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Incentive pay, managerial skills and span of control☆

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ABSTRACT

The use of incentive pay to elicit worker effort is a hallmark of agency theory. Although an extensive literature has investigated the effects of these incentives on both firm and worker performance, less attention has been paid to their heterogeneous use across firms. We document that incentive contracts are more likely adopted in firms with better educated managers and with hierarchies where the span of control is larger. This result is robust to different specification models that account for selectivity effects, measurement errors, heterogeneity in the type of incentive pay and the incidence of teamwork. We rationalize this empirical evidence through a simple principal-(multi)-agent model where a manager optimally allocates her time across two tasks: coordination and supervision. The model hinges on two assumptions: first, the marginal benefit of coordination is assumed increasing in the managers' skills. Second, the marginal benefit of supervision is assumed decreasing in the manager's span of control. With these ingredients the model suggests that managers who are more skilled and having larger span of control should focus more on coordination and less on supervision, and thus, pay higher bonuses to elicit labour effort. Taken together, these results help to extend the debate about the drivers of incentive pay beyond standard worker and industry-level characteristics, and to focus more explicitly on firm and manager features instead.

1. Introduction

The design of mechanisms to elicit worker effort is a hallmark of standard agency theory — for a review, see Seth (2018). In presence of asymmetric information and conflicting interests between employers and employees, contracts are incomplete and residual claimants must undertake actions to prevent subordinates from shirking. Both monetary and non monetary incentives can be important in this respect. Agency models of labour discipline have been mainly focusing on the former, highlighting two strategies that employers can follows.

First, they can couple efficiency wages and labour surveillance, i.e. supervise worker activities under the threat of a sanction if caught shirking (Shapiro and Stiglitz, 1984; Bowles, 1985). Second, they can rely on incentive plans that let a part of the agents' remuneration depend on individual-, team-, or company-performance, hereafter incentive pay. While incentives based on relative performance trigger workers competition in tournament-like settings (Connelly et al., 2014), incentives based on absolute

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performance tighten the link between compensation and productivity and encourage productive workers to self-select in skill-intensive occupations — as the "sorting hypothesis" suggests (e.g., Lemieux et al. (2009)). Moreover, paying-for-performance improve work morale, reduce worker turnover and prevent labour poaching (Kato and Morishima, 2002; Jones et al., 2017).

Yet, the use of incentive pay can undesirably backfire by triggering adverse behavioral responses that undermine the sough-after positive effect on worker productivity. Indeed, paying for performance can induce overworking, increase the probability of on-the-job injuries and the amount of job-related anxiety (Andelic et al., 2023). Moreover, both principals' and agents' biased beliefs on contractual outcomes can distort the design of ex-ante seemingly optimal incentives, hampering productivity ex-post (Kim, 2015). When monetary incentives are based on relative performance, workers may try to sabotage each other to score first in rank-ordered tournaments (Harbring and Irlenbusch, 2008). From a behavioral perspective, incentive pay can generate tensions among envious workers (Benjamin and Jenny, 2021), reduce managerial attention (Dur et al., 2010), and crowd out intrinsic incentives based on trust and reciprocity (Benabou and Tirole, 2003). As Holmström (2017) recalled in his Nobel Prize lecture, in turn, the relative importance of these negative effects may depend on the tasks being performed. Hence, workers', firms', markets' and tasks' characteristics may all play a role in determining the adoption of incentive pay. The available evidence seems consistent with this heterogeneity, as it shows that while the use of incentive pay increases firm performance on average (Blasi et al., 2010) it fails to do so in a variety of settings (Robinson and Wilson, 2006). Indeed, the share of paying-for-performance firms is heterogeneous within and across both countries and sectors: in the comparative evidence reviewed by Bryson et al. (2012b), the use of incentive pay among firms spans from around 10–15 percent in European countries and in the UK to over 40 percent in Scandinavian countries and in the US.

In this paper, we explore two other sources of heterogeneity that, to the best of our knowledge, received no previous attention, i.e. the managers' skills and span of control. Related to this, we ask whether the rate of incentive pay adoption is correlated with the managers' education and span of control and, if yes, why. The purpose of this paper is to answer these questions, both theoretically and empirically.

To frame the issue, we develop a simple principal-(multi-)agent model that studies an intuitive trade-off between supervision intensity and incentive pay. We consider a manager who optimally scale the workers' bonus and allocates her time between two tasks: one (coordination) increases productivity directly by improving work organization; the other (supervision) elicits labour effort by raising the probability of detecting and sanctioning shirkers. Hence, effort provision follows a mixture of efficiency-wage and incentive-pay logic.

The model hinges on two assumptions. First, the productivity gain the manager achieves by allocating time to coordination is increasing in her skills, which, conversely, do not affect her monitoring ability. The rationale is straightforward. Supervision is a relatively standardized task, often relying on routine checks and simple rule enforcement, and is thus less sensitive to the manager's education and ability. By contrast, coordination requires the ability to adapt to changing conditions, solve problems with limited foresight, and innovate to seize emergent opportunities—tasks that benefit more from higher managerial competence.[1] This assumption implies that skilled managers have a relative advantage in coordination activities, and therefore allocate more time to coordination and less to supervision. As a consequence, they must also place greater emphasis on incentive pay to elicit labour effort.

Second, the probability of detecting shirkers is assumed decreases the manager's span of control. As team size increases, the frequency with which the manager observes each worker's effort declines, reducing the marginal benefit of allocating time to supervision. This makes the efficiency wage channel less effective as an effort-extraction mechanism, forcing managers to place relatively more emphasis on incentive pay. In equilibrium, the optimal bonus is thus increasing in both managerial skill and span of control.

Empirically, these two channels suggest that we should observe a positive correlation between the use of incentive contracts, on the one hand, and the managers' skills and span of control, on the other.

These results contribute to the existing literature by showing that the use of incentive pay may depend not only on workers' skills, preferences, and tasks — as suggested by Holmström (2017) — but also on their supervisors'. In this view, managerial skills and span of control are not arbitrary additions but key dimensions of the organizational context that shape how incentive schemes are implemented and perceived. While the impact of managerial talent on firm performance has been widely studied (see, e.g., Battisti et al., 2023), to our knowledge, this is the first contribution to show how it may also shape the use of incentive pay for non-managerial workers. Ignoring this additional source of heterogeneity may lead to biased conclusions about the adoption of such schemes across organizational layers. Moreover, the motivational strength of the efficiency-wage channel may itself depend on workers' preferences and tasks, suggesting ways to further integrate our theory with existing insights. For instance, if task complexity reduces work transparency (see, e.g., Autor et al., 2003; Acemoglu et al., 2007b), and control-averse workers respond negatively to intensified monitoring (Falk and Kosfeld, 2006; Burdin et al., 2018; Belloc et al., 2023), our model implies that managers will optimally allocate more time to coordination in settings where these frictions are more pronounced. This provides a plausible explanation for the widespread use of incentive pay in such environments (e.g., Bryson et al., 2012a; Lazear and Shaw, 2007). While a formal analysis of these interaction effects is beyond the scope of the present paper, they point to promising avenues for future research on how managerial heterogeneity shapes incentive design beyond performance outcomes.

That the optimal bonus is increasing in the managers' skill has noteworthy implications for the theory of incentives. In contract-theoretic models — and in ours too — agents are given shares of the surplus generated in production for incentive reasons. In our

[1] Nothing would change if we allowed the manager's skills to have a positive, albeit small, effect on supervision. As long as this effect is comparatively smaller than the one on coordination, the comparative advantage that skilled managers have in devoting time to coordination would still be present.

framework, the manager's skills lead to surplus growth (and, by extension, to higher bonuses) through enhanced labour productivity. Clearly, one may think of other channels having similar effects. While process innovation (like managerial talent) may increase the surplus through higher labour productivity, product innovation or the access to foreign markets may do so by increasing demand or market power. This implies that the proposed effect of managerial talent on heightened bonus should be extendable to other firm characteristics. The general highlight is that we should observe a greater adoption of pay-for-performance in better performing firms, consistently with what we already know from previous empirical evidence (e.g., Belloc, 2022). Our contribution sheds light on plausible mechanisms that may drive this correlation, proposing a novel perspective on the intertwined roles of managerial talent and span of control in shaping the adoption of incentive pay.

We evaluate these theoretical intuitions through an empirical analysis conducted with granular data on a sample of about 30,000 Italian non-agricultural firms, observed between 2010 and 2015. The data provide a rich amount of information about compensation schemes, workforce structure, head manager characteristics, other ownership and industrial relations aspects together with information on location and sector of activity. Although without establishing causality, the econometric exploration of the data shows that the correlation between incentive pay, span of control and managerial ability is robust to different empirical issues, including possible selectivity effects, imperfections in the measurement of managerial skills, heterogeneity in the type of incentive contracts and the incidence of teamwork. Unfortunately, our data does not include direct information on how managers allocate their time in organizations. Hence, while the shown correlations provide general support to our theory, the empirical analysis should not be taken as a test of the mechanisms proposed by our model. We leave the possibility of digging deeper into the latter to future research.

Our paper contributes to the vast stream of research in personnel economics that studies the optimal combination of incentives in firms, and more precisely, to that analyzing the substitutability between incentive pay and efficiency-wages (MacLeod and Malcomson, 1989; Yang, 2008; Coviello et al., 2022).[2] Extant studies in this sub-field focused on the role of workers', organizations' and markets' characteristics. Our theory conversely emphasizes the role of managers and, in particular, of their skills and span of control. In doing so, our contribution moves a first step in the direction of connecting three hardly communicating streams of research: on worker incentives, on managerial ability, and on firm structure.

Previous works on such topics analyzed the effect of managerial talent on the hierarchical organization and wage distribution of firms — for recent contributions, see Smeets et al. (2019) and Smeets and Warzynski (2008). Different modeling approaches in this stream of research – e.g., those inspired by the seminal works of Lucas (1982), Rosen (1978), and Garicano (2000) – focused on the "scale of operation effect" whereby more talented managers should have larger span of control as to improve the productivity of many workers. Although our model does not explicitly consider the relationship between managerial talent and span of control, it assumes – following previous contributions (e.g., Georgiadis (2013) and Rebitzer and Taylor (1995)) – that a larger staff-to-manager ratio reduces the observability of work effort, forcing managers to increase the workers' bonus. This provides a further theoretical explanation to rationalize the positive correlation that is often observed in the data between earnings and team size — see for instance Garicano and Hubbard (2007, 2009).

