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ABSTRACT

Ceding Control: An Experimental Analysis of Participatory Management

We use an experiment to evaluate the effects of participatory management on firm performance. Participants are randomly assigned roles as managers or workers in firms that generate output via real effort. To identify the causal effect of participation on effort, workers are exogenously assigned to one of two treatments: one in which the manager implements a compensation scheme unilaterally or another in which the manager cedes control over compensation to the workers who vote to implement a scheme. We find that output is between seven and twelve percentage points higher in participatory firms.

JEL Classification: C92, J33, J53, J54, M50

Keywords: voice, control, intrinsic motivation, participatory management, real effort, experiment

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1 Introduction

Many "extraordinary claims have been made about [the effects of] employee involvement" (Lawler, 1995) on worker satisfaction and overall firm performance. Despite the strong intuition that employee participation in decision-making is a "win-win" for employees and firms, the empirical record is mixed (e.g., Capelli and Neumark, 2001). Certainly some of this owes to the list of well-known difficulties that accompany estimation: the inability to suitably control for unobservable heterogeneity, endogeneity, self-selection, or, more fundamentally, the availability of reliable and appropriate data. It may also be true that differences in sample characteristics, research designs, practices, and/or performance metrics have additionally contributed to mixed reported findings.

In this paper, we use an experiment to mitigate some of the hurdles that hinder the identification of any causal effect of participation on performance. In particular, unlike the field where important aspects of production and motivation (like participation) are often determined endogenously, experiments allow one to implement exogenous, ceteris paribus changes. In our case, we compare groups of workers that were exogenously allowed (or not allowed) by a manager to participate in the running of the firm by having their vote determine the group's compensation policy. Because we collect compensation preferences before anyone learned the details of the experiment, they too are exogenous and allow us to control for worker selection. In this setting, we find that the average treatment effect of ceding authority to workers on effort in a real effort task is large (between seven and twelve percentage points), statistically significant and robust.

We allow managers to choose to either implement a compensation scheme unilaterally or cede the right to choose to the workers in an environment in which nothing is known of the worker characteristics and managers (along with their preferences) are randomly assigned to firms. Interestingly, in this setting we find that managers are reluctant to cede decision-making authority despite the possibility that it might be beneficial to do so. This finding replicates a

result that is now common in the related literature (e.g., Fehr et al., 2013, Bartling et al., 2014).

Considering our main contribution, we find a large and significant effect of participation, one that echoes the recent results on institutional choice and democracy found in Dal Bó et al. (2010). Like Dal Bó et al., we find that democratic participation affects motivation; however, while our experimental manipulation to account for possible selection effects is similar, it is also a bit simpler. Dal Bó et al. allow participants to vote on whether or not to modify the payoffs of a social dilemma game but a computer then decides whether or not to heed the results of the vote. When the computer ignores the vote, it decides to modify the game randomly. In our simplification the context is also a bit more natural in that a human manager takes the role of the computer and decides to cede control to the workers before knowing the outcome of the vote.

Reflecting on our previous work, the difference in output between workers in participatory firms and those in no-voice, traditional firms is larger, but in the same "ballpark" as a related estimate described in Mellizo et al. (2014). This original study estimated an effect of voting on effort to be between 7 and 9 percentage points, at most while our current upper bound estimate is close to 12 percentage points. However, there are substantial differences between the current experiment and the previous one, including one that might account for the larger effect. In addition to new design elements that allow us to more convincingly estimate a causal relationship, the elicitation of *ex ante* preferences to control for selection effects, changes in the compensation schemes available (a piece rate instead of revenue sharing) and a larger sample, we added an aspect of relational contracting (Macneil, 1985) to the current experiment, which might partially explain why the current effect is more pronounced. In the current experiment managers could either trust workers to pick a compensation scheme that would benefit everyone or not trust them and pick the scheme themselves. The manager's confidence in the workers' vote could very well interact positively with standard intrinsic motivational effects resulting from just allowing the workers more autonomy (Falk and Kosfeld,

2006; Charness et al., 2012). In our previous experiment things were simple but less realistic: there were no bosses and compensation schemes were either imposed randomly or via the worker's vote – an environment in which only the intrinsic motivation channel was likely to affect effort.

A more extensive review of the literature on participatory management and worker voice can be found in the online appendix that accompanies this paper, along with the experimental instructions and various robustness tests. What follows is a description of our experiment and a detailed analysis of our main results.

2 Experimental Design and Procedures

To provide a fresh estimate of the causal effect of participation on motivation, we conducted five one-hour sessions with a total of 320 experimental subjects who earned an average of 15.25 € (standard deviation of 7.2 €) including a 5 € show-up fee. After arriving, participants were seated randomly at computer terminals where they found scratch paper, a pencil, a sheet of paper with a number place (Sudoku) logic puzzle, and instructions for an initial two-minute practice period during which all subjects familiarized themselves with the work task that would be used in the experiment.

