table 8 since the percentages are just a consequence of correct and incorrect multiplications. Focusing first on the specifications without interaction effects, one can see that for correct multiplications all the coefficients that were significant before remain significant except one (Period 3 in Stage 3) with some of them being now significant at a lower level. For incorrect multiplications, the two coefficients that were significant before remain significant, but both at a lower level of significance. Something similar happens for the specification with interactions: some coefficients cease to be significant and some remain significant, but at a lower level. Finally, the pattern of changes in the significances between tables 9 and C is similar to that from Table 8 to Table C.

at the highest production stage is successfully completed and production mistakes being more costly the higher the production stage. In the resulting production process every stage has to perform at a high level in order to maximize profit, yet has a cushioning in the form of small pooling so that a bad performance by one person at any given time does not mean immediate disaster and shut down. Our setting is related to the weakest-link gam of Van Huck et al. (1990), but is more complex and involves real effort to allow us to get at some of the issues we are interested in.

Our results show that even extreme payment inequality does not significantly increase a work group's performance in real effort tasks with high interdependence. For both procedures for allocating people into position that we use in our treatments, we find only small and insignificant changes to performance when comparing equal pay and the exponentially unequal pay treatments. Moreover, with experience the equal profit sharing scheme even outperforms the unequal scheme, due to an increase in production performance both at the top and bottom stages of the production process. We find this result even though the amount of pay for two of the three stages in the production line differ by 400%, and the comparative difference in pay between the two stages (one and three) is 1600%. The high interdependence in production that we study makes steep incentives ineffective and even counter-productive.

We also find that allocating more capable people to higher stages of the production process has a significantly positive effect on profits in all cases. Given the high interdependence between production stages this is not obvious, since under ranked allocation the worst performers are allocated to stage 1 and this could conceivably create a bottleneck at the bottom of the hierarchy. All these results hold regardless of whether the profit sharing scheme is exogenously imposed or endogenously chosen by the person assigned to the top of the hierarchy. Hence, issues of menu-dependence and reactions to intentions do not alter our results.

We believe that our model of a production process could become a paradigm to study many other issues related to highly interdependent work groups. Among other possibilities, we could study other compensation schemes different from profit sharing schemes, add supervision and other realistic features of work environments, but we leave this for future research.

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APPENDIX A
INSTRUCTIONS

All comments in bold letters (like this one) are added for the reader and do not belong to the original instructions. These comments mark the parts that correspond to each treatment.

All treatments

Instructions

Welcome and thank you very much for your willingness to participate in this experiment. You will receive 4 euros for showing up for the experiment. In addition, you can make money during the experiment. From now on, contact, in any way, with other participants in the room is not allowed. If you have a question, raise your hand and we will come to your table. This is a sequential experiment so that not everyone will act at the same time. While waiting for your turn to participate you can do anything you want without leaving your place. And, please, keep checking your screen constantly to participate when it's your turn.

For the purpose of this experiment you will all be workers in a production process of different companies that do not have a relationship with each other. In each company there are 7 workers. You work for one company and you will be assigned to one of the 3 groups of workers of the same type: level 1 workers (positions 1, 2, 3 and 4), level 2 workers (positions 5 and 6) and level 3 workers. In each company, four of you will be workers at level 1, two will be level 2 workers and one will be a level 3 worker. You will be informed of your place in the company (on the screen you will see your number and level) as soon as the experiment begins. Nobody will know the identities of the other workers in the company.

Before you are assigned to a group of workers you will have five minutes to make 2, 3, and 4-digit multiplications. You will all receive the same sequence of multiplications.

Treatments with Random Allocation to Positions

Once the experiment begins, you will be asked to solve multiplications at certain times, so this is a good opportunity to practice and understand how the introduction of the solutions on the screen works.

These initial five minutes will not count for the experiment, but it is a mere practice. After these five minutes, the experiment will officially begin.