More novel in our theory is the relationship between labour productivity, managers' skills, and the use of incentive pay. By assuming that abler managers have a more sizeable impact on labour productivity, and that they thus allocate more time to coordination rather than supervision, our model indeed suggests a mechanism that explains why more skilled managers should pay higher bonuses. This provides novel theoretical insights to explain the earning distribution both within and across firms. It should be noted that other theoretical approaches may lead to different conclusions. For instance, the "knowledge hierarchy approach" à-la Garicano suggests that the relationship between managerial talent and organizational structure may be more nuanced when the number of hierarchical layers (and not just the managers' span of control) is taken into account — for a recent overview, see Garicano and Rossi-Hansberg (2015). In such theory, the presence of more educated managers is associated with the emergence of organizations characterized by more hierarchical levels, leading in turn to a reduction in each manager's span of control. Following our reasoning, a lower staff-to-manager ratio should trigger a reduction in the use of incentive pay, which would then lead to the emergence of a negative association between the use of these incentives and the education of the managers. At the same time, however, it is important to notice that in models à-la Garicano the structure of the organization and the related allocation of skills across hierarchical layers is endogenously defined by the cost-minimization choices of the employers. Thus, the employer is changing both the structure and the skill allocation at the same time. Taking the structure of the organization as given, instead, as we do in our framework, more educated managers may still find it optimal to allocate more time to coordination than to supervision, thus leading to a marginal increase in the use of incentive pay. Overall, we believe that, far from being conflicting, the two theoretical approaches are actually complementary and may be used to address different questions concerning the optimal design of organizations.

Our study may be interesting also if read in light of other stylized facts that have been recently discussed by personnel and labour economists. The first is the divergence in the managers' human capital across countries and firms, as shown by Bloom et al. (2014b) among others. If our theory is correct (and so is the empirical analysis in support) better-managed firms not only are more productive, but also more prone to adopt incentive pay, which may provide a further explanation to the mounting cross-firm and cross-country wage inequality described by a number of recent studies — see Eeckhout (2021) for a discussion. The second is that firms are becoming flatter, i.e. have increased the number of employees directly reporting to the same top-manager (Caroli and Van Reenen,

[2] Others have focused on the relationship between incentive pay and career concerns in internal labour markets (Ortín-Ángel and Salas-fumás, 1998; Schöttner and Thiele, 2010) or on how team and individual incentives should be combined, both in tournament (Danilov et al., 2019) and non-tournament settings (Bag and Wang, 2019).

2001; Acemoglu et al., 2007a; Rajan and Wulf, 2006; Guadalupe and Wulf, 2010; Bloom et al., 2014a). Whether this tendency is leading to improved worker autonomy and greater delegation is still controversial. Without entering this issue explicitly, our study suggests that flexible remuneration schemes linking pay to performance may be better suited to support managerial activities in flatter firms.

As the above discussion made clear, there are "too many" reasons as to why firms may decide to use pay-for-performance schemes. If some can be properly red through the lens of agency theory, others, related to retention and morale, may call for different approaches. The coexistence of these theoretical mechanisms, in turn, make the empirical assessment of incentive pay particularly challenging. The preceding discussion has already highlighted some of our study's limitations, and others will be acknowledged in the empirical section and in the Conclusions. Despite their relevance, we believe that the message delivered by our paper remains valid and important for the theory of incentives and organization.

The remainder of the paper is organized as follows. In Section 2, we setup and solve our theoretical model. Section 3 shows that the correlation between incentive pay, span of control and managerial ability is systematic in the data. Section 4 comments and concludes.

2. The model

2.1. Setup

We develop a three-stage, partial equilibrium, labour discipline model where a firm employs a manager of ability $\alpha \in \left(\underline{\alpha}, \overline{\alpha}\right)$, to oversee a team of $l \geq 1$ identical workers.[3] Each agent in the organization is endowed with a unit of time. Workers optimally choose the share of time $e \in (0,1)$ in which they work and exert positive effort, and shirk by providing no effort in the remaining share $1-e$. The manager allocates her time across two tasks. In a share $\tau \in (0,1)$ of her time she coordinates and organizes the workers, improving labour productivity. In the remaining share $1-\tau$ she monitors the labour process, sanctioning those who are caught shirking. To model this, we assume that workers enjoy a contingent utility $\upsilon > 0$ as long as they hold the status of hard workers, and that this utility drops to zero if they are caught shirking. We think of υ as measuring different benefits, such as expectations of future promotions and employment stability, and protection from disapproval and hierarchical peer pressure.[4] The workers' cost of effort is given by δe^2; the manager's coordination and supervision costs by $\gamma\tau^2$ and $\eta(1-\tau)^2$ respectively, with $\delta, \gamma, \eta > 0$.

As common in agency models, we assume that individual output can take two values: high, $H > L$, or low, $L \geq 0$. The probability of high output, in turn, is assumed increasing in the workers' effort and, for simplicity, given by e.[5] To keep things simple, we also assume that the only-labour inputs production function that aggregates individual outputs in total output has constant returns to scale: total output is just the sum of individual outputs.

Consistently with the scale of operation effect recalled in the Introduction, we model the effect of coordination on labour productivity by assuming that the share of time allocated to coordination increases the productivity of each worker to an extent that depends positively on the manager's ability α. More specifically, we assume that individual output, y, is given by

$$y = \alpha\tau\left[eH + (1-e)L\right]. \tag{1}$$

While the workers' output is observable and verifiable by a third party (so that incentive pay can be made contingent on output), their individual effort is only imperfectly so depending on the probability $q \in (0,1)$ that the manager "sees" a given worker during the productive period. Hence, the manager faces the well known moral-hazard problem studied by principal–agent/labour-discipline theorists. We specify the detection probability q as an increasing function of the time the manager dedicates to supervision, and, as in Rebitzer and Taylor (1995) and Georgiadis (2013), as a decreasing function of l, the manager's span of control. More specifically, we assume that q takes the specific functional form

$$q = \frac{1-\tau}{l}. \tag{2}$$

To overcome the moral-hazard problem and elicit labour effort, the manager can use (and combine) two different instruments. First, she can increase the bonus b she pays in case of good performance, that is, when realized output is $\alpha\tau H$ rather than $\alpha\tau L$, which happens with probability e. Second, she can increase the share of time $1-\tau$ she allocates to supervision as to increase the probability of detecting and sanctioning shirkers.

Given the above discussion, the manager's expected payoffs $E(\pi)$ is given by

$$E(\pi) = (y - w - eb)\,l - \gamma\tau^2 - \eta(1-\tau)^2, \tag{3}$$

[3] To ensure that the model's optimization problems stay globally concave, and all solutions are interior we assume the following restrictions on the managers' ability: $\underline{\alpha} \equiv 1/l$ and $\overline{\alpha} \equiv (1+\sqrt{1+8l})/(2l)$. For a derivation see the Theoretical Appendix. The staff-to manager-ratio that defines the manager's span of control, $l/1$, is assumed fixed in the short-run, that is, l is exogenous to the manager's choice. Moreover, we assume that the manager is given full residual rights over the team's output, which implies that she is in a standard principal-(multi-)agent relationship with the employees in her team. Both the manager and the workers are risk-neutral expected utility-maximizers with outside options normalized to zero.

[4] Efficiency-wage theorists normally assume that caught shirkers are fired. Yet, disciplinary dismissals are not the only mechanism, nor necessarily the most efficient, to punish caught shirkers. Depending on labour market conditions (Ichino et al., 2003) and judges' political bias (Berger and Neugart, 2011) they can indeed be prohibitively costly (Gáldón-Sanchez and Güell, 2003). In this case, firms may impose other sanctions, relying on internal labour markets mechanisms (e.g., denial of future promotions) or hierarchical peer pressure. This is why we leave the interpretation of υ voluntarily broad.

[5] The restriction in footnote (3) ensures that in equilibrium $e^* < 1$.

while the workers' expected utility $E(U)$ by

$$E(U) = e(w + b + v) + (1 - e)\,[qw + (1 - q)(w + v)] - \delta e^2. \tag{4}$$

The timing of the game is as follows. At stage 1, the manager offers a contract that specifies the optimal combination of fixed and variable pay, $w + b$, taking into account the workers' participation, limited-liability and incentive compatibility constraints. We assume that negative wages are not feasible, so that $w, w + b > 0$, because workers are wealth-constrained, protected by limited liability, or because the manager has to respect a legal minimum wage normalized to zero. At stage 2, the manager optimally chooses the shares of time allocated to coordination, τ, and supervision, $1 - \tau$. At stage 3, workers choose their effort e. As usual, we derive the subgame perfect equilibrium by backward induction. The derivation of the model's solution is given in the Theoretical Appendix.

2.2. Solution

Since our focus here is on the relationship between the manager's ability, span of control and the use of incentive pay, we can, without loss of generality, normalize

$$\gamma = \delta = \eta = \frac{1}{2};\ v = H = 1;\ L = 0. \tag{5}$$

Hence, the remainder of the analysis considers four endogenous variables (w, b, τ, e) and two exogenous parameters (α, l), the proxies of which will constitute the focal regressors of our empirical analysis.

At stage 3, each worker maximizes her payoff (4) w.r.t. to e, choosing

$$e(\tau, b) = b + q. \tag{6}$$

The best-response schedule in Eq. (6) defines a family of iso-effort curves that are negatively sloped in the (b, q) space, which suggests that incentive-pay and the efficiency-wage channel can be used as substitutes to elicit worker effort. Since the detection probability q is assumed decreasing in l the efficiency-wage motivation is weaker in larger teams, and greater emphasis must be put on incentive pay to elicit labour effort.

In the second stage of the game, the manager anticipates the workers' best-response (6) and maximizes (3) w.r.t. τ, choosing

$$\tau(b) = \frac{1 + \alpha + (1 + \alpha l)b}{2(1 + \alpha)}. \tag{7}$$

The share of time (7) the manager dedicates to coordination is increasing in the incentive-pay b, which implies that the share $1 - \tau(b)$ dedicated to supervision is decreasing in the size of the bonus. Since incentive pay and supervision can be used as substitutes to motivate workers, a higher bonus allows the manager to reduce the share of time dedicated to supervision and increases that dedicated to coordination. Moreover, the optimal coordination time (7) is increasing in l, the manager's span of control. This is readily explained. According to (2), the probability of being observed by the manager is decreasing in l, and so is the marginal benefit of dedicating time to supervision. Hence, the larger the team, the smaller the share of time dedicated to supervision. Finally, the optimal coordination time (7) is increasing in α, since $\partial\tau(b)/\partial\alpha = b(l - 1)/2(1 + \alpha)^2 > 0\ \forall\ l > 1$. By assumption, the workers' output (1) depends positively on the manager's ability, and so does the marginal benefit of allocating time to coordination. Because of this, the abler is the manager, the larger the share of time she optimally allocates to coordination, and the smaller that dedicated to supervision.

At stage 1, anticipating her decision at stage 2 and the workers' decision at stage 3, the manager offers a contract (w, b) that maximizes her payoff (3) subject to the workers' participation and limited liability constraint. Formally, the contracting problem is

$$\max_{w,b} E(\pi)\ \text{s.t.}\ E(U) \geq 0;\ w, w + b \geq 0, \tag{8}$$

the solution of which is given by:

Proposition 1. *In equilibrium, the optimal fixed wage is $w^* = 0$, and the optimal bonus,*

$$b^*(\alpha, l) = \frac{(1 + \alpha)(l\alpha - 1)}{l[\alpha(2 - l\alpha) + 4] - 1}, \tag{9}$$

is increasing in the manager's ability α and span of control l.