In the first stage of the experiment, a two-minute practice period, subjects added different sets of five two-digit numbers that appeared on their computer screen. We did not allow the use of calculators but subjects could use the scratch paper and pencil we provided them. The numbers to be added in each problem were randomly generated. We used this work-task since it yields low intrinsic reward, requires little skill for a college student, and because previous work has found that it does not result in biased performance in any systematic manner (Niederle and Vesterlund, 2007). When the two-minute practice period ended, subjects saw a summary screen that indicated to them how many problems they correctly solved before proceeding to the next stage in the experiment. To prevent strategic voting over compensation schemes as much as possible, participants only saw their own output in the practice

period, not the distribution of output for their group or the session.

At the beginning of the second stage of the experiment, subjects were informed that they had been randomly and anonymously grouped with three other subjects to form a firm connected through the computer network. Subjects then learned that they would be assigned to one of two roles with different responsibilities—either a manager or a worker—though at this point in the study they were not told their roles. In the next phase of the instructions subjects learned that all of the firm's earnings were tied directly to the number of correct answers by workers to simple math problems presented in exactly the same (random) way as in the practice period. Specifically, all subjects learned that each correct answer provided by any worker would generate 0.75 € of revenue for the firm, 0.25 € of which went towards compensating the manager, and the remaining 0.50 € going towards the compensation of the workers. Participants then learned that workers would have fourteen minutes to produce correct answers.

The determination of the worker's compensation was ultimately the responsibility of the manager. That is, the manager was given decision-rights over implementing one of two possible compensation schemes for workers. Firms would either operate under a piece-rate scheme equal to 0.50 € per unit of output, or a rank-order tournament where the number of correct answers from all group-members would be first summed, multiplied by 0.50 €, and then distributed to workers based on their ranks. The highest performer would receive 60% of the compensation proceeds, the second highest performer 30%, and the lowest 10%. We use these two compensation schemes since, from the perspective of rational agents, both stimulate effort (Lazear and Rosen, 1981).

The payoff going to the manager was significant because we wanted managers to carefully consider their choices and anticipate how their choices might affect worker effort. At the same time, we picked the parameters of the compensation schemes so that workers consistently earned more than the manager made off their individual efforts. We chose to do this to minimize any invidious comparisons between workers and the manager. Under the piece rate, for each unit produced by worker i the boss earns 25 cents and the worker earns 50. In

the tournament, winners and runners up always do better than the manager (earning 60 and 30 cents of their own value added, respectively). In addition, even the tournament loser will earn more than what the boss receives from her effort in many instances. In the end, fewer than 10% of workers earned less than the manager.

We then collected the compensation scheme preferences of the participants. These preferences were conditioned on the yet-unknown role assignment. Participants could register a preference for the piece rate scheme or the tournament and condition their choices on ending up as a worker or a manager. Once preferences were recorded, subjects were randomly assigned to one of the two roles by the computer program and informed of their job on their screen. While our preference elicitation was not incentivized, it was not clear why incentives would be necessary to get participants to reveal this information truthfully (an intuition corroborated by the strong associations found between stated preferences and choices in Tables 3 and 5 of the next section).

Once participant roles were revealed, we explained that the workers would vote for a compensation scheme while the managers decided whether to cede authority and let the worker vote determine (majority rule) the pay structure or implement a scheme unilaterally. Whether the manager ceded control or not determined the treatment into which workers were sorted. In the "No Participation" treatment, the manager decided on the compensation scheme unilaterally and in the "Participation" treatment, the manager allowed the worker vote to determine the compensation scheme.

Despite ceding seeming like an unusual choice to face for our managers, it is externally valid. For example, as discussed at some length in Semler (1989, 1993), the Brazilian manufacturing firm Semco has experimented with letting its workers set their own wages. Further, ceding control over other related parameters of the job (work hours and working from outside the office) is now standard practice.

Importantly, the worker and managerial choices were made simultaneously so managers could not condition their choices on the outcomes of the vote and workers could not vote based on the votes of the other workers or the manager's

decision to cede control or not. After the votes and managerial decisions were recorded, participants learned the decision taken by the manager in their firm, the outcome of the vote among workers regardless of whether the votes actually determined compensation or not, and the compensation scheme to be implemented for the work task of solving addition problems.

During the fourteen-minute production stage, workers added while managers waited. Recall that all subjects were given puzzles with the instructions and were never instructed against using them. The primary reason for the puzzle was to allow managers to have something to do while they waited for production to end. If they worked on the puzzle, they could preserve role anonymity in the experiment. We also provided the puzzles to reduce the opportunity cost of not adding for the workers. If they did not want to add, workers could work on the puzzle and appear as busy as the others.

At the completion of the work period, all subjects received a summary of their performance (i.e., the number of correct answers), the number of correct answers solved by the firm's highest performer, the total number of correct answers produced by the firm, their relative rank, their payout, the manager's earnings, and the total firm revenue generated during the work period. At this point the experiment was completed and subjects were asked to fill out a brief post-study questionnaire. While subjects filled out the questionnaire final payments were gathered and distributed privately to each subject, one-by-one, as they left the lab. All sessions were conducted at the LINEEX laboratory at the University of Valencia and the experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007).

