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Delegation and Worker Training

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Abstract: This paper models a principal-firm offering training to its agent-worker under alternative organizational structures: *integration*, where the principal retains authority to overrule the investment project recommended by the worker; and *delegation*, where the principal cannot overrule the worker's preferred investment project. We identify the conditions under which delegation increases the profit-maximizing training intensity. Empirical estimates from matched employer-employee data show that workplaces delegating authority do provide more worker training. This result persists in two cross sections, in panel fixed effect estimates and across many robustness checks including an instrumental variable exercise that also controls for establishment fixed effects.

JEL: D21, D22, D23, M53, M54
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1. Introduction

Delegation of decision making allows employers to capture the superior knowledge and information of workers. The objective functions of workers, however, may differ sharply from those of their employers. This tradeoff between enhanced information and misaligned incentives lies at the heart of a growing literature claiming that delegation and incentives are complementary – the more authority delegated to workers, the stronger must be the incentives for workers to have objectives matching their employer.

Yet, the intensity of incentives seems unlikely to be the only managerial strategy that accompanies delegation. In this paper we investigate the relationship between delegation and the provision of firm-sponsored training. We contend that training can reduce information and effort costs of workers thereby making its provision complementary to delegation. Following the presentation of our model, we conduct a series of empirical tests using linked employer-employee data. Our results confirm a large positive association between training and delegation in two representative workplace cross-sections; in fixed effect panel estimates, using alternative functional forms and in a sensible instrumental variable exercise that also controls for workplace fixed effects.

This investigation is timely, as actual firm structure has evolved from the highly centralized decision making apparent until the late 1970's to an increasingly attenuated hierarchical structure. This increased degree of delegation is relatively more evident in Scandinavian and in Anglo-Saxon countries including the United States [Aghion *et al*. (2014)]. This pattern of enhanced 'employee empowerment' and decentralization provides workers a louder voice in decision making and greater autonomy over their tasks [De Paola and Scoppa (2006)]. Empirical studies discussing the growth of delegation and its consequences include Osterman (1994), Caroli *et al*. (2001) and Rajan and Wulf (2006).

The growth in actual delegation has been matched by a recent literature on the relationship between incentives and delegation. The roots of this literature, which we summarize in the next section, run deep. Hayek (1945) provided an information and incentive-based rationale for decentralized (market) economic institutions, whereas Lange (1936, 1937) focused on the superior ability of centralized allocation to account for externalities. In his own investigation, Simon (1951) noted that decision-making within firms works best when the objectives of decision-makers closely align with those of the organization. More recently, researchers emphasize that appropriately allocating authority and providing incentives defines a key aspect of successful management that determines the success of organizations [Garicano and Rayo (2016)] and productivity differences across firms and countries [Bloom *et al*. (2012a)].

Our theoretical analysis models a principal-firm implementing an investment project with a worker-agent who assembles information on the expected payoffs for potential projects. We modify Aghion and Tirole (1997) to incorporate the firm's decision on the level of training to provide for its workforce. Our modification recognizes that assembling information requires costly effort by the agent and that this cost can be reduced through the provision of firm-sponsored training. We compare the firm's profit-maximizing training intensity under two alternative authority structures: *integration*, where the principal retains the ability to overrule the investment project recommended by the worker; and *delegation*, where the principal cannot overrule the worker's preferred investment project.

Our model predicts greater training under delegation for sufficiently high congruence between the preferences of the principal and the agent. When the principal benefits similarly from the agent's preferred project and the principal's preferred project, additional training causes the worker to exert sufficiently greater effort under delegation. This increased effort justifies the expense of additional training.

We test this prediction using two large British nationally representative matched employer-employee cross sections and an associated panel. Our main measure of delegation aggregates employee responses within workplaces to identify workers' influence over their tasks. Those establishments that delegate and those with workers greatly influencing their own tasks, offer more training. This persists across a variety of specifications, alternative sample restrictions and using alternative definitions of delegation. It also persists in establishment fixed effect estimates, under alternative functional forms and in reasonable instrumental variable estimates that also control for fixed effects. The empirical relationship between delegation and training appears remarkably durable.