The mechanisms behind Proposition 1 have already been anticipated by the discussion following Eqs. (6) and (7). First, supervision and incentive pay can be used as substitute to elicit worker effort. Second, the abler is the manager, the greater is the incentive to coordinate instead of supervise, and thus, to put more emphasis on pay-for-performance to elicit labour effort. Third, since supervision is less efficient in larger teams, the wider is the span of control, the lower is $1 - \tau$, and the greater is the size of incentive pay. This straightforwardly leads to formulate the following testable prediction, that will guide our empirical analysis

Hypothesis 1. The use of incentive pay correlates positively with the managers' skills and span of control.

Testing the predictions of Hypothesis 1 would require studying the correlation between the size of the workers' bonus and our two variables of interest, managers' ability and span of control. In the absence of continuous measures of the incentive component in the worker's pay, the exercise would be equivalent to assess whether the probability of using incentive pay (of any size) rises with the managers' skills and span of control. This is what we do in our empirical analysis.

2.3. Discussion

Before assessing if Hypothesis 1 is confirmed in the data, some comments on the model's assumptions and limitations are in order. First, the model overlooks that measuring the workers' output may require sinking a fixed cost to setup a metering system, as explicitly acknowledged, for instance, by Brown (1990) and Lemieux et al. (2009). The cost of such system, in turn, may depend on the chosen type of incentive scheme, on the efficiency of surveillance systems, on the features of work organization, on the degree of task complexity, and on the choice of the technology of production, which "will generally affect the ease of monitoring, one way or another" (Bowles, 2004, p. 276). For instance, Brown (1990) shows that incentive pay is more likely to be adopted in more routine jobs, while Barrenechea-méndez et al. (2016) provide evidence that the use of HR-management practices such as job rotation and team production reduce effort observability. In addition, advances in digital monitoring are currently allowing an unprecedented expansion of the managers' surveillance capabilities (Tapscott, 2003). In the context of our model, more performative monitoring technologies would lead to a decrease in the optimal bonus, consistently with the idea that monitoring is a way of shifting rents away from workers towards employers (Acemoglou, 2024). While the model's results are robust to such considerations (which only determine the relative efficiency of monitoring as an effort-extraction mechanism), they generate additional sources of variability in the adoption of incentive schemes that are likely to be empirically relevant.

Another limitation of our model is that team size is assumed fixed in the short run. While the assumption is empirically motivated (what we wish to test is the firm-level correlation between the use of pay-for-performance and span of control), it has nonetheless reasonable interpretations. In contexts where employment protection legislation is tight and redundancies are costly (such as Italy, the country we analyze empirically), downsizing for organizational reasons may be prohibitively inefficient. Similarly, when recruiting and training is expensive and the use of flexible labour legally constrained or poorly productive, hiring decisions should be understood as medium-to-long-term investments. Finally, managers rarely "start from scratch" in choosing how many workers to supervise, as they often take over already formed teams. The situation they inherit from their predecessors, in this case, may constrain their flexibility of action.

A final consideration about Hypothesis 1 concerns the managers' actual discretion over the adoption of incentive pay. In large firms with multiple managerial layers, individual managers often have well defined roles — e.g., in Human Resources, Innovation, or Finance — and may lack decision-making authority over compensation schemes. Nonetheless, the message of our model remains valid, as contract-designers should fine-tune incentive-pay to maximize their agents' productivity taking into account how it is shaped by their direct managers' ability and span of control.[6] Moreover, in small firms with few managerial layers, managers typically holds authority over a vast array of operational decisions, including the design and implementation of incentive pay structures. This is even more true for single-headed firms where the manager — often, the owner-entrepreneur — is in charge of all strategic decisions.[7]

3. Empirical analysis

3.1. Data

Performance-related pay for subordinate workers is widely used worldwide, to different extents across countries and firms. A broad range of different variable schemes based on sales, production or hierarchical subjective evaluation can be observed, with certain types of contracts emerging more likely than others depending on the institutional context (Bryson et al., 2012b). The Italian case is well-suited to look at the use of these contracts given the availability of granular data on their adoption. In addition, Italian firms rarely use other forms of variable compensation based on financial rather than productive performance (such as stock options and stock ownership), which are often hard to measure and may likely substitute for the productivity-based instruments we analyze in this paper, thereby making it difficult to document how this latter type of arrangements correlates with the hierarchical governance of the firm.

We analyze the correlations suggested by our theoretical model by using data from the 2010 and the 2015 wave of the "Rilevazione Imprese e Lavoro" (RIL), conducted by the Italian National Institute for Public Policy Analysis (INAPP). These data cover a representative sample of non-agricultural private firms operating in Italy. Quite importantly for our purposes (see below), no minimum size is foreseen for firms to be included in the surveyed sample, which implies that the reference population include also small and micro firms (which are very common in Italy). After data cleaning, the pooled sample amounts to about 55,000 firm-year observations. For each firm, a rich array of variables is available, including information about compensation schemes (whether the wage is entirely fixed or it includes an incentive component), workforce structure (i.e. the size of each of the firm's hierarchical layers), head manager characteristics (sex, age, education and whether the head manager is hired from outside the firm), ownership

[6] The timing of our model best fits three-layer hierarchies composed by a principal, a middle manager, and an agent. At stage 1, the principal chooses the agent's compensation scheme anticipating how the manager optimally allocates her time between coordination and supervision at stage 2 and how this affects the agent's optimal effort at stage 3.

[7] In this view, Italy is a perfect case study, as Italian firms are commonly small and characterized by lean hierarchies. In the data we use for the empirical study, nearly 65% of firms have fewer than 16 employees, and 74% report no managerial staff beyond the head manager, who typically has broad discretion over the use of incentive plans. Related to this, Damiani et al. (2023) show that the 2016 tax break introduced by Law 208/2015 — which allowed performance-related bonuses up to €3000 to be taxed under a reduced 10% substitute regime — significantly boosted the use of performance pay, especially among small, family-owned firms. This policy change provides a quasi-experimental setting to assess whether managers have authority over compensation decisions: the observed adjustment suggests that, despite formal constraints, incentive pay remains well within the manager's sphere of influence, particularly in SMEs like those in our sample.

Table 1
Descriptive statistics.

Variable	Mean	Std. Dev.
Incentive pay for subordinates (1 = adopted, 0 = not adopted)	0.058	0.235
Span of control (logarithm of the # of subordinates per manager)	1.923	1.252
Head manager with higher education (1 = yes, 0 = no)	0.273	0.445
External head manager (1 = yes, 0 = no)	0.045	0.208
Male head manager (1 = yes, 0 = no)	0.845	0.361
Head manager aged 60+ (1 = yes, 0 = no)	0.311	0.463
Small size (1 = yes, 0 = no)	0.521	0.499
Large size (1 = yes, 0 = no)	0.037	0.189
Group membership (1 = yes, 0 = no)	0.134	0.340
Family ownership (1 = yes, 0 = no)	0.481	0.499
Exporter (1 = yes, 0 = no)	0.227	0.418
Association membership (1 = yes, 0 = no)	0.526	0.499
Unionization (rate)	0.234	5.307
Open-end contracts (rate)	0.881	0.211
Female workforce (rate)	0.328	0.336
Labour turnover (rate)	0.522	0.421

type (family ownership), industrial relations (unionization, share of open-end contracts, gender composition and labour turnover), regional location and sector of activity, plus information on other firm characteristics (membership in a group and in employer associations and exporting status). See Table 1.

In particular, the RIL-INAPP data provide granular information about the adoption of various types of incentive pay at each layer of the firm hierarchy, along with the number of workers at each of four layers: managers ("*dirigenti*"), middle-managers ("*quadri*"), white-collars ("*impiegati*"), and blue-collars ("*operai*"). When a firm adopts an incentive pay scheme, on top of the fixed wage, at any of its layers, we have information on whether this is based on individual performance, team performance and/or firm performance (i.e. profit sharing). Thus, to build our dependent variable we first divide the workforce in managerial (top and middle managers) and non-managerial workers (blue and withe collars). Then, we measure whether incentive pay are used for subordinate workers with a dummy variable equal to 1 if any among individual-based, team-based and firm-based (i.e. profit sharing) incentives is adopted at any of the non-managerial layers and 0 otherwise.

With reference to the possible drivers of incentive pay, we focus our attention on the managers' skills and span of control. The measure of span of control we rely upon is given by the ratio between the number of subordinate workers (both white and blue collars) and the number of managers (including middle-managers). Such ratio allows us to capture the average number of employees each manager is supposed to supervise, which is strictly in line with parameter l in our model. For what concerns managerial abilities (i.e. parameter α), unfortunately, we do not have detailed information about the characteristics of all managers active in the firm, which prevents us from obtaining a comprehensive metrics of skills across all managerial layers. However, we do observe the education of the head manager, namely the manager at the top of the organization, who exerts direct control over the firm operations and in most instances it is the single entrepreneur. On this basis, we compute managerial skills through a dummy variable taking value equal to 1 if the head manager has a university degree and 0 otherwise. Although this variable allows us to measure skills only at the very top of the organization, we have to consider that in Italy most firms are of relatively small size (in our sample nearly 65% report less than 16 employees) and their managerial structure is rather thin. In our data, 74% of the surveyed firms report neither middle-managers nor additional managers besides the head in their organization. For these firms the head manager is indeed the only person with coordination and supervision responsibilities, and our proxy based on education captures his/her managerial skills reasonably well. Descriptive statistics are reported in Table 2.

The use of incentive pay for subordinate workers is rather limited as it occurs only in about 6% of the firms. However, in line with our predictions, its use varies considerably depending on the span of control and managerial skills of the firms. In Fig. 1, we display the share of firms using incentive pay for subordinate workers along the distribution of the span of control. As usual, the managers' span of control is defined as the staff-to-manager ratio, indicating the number of workers each manager has under her direct supervision. While the incidence of incentive pay is very limited (below 1%) for firms in the 1st quintile, it rises remarkably for firms in the 5th quintile, approaching 11%. Similarly, paying-for-performance firms have, on average, a lower staff-to-top-manager ratio, i.e. they are flatter. In Fig. 2, we compare the "averaged" hierarchical structures of incentive pay adopters and non-adopters, showing that the former are on average wider at the bottom of the hierarchy, having a number of white and blue collars that is at least as twice as that in firms paying only fixed wages. Fig. 3 compares the cross-sector incidence of incentive pay for subordinate workers in firms with and without tertiary educated head manager. In most cases, firms with better educated managers are significantly more likely to pay for performance compared to the others. Next, we show the robustness of these correlations in a number of regression exercises.

3.2. Baseline results

We start by considering the following baseline model:

$$\text{Incentive pay}_{ij} = \beta_0 + \beta_1 \text{ Span of control}_{ij} + \beta_2 \text{ HM with higher education}_{ij} + \mathbf{d}\mathrm{X}_{ij} + \varepsilon_{ij} \quad (10)$$

Table 2
Incentive pay, span of control and managerial skills.

