Profit Sharing, Interconnected Autonomous Teams, and Employee Productivity

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Abstract

Interconnected autonomous teams (IAT) reflect a human resources policy of organizing employees into a network of autonomous teams and allowing individuals to work on more than one of those teams. This paper studies how such a policy influences the productivity effects of profit sharing (PS). We first argue that the presence of IAT could mitigate the "free rider" problem in each team of the network. Next, using the European Working Conditions Survey, we document a positive relationship between employee productivity and the interaction between PS and IAT. We interpret this result as a confirmation that IAT might indeed alleviate the "free rider" problem associated with profit sharing schemes.

Introduction

The economics literature suggests that, in order to observe the motivational effects of profit sharing (PS) on employee productivity, profit sharing must be implemented together with other factors that mitigate the associated effect of free riding (Weitzman and Kruse, 1990). Scholars have devoted considerable effort in the search for these factors, resulting in an extensive list of suggestions.[1] Our paper contributes to this literature by identifying a possible but—to the best of our knowledge—previously unexplored factor: the human resources (HR) policy that organizes employees into autonomous teams (empowered to sanction their members) and allows individuals to work on more than one team. We call this HR policy *interconnected autonomous teams* (IAT), and we argue that this policy could mitigate the free-rider problem in each team of the network.

The presence of IAT seems to underlie the organizational design of many modern companies. For example, it is present in large technological organizations (e.g., Google, Cisco) and in diverse European companies—as shown, for instance, in the European Working

[1] See, for example, the literature reviews of Kruse (1993), Prendergast (1999), and Pérotin and Robinson (2002) or the recent contribution of Carpenter, Robbet, and Akbar (2018).

Conditions Survey (EWCS).[2] Yet despite the importance of IAT for practitioners, academics have overlooked its implications for companies and in particular for those that have adopted profit sharing. There are anecdotal indications that this HR policy may mitigate the threat of free riding. For example, Google motivates its employees through collective incentives (Alphabet, 2019, p. 18), and it organizes its product development process by way of autonomous teams whose engineers are allowed to work on more than one team (i.e., using IAT) (Hamel, 2007). As this author notes, Google benefits from "an effective peer to peer monitoring within and across the company's hundreds of teams". It seems reasonable to suppose that these benefits can be attributed, at least in part, to the presence of interconnected autonomous teams.

Knez and Simester (2001) examine how autonomous teams influence the productivity effects of profit sharing, but their set-up does not consider the possibility that employees work on more than one team. We will refer to this type of team arrangement as *non-interconnected autonomous teams* (NIAT). These authors suggest that the organization of employees into NIAT might reduce the cost and increase the accuracy (i.e. improve the efficiency) of monitoring and of sanctions for team members' shirking behavior. Yet they also note that NIAT cannot, in themselves, mitigate the free-rider problem that stems from profit sharing because they do not induce team members' agreement on adopting a high-effort norm that could serve as a basis for monitoring and sanctioning behavior of a shirking nature (i.e., deviations from that effort norm). Absent this norm, the resulting equilibrium will be uncertain. We argue that, unlike NIAT, IAT meet the two requirements identified by Knez and Simester (2001) for alleviating the free-rider problem. First, because autonomous teams are involved, IAT improve the efficiency of each team's monitoring and sanctioning. Second, IAT favor the adoption of a high-effort norm in the network's teams. This second effect arises because the possibility of employees working on more than one team creates positive expectations about the level of effort

[2] According to this survey, some 24% (25% in 2010 and 23% in 2015) of the surveyed employees reported working in interconnected autonomous teams.

that other teams are willing to exert. Hence, IAT might suffice to enhance the productivity effects of profit sharing.

Using data on a representative sample of European employees drawn from the European Working Conditions Survey administered in 2010 and 2015, we provide evidence that supports this prediction by testing for whether there is a positive association between employee productivity and the PS–IAT interaction. These data also shed light on a second implication of our theoretical discussion. The presence of autonomous teams is necessary but not sufficient to alleviate the free-rider problem and to enhance the productivity effects of profit sharing—as long as there is no mechanism (as in the NIAT case) for inducing team members to adopt a high-effort norm. Our argument is that IAT do include such a mechanism (viz., the possibility that employees work on more than one team), which means that IAT will enhance the productivity effects of PS more than do NIAT. We assess this argument by testing for whether the PS–IAT interaction is, in fact, more strongly related to employee productivity than is the PS–NIAT interaction.

Following Weitzman and Kruse's (1990) suggestion that enhancing the productivity effects of PS require the mitigation of free riding, research has identified several factors that might serve this purpose. For example, company size (Alchian and Demsetz, 1972), employee stock ownership plans (Jones and Kato, 1995), task interdependence (Heywood and Jirjahn, 2009), and peer reporting or "whistleblowing" (Carpenter, Robbet, and Akbar, 2018). We contribute to this literature by adding another factor to that list: the presence of IAT. The idea that autonomous teams can diminish the free-riding problem due to PS is not new. Kruse (1993), who points out that autonomous teams could help establish "a cooperative agreement to work harder", may well have been the first author to make this connection. However, the empirical literature that investigates whether PS must be combined with autonomous teams in order to improve productivity has reported inconclusive results. For example, Kruse (1993) and Robinson and Wilson (2006) find no significant effect, whereas Cooke (1994) and Long and

Fang (2013) find a positive and statistically significant one. Knez and Simester (2001), who posit that autonomous teams must be accompanied by other policies for such cooperative agreement to be achieved, offer a possible explanation for that ambiguity of the results. We contribute to this (more focalized) literature by proposing a mechanism that may supplement autonomous teams to mitigate free riding: the possibility that employees work on multiple teams.

The rest of our paper proceeds as follows. In the next section, we set the context by discussing why PS-induced productivity requires the simultaneous presence of other factors. We then review prior research on how NIAT influence the productivity effects of profit sharing, develop our theoretical arguments, and state the hypotheses to be tested. Thereafter, we describe the sample data and the measures used in our estimations as well as the econometric specifications and our results. We conclude by discussing our study's contributions, managerial implications, and limitations.