The paper is set out as follows: Section 2 sets our study in the context of related literature. Section 3 provides the theoretical framework and identifies the conditions under which delegation increases training. Section 4 discusses the data and empirical methodology. Section 5 presents empirical results. Section 6 concludes and gives suggestions for further research.

2. Related Literature

We briefly review the theoretical and empirical work surrounding the Aghion and Tirole (1997) hypothesis that delegation and incentives go hand in hand. We argue that their model is a sensible framework for examining the question that interests us - the relationship between delegation and employer-provided training.

Theoretical work typically views the choice of delegation in terms of information and control. Delegation allows a principal to access an agent's superior information but with the risk that the agent's objectives differ from those of the principal. This tradeoff exists because the agent will not fully communicate private information when the principal retains authority. This results either because of high communication costs stemming from bounded rationality

[Jensen and Meckling (1992)] or because of the agent's strategic use of the information [Holmstrom (1977, 1984)].

Grossman and Hart (1986) enhanced the early work on control and information by recognizing that while decision rights are conferred by asset ownership, incomplete contracting engenders a trade-off between integration and non-integration. Since bargaining power increases with asset ownership, an independent supplier will generally be more motivated than an integrated supplier to undertake non-contractible relation-specific investments.[1] Aghion and Tirole (1997) – hereafter AT – build upon Grossman and Hart (1986) by recognizing that the provision of information can be a critical non-contractible relation-specific investment.

AT model a hierarchical relationship between a principal-firm and an agent-worker who together implement a single investment project. The firm tasks the worker with assembling information regarding the expected payoffs across an array of potential projects. The firm chooses from two alternative organizational structures: *integration*, whereby the firm maintains formal authority over investment decisions and can ignore the worker's recommendation as to the 'best' investment project; and *delegation*, whereby the worker selects a particular project and cannot be overruled by the firm. AT show that delegating authority to the worker encourages the latter to increase effort into ascertaining which project should be implemented. However, this higher effort comes at a price since it can be achieved only with a loss of control and the increased likelihood that the chosen scheme will not maximize the employer's payoff.

Baker *et al*. (1999) sets AT's analysis within a repeated game framework arguing that delegation can only be informal, since the principal always retains the legal ability to overturn the agent's decision. Yet, informal delegation can remain in equilibrium as

[1] See Woodruff (2002), Baker and Hubbard (2003) and Acemoglu *et al*. (2010) for empirical support of this prediction.

reputational issues arise on both sides. The principal wants to ensure that delegation is credible and the agent wants to maintain the principal's faith in his ability to select 'good' projects. In a similar vein, Hart and Holmstrom (2010) stress that delegation will also remain if overturning an agent's decision comes with the cost of agents taking unobservable actions that damage the firm. Further, Bolton and Dewatripont (2013) isolate a series of financial contracts in which delegation can actually be legally formal. In sum, it may be reasonable to anticipate delegation to persist despite the typical ability of the principal to reverse such a decision.

Zabojnik (2002) shows that it may be less costly to motivate an agent to work on his own project rather than on the principal's project. Intuitively, if the agent believes that the principal's project has a low probability of success, there exists little incentive to supply effort and a strong and expensive incentive contract will be required. Thus, it may be optimal to delegate decision-making to the worker even if the manager is *better* informed. In a similar vein, De Paola and Scoppa (2006) suggest an AT framework where the principal cannot observe the agent's effort and is compelled to adopt performance-related pay to induce agent effort, tying the latter's remuneration to the gross return from the implemented project. The introduction of such a payment scheme requires compensating for the agent's limited liability, risk aversion and the possible financial consequences incurred by the agent whose advice is not followed by the principal. This compensation introduces another cost to retaining authority, again suggesting a greater likelihood of delegation.

Dessein (2002) suggests a modeling framework where the agent does not make any effort investment in assembling information but simply has private information on projects' payoffs. If the principal retains authority, the agent engages in a pattern of strategically noisy communication. Thus, the principal faces a trade-off between making the decision based on the agent's noisy signal and delegating authority to the agent who has perfect information but

incongruent objectives. For a broad range of parameters, the loss of control implied by delegation proves less costly for the principal than the loss of information under centralization. As a potential illustration, Aoki (1986) argues that delegation to workers is particularly valuable in times of uncertainty when a rapid and agile response to change is most critical. It could be precisely in these circumstances that an agent's strategic transmission of information may be particularly noisy. In such a case Dessein (2002) would argue that the cost of retaining authority is not the reduction of the agent's incentive to acquire information (as in AT) but simply a large distortion and loss of information due to the introduction of noise in the signal sent by the agent.