	[1] The firm uses any incentive pay	[2] The firm uses any incentive pay	[3] The firm uses any incentive pay	[4] The firm uses any incentive pay
Span of control	0.028***	0.004***	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
HM with higher education	0.084***	0.034***	0.034***	0.034***
	(0.003)	(0.002)	(0.003)	(0.003)
Small size		−0.065***	−0.056***	−0.054***
		(0.002)	(0.003)	(0.003)
Large size		0.099***	0.102***	0.098***
		(0.006)	(0.006)	(0.006)
Group membership		0.048***	0.049***	0.046***
		(0.003)	(0.003)	(0.003)
Family ownership		−0.015***	−0.016***	−0.015***
		(0.002)	(0.002)	(0.002)
Exporter		0.016***	0.012***	0.013***
		(0.002)	(0.003)	(0.003)
Association membership			0.044***	0.043***
			(0.002)	(0.002)
Unionization			0.000	0.000
			(0.000)	(0.000)
Open-end contracts			0.048***	0.043***
			(0.010)	(0.008)
Female workforce			−0.063***	−0.061***
			(0.006)	(0.006)
Labour turnover			−0.038***	−0.037***
			(0.004)	(0.004)
External HM				0.033***
				(0.004)
Male HM				0.005
				(0.004)
HM aged 60+				0.009***
				(0.002)
Industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
# of obs.	54,534	46,313	37,040	37,040

Notes: Estimates from logistic models with robust standard errors in parentheses. Marginal effects are displayed. The dependent variable is a variable indicating whether the firm uses any type of incentive pay (individual, team-based, profit sharing) for subordinate workers. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

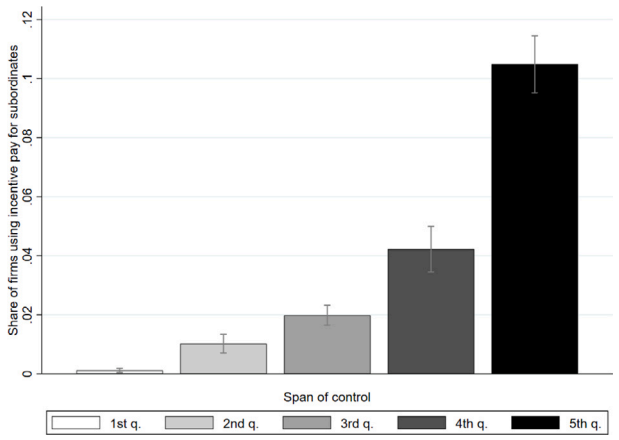

Fig. 1. Use of incentive pay by quintiles of span of control.
Notes: Pooled data from RIL-INAPP 2010 and 2015. Sample weights are used. The use of incentive pay for subordinates refer to any type of incentive pay, i.e. individual incentives, team incentives, and/or profit-sharing.

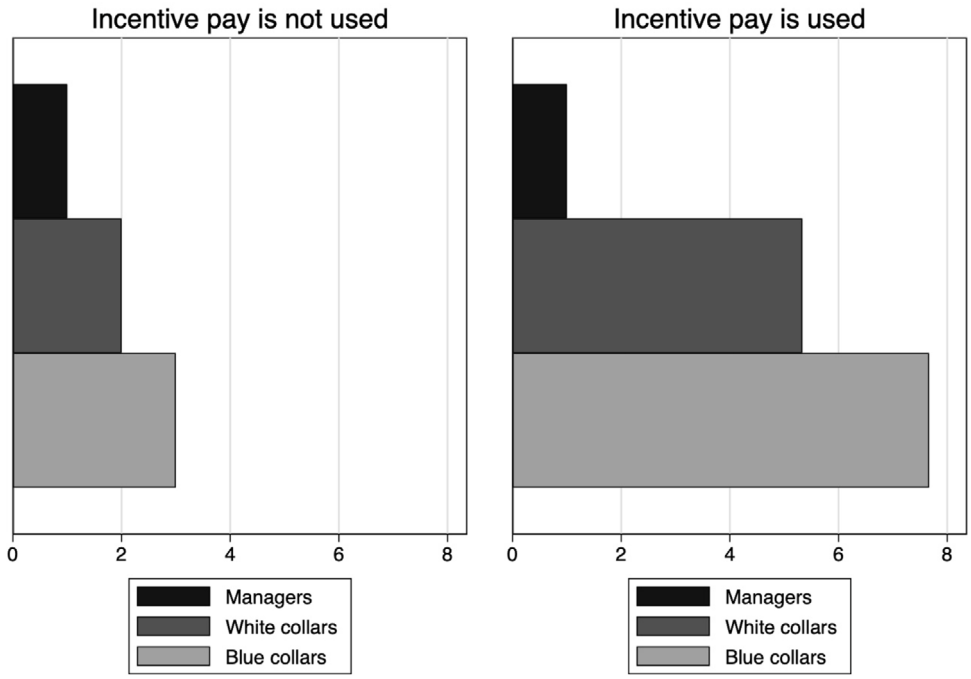

Fig. 2. Use of incentive pay and the hierarchical structures of firms.
Notes: Pooled data from RIL-INAPP 2010 and 2015. Sample weights are used. The use of incentive pay for subordinates refer to any type of incentive pay, i.e. individual incentives, team incentives, and/or profit-sharing. The vertical height of each bar represents the "deepness" of each hierarchical layer: without further information on this available in the data, we treat layers as equally deep. The width of each bar, instead, represents the horizontal size of the layers in terms of number of workers.

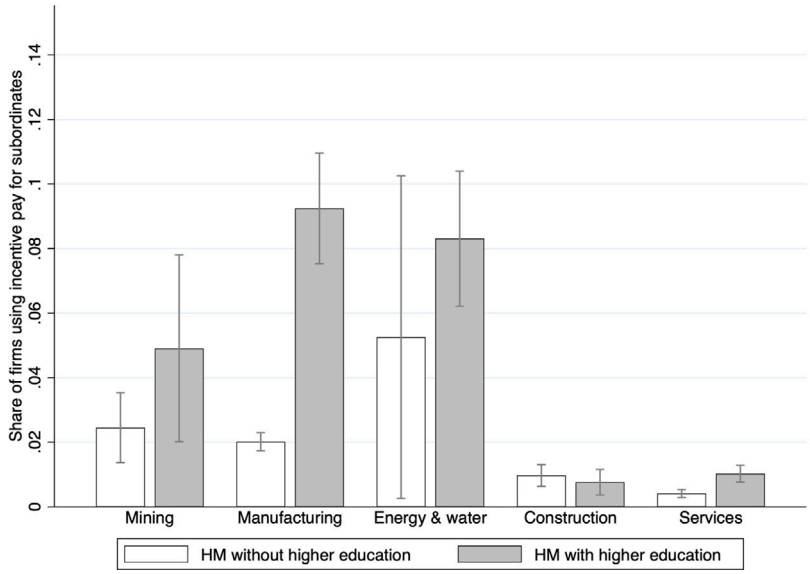

Fig. 3. Use of incentive pay by head manager (HM) education status across sectors.
Notes: Pooled data from RIL-INAPP 2010 and 2015. Sample weights are used. The use of incentive pay for subordinates refer to any type of incentive pay, i.e. individual incentives, team incentives, and/or profit-sharing.

where subscript i and j refers to the firm and industry respectively; the dependent variable is a dummy equal to 1 if firm i in industry j uses any type of incentive pay for subordinate workers (i.e. individual incentives, team incentives, and/or profit sharing); "Span of control" is the firm-level average number of subordinate workers per manager expressed in logarithm; "HM with higher education" is a dummy taking value equal to 1 if the head manager in firm i has a university degree; $\mathbf{X_{ij}}$ is the vector of controls;

and ϵ_{ij} are the residuals. This model is estimated through a logistic regression run on the pooled 2010 and 2015 sample. This means the we exploit only the cross-sectional dimension of our data. Indeed, most of the heterogeneity in the adoption of incentive pay and in managerial characteristics (i.e. education and span of control) is observed across firms, while within-firm longitudinal variations in these variables are minimal and insufficient to implement fixed effects panel models. In any event, it would have been difficult to interpret the empirical link between managerial structures and pay schemes as entirely due to marginal variations in the composition of the management of a same firm over time. In our empirical setting, we circumvent this issue by focusing on cross-firm differences.

The estimated marginal effects are reported in Table 2. In column (1) we estimate a model in which alongside our focus regressors we control only for industry, region and year fixed effects. Both the span of control and the presence of a head manager with higher education are positively associated with the probability of using incentive pay for subordinate workers. In columns (2)–(4) we add more controls sequentially to test the robustness of the results. In column (2), estimates control for firm-level characteristics through a battery of dummy variables identifying small (below 10 employees) and large firms (above 250 employees), firms belonging to a business group, firms that are family owned and firms that sell part of their output abroad. In column (3), we also account for differences in the system of industrial relations, including a dummy variable selecting those firms that are member of an employer association, the firm-level unionization rate and the fraction of workers with open-ended contract. Finally, in column (4) we control for some additional differences in head manager characteristics, such as whether the head manager is external (i.e. hired from outside the company/owning family), his/her gender as well as his/her age. In the most complete model a unit increase in the span of control is associated with 0.2 percentage point increase in the probability of using incentive pay for subordinate workers. Such effect rises to 3.4 percentage point increase if we consider the presence of a head manager with higher education.

With respect to the control variables we find results that are largely in line with our expectations and previous evidence. In particular, the use of incentive pay schemes for subordinate workers is more likely in firms that are larger, more oriented toward export and part of a group. These findings are consistent with the idea that in complex organizations incentive pay are relatively convenient effort extraction mechanisms as opposed to direct monitoring, and they are thus more frequently used. Similarly, variables that are partially correlated with the quality of management, such as the presence of a head manager selected from outside the firm and the absence of family ownership, are also positively associated with the use of incentive pays. This, likewise the result for our focus variable (manager education), is coherent with the theoretical intuition according to which the adoption of this type of incentives is more common in firms with high-quality managers, who find it more convenient to induce effort via bonuses rather than through monitoring (which would take time away from coordination).

Moreover, the use of incentive pay for subordinate workers is more likely in firms that are member of employer association as well as in firms that make larger use of standard employment contracts. While this is partly a consequence of the industrial relation system on the basis of which such incentive schemes have to be agreed upon, it is also consistent with our theoretical model. Indeed, anti-shirking sanctions relying on internal labour market mechanisms such as denial of future promotions or hierarchical peer pressure are less effective for workers with non-standard contracts, who likely react less to internal career concerns. Conversely, our estimates suggest that the use of incentive contracts for low-level workers is less likely in organizations characterized by high labour turnover and large shares of female workers. This is at odds with a number of previous results obtained in the literature – starting from the early study of Brown (1990) – that show that high turnover and less protected workers (such as females, whose discrimination in the labour market is sadly renown) tends to be associated with short term incentives.