3 Results

Although our primary interest is the relationship between participation and worker productivity, we first report the results of "balance tests" for our experiment and examine both manager choices and worker votes. As part of the post-experiment questionnaire, participants reported their gender, their competitiveness (on a 1 to 5 Likert scale) and their "enjoyment of math" (also

on a 1 to 5 scale). The means of these variables, along with the means of output in the practice period (our measure of ability) are collected in Table 1. The wording of the competitiveness question was put in the context of sports, a context in which competitiveness is seen as a virtue: "concerning just sports and leisure activities, how competitive do you think that you are?" and the math enjoyment question was phrased simply: "I enjoy solving math problems."

Table 1: Mean observables by treatment.

	Male	Ability	Enjoy Math	Competitiveness
No participation	0.50	7.31	3.51	4.11
	(0.50)	(4.18)	(1.11)	(0.89)
Participation	0.43	7.13	3.45	3.98
	(0.50)	(5.02)	(1.20)	(1.02)

Notes: (s.d.); No participation refers to the treatment in which the manager decided the compensation policy unilaterally and Participation indicates the worker vote determined the policy.

Balance, according to t-tests, has been achieved because none of the participant characteristics differ significantly between the two treatments. What differences do exist, however, should to work *against* finding a participation effect. Fewer men were assigned to the Participation treatment in which their votes counted and the extensive previous literature (e.g., Niederle and Vesterlund, 2011; Carpenter et al., 2010) suggests that (i) men prefer tournaments (relative to women) and (ii) tournaments tend to be more productive. Those in the No participation treatment were also slightly more competitive, on average, and, most importantly, ability is a little higher in the No participation treatment. Significant or not, we shall control for these differences in our analysis.

The preferences and choices of our managers are summarized in Table 2 (raw preferences, not dependent on roles, are reported in the online appendix Table A1). Starting with the bottom row, we see that there were 80 firms (composed of 240 workers and 80 managers), and the managers were hesitant to cede control to the workers. In just one-quarter (20/80) of the firms did

the manager let the vote of the workers determine the compensation scheme. In the other sixty cases, managers were more likely to pick the tournament (37/80) than the piece rate (23/80). This unavoidable imbalance will make it more difficult to estimate a participation effect precisely.

Table 2: Manager preferences and choices.

	Piece Rate	Tournament	Cede	total
Prefer Piece Rate	21	5	12	38
Prefer Tournament	2	32	8	42
total	23	37	20	80

Another important feature of the manager data is that compensation scheme preferences elicited before any roles were revealed seem to strongly determine choices. Considering the rest of Table 2, one can see the clustering of observations in which manager preferences are in accord with choices. The exception is among the "ceding" managers. Here manager preferences were more evenly split between the pay schemes. Despite the dilution of the link between preferences and choices coming from the last column, Cramer's V, a measure of association for categorical variables, is quite large (0.67) in Table 2, indicating the non-ceding managers followed their preferences closely. A more controlled demonstration of this result comes from Table 3 in which we report multinomial logit results showing that managers who prefer tournaments, *ex ante*, are less likely to pick piece rates and more likely to pick the tournament when ceding control is the point of reference. Table 3 also suggests that managers of higher ability were more likely to pick the tournament, while, interestingly, none of the other participant characteristics seemed to matter (i.e., although men might be more likely to opt into a competition, we find they are no more likely than women to impose one on someone else).

Table 3: Manager Preferences and Choices.

	(1a)	(2a)	(1b)	(2b)
	Chooses Piece Rate		Chooses Tournament	
Prefers Tournament	-1.946**	-1.965*	2.262***	3.624***
	(0.875)	(1.032)	(0.667)	(0.833)
Ability		-0.138		1.515***
		(0.502)		(0.586)
Male		0.860		0.205
		(0.707)		(0.725)
Enjoy Math		0.238		-0.275
		(0.346)		(0.303)
Competitiveness		-0.414		-0.420
		(0.387)		(0.393)
Observations	80	80	80	80

Notes: Dependent variable is whether a manager decided to use the piece rate or the tournament and ceding control to the workers is the baseline; manager compensation preferences elicited ex ante; multinomial logit coefficients; (robust standard errors); * p<0.10, ** p<0.05, *** p<0.01.

Like the managers, worker votes are very consistent with their stated preferences. In Table 4 we illustrate the association between worker preferences, elicited before the experiment began, and the votes the workers cast during the experiment. Overall, the workers seem to shy away from competition: 62% (148/240) registered a preference for the piece rate over the tournament and the vote ended with a similar proportion, 59% (142/240), casting a ballot for the piece rate. Looking at the cross tabulation, one sees the same clustering in the worker data as was evident in Table 2. Here the value of the association statistic is also quite high (V=0.69).

Table 4: Worker preferences and votes.			
	Vote Piece Rate	Vote Tournament	total
Prefer Piece Rate	127	21	148
Prefer Tournament	15	77	92
total	142	98	240

To corroborate the conclusions drawn from Table 4, we report marginal effects after probit regressions in Table 5. First, replicating the vast literature on gender differences mentioned above, we find that men are, indeed, more likely (21pp, $p<0.01$) to vote for the tournament. However, no other characteristic predicts the vote. The fact that ability does not correlate with voting for the tournament suggests that not showing workers the distribution of ability prior to the start of the experiment did help attenuate strategic voting. Nevertheless, the most important result from Table 5 is that workers with a preference for the tournament were 70pp more likely to vote for it ($p<0.01$).