Setting the Stage: The Ambiguous Effects of Profit Sharing

Economic theory suggests that, in comparison with fixed wages, profit sharing has a positive effect on employee productivity through its motivational aspect,[3] although the associated free rider problem might limit the extent of this effect (Weitzman and Kruse, 1990). The argument for a positive effect, which follows from agency theory (e.g., Hölmstrom, 1979), is that giving employees a stake in the profits will align employees' interests with the firm's interests and thereby induce productivity-enhancing behaviors (Jensen and Meckling, 1976; Kruse, 1993; Ben-Ner and Jones, 1995; Pérotin and Robinson, 2002; Bayo-Moriones and Larraza-Kuintana, 2010). Profit sharing encourages two types of behaviors in particular.

[3] Motivation is not the only mechanism through which PS might enhance employee productivity. Profit sharing may do so as well by rendering wages more flexible or by attracting high-productivity workers (see the discussion in Long and Fang, 2013). In accordance with the objectives of this study, however, we focus on the motivational channel.

First, to the extent that company profits (and hence employee earnings) depend—to some extent—on employees' productive effort, compensation in the form of profit sharing will increase the cost to employees of their own shirking. Thus, PS gives workers an incentive to police their respective productive efforts (Cooke, 1994; Robinson and Wilson, 2006). Second, as a collective compensation system, profit sharing also incentivizes employees to monitor—and, as need be, sanction—the shirking behavior of their fellow employees (Kandel and Lazear, 1992; Knez and Simester, 2001; Freeman, Blasi, and Kruse, 2010; Carpenter, Robbet, and Akbar, 2018).[4]

Nonetheless, there are limitations that preclude full realization of these positive effects on employee behaviors. The first effect is limited in the sense that employees can appropriate just 1/*N* of the benefits but must bear all the costs associated with their marginal effort. This fact may reduce employees' incentives to exert productive effort while creating incentives to free ride on the efforts of co-workers (Alchian and Demsetz, 1972). Most literature refers to this limitation as the free-rider problem; however, to be more precise, we use the term *first-order free-rider problem* (FOFRP; cf. Knez and Simester, 2001). This problem need not arise, given the aforementioned second positive effect (i.e., employees monitoring and sanctioning each other). Yet that second effect, too, is limited because efforts to monitor and sanction are usually costly. As a result, employees may refrain from exerting such effort and instead seek to free ride on the monitoring and sanctioning efforts of their colleagues. This limitation is referred to as the *second-order free-rider problem* (SOFRP; see Fehr, 2004; Panchanathan and Boyd, 2004).

So absent further consideration of the factors that could magnify or attenuate these limitations, the impact of profit sharing on employee productivity cannot be anticipated by the theory (Ben-Ner and Jones, 1995). The literature has devoted substantial effort to identifying

[4] Employees could also improve their peers' productivity by sharing relevant information with management (Weitzman and Kruse, 1990; Kruse, 1993; Cooke, 1994; Pérotin and Robinson, 2002) or with other employees (Ben-Ner and Jones, 1995; MacDuffie, 1995; Kalmi, Pendleton, and Poutsma, 2005; Robinson and Wilson, 2006) or by training junior colleagues (Pérotin and Robinson, 2002).

factors that could help companies reduce the free-rider problem. The list is extensive (see, for example, the literature reviews of Kruse (1993) or Pérotin and Robinson (2002) as well as the contributions of Heywood and Jirjahn (2009) and Carpenter, Robbet, and Akbar (2018)), being presence of autonomous teams one of the factors that has attracted perhaps the most scholarly attention (Kruse, 1993; Knez and Simester, 2001; Long and Fang, 2013). We remark that, because these studies do not consider the possibility of employees working on more than one team, they have actually investigated the effects of *non*-interconnected autonomous teams.

Prior Research on How NIAT Influence PS Productivity Effects

Knez and Simester (2001) present a thorough study of how NIAT influences the productivity effects of profit sharing. After exploring why profit sharing increased employee productivity at Continental Airlines—a large firm whose layout was conducive to free riding[5]—these authors conclude that the presence of NIAT mitigated the SOFRP (and consequently the FOFRP) in each team of the company.

Knez and Simester (2001) point to three possible reasons for this outcome. First, the presence of NIAT reduced mutual monitoring and sanctioning costs within teams—that is, because the size of those teams was much smaller than that of the entire company. Second, this cost reduction was reinforced by the firm's strong interlinkage of within-team tasks. This characteristic is hardly exclusive to Continental Airlines teams, as it is not unusual for companies to implement teams with the explicit intention of interlinking tasks (Heywood and Jirjahn, 2009). Finally, the organization of employees into NIAT ensured repeated interactions with the same colleagues, which improved the accuracy of monitoring and sanctioning.

However, organizing employees into NIAT has the downside of not necessarily inducing individual teams to adopt a high-effort norm. Yet such a norm is necessary because team members need some reference in terms of which their fellow employees can be evaluated

[5] At the time of their study, Continental Airlines employed about 35,000 workers geographically dispersed between airports and terminals.

for purposes of monitoring and sanctioning (Kandel and Lazear, 1992). The effort norm (i.e., high or low) that team members are willing to adopt depends on their expectations regarding the effort level of other teams (Knez and Simester, 2001). If the focal team's members expect other teams to exert high effort, then they will agree to set a high-effort norm because the increase in their earnings will surely exceed their increased cost of effort; otherwise, they will not agree on a high-effort norm. The problem with NIAT is that they do not feature a mechanism for creating favorable expectations regarding the effort level expended by other teams—for example, mechanisms that would facilitate mutual monitoring and sanctioning among teams.

Knez and Simester (2001) acknowledge this limitation. To explain how Continental Airlines teams set a high-effort norm, they argue that the firm "accidentally" assisted by introducing its PS plan at the same time as a flight schedule improvement. In particular the authors suggest that the latter policy led to an immediate increase in the company's performance and that employees could not tell whether that improved performance resulted from the revised flight schedule or from the simultaneously implemented PS plan. The possibility that other teams were working harder in response to the PS plan made it optimal for team members to adopt a high-effort norm. So without the flight schedule improvement, the presence of NIAT might not have been enough to enhance the PS-induced increase in productivity.