Treatments with Ranked Allocation to Positions

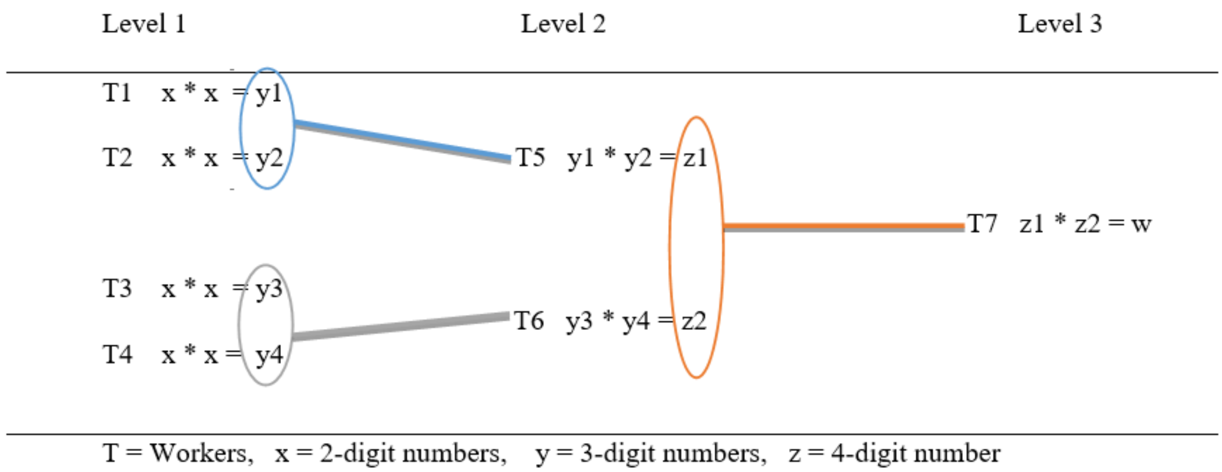
Your position within the company depends on the total number of correct and incorrect answers. The correct answers with 4-digit multiplications (4 points) have more value than those of 3 digits (2 points), and these have more value than those of 2 digits (1 point). And the incorrect ones remain 0.1 points for the multiplications of 2 digits, 0.2 for those of 3 digits and 0.4 for those of 4 digits. At the end of these 5 minutes, the person who gets the most points will be assigned to position 7, the next two will be assigned to positions 5 and 6 (not in order), and the rest will be assigned to positions 1 through 4 (no In order). You can see the different positions in the chart below. In case of ties, the allocation to positions will be random among those tied.

Treatments with Endogenous Choice of Profit Sharing Scheme

After these 5 minutes, the worker who is in level 3 (participant in position 7) will choose how to distribute the profits between two possible options. We will explain the two options at the end of the instructions.

All treatments

The experiment begins with the four first level workers. They will have 4 minutes to individually solve 2-digit multiplications (ex. 25 * 30 =?) that will appear on the screen. Each correct answer will be transmitted to another worker. The correct answers of workers 1 and 2 will be transmitted to player 5 and the correct answers of players 3 and 4 will be transmitted to player 6. The incorrect answers will be lost, that is, they will not be used later and will have a cost for the company. Remember that only the organizers of the experiment will know what position you occupy as a worker and in which company you are in.



Once level 1 workers finish, level 2 workers will have 6 minutes to solve as many 3-digit multiplications as possible from those available to him / her (Ex. 234 * 197 =?). The level 2 multiplications will be based on the numbers obtained in the previous step with the correct answers from the corresponding workers of level 1. Workers 5 and 6 will solve these operations for 6 minutes or until they finish the available multiplications (obtained from the Correct answers from level 1). All correct answers from players 5 and 6 will be put together and transmitted to level 3. Again, the incorrect answers of participants 5 and 6 will be lost and will not be used later, although they have a cost for the company.

At level 3 worker 7 has 8 minutes to solve 4-digit multiplications (3422 * 7324 =?). These 4-digit multiplications will be obtained from the correct multiplications of the level 2 workers. The time available in level 3 ends after 8 minutes or when the worker completes the available operations (the correct answers of level 2). Remember that in order to have correct multiplications in level 3 correct answers are required in levels 1 and 2. The correct answers of level 3 will generate the income of the company and the incorrect answers of each level will generate costs. The cost of an incorrect response will be higher the higher the level. The following equation specifies the relationship between multiplications and profits:

Company Profits

Profit=(number of correct answers*8 euros)- [(number of incorrect answers in Level 1* 0.15 euros) + (number of incorrect answers in Level 2* 0.30 euros + (number of incorrect answers in Level 3* 0.60 euros)]

That is, the total profit that the company receives will depend on the worker 7's correct answers minus some cost for each incorrect response from each worker in each level. Note that incorrect answers at level 1 have a cost of 0.15 euros; An incorrect answer in level 2 has a cost of 0.30 euros and an incorrect answer in level 3 has a cost of 0.60 euros.

Treatments with Equal Profit Sharing

The profit will be distributed among the 7 workers in an equal way so that each one will receive a 14.29%.

Treatments with Unequal Profit Sharing

The profit will be distributed among the 7 workers so that: participants 1, 2, 3, and 4 will each receive 3.57% of the total profit, participants 5 and 6 will receive each one 14.29 of the total profit and Participant 7 will receive 57.16% of the total profit.