This baseline evidence may be biased in at least four ways that can be tackled with the data at hand. First, the correlation between incentive pay and span of control might be driven by the quality of management itself. Second, our span of control measure is given by the inverse ratio between managerial and non-managerial workers and thus cannot but provide an imprecise proxy of the actual number of subordinates that each manager has to supervise. Our measure of managerial skills (top manager's education) may be biased for the very same reasons, given that we do not have information on the education of the other managerial workers in the organization. Third, the correlation between incentive pay, span of control and managerial skills may be heterogeneous across the different types of incentive scheme. Fourth, the positive association between the use of incentive pay and the span of control might be driven by the adoption of specific organizational practices in flatter firms, such as teamwork, which are not expressly controlled for in our estimates. The next Section addresses these empirical issues.

3.3. Robustness checks

3.3.1. Selectivity effects

First, the quality of the management may be an important determinant of the span of control. As showed by Smeets et al. (2019), among others, more talented managers are better able at supervising larger numbers of workers, thereby implying that firms with more qualified managers have larger spans of control for reasons not explicitly accounted for by our theoretical model.[8] On the other side, firms that have a larger span of control for exogenous (e.g. technological or sectoral) reasons may attract or select more educated managers. Such selectivity effects may drive the observed correlation between span of control, managerial quality and the adoption of incentive pay schemes. To tackle this problem, we use here a propensity score matching (PSM), originally introduced by Rosenbaum and Rubin (1983), and verify whether our correlations of interest remain statistically significant after controlling for possible selectivity.

[8] As argued in the Introduction an opposite theoretical prediction can be made by relying on models à-la Garicano, which suggest that in more hierarchical firms managers at the top tend to have better skills. For more details see Garicano and Rossi-Hansberg (2015).

Table 3
Robustness checks: PSM.

	[1] The firm adopts any incentive pay (ATT)	[2] The firm adopts any incentive pay (ATT)
Span of control above sector-year median	0.062***	
	(0.003)	
HM with higher education		0.094***
		(0.002)
# of treated obs.	13 178	23 167
# of control obs.	41 378	39 700
t	21.907	41.058
Common support	Yes	Yes
Balancing property	Satisfied	Satisfied
Matching ATT estimator	NN	NN

Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

In this exercise, we need to disentangle two possible treatments, i.e. span of control and managerial quality. To make the analysis as clean as possible, we consider these two dimensions as reflected in two dummy variables. As for the span of control, we compute a dummy variable equal to 1 if the firm has a span of control which is above the median within its sector-year cell, with sectors classified at the 2-digit level, and equal to 0 otherwise. As for the quality of management, we still rely on the dummy variable for the HM with higher education. Then, we run two separate PSM analyzes, one for each treatment variable. In simple words, we estimate a propensity score, for firm i at time t, as the probability of being treated with a span of control above the median within the sector-year and with a HM with tertiary education, conditional to each other and to a number of other covariates (including the type of firm ownership, age and sex of the HM and whether the HM is hired from outside the firm). If treated and control firms have the same propensity score, the average treatment effect on the treated (ATT) can be attributed to the treatment itself. As usual, we verify that the common support condition is met, in order to rule out perfect predictability of the treatment. The matching procedure is based on the Nearest Neighbor (NN). As a result, the PSM estimator for ATT is simply the mean difference in the adoption of incentive pay over the common support, weighted by the propensity score distribution of firms.

The results are presented in Table 3. Reassuringly, the results obtained with the PSM method are in line with those from our baseline analysis. Having a span of control above the median of the sector-year and a HM with tertiary education are associated with a higher probability of adopting incentive pay by 6.2% and 9.4% respectively.

3.3.2. Measurement of managerial skills

The measure of span of control we have been using so far is defined as the inverse ratio between managerial and non-managerial workers. Hence, it cannot but provide an imprecise measure of the actual number of workers each manager has to oversee. Besides, we do not have information on the level of education of middle managers, which makes our measure of managerial skills just as imprecise. While it is true that head managers generally exert a strong influence on labour organization and human resource management, it is not unlikely that other managerial workers (when present) are also involved in these activities. As a consequence, our measure may fail to adequately account for the effect of managerial talent on the use of incentive pay for low-level workers.

To check whether this limitation affects our results we run a robustness check where we replicate the baseline analysis by restricting the reference sample only to firms that do not report any managerial position other than the head managers in their organization. This, obviously, leads us to loose some observations and to focus primarily on firms that are of relatively small size. However, as stated above, in the Italian industrial demography small firms are by far the majority. Moreover, firms with only the head manager do not seem to belong systematically to any specific type of industry or region (see Fig. A.2.1 in Appendix A.2). Together with the fact that we can correctly measure the skills of the single manager for these firms, this makes us confident that this analysis can provide a good refinement test of the correlations suggested by our theoretical model.

Table 4 reports the results of this exercise. In all the estimated models the empirical association between the managers' span of control and level of education, on the one hand, and the probability to use incentive pay, on the other, remains positive and significant. Compared to the baseline, we find that, while the magnitude of the span of control's coefficient increases, the one related to the manager's education diminishes (in both cases we tested such differences through a Wald test and the p-value is < 0.001). In particular, in this sub-sample of firms a unit increase in the span of control is associated with 1.5 percentage point increase in the probability to use incentive pay (it was 0.2 in the baseline). Instead, the presence of a head manager with higher education is associated with only 0.4 percentage point increase in the adoption of incentive pay (compared to 3.4 in the baseline). One possible explanation for this difference that is loosely consistent with our theory is that small firms are normally involved in simple businesses where the managers' ability is likely to have a less significant role on performance. At the same time, since in firms with only the head manager there is only one subject with supervision responsibilities, a marginal increase in the number of subordinates may significantly undermine the effectiveness of his/her monitoring, thus tightening the empirical association between span of control on the use of incentive pay compared to firms with more structured managerial layers.

Table 4
Robustness checks: sub-sample with only HM.

	[1] The firm uses any incentive pay	[2] The firm uses any incentive pay	[3] The firm uses any incentive pay	[4] The firm uses any incentive pay
Span of control	0.014***	0.014***	0.016***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)
HM with higher education	0.007***	0.007***	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
Industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Firm-level characteristics	No	Yes	Yes	Yes
Industrial relations	No	No	Yes	Yes
HM characteristics	No	No	No	Yes
# of obs.	41,234	41,234	25,375	25,375

Notes: Estimates from logistic models with robust standard errors in parentheses. Marginal effects are displayed. The dependent variable is a variable indicating whether the firm uses any type of incentive pay (individual, team-based, profit sharing) for subordinate workers. Firm-level characteristics: small size, large size, group membership; family ownership; exporter. Industrial relations: association membership, unionization rate, fraction of open-end contracts, labour turnover, share of female workforce. Head manager (HM) characteristics: external, male, aged 60+. Significance level: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

3.3.3. *Heterogeneity of incentive pay schemes*

A third potential limit of our analysis is that in the baseline estimates we do not differentiate among distinct types of incentive pay. In reality, firms can often choose among a variety of solutions depending on how incentives are designed. It is certainly possible that the empirical association between the use of incentives on the one hand and span of control and manager education on the other holds only for certain types of variable pay and not for others. Fortunately, the RIL-INAPP data contains information that allows us to partially deal with this issue. In particular, as stated above, in our data we do observe whether the incentive pay used by the firms is based on individual performance, team performance and/or firm performance (i.e. profit sharing). Although, incentive pay based on firm performance is by far the most commonly used, other types of incentive pay are used as well. At the descriptive level, the use of all types of incentives tends to be higher in firms with a larger span of control and a head manager with higher education (see Fig. 4). However, we want to check whether this positive relation survives also in a multivariate setting.

To do so, we replicate our baseline analysis on all firms as well as on the sub-sample of firms that reports only the head manager by distinguishing the dependent variable depending on the type of incentive pay that is used. Results are reported in Table 5. When we consider all firms (columns 1–3), the managers' span of control turns out to be positively associated with the use of individual incentive pay, but not with the use of group incentive pay (such as team incentives and profit sharing). Overall, this suggests that marginal increases in the number of workers that need to be monitored exert a relatively stronger influence on the introduction of incentive systems linked to individual performance as opposed to collective performance, possibly because they lower the risk of running into standard $1/n$ metering issues. Such difference, however, is not present when we consider small firms with only the head manager (columns 4–6), as in this case the effect of the span of control is always positive and significant. This may suggest that this type of firms are relatively less affected by $1/n$ metering problems.

With reference to managerial skills we find that in the extended sample of firms (columns 1–3) the presence of a head manager with higher education rises the probability of using all types of incentives. The magnitude of this effect is particularly large for profit sharing, which is, as we said, the most commonly used form of incentives. In the sub-sample of firms with only the head managers (columns 4–6), instead, the effect is more heterogeneous. While the coefficient of manager education is positive and significant for profit sharing, no statistically significant effect emerges for individual and team-based incentives. Once again, one possible explanation for this result rests on the specific type of firms that we are considering in this sub-sample. Since they are relatively small and with a "thin" managerial structure, they lack the organizational resources that are necessary to administer incentive schemes requiring the constant metering of individual and/or team performance. Thus, it is not surprising that the effect of managerial skills is significant only for the incentive scheme which likely presents the lowest organizational costs, namely profit sharing. It may also be the case that in small firms, where a few employees work closely, individual-based incentive pay may generate tensions between workers more easily as opposed to profit sharing schemes, which instead may reinforce collaboration in a small workplace. If more qualified managers are also better aware of these issues, they may adopt profit sharing more likely than less educated managers in small companies.[9] Incidentally, this is loosely consistent with the early evidence presented in Brown (1990) showing that large firms adopt incentive contracts more often than small firms.