Theory and Hypotheses

We now argue that this limitation of NIAT, in terms of mitigating the SOFRP, can be overcome by allowing team members to work on more than one team—in other words, by implementing IAT rather than NIAT. Before developing that argument, we shall consider the NIAT case in more detail.

Ambiguous effects of NIAT. In principle, we might expect that profit sharing will give team members the incentive to monitor and sanction the shirking behavior of other teams (i.e., in addition to their own teammates' shirking behavior). That dynamic would create, in any team

member of the network, positive expectations about other teams' effort levels; hence it would favor the adoption of a high-effort norm in each team. Note, however, that the monitoring and sanctioning efforts in this case might be costly. Individual teams tend to be geographically dispersed—for example, across different offices or plants—and so it is difficult for the members of one team to visit the premises of another team for the sole purpose of monitoring and sanctioning. Therefore, since employees have no guarantee that other teams will exert a high level of effort, one cannot say with certainty that NIAT will create positive expectations favoring the adoption of high-effort norms. Moreover, it may well be that the impracticality of monitoring and sanctioning across teams instead creates negative expectations and thus leads to adoption of a low-effort norm. Without further assumptions, the effect of NIAT on the effort norm adopted by teams cannot be anticipated.

Hence neither is it possible to predict how NIAT influence the productivity effects of profit sharing. If a high-effort norm were adopted (for any reason), then we might expect a positive effect. The existence of this norm—when combined with the reduced cost and increased accuracy of the monitoring and sanctioning deviations from it (as implied by the organization of workers into autonomous teams)—should mitigate the SOFRP in each team. That mitigation should, in turn ameliorate the FOFRP and thereby enhance employee productivity. But if a low-effort norm is adopted, we might expect that team members will reduce effort and attempt to free ride on the effort of other teams (Knez and Simester, 2001). Hence NIAT should undermine productivity. In an empirical implementation, the average effect on employee productivity (i.e., positive, negative, or null) will depend on the relative strength of these two antagonistic effects.

IAT and effort norms. Interconnected autonomous teams allow employees to work on more than one team. We might therefore expect that some employees *will* be working on multiple teams. Note that, under this arrangement, those employees' costs of monitoring and sanctioning the shirking behavior of the teams where they work will be low (or at least lower

than if they were to monitor and sanction those teams under the NIAT arrangement). That is, because those employees will interact with those teams not only for monitoring and sanctioning purposes but also because they work with them. So we can expect that, in the presence of PS incentives, such employees can monitor and sanction multiple teams—and not just a single team, as would likely occur in the NIAT case. Take now the perspective of a team with a member (viz., a *rotating employee*) who also belongs to another team. We can say that the former team can monitor and sanction the shirking behavior of the later team, from which it follows that all the workers of the company will develop positive expectations about the later team level of effort.

It could be argued that, because the monitoring and sanctioning efforts of the rotating employees are not permanent (since they spend only part of their time in a given team), IAT might not ensure that those workers properly monitor and sanction all the teams where they work—a deficiency that could compromise generation of positive expectations about the level of effort that other teams are willing to exert. This is obviously an empirical point, but we remark that team's members will view the monitoring and sanctioning effort by the rotating employees as being effective. Because team tasks are interdependent, shirking by an individual employee reduces not only her own productivity but also the productivity of the team and, indeed, of the whole organization. This dynamic increases the cost of co-workers' shirking (Heywood and Jirjahn, 2009), which provides strong incentives for the rotating employee to monitor and sanction all the teams to which he belongs.

The team's members of a given team will develop the willingness to adopt a high-effort norm if the expected increase in individual earnings (the productivity of the whole organization divided by the number of workers) exceeds the increase in individual effort costs. This result will be surely observed if most teams of the network are interconnected—that is, if most teams share at least one member with another team. Remember that an interconnected team is expected, by all individuals of the organization, to exert a high level of effort. We argue that it

is reasonable to expect that, in companies that make use of Interconnected autonomous teams, most of the teams *will* be interconnected. IAT arrangements are typically implemented in companies with workers with wide-ranging interests (see e.g. Hammel, 2007). We may therefore expect that, if those workers have the opportunity (as it would be the case if IAT were implemented), they will participate simultaneously in multiple projects, which dramatically increases the chances that all the teams of the network are interconnected.

IAT and employee productivity. An IAT arrangement is likely to meet the two requirements identified by Knez and Simester (2001) for mitigating the SOFRP in the network teams. Just as in the NIAT case, IAT organize employees into autonomous teams and so should reduce the cost and increase the accuracy of efforts to monitor and sanction shirking behavior. Furthermore, by allowing employees to work on more than one team, an IAT policy could induce teams to adopt a high-effort norm that would serve as a benchmark for such monitoring and sanctioning. The mitigation of the SOFRP in each team entails that the FOFRP will also be lessened, thus enhancing the productivity effects of profit sharing.

A potential flaw in the argument that IAT might alleviate the SOFRP is that employees may avoid monitoring and sanctioning efforts owing to their fear of damaging social relations, since they repeatedly work with the same colleagues. This reluctance to monitor and sanction would compromise the efficiency of those efforts and hinder creation of positive expectations. Yet Knez and Simester (2001) are skeptical about this possibility because teams are conducive to developing a *consensus* that a norm has been broken,[6] which reduces the cost of damaging relations among colleagues (Coleman, 1990).

In sum, the considerations above amount to a strong indication that IAT might enhance the productivity effects of PS by mitigating the SOFRP (and hence the FOFRP) within all of a network's teams. This notion is formalized in our first hypothesis, as follows.

[6] For example, they allow a team member's performance to be easily observed by all other members of the team.

Hypothesis 1. *There is a positive association between employee productivity and the combination of profit sharing and interconnected autonomous teams.*

We are not claiming that the presence of IAT is the only factor capable of enhancing profit sharing's productivity effects. The literature (see e.g. Kruse, 1993; Pérotin and Robinson, 2002) makes it clear that PS effects could be boosted by myriad factors**.**

We argue not only that IAT might suffice to enhance the productivity effects of PS but also that interconnected autonomous teams might do so to a greater extent than do non-interconnected autonomous teams. Recall that, without additional assumptions, one cannot determine how NIAT influence the productivity effects of profit sharing. Yet if we assume that employees work on more than one team—that is, if IAT rather than NIAT is implemented—then it is possible to predict that the productivity effects of PS will be enhanced. These considerations lead to our second hypothesis.