Treatments with Endogenous Choice of Profit Sharing Scheme

The distribution of the profit among the workers will depend on the option that the participant 7 has chosen previously. You will know the participant's decision 7 before the first period begins.

The distribution options are:

1) The profits will be distributed among the 7 workers in an equal way so that each one will receive a 14.29%. (100/7)

2) The profit will be distributed among the 7 workers so that: participants 1, 2, 3, and 4 will each receive 3.57% of the total profit, participants 5 and 6 will receive each one 14.29 of the total profit and Participant 7 will receive 57.16% of the total profit.]

All treatments

You will receive information on the profit of the company and on your part of it. At that point the period will end.

There will be a total of three identical periods like the one we have just explained. At the end of the experiment you will receive 4 euros plus all that you have won in the three periods.

APPENDIX B [18]

Our experimental design bears some relation to a sequential game of incomplete information. However, a number of elements are impossible to integrate in a proper game-theoretic description and analysis.

There are three main difficulties. The first difficulty stems from the fact that in the experiment participants perform a real-effort task (instead of stated effort, which is more commonly used in experimental work). Real effort is a necessary component of our design. Without it we would not be able to study Ranked vs. Random allocation to positions, which is one of our main focuses. Real effort leads to performance, depending on participants' abilities and effort levels. Participants' abilities and effort costs are unknown to all participants and to the experimenters.[19] Effort is a complex object, since it can not be simply captured by the number of multiplications a participant completes but also depends on the concentration with which multiplications are completed, which is unobservable.

Second, the experiment takes place in real time. Participants work on their task during a certain time span during which they get feedback on their performance. They can, hence, change their behavior during the time span. This feature of the design is intuitive and allows for a clear difference between treatments to emerge.

Third, the information feedback that participants received was not designed to facilitate a game-theoretic analysis. In particular, participants do not learn the individual performance of the other six participants while they are producing. Participants at stages 2 and 3 only know if those at the previous stage have supplied enough correct multiplications so that they can proceed with

[18] We thank Anna Bayona for helpful suggestions for writing this appendix.

[19] See Charness and Kuhn (2011) for a survey of labor laboratory experiments with many references to research using real effort.

their multiplication. The design of this feedback was based on ‘realism’, since we think that it makes sense to assume that workers at a particular production stage do no know exactly what has occurred at previous stages.

At the end of each complete period of three stages they are informed about the total numbers of correct and incorrect multiplications at each stage. This information including incorrect multiplications is necessary for the profit calculation.

For proper sequential games of incomplete information the suitable equilibrium concept is Perfect Bayesian Equilibrium. For its formulation one needs to specify strategy profiles and beliefs satisfying four main requirements (see Gibbons, 1992): (1) At each information set, the player that moves must have a belief (a probability distribution) about which node of the information set has been reached; (2) Given their beliefs, players’ strategies must satisfy the sequentially rational criterion; (3) At information sets on the equilibrium path, beliefs must be determined by the Bayes’ rule and players’ equilibrium strategies; (4) At information sets off the equilibrium path, beliefs must be determined by Bayes’ rule and the players’ equilibrium strategies where possible.

With respect to strategies, given the real-effort and real-time character of the setting they are not a simple object and we have no information about them. We do not know whether participants set themselves goals. If they do, do they do it in terms of a certain number of completed multiplications or in terms of correct multiplications? Do they update their goals depending on the feedback they obtain and, if so, how do they do it?

Given the real-effort character of our design, participants can not form beliefs in any rigorous sense, since they don’t have standard information about abilities and effort levels of others’.

Given these limitations we have to limit ourselves to pointing out some benchmarks in term of feasibility. First, consider the configuration where all seven players choose to make zero multiplications. This configuration is feasible and stable, since no unilateral deviation by any of the four players in stage 1 is profitable. Second, there will be a highest possible profit level which will depend on the distribution of participants' abilities over the levels of the hierarchy. Any intermediate production between zero and this highest level is also feasible.