Stein (2002) shows that delegation dominates when information is not verifiable ('soft'). The agent has a greater incentive to search for soft information because of the confidence that this effort will bear fruit. In contrast, without delegation the agent knows that the principal may reject his recommendation, thus rendering the gathered information useless. Bester and Krahmer (2008) provide a further variation on AT by modeling a situation where the agent's job is to complete rather than to identify a project. Thus, the effort choice occurs *after* identifying a project. The principal now anticipates that effort is positively associated with the agent's private benefit, implying that the choice of project is affected by the agent's preferences even when the principal maintains authority. This makes delegation less attractive.

A substantial body of empirical research tests the AT hypothesis of a positive relationship between delegation and incentives. Aghion *et al.* (2014) summarize the evidence suggesting that the congruence of preferences (as proxied by trust) helps to account for delegation. Such congruence might also follow from the use of explicit incentives, thus potentially explaining Nagar's (2002) empirical finding of a significant positive correlation between the extent of incentive-based payment for bank managers and their degree of

autonomy (a proxy for delegation). Colombo and Delmastro (2004) find that plant managers in Italian metalworking are more likely to be delegated authority when monetary incentives are introduced. Wulf (2007) finds that division managers who are corporate officers (e.g. presidents, vice presidents and chief financial officers) are more likely to have their pay tied to both indigenous performance measures (such as division sales) and global performance measures (such as firm sales) than their non-officer counterparts.

MacLeod and Parent (1999) find that US workers paid piece rates and commissions have less job autonomy to perform a task from beginning to end but perform a greater number of tasks. Itoh *et al*. (2008) empirically show that delegation from core to affiliated Japanese firms is positively correlated with incentives for accountability. Cross sectional studies of Danish [Foss and Laursen (2005)] and British [De Varo and Kurtulus (2010)] establishments find a positive relationship between delegation to workers and incentives.

De Varo and Prasad (2015) highlight that incentive pay may induce risk averse agents to work harder but select sub-optimal tasks if the performance signal is noisy. For example, surgeons may not operate on high-risk patients and academics may pursue 'safe' research strategies. They test this tradeoff between inducing effort and selecting tasks by comparing 'complex' jobs (where task selection is valuable, as in the previous examples) and 'simple' jobs (where task selection is less valuable and effort is more easily measured). They show that delegation and incentives are positively correlated for simple jobs but *negatively* correlated for complex jobs.

More generally, delegation may be critical for firm success. Bloom *et al*. (2012b) use a sample of manufacturing firms across countries to show that the failure to delegate authority (often resulting from lack of trust) impedes firm growth. Boedker *et al*. (2011) find that of 32 management practices, delegation has the highest correlation with their 'High Performing Workplace Index' built up from financial performance, customer focus,

innovation and employee experience.

In what follows, we extend the AT modeling framework by recognizing that employer-provided training reduces the agent's effort cost of assembling information about projects' payoffs. We identify the conditions under which delegation increases training and show that this positive relationship need not always hold, thus motivating our empirical testing.

We use matched employer-employee data to estimate the determinants of firm-sponsored training. Such estimates are not uncommon but frequently focus on the role of competition in labor and product markets [Acemoglu and Pischke (1998, 1999), Manning (2003)].[2] In this framework, Brunello and Gambarotto (2007) confirm that employers provide less training in more competitive labor markets, whereas Bilanakos *et al.* (2016) find that a dominant product market position strengthens the incentives of firms to invest in training. While recognizing this previous work in our estimates, we will test whether the delegation of decision-making authority plays an independent role in an establishment's choice of training intensity.