Table 5: Worker Preferences and Votes.		
	(1)	(2)
Worker Prefers Tournament	0.695***	0.703***
	(0.048)	(0.049)
Ability		-0.033
		(0.063)
Male		0.207***
		(0.077)
Enjoy Math		0.014
		(0.034)
Competitiveness		0.009
		(0.042)
Observations	240	240

Notes: Dependent variable is one when the worker voted for a tournament; Tournament preferences elicited ex ante; probit marginal effects reported; (robust standard errors); * $p<0.10$,** $p<0.05$, *** $p<0.01$.

In terms of the results of the worker votes, when the vote was determinative (that is, in the Participation treatment), 60% of the firms adopted piece rates and 40% adopted the tournament. As one may recall from Table 2, when the manager chose the compensation scheme, the percentages are almost exactly reversed: 38% of managers picked the piece rate and 62% picked the tournament. Using a proportions test, the difference in the incidence of tournaments between the two types of firms is only marginally significant (p=0.09). Overall, 35 of the 80 firms used the piece rate and 45 used the tournament.

We now switch the focus of our analysis to worker output. As one can see in Figure 1, there is a nice, symmetric, distribution of the number of correct answers that our workers produced. The mean number of sums created was 27 (s.d. 10.14) and output varies from zero to sixty sums.

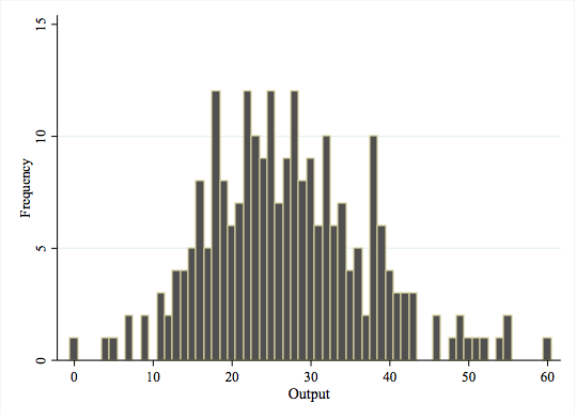

Figure 1: The distribution of worker output.

The main purpose of the experiment is to identify the effect of participation, manifested in the right to vote, on worker effort and output. To identify any effect of participation as causal, we must exploit exogenous variation in the decisiveness of the vote. This variation is assured by our design. While the assignment of workers to the voting treatment is not completely random because managers decide to cede control or not, it is clearly exogenous for the workers – they have no say in this choice. Further, though managers may act on their preferences and therefore not decide whether to cede control to the

workers randomly, they are randomly assigned to the firms. And, given the restrictions we placed on information about the characteristics of the workers (ability, in particular), managers could never condition their choices to cede or not on these attributes.

With this in mind, the natural place to start our analysis is a simple comparison of mean outputs between the participation treatments. This comparison is illustrated in Figure 2 where we compare the natural log of output in the two treatments (one was added before taking the log of the one zero observation seen in Figure 1), allowing us to speak more conveniently in terms of percentage point differences. Indeed, mean output is almost 7pp greater in the Participation treatment as hypothesized; however, because managers were hesitant to yield control and only 60 of the 240 workers are in participatory firms, the confidence intervals are larger than one might have wished. As a result, the difference in means is not significant using a simple t-test (p=0.34).

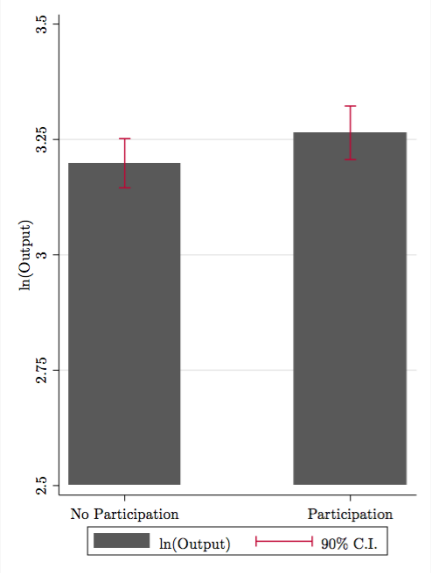

Figure 2: Mean output by participation.

Recall, however, that the differences in observables seen in Table 1 are likely to mask the effect of voting in the summary statistics. To examine this possibility, we report regressions in Table 6 that account for these differences. In the

first column we replicate our t-test and find a 6.6pp (p=0.23) difference when no controls are added. In the second column we add the controls for ability, gender, math enjoyment and competitiveness and see that the point estimate on the voice treatment does increase substantially. Here the estimate is that workers with voice produce 11.3pp more than those without (p=0.02), a substantial effect, especially given the subtlety of the treatment differences (i.e., the only difference is that the vote counted in one treatment and it didn't in the other). From the rest of column (2) we also see that our measure of ability is, indeed, a strong predictor of output as is one's math enjoyment. However, we do not find significant effects of gender or competitiveness. Though the differences in ability and math enjoyment are not significant between the treatments (Table 1), they exist and because the effects of these characteristics on output are so large, the omission of even small differences from the analysis biases our estimate of the participation treatment effect.