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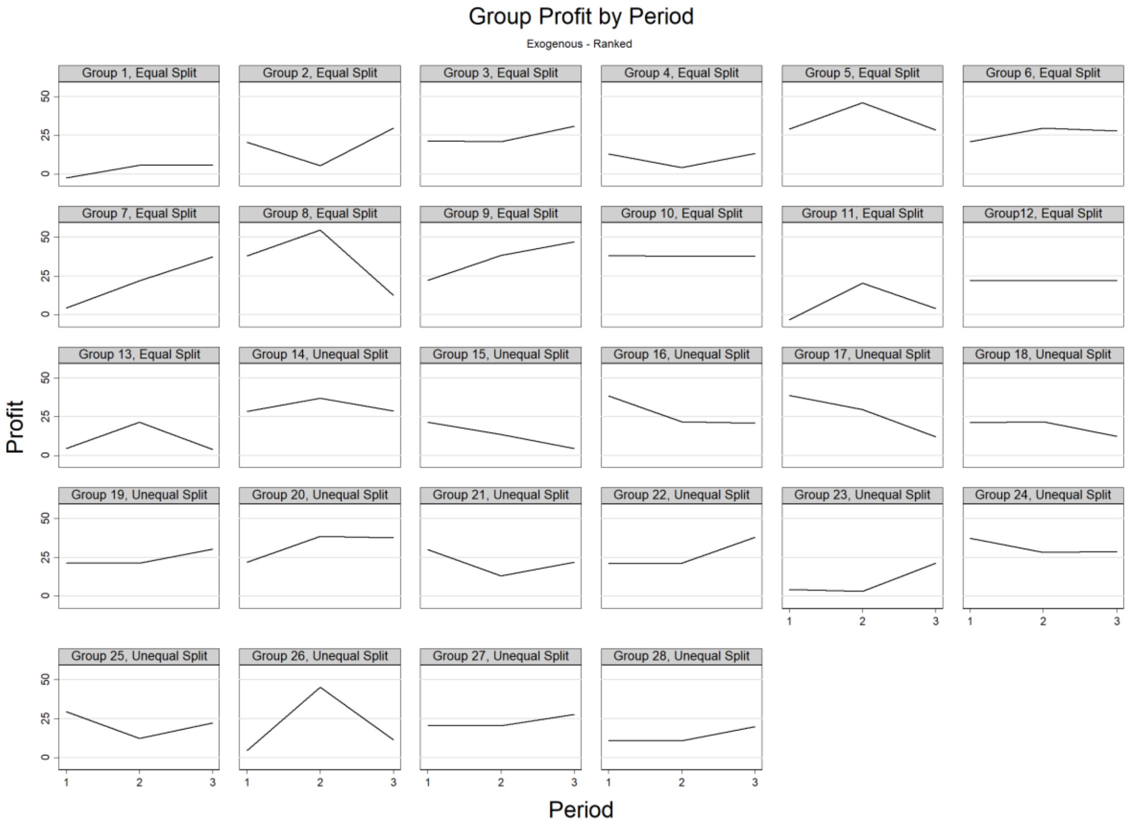