[9] In addition, a broad literature shows that profit sharing may be adopted in the pursuit of other goals than motivating effort as suggested in standard principal–agent models. For example, Jones et al. (2017) find that profit sharing may be used as a practice complementary to employee involvement and participation at various levels of the governance structure of the firm (such as improved consultation routines, job rotation, and self-management), thereby

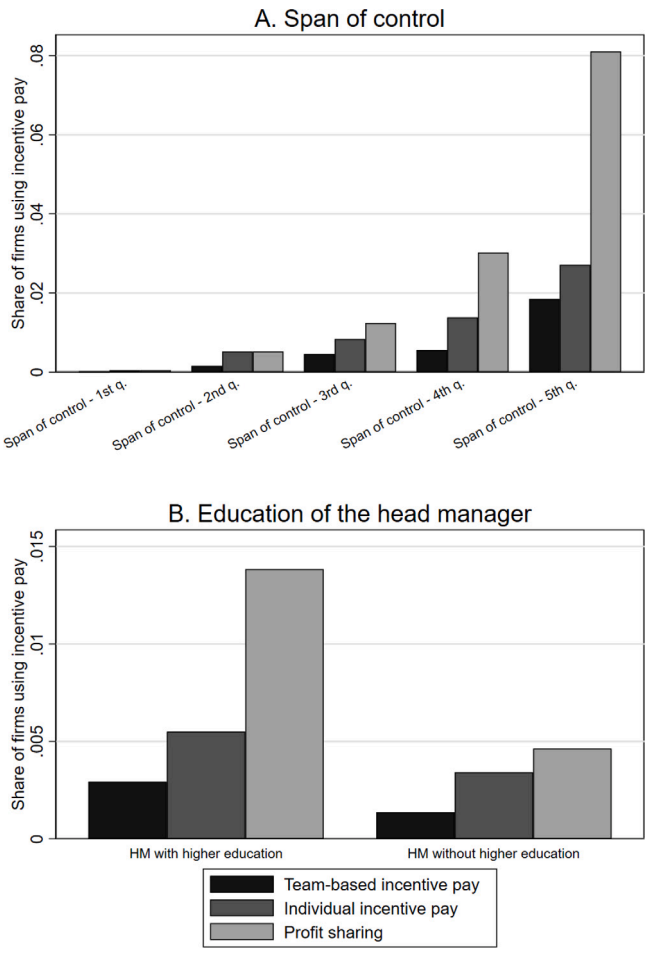

Fig. 4. Span of control, education of the head manager and type of incentive pay.
Notes: Pooled data from RIL-INAPP 2010 and 2015. Sample weights are used. Team-based incentives pay refer to incentives linked to team performance. Individual incentive pay refers to incentives linked to individual performance. Profit sharing refers to incentives linked to firm performance. In panel A the *x*-axis refers to different quantiles of the span of control. In panel B the *x*-axis refers to head manager (HM) with and without higher education.

3.3.4. Incidence of teamwork

An additional issue that could affect our estimates concerns the incidence of teamwork. An extended literature has indeed documented that team organization has become a common practice in modern firms (Laursen and Foss, 2013). When present, teamwork is often combined with flatter organizational structures as well as with a higher propensity to use incentive pay for subordinate workers on top of fixed wages (Burdin and Kato, 2022). Under these conditions, the positive association between the span of control and the use of incentive pay that we detect in our baseline estimates could simply be the consequence of the fact that flatter firms have a higher incidence of teamwork, which in turn rises the probability of using incentive pay.

A proper way of dealing with this issue would require introducing the firm-level incidence of teamwork among the other controls included in our baseline estimates. Unfortunately, however, this information is not available in the RIL-INAPP survey. As an alternative strategy, we rely on information reported in the 2015 wave of the survey "Qualità del Lavoro" (QdL) conducted by INAPP. This survey (which is the Italian version of the EU's Working Condition Survey) reports rich worker-level information about the characteristics of individual jobs, including whether each job requires work to be performed in teams. On this ground, we

favoring employee retention and the attraction of more collaborative workers. Kato and Morishima (2002) show that financial participation, including the use of profit sharing, may be used to improve trust in management, particularly when combined with other practices that facilitate worker participation and that make the workplace climate better, with possibly significant effects on a number of performance indicators (see, e.g., Belloc (2022) about the link between profit sharing and innovation).

Table 5
Robustness checks: span of control, managerial skills and types of incentive pay.

	All firms			Firms with head manager only		
	[1] The firm uses individual incentive pay	[2] The firm uses team-based incentive pay	[3] The firm uses profit sharing	[4] The firm uses individual incentive pay	[5] The firm uses team-based incentive pay	[6] The firm uses profit sharing
Span of control	0.003***	0.001	0.001	0.005***	0.003***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
HM with higher education	0.007***	0.006***	0.026***	−0.000	0.001	0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
# of obs.	36,423	36,423	37,040	24,686	23,613	24,501
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimates from logistic models with robust standard errors in parentheses. Marginal effects are displayed. In columns (1) and (4) the dependent variable is a variable indicating whether the firm uses individual incentive pay for subordinate workers. In columns (2) and (5) the dependent variable is a variable indicating whether the firm uses team-based incentive pay for subordinate workers. In columns (3) and (6) the dependent variable is a variable indicating whether the firm uses profit-sharing for subordinate workers. Sample split based on whether in the firm there are other managerial positions besides the head manager (HM). Firm-level characteristics: small size, large size, group membership; family ownership; exporter. Industrial relations: association membership, unionization rate, fraction of open-end contracts, labour turnover, share of female workforce. Head manager (HM) characteristics: external, male, aged 60+. Significance level: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

build an industry-level measure capturing the incidence of teamwork across sectors (aggregated at 2 digits) and we then merge this information with the RIL-INAPP data. This allows us to carry out an empirical exercise where we clean the baseline estimates from potential spurious correlations due to teamwork by focusing on sectors in which the use of such organizational practice is relatively limited.

The results of this exercise are reported in Table 6. Column (1) shows the estimated coefficients for our main variables of interest when restricting the sample to sectors characterized by relatively high incidence of teamwork. Column (2), instead, considers only those sectors in which teamwork is relatively uncommon. In line with our expectations we find that where the incidence of teamwork is high the association between span of control and the use of incentive pay becomes weaker and statistically insignificant. This suggests that teamwork is a potentially relevant factor mediating the relationship between these two variables. At the same time, however, in sectors where the incidence of teamwork is low our baseline results are confirmed. The coefficients of span of control and managerial skills are both positive and significant, and their magnitude is slightly larger than in the baseline estimates. Overall, these results suggest that, although teamwork is indeed an important aspect to be taken into account in evaluating the association between the span of control and the use of incentive pay, there is some evidence that at least part of this association is not explained by teamwork alone.

3.3.5. The role of the workers' outside option

To further test the empirical validity of our theoretical argument, in this sub-Section we explore the role of the workers' outside options. What we run here is not a robustness check of the econometric results strictly speaking, but an exercise to further verify whether the empirical evidence is consistent with the essential ingredients of our theoretical argument.

Our model, as that of Coviello et al. (2022), assumes that worker effort can be elicited by a combination of incentive pay and efficiency wage. The second channel rests on the possibility of sanctioning workers who are caught shirking. In our framework, we do not specify which sanction workers incur into when they are caught shirking, as to allow for punishments that rely on hierarchical social pressure or internal labour market mechanisms. In standard efficiency-wage models, however, caught shirkers are fired. The cost of such disciplinary dismissals is higher the higher is the rate of unemployment in local labour markets. From the viewpoint of employers who choose the optimal combination pf monitoring intensity and incentive pay, and do use disciplinary dismissals as a worker discipline device, a higher unemployment rate allows a downward adjustment in the workers' bonus by improving the effectiveness of the efficiency wage instrument.

If this argument is correct, we should thus observe lower marginal effects of span of control and managerial skills on the probability of adopting bonus pay where the unemployment rate is higher. To test this point, we estimate the marginal effects of the span of control and HM education, as obtained in Eq. (10), conditional to the region where the firm is located. Then, we plot these conditional effects across different regions, each with its own unemployment rate, in Fig. 5. Graphical inspection of the resulting plots reveals that the effects of both the span of control and HM education are strongly reduced where the unemployment rate is higher, consistently with the theoretical argument whereby firms in thin local labour markets can rely less on the incentive pay channel, as the efficiency-wage motivation is already strong.

Table 6
Robustness checks: span of control, managerial skills and teamwork.

	High teamwork [1] The firm uses any incentive pay	Low teamwork [2] The firm uses any incentive pay
Span of control	0.001	0.009***
	(0.002)	(0.002)
HM with higher education	0.022***	0.051***
	(0.003)	(0.005)
# of obs.	22,256	14,519
Industry dummies	Yes	Yes
Region dummies	Yes	Yes
Year dummies	Yes	Yes

Notes: Estimates from logistic models with robust standard errors in parentheses. Marginal effects are displayed. In both columns the dependent variable is a variable indicating whether the firm uses any type of incentive pay (individual, team-based, profit sharing) for subordinate workers. In columns (1) the sample is restricted to firms belonging to industries with a high incidence of teamwork. In column (2) the sample is restricted to firms belonging to industries with a low incidence of teamwork. Sample split based on data retrieved from the INAPP's 2015 QDL survey, which reports worker-level information about the extent to which individual jobs requires working in team. Industries with a share of teamwork higher than the industry-level median (2 digits) are classified as "High teamwork". The other industries are classified as "Low teamwork". Firm-level characteristics: small size, large size, group membership; family ownership; exporter. Industrial relations: association membership, unionization rate, fraction of open-end contracts, labour turnover, share of female workforce. Head manager (HM) characteristics: external, male, aged 60+. Significance level: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

4. Conclusions

The adoption of incentive pay is highly heterogeneous across firms. While previous works explained such heterogeneity by linking the use of bonus payments to imperfect monitoring, career concerns, internal labour-markets and productivity-related motivations, in this paper we provided an alternative arguments based on hierarchical structure and managerial skills. In particular, we proposed a simple model where a manager chooses whether to include an incentive component in her workers' contract, taking as given the probability of detecting shirkers. As Coviello et al. (2022), we thus consider a framework in which effort provision follows a mixture of efficiency-wage and incentive-pay logic. The model hinges on two fundamental assumptions. First, the productivity gain that the manager achieves by allocating time to coordination is assumed increasing in the manager's skills. Second, the manager's ability to detect shirkers is decreasing in her span of control, as heading larger teams reduces the accurate observability of labour effort. The combination of these factors implies that firms with more skilled managers and a higher staff-to-manager ratio should pay higher bonuses (or use bonuses more likely).

We verify whether these theoretical propositions are empirically grounded by using granular data on a large sample of Italian non-agricultural firms. The correlational evidence is broadly consistent with our theory. In most of the estimated models, the use of incentive pay is positively correlated with both the span of control and the education of the manager. Such correlations survive in a wide arrays of robustness checks. Moreover, the positive association between incentive pay, span of control, and managerial skills tends to be weaker in regional labour markets characterized by higher degree of unemployment. This result is consistent with the fact that where the value of the outside option is lower, the efficiency wage channel becomes relatively more effective, allowing a downward adjustment in the need of using incentive pay to elicit the desired level of effort.

With our paper we provide two main insights for research and the more general debate about the use of incentives in organizations. First, we suggest that alongside standard agency and monitoring issues, the decisions concerning the use of incentive pay may be affected by the managers' characteristics. By failing to take this into account, previous research has provided only a limited understanding of the reasons why incentive pay is more likely to be used in some contexts as opposed to others. Our work contributes to fill, at least partially, this gap. Second, in our paper we provide an argument for the use of incentive contracts that shifts the debate about the drivers of such contracts away from standard worker and industry-level characteristics and it focuses instead on firm and manager structural features. On this basis, one contribution of our paper is to point out a set of previously neglected firm-level factors that can make the introduction of incentive pay relatively easier.