Given assignment to a participatory firm is exogenous, we can interpret the point estimate on the Participation treatment causally. Yet one's intuition might suggest that the mixture of firm types (piece rate or tournament) between the conditions will influence this (average) treatment effect. We know, for example, that tournaments are a bit less common among our participatory firms and so would the point estimate be even larger if we accounted for this? The problem is that one cannot address this concern by simply adding an indicator for the compensation scheme to the regressions in Table 6. To do so would be an example of a "bad control" (Angrist and Pischke, 2009). Specifically, the compensation scheme implemented was the result of choice and not fixed at the start of the experiment. Nevertheless, our experiment was designed in anticipation of this issue. Instead of conditioning on the compensation scheme, we can add worker compensation preferences to the regression. These preferences are exogenous (fixed before any knowledge of the experiment was revealed) and, as seen in Table 5, worker preferences correlate highly with votes and, therefore, with which scheme is implemented.

As seen in column (3) of Table 6, worker preferences do appear to matter: those who prefer tournaments work harder but what is really being captured

is that workers who prefer tournaments are more likely to vote for and end up in one and work harder as a result. Most importantly, the inclusion of these preferences does increase the participation point estimate; however, not by much. The estimate is now closer to 12pp than 11 and we conclude that the marginally significant difference in the number of tournaments between the two sectors is not large enough to matter much.

Table 6: Does participation increase output?

	(1)	(2)	(3)
Participation	0.066	0.113**	0.116**
	(0.055)	(0.048)	(0.047)
Ability		0.310***	0.307***
		(0.039)	(0.039)
Male		0.023	0.018
		(0.049)	(0.049)
Enjoy Math		0.109***	0.107***
		(0.023)	(0.022)
Competitiveness		0.038	0.037
		(0.029)	(0.029)
Worker Prefers Tournament			0.088*
			(0.047)
Constant	3.198***	2.082***	2.067***
	(0.037)	(0.187)	(0.189)
Observations	240	240	240
R^2	0.004	0.298	0.307

Notes: Dependent variable is the natural log of worker output; OLS; (robust standard errors); * p<0.10, ** p<0.05, *** p<0.01.

To be thorough, we also examined a specification in which we interacted participation with all the observables (including Participation × Worker Prefers Tournament) but the resulting F-test indicated that the interactions added little or nothing to the analysis (p=0.19). We also added the manager compensation scheme preferences which were never significant, nor did they have any impact on the Participation point estimate. The results of other, more

standard, robustness checks appear in appendix Table A2. In a first regression we use the specification in column (3) of Table 6 and cluster the standard errors at the level of the work group. This has little effect and the point estimate remains significant at better than the 5% level. In a second regression we revert back to using robust standard errors but include session fixed effects. In this case the point estimate increases to 0.119 and is significant at better than the 1% level. In two additional regressions we examined using the raw output amount as the dependent variable, instead of its natural log and, again, the results were very similar, though the point estimate looses significance in one specification. Lastly, we considered the hypothesis that workers may have been disappointed when their preferred compensation scheme was not used and that this might have demotivated them; however, we found no evidence of this effect, either overall or within the voting treatment. Given our various point estimates all fall within a tightly bound interval (between 11 and 12 percentage points) and remain significant in all but one specification, we conclude that our measure of the causal effect of participation on effort is robust.

Turning to the managers, the question is whether there is an opportunity cost for ceding managers – do managers who empower workers to participate in the running of the firm sacrifice profits? Given the productivity bump accruing to participatory firms, one might expect ceding is good for profit; however, as mentioned above this will also depend on the frequency of productive tournaments in the two "sectors". Looking just at mean firm profit, participatory firms actually appear to do a bit better (i.e., 3.5pp). Digging a bit deeper in Table 7, in which we use the same empirical strategy as we used for worker output (i.e., controlling for mean worker characteristics and the compensation preferences of the manager) the difference rises to almost 9 percentage points and is significant at better than the 10% level. Ceding control in our experiment also seems to have increase the profitability of the firm.

Table 7: Do ceding managers earn less?			
	(1)	(2)	(3)
Participation	0.035	0.079	0.087*
	(0.056)	(0.051)	(0.050)
Ability (firm mean)		0.184***	0.192***
		(0.0347)	(0.049)
Male (firm mean)		0.153	0.139
		(0.093)	(0.099)
Enjoy Math (firm mean)		0.119***	0.127**
		(0.056)	(0.056)
Competitiveness (firm mean)		0.054	0.056
		(0.040)	(0.039)
Manager Prefers Tournament			0.042
			(0.050)
Constant	4.071***	3.020***	2.949***
	(0.036)	(0.1307)	(0.307)
Observations	80	80	80
R^2	0.003	0.337	0.343

Notes: Dependent variable is the natural log of firm revenue; OLS; (robust standard errors); * p<0.10, ** p<0.05, *** p<0.01.