Hypothesis 2. *Employee productivity is increased more by the PS–IAT combination than by the PS–NIAT combination.*

No published empirical studies address either of these hypotheses.

Data

In this section, we describe the sample data and the measures used in our estimations.

Survey description. The data are taken from the European Working Conditions Survey, which is an effort of the European Union (EU) to provide comparable and reliable information on employees' working conditions across Europe. The EWCS survey is based on face-to-face interviews with workers aged over 15, and employed at the time of the interview, in almost all the economic sectors of the NACE classification.[7] Six cross-sectional waves of the EWCS have been conducted so far; we focus on the fifth and sixth, carried out in 2010 and 2015

[7] Sectors excluded from the sample are agriculture, household labor, and extraterritorial organizations.

(respectively), because they are the only ones that include the information needed to test our hypotheses. These latter two waves report on 34 and 35 countries,[8] respectively, and the interviews were conducted with 43,816 individuals in 2010 and 43,850 in 2015. We follow part of the literature (e.g., Heywood and Parent, 2012) in excluding employees from the public sector, since those employees are unable to affect the profits of the organizations in which they work. This exclusion, combined with the incompleteness of some questionnaires, leaves us with smaller samples (as specified in each estimation) for purposes of analyses. To the best of our knowledge, the EWCS is the only source of the information needed for addressing our research questions.

There are a number of noteworthy advantages to using this database. First, the data on individual employees allow adjustments for employee ability (e.g., education, training, and other proxies for ability), which allows (at least partially) disentangling profit sharing's incentive effects (the focus of our study) from its sorting effects (see Lazear, 1986). This feature is not characteristic of most data sets used to provide evidence of productivity gains due to PS, which are typically based on establishment or firm data; see Kruse (1993) or Pérotin and Robinson (2002) and the references therein, or the recent contribution of Delahaie and Duhautois (2019). Second, because the survey includes questions related to the companies where employees work, our estimations can reflect most of the controls commonly used in the literature. Finally, to avoid sample selection problems and to ensure comparability across countries, the EU follows stringent sampling and weighting procedures; these are detailed in the survey's online technical report.[9]

Outcome variable. The EWCS does not include a direct measure of employee productivity. However, it contains information on employees' earnings—a variable that is commonly used in the literature to proxy for employee productivity (see e.g. Booth and Frank,

[8] The 2010 wave includes the EU-28 along with Albania, Kosovo, Macedonia, Montenegro, Norway, and Turkey; the 2015 wave also includes Serbia.

[9] https://www.eurofound.europa.eu/sites/default/files/ef_survey/field_ef_documents/6th_ewcs__technical_report.pdf

1999; Azfar and Danninger, 2001).[10]—and on the number of hours worked. We therefore use (logged) earnings per hour as our outcome variable, *Employee productivity*.

Explanatory variables. The EWCS asks surveyed individuals to report whether or not the earnings from their primary job included payments based on the company's overall performance (i.e., profit sharing). We use the responses to construct our binary *PS* variable. The survey also contains information that we use to construct binary variables for the two team arrangements that are relevant to our empirical analysis. The first, *IAT*, takes the value 1 for employees who work on more than one team or 0 for those who do not work on any team. The second indicator, *NIAT*, is set to 1 for employees who always work on the same team or to 0 for those who do not work on any a team. The variables *PS*, *IAT*, and *NIAT* allow us to create the relevant interactions to be used in the estimations.

Control variables. We control for variables related to company and job characteristics—namely, workplace size (*Workplace size*), the presence of trade unions (*Trade union*) and incentive mechanisms (*Incentives*).[11] The survey responses allow us to control also for several employee characteristics: age (*Age* and Age^2), gender (*Gender*), tenure (*Tenure* and $Tenure^2$), education (*Education*), firm-provided training (*Training*), occupation in the company (*Occupation*), and salary increase (*Salary increas*e). We include this last variable to proxy for workers' unobservable ability (Baker, Gibbs, and Holmstrom, 1994; Gibbons and Waldman, 1999). Finally, we account for characteristics of the environment in which the workers work by

[10] Booth and Frank (1999) formalize the theoretical equivalence between earnings and employee productivity. In the context of competition, in the absence of trade unions and after controlling for observable ability, they show that earnings are equal to the productivity gains from performance-related pay *net* of the costs associated with monitoring output. There are three reasons why the data we use are suitable for verifying that equivalence. First, they allow us to control for unions and education. Second, the environment in which companies operate (i.e., the EU) is fairly competitive. Third, that competition means that we can reasonably assume that companies have similar monitoring costs.

[11] The *Incentives* factor is built from the items described in Table 1, despite some of them do not correspond to what is traditionally understood as an incentive system. Yet these unorthodox factors (pay for additional hours of work/overtime, bad conditions, and Sunday work) are relevant in the context of our study because they can motivate workers to work longer hours, in undesirable working conditions and Sundays, which could affect their earnings. Our findings are essentially unchanged when the estimates exclude these factors.

including industry (*Industry*) and country (*Country*) fixed effects. Definitions of the variables used in our analysis are given in Table 1.

[[INSERT **Table 1** about Here]]

Table 2 reports the means and standard deviations of the variables used in our estimations based on the 2010 and 2015 samples, both independently and pooled. Over these three samples, 11% of the surveyed employees reported that their total compensation includes profit sharing and about 24% reported working on interconnected autonomous teams. Workers who receive PS and work on IAT account for about 1.7% of those responding (results not presented[12]). The raw data also show that the combination of PS and IAT is correlated with employee productivity and that this positive correlation is statistically significant at the 1% level (results not presented). In addition, the data reveal that employees who receive PS and work on IAT earn (on average) €13.32 per hour, which is more than the €10.21 hourly average earned by employees who receive PS and work on NIAT (results not presented). These figures hint at the validity of our hypotheses, although they are not adjusted for other determinants of employee productivity.