3. Theoretical Model

3.1 Setup

We consider a principal-owner, P, and an agent-employee, A, who either implement a single investment project or choose to do nothing. P tasks A with collecting information about the payoffs of $n > 3$ possible and a priori ostensibly identical projects. The principal's gross profit associated with each project $k \in \{1,2,...,n\}$ is B_k and the agent's corresponding private benefit (which may include on-the-job perks or the possibility of signaling his ability) is b_k. These payoffs do not take into account any wage payments from P to A. The case where P

[2] For empirical evidence on the determinants of firm-sponsored general training see, for example, Katz and Ziderman (1990), Krueger (1993), Acemoglu and Pischke (1998) and Booth and Bryan (2005).

and A do nothing is summarized in a 'project zero' yielding payoffs $B_0 = b_0 = 0$.[3] The principal reaps $B>0$ from her preferred project while the agent reaps $b>0$ from his own preferred project. The agent's benefit from *P*'s preferred project is βb and the principal's profit from *A*'s preferred project is αB, where $\alpha, \beta \in (0,1]$ are exogenous congruence parameters.

The principal chooses training level *I* to provide the agent. The training cost incurred by P is $c(I)$ with $c'(0)=0$, $c'(I)>0$ and $c''(I)>0$ for $I>0$. Both the principal and the agent begin unaware of the payoffs from the various projects. P acquires perfect information about the payoffs of all projects with exogenous probability *E* but remains ignorant with probability *1 – E*. A chooses effort *e* devoted to acquiring information about the projects' payoffs and becomes perfectly informed with probability *e* but learns nothing with probability *1 – e*. We assume that training reduces the agent's marginal effort cost as captured in the effort cost function $g(e,I)$ with $\partial g/\partial e>0$, $\partial^2 g/\partial e^2>0$, $\partial g/\partial I<0$ and $\partial^2 g/\partial e \partial I<0$.

In order to focus on the role of delegation in P's training decisions, we suppress the labor market by setting the agent's wage to zero. This could reflect that A is infinitely averse to income risk and thus receives a constant wage equal to his reservation wage which is normalized to zero. We follow AT by considering integration (*n*) and delegation (*d*). Under integration, P can overrule A's recommendation and, if informed, adopt her preferred project. Under delegation, P cannot overrule A's recommendation and optimally accepts it since $\alpha>0$. Of course, an uninformed agent will accept P's proposal (if any) given that $\beta>0$. Since the projects cannot be contracted upon ex ante, the model follows Grossman and Hart's (1986)

[3] We also assume that for each party there exists at least one project generating a loss of such magnitude that both P and A prefer inaction to implementing a random project in the absence of information about payoffs.

incomplete contracting approach. Specifically, the initial contract allocates formal authority to either P or A and the overall sequence of actions is described in Figure 1.