4 Discussion

In his seminal 1937 essay, Ronald Coase used Dennis Robertson's imagery describing firms as "*islands of conscious power in [an] ocean of unconscious cooperation*" to underscore his view that firms are planned economies based on the managed coordination of resources, and further, that the ability for firms to skip the market by making decisions over how to organize production makes them more efficient than if production was coordinated by the market.

For most economists, the primary lesson taken away from Coase is that all coordinating mechanisms have positive transactions costs, which once considered, give rise to the large class of "make, buy or integrate" problems at

the heart of the post-war economic theory of the firm. And although much of this theory accepts the role of management coordination in economizing production, both the particulars of managerial procedures and their potential for affecting the efficacy of a given policy are generally not considered. For example, Alchian and Demsetz (1972) theorize over the role of a monitor-manager of team production, and Williamson (1971) suggesting that "*fiat is frequently a more efficient way to settle minor conflicts over [appropriable quasi-rents]*," yet neither express an interest in understanding how a coordinator would go about doing this, or why we should expect compliance. Demsetz (1997) goes so far as to making a normative claim that "*[the] objective is to understand price-guided, not management guided, resource allocation. The firm ...is that well known black-box into which resources go and out of which goods come, with little attention paid to how this transformation is accomplished.*" Our study suggests that to the extent there are economic benefits to managerial practices, it may also mean that they can be systematically exploited to increase the efficiency of the firm at relatively little cost.

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7 Online Appendix

7.1 Related Literature

Before turning to the specifics of our experimental design and some additional analysis of our results, we first provide an abbreviated review of literature on the relationship between participative management and firm performance. It is a literature that has evolved along two dimensions, a theoretical one that focuses on the behavioral rationales for changes in firm performance and an empirical one that assesses such first order questions as the moderating effects of context, scale of participation and other complementary factors.

The *sine qua non* of most discussions surrounding participatory management is its effect on the performance or competitiveness of firms. Given the extensive list of possible mechanisms by which participative management possibly releases "energies and enthusiasms which ordinarily lie dormant" (Patchen, 1964) mixed empirical findings fuel a recurring line of research that aims to evaluate if, when, and how participative management is successful. A partial list of theoretical claims linking participatory management to greater firm performance include: (1) the notion that participation leads to a different set of firm goals reflective of the needs and objectives of those included in the decision-making process (Latham et al., 1988); (2) that participation

in decision-making fosters the "self-actualization" of employees (e.g., Argyis, 1955); (3) that participation fosters a culture of mutual cooperation and support among employees (e.g., Likert, 1961); (4) that the invitation to participate in decision-making by management could be reciprocated with higher effort in a manner similar to gift-exchange (Ohana et al, 2013); (5) that the employee, now partially responsible for the organization's objectives through their participation, feels a sense of personal success or failure when the goals are reached or not reached (Porter et al., 1975; Straw & Ross, 1978); (6) that participation helps reveal and disseminate private information that employees hold about themselves, lowering moral hazard (Baiman and Evans, 1983); or that (7) participation improves communication among employees fostering mutual monitoring (Bowles et al., 1993). Indeed, the intuition linking employee involvement in decision-making and performance is so strong that other theoretical models such as that of Freeman and Lazear (1995) take these productivity increases among labor as given.

It is also true, however, that some theorists have drawn attention to the challenges and possible adverse consequences of participatory management, a topic that our study does not address. At the most basic level, personnel may not be willing and/or able to seek productivity improvements (Levine, 1995). Workers may also simply be less informed than managers. Jenson and Meckling (1979) also point out that the value of a worker sharing an idea could be larger than the value of the idea itself. They also note that the transaction costs associated with fostering participation could be prohibitively high. Williamson (1980) similarly worries that managerial talent may be wasted under democratic management while Webb and Webb (1920) claim that worker-elected managers would have more difficulty supervising workers than conventional managers because of the threat of removal. It might also be that once participation in decision-making is established, that the firm loses organizational flexibility since it could become difficult and risky for the firm to revert to a more autocratic management style (Levine, 1995). Finally, Kremer (1997) suggests that democratic management might lead to inefficient personnel incentives and Alchien and Demsetz (1972) claim that it would result in

inefficiencies under team production.

The empirical research investigating the effects of participation in decision-making on performance is large with several excellent meta-studies, including those of Levine and Tyson (1990), Spector (1986), Doucouliagos (1995) on the effects of labor-managed firms, Pereira and Osborn (2007) on quality circles, and Subramony (2009) on human resource management bundles. When read as a whole, a few common elements emerge. First, and most importantly, management that includes employees in the decision-making process appears to be weakly associated with higher firm performance, though no causal link has been established. Second, a glance at the results from the studies sampled within these meta-analyses shows wide and mixed variation. Again, we suspect that there are several reasons that complicate the clean identification of a relationship. First, to quote Lawler et al. (1995) once more, "[o]btaining reliable data on the extent of employee involvement... is difficult. No standard definitions of what is to be counted have been devised, determining the proportion of employees involved is problematic, and many defunct programs are still reported as active." Further, measuring the impact of managerial practices (or concepts) such as employee participation in decision making is difficult because of the variation in participation, the number of people involved, the issues at stake, the actual amount of power that each worker has to affect different aspects of the job, the gap between the degree of formal participation as described in firm by-laws and the actual level of influence workers have, the presence/absence of dominant or passive personalities in the group, and so on. These and other confounding issues, such as the possibility that participatory management could be disproportionately adopted by firms for unidentifiable reasons (i.e. non-random assignment), will bias the estimation of the true effect of participation.