[[INSERT **Table 2** about Here]]

Econometric Specifications and Results

Effect of the PS–IAT Interaction on Employee Productivity (Hypothesis 1)

Econometric specification. We test Hypothesis 1 by estimating this equation:

$$Q_i = \beta_0 + \beta_1 PS_i + \beta_2 IAT_i + \beta_3 (PS_i \times IAT_i) + \beta_4' X_i + u_c + n_s + \varepsilon_i; \qquad (1)$$

here *i* indexes individual employees, Q_i represents employee productivity, PS_i captures whether or not employees receive PS, and IAT_i denotes whether or not they work on IAT or on no team. The interaction term, $PS_i \times IAT_i$, is the variable of interest. The X_i term is a vector of control

[12] All the results not presented in the paper are available from the authors upon request.

variables that includes company, job, and employee characteristics (as described in the preceding "Data" section). Country (u_c) and industrial sector (n_s) fixed effects are added to control for potential unobserved differences among countries and industries.

The estimation of Equation (1) can be conducted with two alternative assumptions about the error term ε_i. Assuming that it is uncorrelated with the interaction, we could estimate this equation using ordinary least squares (OLS). This approach is typical of most empirical literature on the productivity effects of PS (see Robinson and Wilson, 2006). Yet if we assume that ε_i is correlated with the interaction (i.e., that the interaction is endogenous) then, in light of the cross-sectional nature of our data, the equation would have to be estimated using instrumental variables (IV) approaches. Given the difficulty of finding appropriate instruments, we conduct the main estimations while relying on the former assumption. Hence those estimates must be interpreted with caution, since they provide evidence for a *correlation* between the interaction term and employee productivity (conditional on a set of controls) but not for *causality*. In the Robustness Check Section we relax this assumption and estimate Equation (1) via two-stage least squares (2SLS). However, data limitations dictate that this technique of reducing potential endogeneity can be applied only to the 2015 sample. We remark, though, that the similarity in the OLS and 2SLS results hints at the accuracy of the former (OLS) estimates.

OLS estimation results. Table 3 presents the results of our OLS estimates of Equation (1)—with standard errors clustered at the country level—for the 2010, 2015, and pooled samples. The R^2 values (which exceed 85% in all three cases) show that the model fits the data very well. Because the standard errors are clustered, we report no *F*-test results. Yet in order to develop some insight regarding the overall significance of our explanatory variables, we also estimate Equation (1) *without* clustering the standard errors (results not presented). In the three samples, the *F*-test rejects (at the 1% level) the null hypothesis that our parameter estimates of the explanatory variables are all zero. Turning to table 3, our estimate for the

PS × *IAT* interaction is positive and significantly different from zero at conventional levels of significance in the three samples (*p*-values of 0.007, 0.091, and 0.054 for the 2010, 2015, and pooled samples). These results support Hypothesis 1. The main effects of *PS* are positive and statistically significant in all three samples. The signs of the main effects of *IAT* do not exhibit the same pattern across the three samples, but they are not statistically significant in any case.[13] Examining the other covariates, we find that most of them are in line with expectations.

[[INSERT **Table 3** about Here]]

Do IAT Enhance PS Productivity Effects More Than NIAT Do? (Hypothesis 2)

Empirical strategy. Testing Hypothesis 2 requires that we find the difference between two interaction estimates (*PS* × *IAT* − *PS* × *NIAT*) and then test for whether (or not) this difference is statistically significant. We already have the estimate for *PS* × *IAT* (Table 3), so we need only estimate the *PS* × *NIAT* interaction. For this purpose, we estimate the following equation:

$$Q_i = \alpha_0 + \alpha_1 PS_i + \alpha_2 NIAT_i + \alpha_3 (PS_i \times NIAT_i) + \alpha_4' X_i + u_c + n_s + \varepsilon_i. \qquad (2)$$

OLS estimation results. Panel A of Table 4 presents the results of our OLS estimations of this equation for the 2010, 2015, and pooled samples. The *PS* × *NIAT* interaction is not significantly associated with employee productivity in any of the three samples, which is consistent with the implications of our theoretical discussion. As we concluded there, implementing NIAT does not, ceteris paribus, guarantee that the productivity effects of PS will be enhanced. Results for the other covariates—and for the R^2 values—are strongly similar to those obtained via OLS estimation of Equation (1).

[[INSERT **Table 4** about Here]]

Turning to Panel B of Table 4, we see that results of a Wald test indicate that the null hypothesis (namely, that there is no difference between interactions, *PS* × *NIAT* = *PS* × *NIAT*)

[13] We do interpret the main effects of *PS* and *IAT* because the three interactions are ordinal.

can be rejected at conventional levels of significance in the three samples: $p = 0.063$, 0.089, and 0.085 for (respectively) the 2010, 2015, and pooled samples. In other words, these results constitute evidence that the PS–IAT combination is more positively associated with employee productivity than is the PS–NIAT combination, an outcome that supports Hypothesis 2.

Robustness Checks

Here we conduct a series of robustness checks with the aim of reinforcing some critical aspects of the paper. The results are not presented for reasons of space but we remark that they are available from the authors upon request.

Endogeneity concerns and results of the 2SLS estimations. The estimations presented in Table 3 control for a rich set of variables; yet it could be that we left out some unobservable variables that are related both to employee productivity and to (components of) the interaction term, which might lead to omitted variable bias. There could also be a reverse causality problem (Ehrenberg, 1990; Kruse, 1993; Cooke, 1994; Kraft and Lang, 2016).[14] For example, employees who are more productive might self-select into companies that feature high-performance HR practices (e.g., PS and/or IAT). Although our data allow us to control for the leading determinants of employee productivity (viz., education and ability), those controls may not eliminate the potential for endogeneity bias due to that source. Because our survey data are cross-sectional, addressing these concerns requires that we instrument for the $PS \times IAT$ interaction.

A common approach in the PS literature (e.g., Kruse, 1993; Bhargava, 1994; Cahuc and Dormont, 1997) is to instrument the potential endogenous variable with a previous observation of that variable. Since we have only two waves, we therefore use the 2010 sample interaction

[14] Our data are not subject to measurement error arising from sampling because the theoretical concepts used as independent variables (i.e., profit sharing and team arrangements) are easily identifiable by the interviewee. In contrast, the dependent variable is measured with error. However, this measurement error is not problematical because it is absorbed by the disturbance and so does not bias coefficients for the variables on the right-hand side of the equation.

as an instrument for the 2015 sample interaction (the endogenous variable in 2015). Because the EWCS is not a panel of employees, we cannot know the value of the interaction in the 2010 sample for each employee in the 2015 sample. Hence we identify individuals from the 2010 sample that are characterized by the same country, industry, workplace size, and occupation; we then compute the mean value of their interaction. These values are then used to instrument the interaction in the 2015 sample of each employee (in the corresponding country, industry, workplace size, and occupation that were used to calculate the averages).