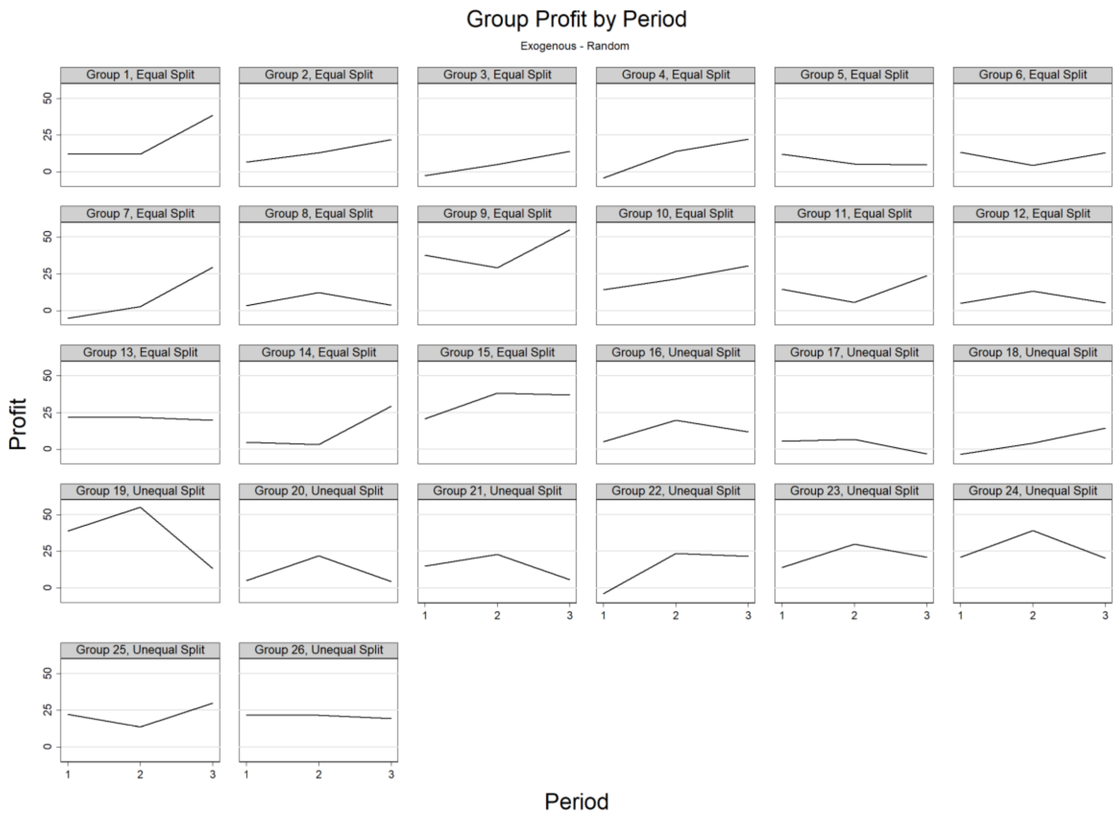
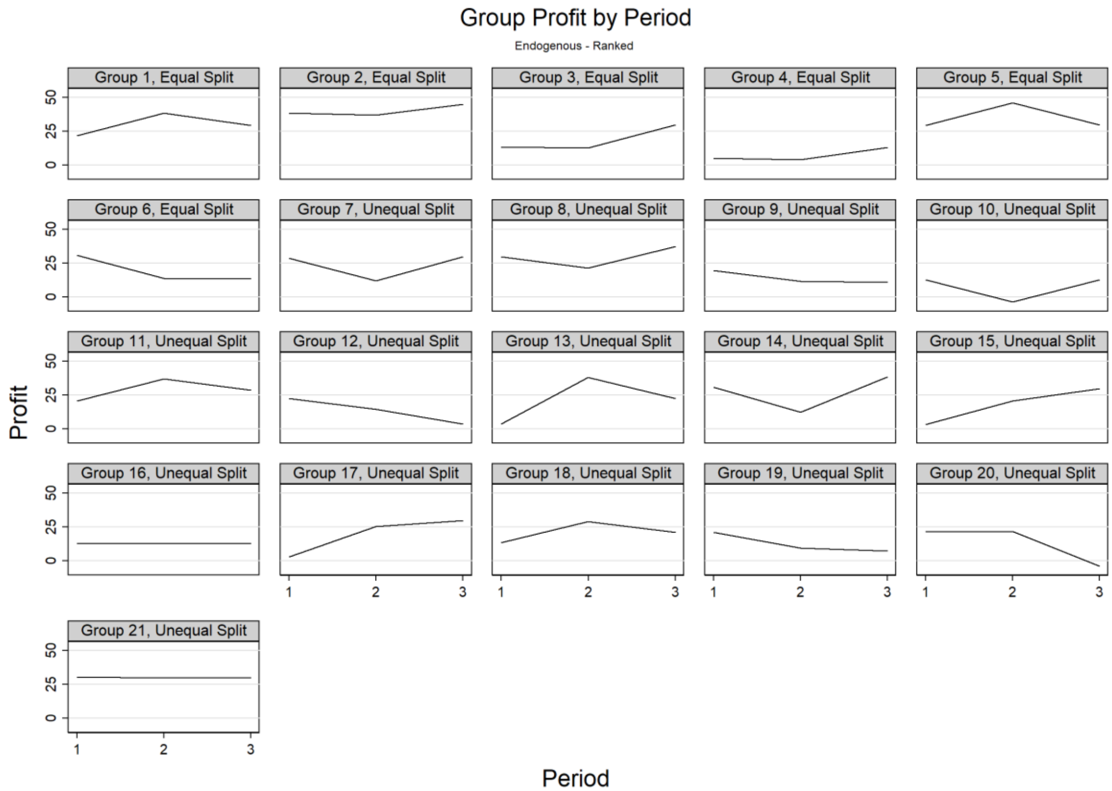
APPENDIX C