Although the context is often focused on social dilemmas, there is a small related behavioral literature that demonstrates the power of experiments to identify the effects of participation, specifically voting. For example, considering cooperation in an induced value framework, Sutter et al. (2010) find that punishment regimes are much more effective in the voluntary contribution con-

text when they are voted on and Markussen et al. (2014) show that intergroup competition can increase the efficiency of public goods provision when implemented by a vote but that veto power by those unlikely to benefit much from the outcome can undermine this effect. Except for the few studies to which we compare our results in the main text of the paper (including Fehr et al., 2013; Bartling et al., 2014 and Mellizo et al., 2014), there are, to our knowledge, no experiments that specifically address the exogenous identification of participation on real effort in a principal-agent context, our focus.

7.2 Experimental instructions and protocol

[Paper instructions, back-translated from Spanish] Thank you for participating in our study today. You will earn 5 euro just for showing up on time and during the experiment, you will have the opportunity to earn more money. You will be paid in cash today, at the end of the experiment. At the conclusion of the experiment, the payments that you have accumulated will be paid to you in cash.

Please note that any and all actions and decisions that you make in the exercises or responses you provide are strictly confidential and anonymous. We intend to use the data collected from our study for academic work as it relates to firm organization, strategic human resource management, and industrial relations.

A lab assistant will read the initial set of instructions aloud to you as you read them to yourselves. If you have any questions while these instructions are being read, please raise your hand and we will attempt to answer them. You are not allowed to communicate with other participants during the experiment, even to clarify instructions. Again, if you have any questions, please raise your hand and a lab assistant will assist you. At the end of the experiment session, we will call you individually by your ID number distributed to you to give you your earnings in cash.

As a part of this experiment, you will be engaging in a simple production task that consists of adding up sets of 2-digit numbers. The use of a calculator

is prohibited, but you will be allowed to scratch paper and pencil that is provided to you on your desk. The numbers that you will be adding together are randomly drawn and each problem will be presented on the computer screen in front of you in the following way:

[screen shot of addition problem effort task]

After you submit an answer on the computer, you will be given a new problem to solve. To familiarize yourself with the computer interface and also the addition task we will ask you to do in the study, please now turn to your computer screen and await further instructions.

Subjects then engage in the practice period that is managed through the computer program for 2 minutes and then read instructions for the second part of the experiment.

[Paper instructions] In this stage of the experiment, you will be randomly put into a group with 3 other people (4 total in your firm) and you will be connected with the other firm members through the computer network. The firm is comprised of 3 workers and 1 manager. All of the firm's earnings and the earning of the firm's members (i.e. your earning for today's study) are tied directly to the number of correct answers to simple math problems that workers produce. The math problems that workers will be encountered with will be presented in exactly the same manner as they were in the previous practice period. Each correct answer provided by a single worker generates 0.75 € of revenue for the firm. Workers will have 14 minutes to produce correct answers.

For example: Let us assume that Worker 1 solves 15 addition problems correctly, Worker 2 solves 30 correctly, and Worker 3 solves 45 correctly. Firm output will be 15 + 30 + 45 = 90 total correct answers. 90 correct answers (Number of Correct Answers) X 0.75 € (revenue generated by each correct answer) equals 67.50 € (Firm Revenue).

The determination of the worker's compensation is ultimately the responsibility of the manager. The manager will be able to implement 1 of 2 possible compensation schemes for workers. A description of these 2 different

compensation schemes for workers and a description of how the manager is compensated will now be given to you on the computer screen. Are there any questions?

Subjects then receive the following information on their computer screens that they can go through at their own pace.

[On screen instructions] As the instructions in the handout indicated to you, you have been randomly put into a group with 3 other people (4 total). 3 of you will be randomly designated to be workers and 1 of you will be randomly designated to be the manager. You are connected though the computer network in this room and your respective identities will remain anonymous for the duration of the experiment.

The Role of Managers and Workers: the 3 workers will perform the task of adding up sets of 2-digit numbers for 14 minutes. Each correct answer provided by a worker produces 0.75 € of revenue for the firm comprised of 3 workers and 1 manager The manager receives 0.25€ for each correct answer provided by workers. The remaining 0.50 € (0.75 - 0.25) of the value produced by a correct response is used for compensation for workers in one of two ways described below.

Compensation Scheme Possibilities for Workers: Compensation Scheme 1 (CS1) for workers. Recall the value of a correct response is 0.75 € in revenue for the firm and the manager receives 0.25 € out of this value. Under CS1, the worker receives 0.50 € for each correct response provided.