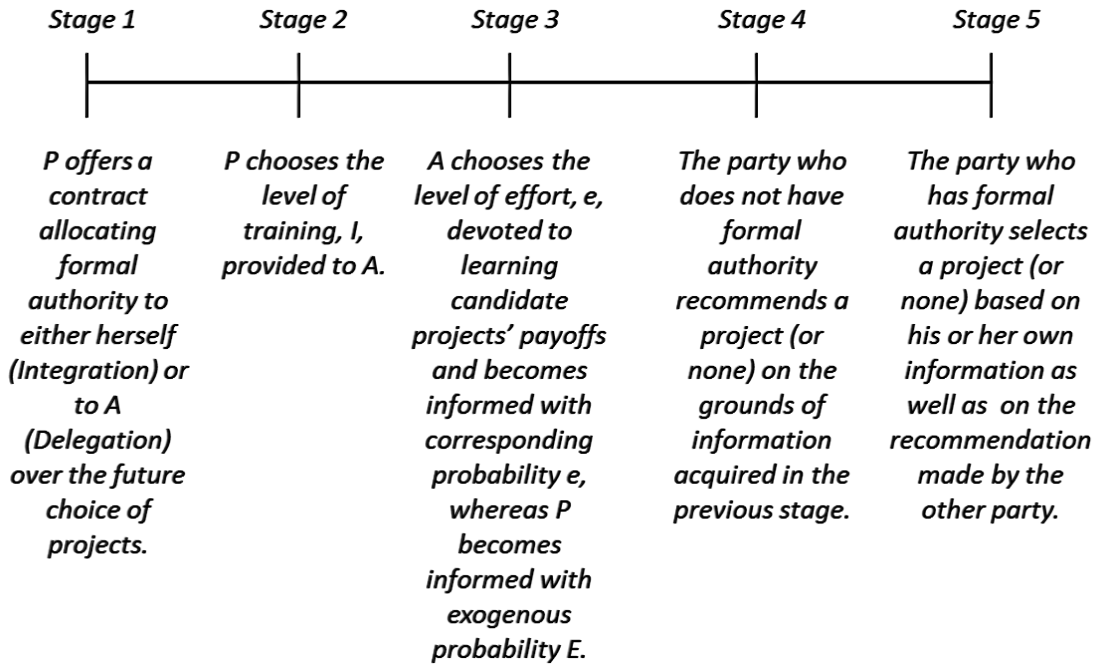

Figure 1. *Time sequence of actions.*

Under integration, the payoffs of P and A, u_P^n and u_A^n respectively, are given by:

$$u_P^n = E \cdot B + (1-E)e \cdot aB - c(I) \tag{1}$$

$$u_A^n = E \cdot \beta b + (1-E)e \cdot b - g(e,I) \tag{2}$$

The payoffs associated with delegation are:

$$u_P^d = e \cdot aB + (1-e)E \cdot B - c(I) \tag{3}$$

$$u_A^d = e \cdot b + (1-e)E \cdot \beta b - g(e,I) \tag{4}$$

3.2 Equilibrium

The model is solved recursively under each authority structure (integration and delegation). In both cases, we first characterize A's optimal effort given the training level. Then, we move back to identify the profit-maximizing training level anticipating the worker's optimal effort.

Case 1: Integration

Under integration, the agent's effort level results from the solution of the following optimization problem:

$$\max_{\{e\}} u_A^n = E\cdot\beta b+(1-E)e\cdot b-g(e,I) \text{ s.t. } 0\le e\le 1$$

We focus on the interior solution now and discuss boundary solutions later. The first-order condition for maximization is:

$$\partial u_A^n/\partial e=(1-E)b-(\partial g/\partial e)=0 \quad (5)$$

The second-order condition $\partial^2 u_A^n/\partial e^2=-\partial^2 g/\partial e^2\le 0$ is always satisfied by assumption. Therefore, (5) yields A's utility-maximizing effort function $e^*(I;b,E)$. From Varian (1992, pp. 490-1) we know that the signs of $\partial e^*/\partial b$ and $\partial e^*/\partial E$ are the same as the signs of $\partial^2 u_A^n/\partial e\partial b$ and $\partial^2 u_A^n/\partial e\partial E$, respectively (under the second-order condition). Since $\partial^2 u_A^n/\partial e\partial b=1-E>0$ and $\partial^2 u_A^n/\partial e\partial E=-b<0$, we conclude that $\partial e^*/\partial b>0$ and $\partial e^*/\partial E<0$. The agent contributes more effort when his private benefit is higher and the probability that P becomes informed is lower. The impact of training on effort follows from the optimal choice function $e^*(I)$ which must satisfy the condition:

$$\partial u_A^n(e^*(I),I)/\partial e=0 \quad (6)$$

Differentiating both sides of (6) implies:

$$\left(\partial^2 u_A^n / \partial e^2\big|_{e=e^*}\right)\cdot\left(\partial e^* / \partial I\right)+\left(\partial^2 u_A^n / \partial e \partial I\big|_{e=e^*}\right)=0 \tag{7}$$

Solving for $\partial e^* / \partial I$, we get:

$$\frac{\partial e^*}{\partial I}=-\frac{\left(\partial^2 u_A^n / \partial e \partial I\big|_{e=e^*}\right)}{\left(\partial^2 u_A^n / \partial e^2\big|_{e=e^*}\right)}=-\frac{\left(\partial^2 g / \partial e \partial I\big|_{e=e^*}\right)}{\left(\partial^2 g / \partial e^2\big|_{e=e^*}\right)} \tag{8}$$

which is positive from the assumptions $\partial^2 g / \partial e^2 > 0$ and $\partial^2 g / \partial e \partial I < 0$. Intuitively, an increase in training induces A to work harder by reducing his marginal cost of effort.