Table A: Pre-experiment: Average number of correct and attempted multiplications per player

		2x2 Digits		3x3 Digits		4x4 Digits	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Equal split - Random	Correct	1,543	1.110	0,895	0.909	0,495	0.622)
	Attempted	2,076	0.906	1,762	0.883	1,257	0.981
	% Correct	74,3%		50,8%		39,4%	
Unequal Split - Random	Correct	1,390	0.876	0,844	0.708	0,455	0.680
	Attempted	1,844	0.689	1,597	0.613	1,091	0.653
	% Correct	75,4%		52,8%		41,7%	
Equal Split - Ranked	Correct	1,538	0.886	0,934	0.814	0,473	0.638
	Attempted	2,132	0.653	1,813	0.698	1,286	0.655
	% Correct	72,2%		51,5%		36,8%	
Unequal Split - Ranked	Correct	1,619	1.060	1,067	0.993	0,686	0.751
	Attempted	2,200	0.813	1,905	0.838	1,371	0.846
	% Correct	73,6%		56,0%		50,0%	
Endogenous Split-Ranked	Correct	1,571	0.958	0,959	0.843	0,497	0.676
	Attempted	2,122	0.661	1,776	0.680	1,265	0.696
	% Correct	74,0%		54,0%		39,2%	
Endogenous Split-Random	Correct	1,518	0.838	0,964	0.869	0,446	0.598
	Attempted	2,009	0.651	1,714	0.703	1,170	0.642
	% Correct	75,6%		56,3%		38,2%	


Group Profit by Period
Exogenous - Ranked
Group 1, Equal Split
Group 2, Equal Split
Group 3, Equal Split
Group 4, Equal Split
Group 5, Equal Split
Group 6, Equal Split
Group 7, Equal Split
Group 8, Equal Split
Group 9, Equal Split
Group 10, Equal Split
Group 11, Equal Split
Group12, Equal Split
Group 13, Equal Split
Group 14, Unequal Split
Group 15, Unequal Split
Group 16, Unequal Split
Group 17, Unequal Split
Group 18, Unequal Split
Group 19, Unequal Split
Group 20, Unequal Split
Group 21, Unequal Split
Group 22, Unequal Split
Group 23, Unequal Split
Group 24, Unequal Split
Group 25, Unequal Split
Group 26, Unequal Split
Group 27, Unequal Split
Group 28, Unequal Split
Profit
0
25
50
1
2
3
Period


Group Profit by Period
Exogenous - Random
Group 1, Equal Split
Group 2, Equal Split
Group 3, Equal Split
Group 4, Equal Split
Group 5, Equal Split
Group 6, Equal Split
Group 7, Equal Split
Group 8, Equal Split
Group 9, Equal Split
Group 10, Equal Split
Group 11, Equal Split
Group 12, Equal Split
Group 13, Equal Split
Group 14, Equal Split
Group 15, Equal Split
Group 16, Unequal Split
Group 17, Unequal Split
Group 18, Unequal Split
Group 19, Unequal Split
Group 20, Unequal Split
Group 21, Unequal Split
Group 22, Unequal Split
Group 23, Unequal Split
Group 24, Unequal Split
Group 25, Unequal Split
Group 26, Unequal Split
Profit
0
25
50
1
2
3
Period


Group Profit by Period
Endogenous - Ranked
Group 1, Equal Split
Group 2, Equal Split
Group 3, Equal Split
Group 4, Equal Split
Group 5, Equal Split
Group 6, Equal Split
Group 7, Unequal Split
Group 8, Unequal Split
Group 9, Unequal Split
Group 10, Unequal Split
Group 11, Unequal Split
Group 12, Unequal Split
Group 13, Unequal Split
Group 14, Unequal Split
Group 15, Unequal Split
Group 16, Unequal Split
Group 17, Unequal Split
Group 18, Unequal Split
Group 19, Unequal Split
Group 20, Unequal Split
Group 21, Unequal Split
Profit
0
25
50
1
2
3
Period