This instrument is likely to comply with the requirement that it be correlated with the endogenous variable (i.e., the *relevance* requirement). One could argue that employees with similar characteristics are under the same regime (either under the interaction or not) in both 2010 and 2015. This intuition is reinforced by the strong statistical significance of the instrument in the first-stage equation of the 2SLS estimations (results not presented).[15] The instrument also fulfills the requirement that it be uncorrelated with the unobservable determinants (ε_i) of the dependent variable (i.e., the *independence* requirement). Because PS links current compensation to current profits, one could hardly argue against the current PS plan having positive motivational effects on current employee productivity. But as noted by David Card,[16] it is not clear how a current PS plan can lead directly to productivity increases in upcoming years. Hence the average interaction observed in 2010 may not have direct effects on employee productivity observed in 2015. Furthermore, since IAT (by itself) does not seem to affect productivity, the presence of IAT in 2010 is unlikely to influence productivity in 2015. Results of the 2SLS estimations show that the PS × IAT estimate is positive and statistically significant ($p = 0.074$) and therefore reinforces the support for Hypothesis 1.

Size. In large organizations, it might be more difficult that all the teams of the network are interconnected. So in such organizations, we can expect the power of a team rotation policy

[15] In using this test we follow the recommendations of Angrist and Pischke (2009: 212–13).
[16] As commented near the end of Weitzman and Kruse's (1990) seminal paper.

to create positive expectations regarding the effort level of other teams—and thus to favor the adoption of a high-effort norm in each team—will be lower. That is, because individuals will expect a lower percentage of teams exerting a high level of effort. This dynamic implies a less positive association between *PS* × *IAT* and employee productivity in large organizations than in small ones. Moreover, large organizations might actually favor adoption of a low-effort norm, which would imply a negative association between *PS* × *IAT*. Shedding light on these effects should reinforce support (already provided by results from our test of Hypothesis 2) for the argument that enhanced productivity effects due to PS via organizing employees into teams requires also that employees be allowed to work on more than one team.

To conduct this analysis, we divide the *Workplace size* variable into two categories: employees who work in companies with fewer than 250 employees and employees who work in companies with at least 250 employees, where the latter category characterizes the workers in our sample working in the largest companies. We find that, in the subsample of workers in smaller firms, the estimates of *PS* × *IAT* are positive and statistically significant in all the samples. Yet when only workers in large firms are considered, the estimates of *PS* × *IAT* are not statistically significant—and some of them (for the 2015 and pooled samples) are negative. These results indicate that large organizations, indeed, reduce the power of team rotation to create positive expectations and thereby to favor the adoption of a high-effort norm.[17]

What affects what? Table 3's positive and statistically significant estimates of the *PS* × *IAT* interaction raise the question of whether IAT enhances the productivity effects of PS or, instead, whether profit sharing enhances the productivity effects of interconnected autonomous teams. To gain insight into this question, we re-estimate Equation (1) while *excluding* the interaction term. In this specification, we retain both the *PS* variable and the *IAT*

[17] We also repeat this exercise while dividing *Workplace size* variable into three and four categories. The data do not show a clear monotonic pattern in the direction of the results reported in the text—that is, there is no evidence that the magnitude and degree of significance of the *PS* × *IAT* interaction decline when we move to a category with more employees. Hence our results are evidence that the power of a team rotation policy to create positive expectations, and thus to favor the adoption of a high-effort norm, decreases only in very large organizations.

variable to control for the possibility that they proxy for each other. The results show that our estimates of *PS* are both positive and statistically significant. This outcome, together with the positive and significant estimates of *PS* × *IAT* reported in Table 3, supports our interpretation of IAT as a mechanism through which PS affects employee productivity (see Kruse, 1993). At the same time, our estimates of *IAT* are positive but not statistically significant; hence neither *PS* nor any other variable can be viewed as a pathway through which IAT affects employee productivity.

Alternative specification. To explore the robustness of our findings with respect to Hypothesis 2, we estimate an alternative specification:

$$Q_i = \alpha_0 + \alpha_1 PS_i + \alpha_2 AT_i + \alpha_3 (PS_i \times AT_i) + \alpha_4' X_i + u_c + n_s + \varepsilon_i; \qquad (3)$$

here *AT* is set to 1 for individuals who work on interconnected autonomous teams or to 0 for those who work on non-interconnected autonomous teams. In the three samples, our estimates of *PS* × *AT* are positive but not statistically significant: $p = 0.14$, 0.12, and 0.16 for (respectively) the 2010, 2015, and pooled samples. So under this specification, we cannot reject (at conventional levels of significance) the null hypothesis that there is *no* difference between the average effect—on employee productivity—of the *PS-IAT* and *PS-NIAT* combinations. Even so, we argue that the existence of positive coefficients for *PS* × *AT* that are close to being significant reinforces the findings reported in Panel B of Table 4.

Conclusions

Weitzman and Kruse (1990) argue that realizing the productivity-enhancing effects of profit sharing requires some mechanisms that mitigates the free-rider problem. Our study suggests that IAT could be one of such mechanisms. We contribute to the literature by offering an argument, which builds on Knez and Simester (2001), to explain how this HR policy can reduce the SOFRP (and hence the FOFRP) in each team of the network. We claim that this effect occurs through two complementary mechanisms. First, implementing IAT reduces the costs

and increases the accuracy of each team's monitoring and sanctioning process by (respectively) reducing group size and allowing repeated interactions among team members. Second, it encourages teams to adopt a high-effort norm by creating positive expectations among team members about the level of effort that other teams are willing to exert. These positive expectations arise because the IAT's "team rotation component" makes it possible for teams to monitor and sanction each other.