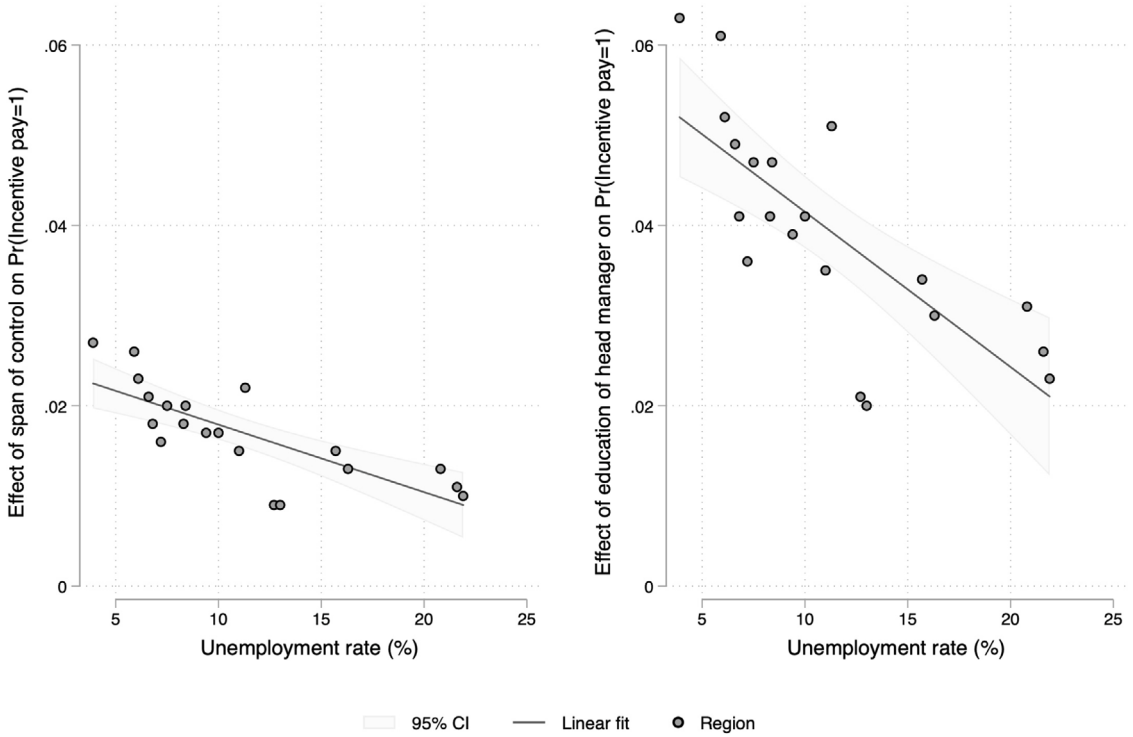

Fig. 5. Marginal effects of span of control and HM education across regions with different unemployment rates.
Notes: Conditional marginal effects obtained from estimating Eq. (10).

Declaration of competing interest

The author they did not benefit from any source of financial support for the particular research the paper describes;

There is no interested party to declare, from whom we received significant financial support, summing to at least $10,000 in the past three years, in the form of consultant fees, retainers, grants and the like;

The author they did not act in any paid or unpaid positions as officer, director, or board member of relevant non-profit organizations or profit-making entities (and this also applies to any close relative or partner of mine);

No other party had the right to review the paper prior to its circulation.

Appendix

A.1. Theoretical appendix

Using the simplification in (5), the workers' problem at stage 3 is

$$\max_{e} E(U) = e(b+q) + w + 1 - q - \frac{1}{2}e^2,$$

with unique solution (6). Inserting (6) in (4) yields the workers' equilibrium payoff

$$E(U) = \frac{(b+q)^2}{2} + w + 1 - q,$$

which is positive $\forall\ q \in (0,1)$. This will be useful in the analysis that follows. Inserting (2) and (6) in (3) yields the manager's problem at stage 2

$$\max_{\tau} E(\pi) = \left[\left(b + \frac{1-\tau}{l}\right)(\tau\alpha - b)\right] l - \frac{1}{2}\left[\tau^2 + (1-\tau)^2\right] = -(1+\alpha)\tau^2 + [1 + \alpha + (1+\alpha l)\, b]\,\tau - \frac{1}{2} - (1+bl)\, b,$$

with unique solution (7). Inserting (6), (2) and (7) in (4) yields the manager problem at stage 3, characterized by the Lagrangian

$$\max_{w,b} \mathcal{L} = \frac{\{1 - l[\alpha(2 - l\alpha) + 4]\} b^2 - 2(\alpha + 1)(1 - l\alpha) b + \alpha^2 - 1}{4(\alpha + 1)} - lw + \lambda_1 E(U) + \lambda_2 w$$

with $\lambda_1, \lambda_2 \geq 0$ as multipliers. As the condition defined in footnote 3 ensures that the bonus is positive in equilibrium – see below for a derivation – the limited-liability constraint $w, w + b > 0$ simplifies to $w > 0$. We have already established that the workers' payoff is positive in equilibrium, so that $E(U) > 0$. Hence, the participation constraint is slack, and $\lambda_1 = 0$. Conversely,

$$\mathcal{L}_w = \lambda_2 - l = 0$$

implies that the limited-liability constraint is binding, so that $w^* = 0$ and $\lambda_2 = l$. Finally, the choice of the optimal bonus is described by

$$\mathcal{L}_b = \{1 - l[\alpha(2 - l\alpha) + 4]\} b - (\alpha + 1)(1 - l\alpha) = 0$$

with unique solution (9). b^* identifies a maximum if the graph of the parabola described by the first term in the Lagrangian is concave-down, which requires that

$$1 - l[\alpha(2 - l\alpha) + 4] < 0 \Rightarrow \alpha < \frac{1}{l} + 2\sqrt{\frac{1}{l}} \equiv \tilde{\alpha}$$

Since $\tilde{\alpha} > \overline{\alpha}$, the above condition is always satisfied if $\alpha < \overline{\alpha}$, as assumed in footnote 3. Moreover, the optimal bonus (9) is positive if $\alpha > \underline{\alpha}$, as assumed in footnote 3. Inserting the optimal bonus (9) in (7) yields the optimal coordination time

$$\tau^* = \frac{1 - l(2 + \alpha)}{1 - l[\alpha(2 - l\alpha) + 4]}$$

The numerator is positive $\forall\ l > 1$ and $\alpha > 0$. Hence, $\tau^* \in (0, 1)$ if

$$1 - l[\alpha(2 - l\alpha) + 4] > 1 - l(2 + \alpha)$$

that is, if $\alpha < \overline{\alpha}$, as assumed in footnote 3. Inserting τ^* and b^* in the worker's effort (6) gives the equilibrium effort

$$e^* = \frac{1 + l\alpha}{1 - l[\alpha(2 - l\alpha) + 4]}$$

where $e^* < 1$ if

$$1 - l[\alpha(2 - l\alpha) + 4] > 1 + l\alpha \Rightarrow \alpha < \frac{3 + \sqrt{16 + 9l}}{2l} \equiv \hat{\alpha}$$

Since $\hat{\alpha} > \overline{\alpha}$, the above condition is always satisfied if $\alpha < \overline{\alpha}$, as assumed in footnote 3. Hence, under the restrictions in footnote 3, all optimization problems are globally concave, and all solutions interior. We then prove that b^* is increasing in α and l as stated in Proposition 1. The numerator of

$$\frac{\partial b^*}{\partial \alpha} = \frac{\left(l^3 + l^2\right)\alpha^2 + \left(6l^2 - 2l\right)\alpha + 4l^2 - 3l + 1}{\left(l^2\alpha^2 - 2l\alpha - 4l + 1\right)^2}$$

defines a concave-up parabola in the (l, α) space that lies above the l axis $\forall\ l > 1$, since $4l^2 - 3l + 1 > 0\ \forall\ l > 1$. This is sufficient to prove that b^* is increasing in α. Similarly, the numerator of

$$\frac{\partial b^*}{\partial l} = \frac{(\alpha + 1)\left(\alpha^3 l^2 - 2\alpha^2 l + \alpha + 4\right)}{\left(1 + \alpha^2 l^2 - (2\alpha + 4)\right)^2}$$

defines a concave-up parabola in the (α, l) space that lies above the α axis $\forall\ \alpha > 0$. This is sufficient to prove that b^* is increasing in l. ■

A.2. Empirical appendix

See Fig. A.2.1.

Data availability

The authors do not have permission to share data.

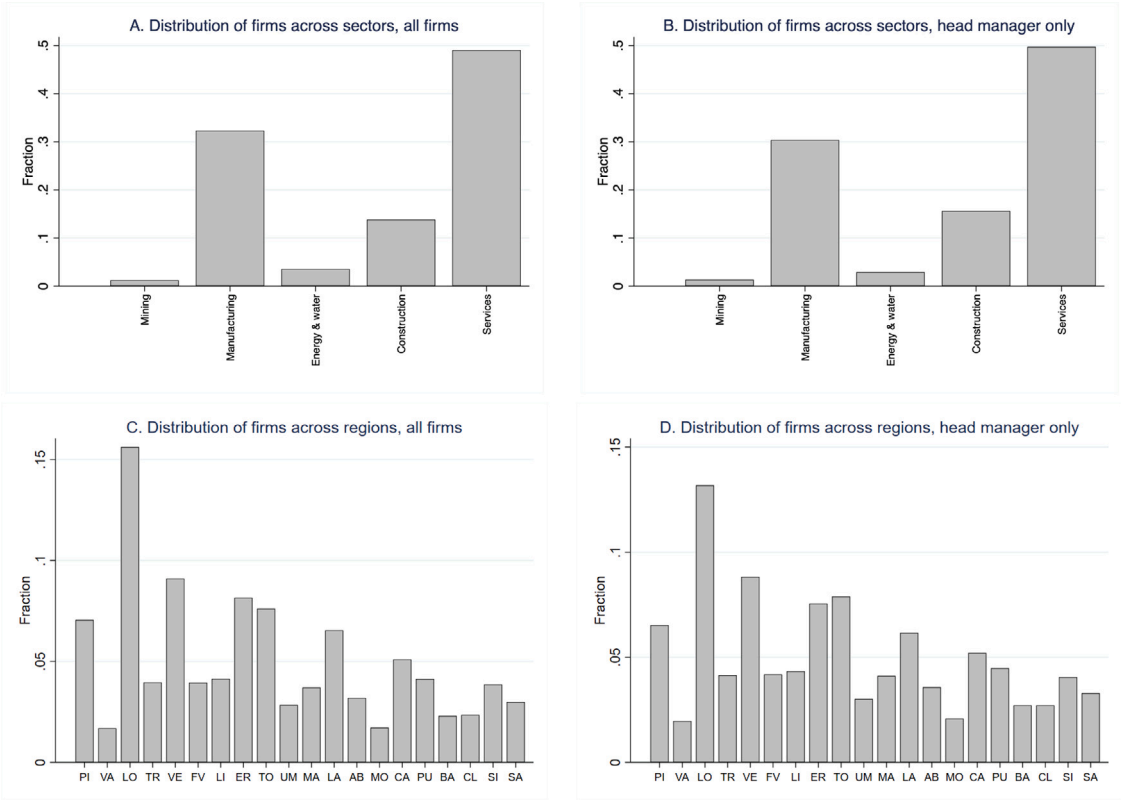

Fig. A.2.1. Distribution of firms across sectors and industry by sample composition.
Notes: Labels of regions are as follows: "PI": Piemonte; "VA": Valle D'Aosta; "LO": Lombardia; "TR": Trentino; "VE": Veneto; "FV": Friuli Venezia Giulia; "LI"; Liguria; "ER": Emilia-Romagna; "TO": Toscana; "UM": Umbria; "MA": Marche; "LA": Lazio; "AB": Abruzzo; "MO": Molise; "CA": Campania; "PU": Puglia; "BA": Basilicata; "CL": Calabria; "SI": Sicilia; "SA": Sardegna.