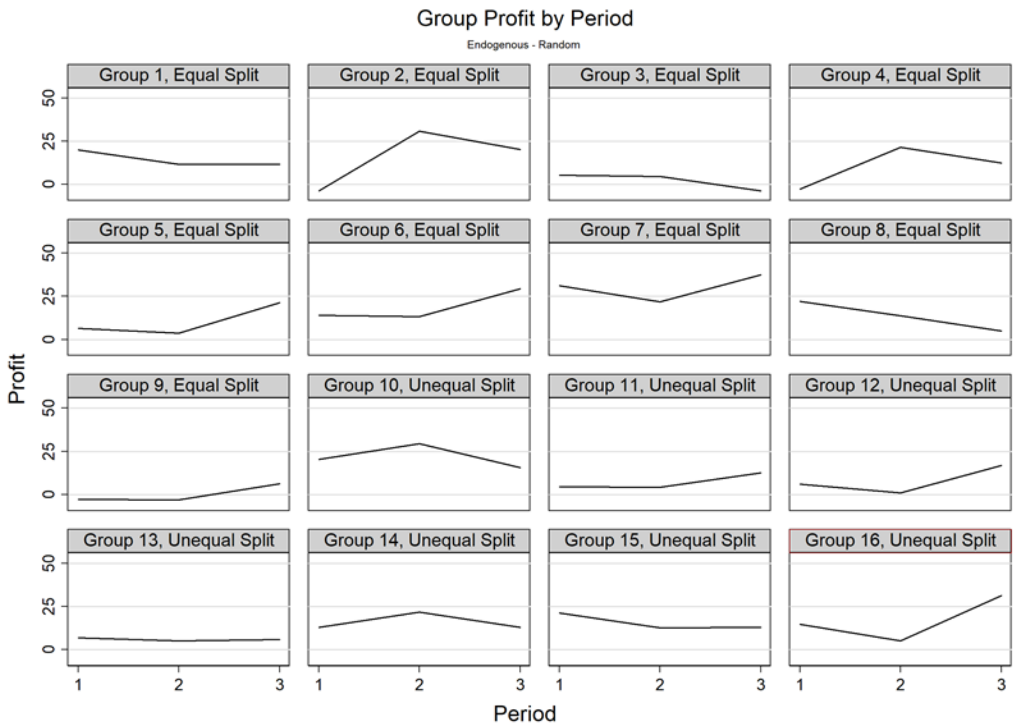

Group Profit by Period
Endogenous - Random
Group 1, Equal Split
Group 2, Equal Split
Group 3, Equal Split
Group 4, Equal Split
Group 5, Equal Split
Group 6, Equal Split
Group 7, Equal Split
Group 8, Equal Split
Group 9, Equal Split
Group 10, Unequal Split
Group 11, Unequal Split
Group 12, Unequal Split
Group 13, Unequal Split
Group 14, Unequal Split
Group 15, Unequal Split
Group 16, Unequal Split
Profit
0
25
50
1
2
3
Period

Table B - Random effects panel regression on group profit – exogenous and endogenous treatments

	Model 1	Model 2	Model 3	Model 4
EXOGENOUS				
Ranked	6.079**	6.079*	12.556	1.944
	(0.038)	(0.084)	(0.325)	(0.450)
Equal Split	-1.013	-4.505	-9.599	-2.490
	(0.356)	(0.508)	(0.325)	(0.450)
Pre-Exp. Points			0.344	0.313***
			(0.325)	(0.001)
Equal* Pre-Exp.			0.266	
			(0.325)	
Ranked* Pre-Exp.			-0.220	
			(0.401)	
Equal*Ranked* Pre-Exp.				0.151
				(0.304)
Period 2	4.677**	4.053	4.677	4.677*
	(0.037)	(0.441)	(0.118)	(0.058)
Period 3	5.019**	0.212	5.019	5.019*
	(0.033)	(1.000)	(0.118)	(0.053)
Equal*Period 2		1.204		
		(1.000)		
Equal*Period 3		9.271*		
		(0.084)		
N	162	162	162	162
ENDOGENOUS				
Ranked	8.951**	8.951**	1.507	4.931
	(0.017)	(0.025)	(0.806)	(0.450)
Equal Split	2.867	1.406	-4.384	-2.656
	(0.205)	(1.000)	(0.641)	(0.304)
Pre-Exp. Points			-0.250	-0.128
			(0.495)	(0.450)
Equal* Pre-Exp.			0.202	
			(0.495)	
Ranked* Pre-Exp.			0.212	
			(0.495)	
Equal*Ranked* Pre-Exp.				0.288
				(0.234)
Period 2	1.408	0.507	1.408	1.408
	(0.284)	(1.000)	(0.495)	(0.450)
Period 3	3.500*	2.625	3.500	3.500
	(0.093)	(0.815)	(0.325)	(0.053)
Equal*Period 2		2.224		
		(1.000)		
Equal*Period 3		2.159		
		(1.000)		
N	111	111	111	111

Note: 273 observations in total, clustered at the group level, separately for exogenous and endogenous groups (54, and 37 groups, respectively); *p*-values - *<0.1, **< 0.05, *** < 0.01. To adjust for multiple hypotheses we use the Benjamini-Hochberg method. We adjust within each model including both the exogenous and the endogenous treatments (for eight hypotheses in model 1, twelve in model 2 etc.). The resulting sharpened False Discovery Rate q-values are shown in parentheses.