Compensation Scheme 2 (CS2) for Workers Under CS2. The number of correct answers from all 3 workers in the same firm of 4 are summed together. Managers still receive 0.25 € from the value of each correct answer but workers will split the remaining revenue as follows: The worker with the highest number of correct answers receives 60% of the remaining revenue. The worker with the second highest number of correct answers receives 30% of the remaining revenue. The worker with the lowest number of correct answers receives 10% of the remaining revenue.

The manager in each group of 3 is ultimately responsible for implementing either CS1 or CS2 for workers. If you were to be randomly allocated to being

a worker, would you prefer to be paid via CS1 or CS2? If you were to be randomly allocated to being a manager, would you prefer to implement CS1 or CS2?

Subjects are then randomly assigned by the computer program to either be a manager or a worker. Subjects learn about their assignment on their computer screen with one of the following messages.

YOU ARE A MANAGER or YOU ARE A WORKER

Managers and Workers receive different screens reminding them of what was already outlined in the instructions at the beginning of Stage 2.

[On screen instructions] The Role of the manager: The manager of your group will now take the decision of either implementing CS1 or CS2. The manager will either implement the compensation scheme A) Unilaterally (Implementing CS1 or CS2 directly) OR B) s/he can allow workers to vote to implement either CS1 or CS2.

As the manager, you now must decide whether you would like to implement either Compensation Scheme 1 or Compensation Scheme 2 or let the vote of workers assign the Compensation Scheme. Recall that your own compensation depends on the output produced by the workers in your group. You will receive 0.25 € for every unit produced by workers.

Worker Voting: The manger is currently deciding whether to implement CS1 or CS2 unilaterally or whether to allow workers to vote for CS1 or CS2. Recall, that the compensation of the manger depends on the output produced by the workers in your group. The manager will receive 0.25 € for every unit produced by workers. As a worker, which compensation scheme do you vote for if the manager decides to cede control?

Workers and managers are then informed of the compensation scheme implemented.

The manager decided that s/he would.... The majority vote from workers was to implement... Therefore, the Compensation Scheme to be Implemented will be... In the following screen, the manager will start the clock for the worker. The worker will have 14 minutes to solve sets of 2-digit numbers.

Workers then engage in the work task for 14 minutes while bosses work on a Sudoku puzzle.

7.2.1 Auxiliary results

We report a summary of the compensation scheme preferences that we collected from all participants in Table A1. As one can see, participant preferences depend, to a great degree on the expected role. When participants imagine being a worker, most 195 of 320 (61%) prefer the piece rate. When they think of being a manager, however, their preferences are slightly skewed towards the tournament: 165 of 320 or 52% prefer the tournament as a manager. Overall, the measure of association, Cramer's V is just 0.36 which is consistent with the larger number of off-diagonal table entries in which a person's preference is role dependent.

Table A1: Compensation preferences and role.

		As a Manager		
		Piece Rate	Tournament	total
As a Worker	Prefer Piece Rate	123	72	195
	Prefer Tournament	32	93	125
	total	155	165	320

The results of robustness checks appear in Table A2. In the first regression we control for ability, gender, math enjoyment, competitiveness and compensation preference, and cluster the standard errors at the level of the work group. This affects the main result little: the point estimate on participation remains significant at better than the 5% level. In the second column we use robust standard errors but include session fixed effects. Here the participation point estimate increases to 0.119 and is significant at better than the 1% level. In columns (3) and (4), we consider a different dependent variable, the

raw number of sums produced. When the standard errors are clustered at the level of the group in column (3), we see that, on average, workers in participatory firms produce 1.6 more sums in the 14 minute work period but the coefficient is not significant at the 10% level ($p = 0.24$). However, when we include session fixed effects, instead, the point estimate increases to 1.833 and is significant at the 5% level. In sum, without controls we find a productivity boost in the participatory firms of almost 7 percentage points. When we control for observables which work against finding this difference (e.g., on average ability is a bit high in non-participatory firms), the point estimate increases to approximately 12 percentage points.

Table A2: Output Robustness Tests.

	(1)	(2)	(3)	(4)
Participation	0.116**	0.119***	1.600	1.833**
	(0.056)	(0.041)	(1.346)	(0.930)
Ability	0.307***	0.677***	6.766***	17.486***
	(0.041)	(0.070)	(0.730)	(1.565)
Male	0.018	0.051	0.863	1.751*
	(0.047)	(0.042)	(1.097)	(0.929)
Enjoy Math	0.107***	0.070***	2.554***	1.555***
	(0.024)	(0.021)	(0.495)	(0.422)
Competitiveness	0.037	0.024	0.758	0.456
	(0.025)	(0.025)	(0.515)	(0.465)
Prefers Tournament	0.088*	0.052	2.204**	1.163
	(0.050)	(0.042)	(1.113)	(0.925)
Constant	2.067***	1.089***	1.303	-27.003***
	(0.193)	(0.168)	(3.275)	(4.052)
Cluster Errors on Group	Yes	No	Yes	Yes
Session Fixed Effects	No	Yes	No	No
Observations	240	240	240	240
R^2	0.31	0.45	0.33	0.55

Notes: Dependent variable is the natural log of output in (1) & (2) and output in (3) & (4); OLS; (robust standard errors); * p<0.10, ** p<0.05, *** p<0.01;

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