References

Acemoglou, D., 2024. Harms of AI. In: Bullock, J., et al. (Eds.), The Oxford Handbook of AI Governance. Oxford.

Acemoglu, D., Aghion, P., Lelarge, Claire Van Reenen, J., Zilibotti, F., 2007a. Technology, information, and the decentralization of the firm. Q. J. Econ. 122 (4), 1759–1799.

Acemoglu, D., Kremer, M., Mian, A., 2007b. Incentives in markets, firms, and governments. J. Law Econ. Organ. 23 (1), 62–82.

Andelic, N., Allan, J., Bender, K.A., Powell, D., Theodossiou, I., 2023. Performance-related pay, mental and physiological health. Ind. Relat. 63 (1), 3–25.

Autor, D.H., Levy, F., Murnane, R.J., 2003. The skill content of recent technological change: An empirical exploration. Q. J. Econ. 118 (4), 1279–1333.

Bag, P., Wang, P., 2019. Input, output or mixed monitoring in teams? J. Econ. Behav. Organ. 166, 471–492.

Barrenechea-méndez, M., Ortín-Ángel, P., Rodes, E., 2016. Autonomy and monitoring. J. Econ. Manag. Strat. 25 (4), 911–935.

Battisti, E., Torre, E.D., Gubitta, A., Paolino, C., 2023. Managerial talent and firm performance: A review and research agenda. J. Manag. Organ. 29 (1), 1–21.

Belloc, F., 2022. Profit sharing and innovation across organizational layers. J. Econ. Behav. Organ. 197, 598–623.

Belloc, F., Burdin, G., Dughera, S., Landini, F., 2023. Contested Transparency: Digital Monitoring Technologies and Worker Voice. IZA Discussion Paper No. 16362.

Benabou, R., Tirole, J., 2003. Intrinsic and extrinsic motivation. Rev. Econ. Stud. 70 (3), 489–520.

Benjamin, B., Jenny, K., 2021. Inequality and incentives with societal other-regarding preferences. J. Econ. Behav. Organ. 188, 1298–1324.

Berger, H., Neugart, M., 2011. Labour courts, nomination bias, and unemployment in Germany. Eur. J. Political Econ. 27 (4), 659–673.

Blasi, J.R., Freeman, R.B., Mackin, C., Kruse, D.L., 2010. Creating a bigger pie? The effects of employee ownership, profit sharing, and stock options on workplace performance. In: Blasi, J.R., Freeman, R.B., Kruse, D.L. (Eds.), Shared Capitalism at Work. The University of Chicago Press.

Bloom, N., Garicano, L., Sadun, R., Van Reenen, J., 2014a. The distinct effects of information technology and communication technology on firm organization. Manag. Sci. 60 (12), 2859–2885.

Bloom, N., Lemos, R., Sadun, R., Scur, D., Van Reenen, J., 2014b. The new empirical economics of management. J. Eur. Econ. Assoc. 12 (4), 835–876.

Bowles, S., 1985. The production process in a competitive economy: Walrasian, neo-Hobbesian, and Marxian models. Am. Econ. Rev. 75 (1), 16–36.

Bowles, S., 2004. Microeconomics: Behavior, Institutions, and Evolution. Princeton University Press, New York.

Brown, C., 1990. Firm's choice of method of pay. Ind. Labor Relat. Rev. 43 (3), 165S–182S.

Bryson, A., Forth, J., Stokes, L., 2012a. Does workers' pay reflect firm performance? IZA J. Labor Econ. 1 (1), 1–29.

Bryson, A., Freeman, R., Lucifora, C., Pellizzari, M., Perotin, V., 2012b. Paying for Performance: Incentive Pay Schemes and Employees' Financial Participation. CEP Discussion Paper No 1112.

Burdin, G., Halliday, S., Landini, F., 2018. The hidden benefits of abstaining from control. J. Econ. Behav. Organ. 147, 1–12.

Burdin, G., Kato, T., 2022. Complementarity in employee participation systems. In: Handbook of Labor, Human Resources and Population Economics. Springer, pp. 1–29.

Caroli, E., Van Reenen, J., 2001. Skill-biased organizational change? Evidence from a panel of British and french establishments. Q. J. Econ. 116 (4), 1449–1492.
Connelly, B., Tihanyi, L., Crook, T., Gangloff, K., 2014. Tournament theory: Thirty years of contests and competitions. J. Manag. 40 (1), 16–47.
Coviello, D., Deserrano, E., Persico, N., 2022. Minimum wage and individual worker productivity: Evidence from a large US retailer. J. Political Econ. 130 (9), 2315–2359.
Damiani, M., Pompei, F., Ricci, A., 2023. Tax breaks for incentive pay, productivity and wages: Evidence from a reform in Italy. Br. J. Ind. Relat. 61 (1), 188–213.
Danilov, A., Harbring, C., Irlenbusch, B., 2019. Helping under a combination of team and tournament incentives. J. Econ. Behav. Organ. 162 (C), 120–135.
Dur, R., Non, A., Roelfsema, H., 2010. Reciprocity and incentive pay in the workplace. J. Econ. Pshychol. 60 (30), 676–686.
Eeckhout, J., 2021. The Profit Paradox. Princeton University Press, Princeton.
Falk, A., Kosfeld, M., 2006. The hidden costs of control. Am. Econ. Rev. 96 (5), 1611–1630. http://dx.doi.org/10.1257/aer.96.5.1611.
Gáldón-Sanchez, J., Güell, M., 2003. Dismissal conflicts and unemployment. Eur. Econ. Rev. 47 (2), 323–335.
Garicano, L., 2000. Hierarchies and the organization of knowledge in production. J. Political Econ. 108 (5), 874–904.
Garicano, L., Hubbard, T.N., 2007. Managerial leverage is limited by the extent of the market: Hierarchies, specialization, and the utilization of lawyers' human capital. J. Law Econ. 50, 1–45..
Garicano, L., Hubbard, T.N., 2009. Specialization, firms and markets: The division of labor within and between law firms. J. Law Econ. Organ. 25, 339–371.
Garicano, L., Rossi-Hansberg, E., 2015. Knowledge-based hierarchies: Using organizations to understand the economy. Annu. Rev. Econ. 7 (1), 1–30.
Georgiadis, A., 2013. Efficiency wages and the economic effects of the minimum wage: Evidence from a low wage labour market. Oxf. Bull. Econ. Stat. 75 (6), 962–979.
Guadalupe, M., Wulf, J., 2010. The flattening firm and product market competition: the effect of trade liberalization on corporate hierarchies. Am. Econ. J.: Appl. Econ. 2 (4), 105–127.
Harbring, C., Irlenbusch, B., 2008. How many winners are good to have?: On tournaments with sabotage. J. Econ. Behav. Organ. 65 (3–4), 682–702.
Holmström, B., 2017. Pay for performance and beyond. Am. Econ. Rev. 107 (7), 1753–1777.
Ichino, A., Polo, M., Rettore, E., 2003. Are judges biased by labour market conditions? Eur. Econ. Rev. 47 (5), 913–944.
Jones, D., Kalmi, P., Kato, T., Makinen, M., 2017. Complementarities between employee involvement and financial participation: do institutional context, differing measures, and empirical methods matter? Ind. Labor Relat. Rev. 70 (2), 395–418.
Kato, T., Morishima, M., 2002. The productivity effects of participatory employment practices: evidence from new Japanese panel data. Ind. Relat. 41 (4), 487–520.
Kim, J., 2015. Managerial beliefs and incentive policies. J. Econ. Behav. Organ. 119, 84–95.
Laursen, K., Foss, N.J., 2013. Human resource management practices and innovation. In: The Oxford Handbook of Innovation Management. Oxford University Press, pp. 505–529.
Lazear, E.P., Shaw, K.L., 2007. Personnel economics: The economist's view of human resources. J. Econ. Perspect. 21 (4), 91–114.
Lemieux, T., Macleod, B., Parent, D., 2009. Bonus pay can be used to induce sorting of high-ability workers. performance pay and wage inequality. Q. J. Econ. 124 (1), 1–49.
Lucas, R.E., 1982. Authority, control, and the distribution of earnings. Bell J. Econ. 13, 311–323.
MacLeod, W., Malcomson, J., 1989. Implicit contracts, incentive compatibility, and involuntary unemployment. Econometrica 57, 447–480.
Ortín-Ángel, P., Salas-fumás, V., 1998. Agency-theory and internal-labor-market explanations of bonus payments: Empirical evidence from spanish firms. J. Econ. Manag. Strat. 7, 573–613.
Rajan, R.G., Wulf, J., 2006. The flattening firm: evidence from panel data on the changing nature of corporate hierarchies. Rev. Econ. Stat. 88 (4), 759–773.
Rebitzer, J., Taylor, L., 1995. The consequences of minimum wage laws: Some new theoretical ideas. J. Public Econ. 56 (2), 245–255.
Robinson, A.M., Wilson, N., 2006. Employee financial participation and productivity: An empirical reappraisal. Br. J. Ind. Relat. 44 (1), 31–50.
Rosen, S., 1978. On the size distribution of business firms. Bell J. Econ. 9, 508–523.
Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70 (1), 41–55.
Schöttner, A., Thiele, V., 2010. Promotion tournaments and individual performance pay. J. Econ. Manag. Strat. 19 (3), 699–731.
Seth, A., 2018. Agency theory. In: Augier, M., Teece, D. (Eds.), The Palgrave Encyclopedia of Strategic Management. Palgrave MacMillan.
Shapiro, C., Stiglitz, J., 1984. Equilibrium unemployment as a worker discipline device. Am. Econ. Rev. 74 (3), 433–444.
Smeets, V., Warzynski, F., 2008. Too many theories, too few facts? What the data tell us about the link between span of control, compensation and career dynamics. Labour Econ. 15, 688–704.
Smeets, V., Warzynski, F., Waldman, M., 2019. Performance, career dynamics, and span of control. J. Labor Econ. 37 (4), 1183–1213.
Tapscott, d., 2003. The Nakedamiani Corporation: How the Age of Transparency Will Revolutionize Business. Free Press, New York.
Yang, H., 2008. Efficiency wages and subjective performance pay. Econ. Inq. 46 (2), 179–196.