We also contribute to the literature by using the last two waves of the European Working Conditions Survey to provide empirical evidence of the positive association between employee productivity and the interaction between profit sharing and interconnected autonomous teams. Thus we establish that the presence of IAT might well enhance profit sharing's productivity effects. Our theoretical discussion also posits that the presence of NIAT is *not* sufficient to enhance the productivity effects of profit sharing. To achieve this effect, a network of autonomous teams must be supplemented with a policy that allows employees to work on more than one team. We provide insights regarding this contention by offering evidence for the hypothesis that the PS–IAT interaction is more positively associated with employee productivity than is the PS–NIAT interaction.

The paper also makes contributions to practice. First, it identifies an HR policy that firms can use to boost the productivity effects of profit sharing. The extant empirical research suggests that, overall, the effect of PS on employee productivity is small[18] and that, in some companies, it is neutral or even negative.[19] This evidence confirms the widely felt need for companies to refine their organizational designs so that profit-sharing plans will, in fact, increase employee productivity. Second, the adoption of PS might enhance the productivity of firms that make use of interconnected autonomous teams. Companies that rely on teams' network arrangements, as in the case of IAT, may struggle to motivate employees via individual

[18] See the meta-analyses of Doucouliagos (1995) and Kruse and Blasi (1997) or the literature review of Pérotin and Robinson (2002).

[19] See the literature reviews of Weitzman and Kruse (1990), Kruse (1993), and Pérotin and Robinson (2002) or the meta-analysis of Nyberg et al. (2018) and the references therein.

performance pay or promotions. In such companies, PS is an alternative to traditional means of incentivizing employee effort. Third, our results are applicable not only to companies with IAT but also to those that have adopted an NIAT arrangement. The latter must realize that they can enhance employee productivity by implementing PS *and* allowing their employees to work on more than one team. These last two points are relevant in light of the tendency worldwide to move away from the traditional top-down organization toward a "network of teams" (see e.g. Kaplan et al. 2016).

The principal limitation of this study is that most of our estimations do not support claims of causality. For the $PS \times IAT$ interaction in the 2015 sample, which is applicable to Hypothesis 1, we were able to find an instrument that satisfies the relevance requirement in both theoretical and statistical terms and that satisfies the independence requirement in theoretical terms. However, we were unable to find an instrument that fulfilled the relevance and independence requirements for the $PS \times IAT$ interaction in either the 2010 or pooled sample. Hence the strategy of reducing endogeneity via a 2SLS estimation could be applied only in the 2015 sample. We nevertheless emphasize that the similarity in patterns between the OLS and 2SLS estimations—for both, the variable of interest ($PS \times IAT$) is positive and also statistically significant—suggests that endogeneity bias is not a serious problem. Future research with access to more suitable data (that allows one to overcome these limitations) is needed to corroborate the evidence presented here.

Table 1. Definitions of Variables

Variable	Definition	Scale
Employee productivity	Hourly earnings deflated by purchasing power parity	Continuous variable
PS	Earnings from the main job include payments based on the overall performance of the company (profit-sharing scheme)	0 = No 1 = Yes
IAT	The individual works on several autonomous teams	0 = No 1 = Yes
NIAT	The individual works on one autonomous team	0 = No 1 = Yes
Workplace size	Number of employees in the workplace	1 = 1 employee 2 = 2–9 3 = 10–249 4 = 250 or more
Trade union	Employees in the company or organization are represented by a trade union, works council, or similar committee	0 = No 1 = Yes
Incentives	Factor scores from the following items: Earnings from the main job include piece rate or	Continuous variable

	productivity pay Earnings from the main job include payments for additional hours of work/overtime Earnings from the main job include payments for bad conditions Earnings from the main job include payments for Sunday work Earnings from the main job include income from company shares	
Female	Gender of the employee	0 = Male 1 = Female
Age	Age of the employee (years)	Continuous variable
Tenure	Number of years that the employee has worked in the company.	Continuous variable
Education	Highest level of education successfully completed by the employee (measured using 1997 International Standard Classification of Education levels)	0 = Pre-primary 1 = Primary 2 = Lower secondary 3 = Upper secondary 4 = Post-secondary 5 = First stage of tertiary 6 = Second stage of tertiary
Training	Factor scores from the following items: A – Training paid for or provided by the employer over the last 12 months B – Training paid by the individual over the last 12 months C – On-the-job training (co-workers, supervisors) over the last 12 months	Continuous variable
Salary increase	Has the worker's salary increased during the last 12 months?	0 = No 1 = Yes
Occupation	2-digit ISCO-88 occupations	28 dummy variables
Industry	1-digit NACE industries	17 dummy variables
Country	Country dummies	36 dummy variables

Table 2. Means [a] and Standard Deviations of Variables by Wave

	2010 EWCS		2015 EWCS		Pooled	
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Employee productivity	0.62	1.44	0.76	1.47	0.70	1.46
PS	0.11	0.31	0.11	0.31	0.11	0.31
IAT	0.25	0.43	0.23	0.42	0.24	0.43
NIAT	0.48	0.50	0.45	0.50	0.47	0.50
Workplace size						
1	0.13	0.34	0.14	0.34	0.14	0.34
2–9	0.31	0.46	0.29	0.45	0.30	0.46
10–249	0.46	0.50	0.45	0.50	0.45	0.50
250+	0.10	0.30	0.12	0.33	0.11	0.31
Trade union	0.47	0.50	0.47	0.50	0.47	0.50
Incentives	–0.02	0.99	0.02	1.01	0.00	1.00
Female	1.48	0.50	1.50	0.50	1.49	0.50
Age	41.68	12.16	43.37	12.75	42.53	12.49
Tenure	10.03	9.91	10.33	10.32	10.18	10.11
Education						
Pre-primary	0.01	0.07	0.01	0.08	0.01	0.08
Primary	0.06	0.23	0.05	0.21	0.05	0.22
Lower secondary	0.19	0.39	0.13	0.34	0.16	0.37

Upper secondary	0.41	0.49	0.42	0.49	0.41	0.49
Post-secondary	0.04	0.20	0.07	0.26	0.06	0.23
First stage of tertiary	0.29	0.45	0.32	0.47	0.30	0.46
Second stage of tertiary	0.01	0.10	0.01	0.10	0.01	0.10
Training	0.05	0.99	–0.07	1.00	0.00	1.00
Salary increase	0.27	0.44	0.25	0.43	0.26	0.44