Table C - Random-effects Panel Regressions on Number of Correct and Incorrect Multiplications in all Treatments

EXOGENOUS	Correct Multiplications		Incorrect Multiplications	
	Model 1	Model 2	Model 3	Model 4
n=648	**Stage 1**			
Ranked	-0.378	-0.378	0.389**	0.389*
	(0.511)	(0.955)	(0.033)	(0.085)
Equal Split	1.050*	0.740	-0.106	0.0225
	(0.100)	(0.499)	(0.511)	(1.000)
Period 2	1.454***	1.308***	-0.009	-0.087
	(0.001)	(0.001)	(0.741)	(0.960)
Period 3	1.903***	1.567***	0.069	0.346
	(0.001)	(0.001)	(0.559)	(0.211)
Equal*Period 2		0.282		0.149
		(0.984)		(0.955)
Equal*Period 3		0.647		-0.534
		(0.615)		(0.153)
n=324	**Stage 2**			
Ranked	1.103***	1.103**	-0.461*	-0.461
	(0.007)	(0.018)	(0.056)	(0.143)
Equal Split	0.036	-0.107	0.128	0.147
	(0.741)	(1.000)	(0.511)	(0.960)
Period 2	0.481**	0.404	0.083	0.0769
	(0.045)	(0.433)	(0.517)	(1.000)
Period 3	0.741***	0.596	-0.056	-0.0192
	(0.007)	(0.211)	(0.594)	(1.000)
Equal*Period 2		0.150		0.0124
		(1.000)		(1.000)
Equal*Period 3		0.279		-0.0701
		(0.960)		(1.000)
n=162	**Stage 3**			
Ranked	0.781*	0.781	0.358	0.358
	(0.056)	(0.143)	(0.219)	(0.433)
Equal Split	-0.130	-0.354	-0.064	0.288
	(0.594)	(0.835)	(0.689)	(0.825)
Period 2	0.481*	0.500	-0.241	-0.0769
	(0.064)	(0.433)	(0.265)	(1.000)
Period 3	0.444	0.0769	-0.037	0.346
	(0.126)	(1.000)	(0.717)	(0.459)
Equal*Period 2		-0.036		-0.316
		(1.000)		(0.825)
Equal*Period 3		0.709		-0.739
		(0.433)		(0.169)
ENDOGENOUS				
n= 444	**Stage 1**			
Ranked	-0.824	-0.824	-0.212	-0.212
	(0.250)	(0.459)	(0.741)	(1.000)
Equal Split	0.575	0.0262	-2.646	-1.518
	(0.427)	(1.000)	(0.107)	(0.211)
Period 2	0.507	0.284	1.068	1.420
	(0.186)	(0.960)	(0.141)	(0.433)
Period 3	1.615***	1.170	1.811	2.830

	(0.001)	(0.143)	(0.257)	(0.548)
Equal*Period 2		0.549		-0.870
		(0.825)		(0.825)
Equal*Period 3		1.096*		-2.513
		(0.216)		(0.695)
n=222	**Stage 2**			
Ranked	0.038	0.038	-0.115	-0.115
	(0.741)	(1.000)	(0.560)	(1.000)
Equal Split	0.207	-0.199	-0.259	-0.257
	(0.560)	(1.000)	(0.324)	(0.906)
Period 2	0.986***	0.841**	-0.189	-0.250
	(0.001)	(0.159)	(0.320)	(0.695)
Period 3	1.257***	0.909***	-0.041	0.023
	(0.001)	(0.001)	(0.689)	(1.000)
Equal*Period 2		0.359		0.150
		(0.955)		(1.000)
Equal*Period 3		0.858**		-0.156
		(0.153)		(1.000)
n=111	**Stage 3**			
Ranked	1.060**	1.060*	-0.454*	-0.454
	(0.016)	(0.058)	(0.081)	(0.169)
Equal Split	0.157	0.044	0.228	0.0236
	(0.594)	(1.000)	(0.324)	(1.000)
Period 2	0.270	0.182	0.378	0.409
	(0.386)	(1.000)	(0.188)	(0.433)
Period 3	0.595*	0.545	0.324*	0.046
	(0.056)	(0.337)	(0.157)	(1.000)
Equal*Period 2		0.218		-0.076
		(1.000)		(1.000)
Equal*Period 3		0.121		0.688*
		(1.000)		(0.243)

Note: Regressions clustered at group level, separately for endogenous and exogenous groups (37, and 54 groups, respectively); *p*-values: * < 0.1, ** < 0.05, ** < 0.01. To adjust for multiple hypotheses we use the Benjamini-Hochberg method. We adjust for all null-hypotheses of models 1 and 3 (24 hypotheses), on one hand, and for those of models 2 and 4 (36 hypotheses) on theother hand. The resulting sharpened False Discovery Rate q-values are shown in parentheses.