[a] Reported means are for earnings deflated by purchasing power parity. If we consider non-deflated earnings per hour, then the means rise to (respectively) 7.60, 9.28, and 8.49 for the three samples

Table 3. Effect of PS−IAT Interaction on Employee Productivity by Wave

Variable	2010 EWCS	2015 EWCS	Pooled
PS	0.056***	0.091***	0.066***
	(0.020)	(0.021)	(0.021)
IAT	0.009	–0.001	0.005
	(0.013)	(0.012)	(0.013)
PS × *IAT*	0.061***	0.047*	0.051*
	(0.021)	(0.027)	(0.026)
Workplace size			
1 (reference)			
2–9	0.073***	0.058	0.052*
	(0.029)	(0.038)	(0.028)
10–249	0.131***	0.090**	0.098***
	(0.034)	(0.037)	(0.030)
250+	0.144***	0.113***	0.132***
	(0.039)	(0.035)	(0.027)
Trade union	–0.011	0.038**	0.018*
	(0.010)	(0.014)	(0.010)
Incentives	0.015**	0.020***	0.006
	(0.007)	(0.005)	(0.005)

Female	–0.112***	–0.098***	–0.096***
	(0.013)	(0.014)	(0.013)
Age	0.015***	0.015**	0.017***
	(0.004)	(0.006)	(0.006)
Age^2	–0.00014***	–0. 00014*	–0. 00017***
	(0.00004)	(0. 00007)	(0. 00006)
Tenure	0.010***	0.010***	0.010***
	(0.002)	(0.003)	(0.002)
Tenure^2	–0.00017***	–0. 00015*	–0. 00016***
	(0.00006)	(0. 00008)	(0. 00006)
Education			
Pre-primary (ref.)			
Primary education	–0.015	–0.150*	–0.144***
	(0.074)	(0.076)	(0.043)
Lower secondary	0.051	–0.064	–0.031
	(0.087)	(0.062)	(0.048)
Upper secondary	0.106	–0.017	–0.015
	(0.086)	(0.065)	(0.052)
Post-secondary	0.122	0.048	0.004
	(0.097)	(0.069)	(0.073)
First-stage tertiary	0.235**	0.137*	0.130*
	(0.096)	(0.074)	(0.065)
Second-stage tertiary	0.232*	0.441***	0.344***
	(0.135)	(0.139)	(0.113)
Training	–0.015**	–0.017**	–0.010**
	(0.007)	(0.008)	(0.005)
Salary increase	0.035**	0.051***	0.026***
	(0.014)	(0.012)	(0.010)
Year-2015	—	—	0.203***
			(0.009)
R^2	0.907	0.884	0.851
N	7,199	9,176	16,375

Notes: The table reports OLS regression coefficients; standard errors (in parentheses) are clustered by country. All regressions include controls (via indicator variables) for occupation, industry, and country. *p < 0.10, **p < 0.05, ***p < 0.01

Table 4. Comparison between *PS* × *IAT* and *PS* × *NIAT* Effects on Employee Productivity by Wave

Variable	2010 EWCS	2015 EWCS	Pooled
Panel A. Effects of the PS–NIAT interaction on employee productivity			
PS	0.061***	0.090***	0.073***
	(0.020)	(0.021)	(0.020)
NIAT	0.005	–0.016**	0.005
	(0.010)	(0.007)	(0.009)
PS × *NIAT*	0.015	0.004	0.003
	(0.025)	(0.025)	(0.018)
Workplace size			
1 (reference)			
2–9	0.057**	0.063	0.055**
	(0.026)	(0.039)	(0.026)
10–249	0.105***	0.099**	0.096***
	(0.030)	(0.038)	(0.029)
250+	0.133***	0.123***	0.133***
	(0.028)	(0.038)	(0.027)
Trade union	–0.009	0.041***	0.020
	(0.009)	(0.015)	(0.014)
Incentives	0.019***	0.018***	0.007
	(0.004)	(0.005)	(0.007)
Female	–0.119***	–0.109***	–0.109***

	(0.015)	(0.014)	(0.013)
Age	0.015***	0.015***	0.018***
	(0.004)	(0.005)	(0.005)
Age^2	–0.000***	–0.000**	–0.000***
	(0.000)	(0.000)	(0.000)
Tenure	0.010***	0.011***	0.009***
	(0.002)	(0.002)	(0.002)
$Tenure^2$	–0.000***	–0.000***	–0.000***
	(0.000)	(0.000)	(0.000)
Education			
Pre-primary (ref.)			
Primary education	–0.018	–0.075*	–0.114***
	(0.053)	(0.042)	(0.040)
Lower secondary	0.066	–0.005	0.006
	(0.054)	(0.036)	(0.033)
Upper secondary	0.107**	0.043	0.013
	(0.050)	(0.039)	(0.036)
Post-secondary	0.130**	0.081**	0.002
	(0.055)	(0.039)	(0.070)
First-stage tertiary	0.235***	0.200***	0.169***
	(0.049)	(0.044)	(0.041)
Second-stage tertiary	0.296***	0.365***	0.329***
	(0.096)	(0.093)	(0.078)
Training	–0.007	–0.019***	–0.006
	(0.006)	(0.005)	(0.006)
Salary increase	0.033***	0.055***	0.018
	(0.008)	(0.012)	(0.027)
Year-2015			0.169
			(0.109)
R^2	0.916	0.882	0.850
N	11,455	14,036	25,491

Panel B. Wald equality tests of estimated coefficients (PS × IAT = PS × NIAT)

PS × IAT = PS × NIAT	$\chi^2 = 3.47$*	$\chi^2 = 2.90$*	$\chi^2 = 2.97$*

Notes: Panel A reports OLS regression coefficients with standard errors (in parentheses) clustered by country. Panel B reports the tests of equality for the coefficients of the interactions between team arrangements and profit sharing. In each cell, we test the null hypothesis that the coefficient of the interaction between *IAT* and *PS* is equal to the interaction between *NIAT* and *PS* versus the alternative hypothesis that the coefficients differ. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

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