The principal anticipates $e^*(I)$ and chooses the training level, I^n, that solves her profit-maximization problem:

$$\max_{\{I\geq 0\}} u_p^n = E\cdot B+(1-E)e^*(I)\cdot aB-c(I)$$

Assuming an interior solution, the first-order condition for maximization is:

$$\partial u_P^n / \partial I=(1-E)\cdot\left(\partial e^* / \partial I\right)\cdot aB-c'(I^n)=0 \tag{9}$$

In words, the equilibrium level of training under integration is determined by equating the marginal training cost with the principal's marginal benefit associated with the positive impact of training on A's effort incentives. Substituting the solution, I^n, into the function $e^*(I)$ yields the equilibrium level of effort, e^n, for the case of integration.

Case 2: Delegation

When formal authority is delegated to A, the latter's utility-maximization problem becomes:

$$\max_{\{e\}} u_A^d = e\cdot b+(1-e)E\cdot\beta b-g(e,I)\ \ s.t.\ 0\leq e\leq 1$$

The first-order condition for maximization is now written as:

$$\partial u_A^d / \partial e = (1-\beta E)b - (\partial g / \partial e) = 0 \tag{10}$$

Under the second-order condition, (10) yields the optimal effort function $\hat{e}(I;\beta,E,b)$. As before, we have $\partial \hat{e} / \partial b > 0$ and $\partial \hat{e} / \partial E < 0$. It easily follows that $\partial \hat{e} / \partial \beta < 0$ since a higher β increases A's payoff from implementing P's preferred project and so dampens A's incentive to become informed himself. The impact of training on effort is again positive and given by:

$$\frac{\partial \hat{e}}{\partial I} = -\frac{\left(\partial^2 u_A^d / \partial e \partial I|_{e=\hat{e}}\right)}{\left(\partial^2 u_A^d / \partial e^2|_{e=\hat{e}}\right)} = -\frac{\left(\partial^2 g / \partial e \partial I|_{e=\hat{e}}\right)}{\left(\partial^2 g / \partial e^2|_{e=\hat{e}}\right)} \tag{11}$$

The comparison of optimal effort levels e^* and $\hat{e}$ rests on the following observation:

$$\partial u_A^d / \partial e|_{e=e^*} = (1-\beta E)b - \partial g / \partial e|_{e=e^*} = (1-\beta E)b - (1-E)b > 0 \tag{12}$$

This implies that $\hat{e}(I) > e^*(I)$. Given the training level, A faces the same marginal cost of effort under each authority structure but reaps a higher marginal benefit under delegation (since $(1-\beta E)b > (1-E)b$) and thus has stronger effort incentives in this case.

Anticipating the new optimal choice $\hat{e}(I)$, P now selects the training intensity, I^d, to solve the following problem:

$$\max_{\{I \geq 0\}} u_p^d = \hat{e}(I) \cdot aB + (1-\hat{e}(I)) \cdot E \cdot B - c(I)$$

The first-order condition for maximization now takes the form:

$$\partial u_P^d / \partial I = \left(\partial \hat{e} / \partial I\right) \cdot aB - \left(\partial \hat{e} / \partial I\right) \cdot EB - c'(I^d) = \left(a-E\right)B \cdot \left(\partial \hat{e} / \partial I\right) - c'(I^d) = 0 \tag{13}$$

The term $(\partial\hat{e}/\partial I)\cdot aB$ represents P's marginal benefit from training due to fostering A's effort incentives. Yet, the term $(\partial\hat{e}/\partial I)\cdot EB$ represents a marginal cost associated with the reduced likelihood that P receives *B* from her own preferred project. Finally, the term $c'(I^d)$ is simply the marginal training cost. If $E \geq a$, we get $\partial u_P^d/\partial I < 0$ and P does not have an incentive to provide training at all. If $E < a$, then I^d is strictly positive under the assumption $c'(0)=0$ and can be determined by solving (13). The equilibrium effort level, e^d, under delegation results from substituting I^d back into the choice function $\hat{e}(I)$.

3.3 The Impact of Delegation on Training Intensity

The equilibrium training intensity under delegation will be higher than under integration if $\partial u_P^d/\partial I|_{I=I^n} > 0$, where:

$$\partial u_P^d/\partial I|_{I=I^n} = (a-E)B\cdot\partial\hat{e}/\partial I|_{I=I^n} - c'(I^n) = (a-E)B\cdot\partial\hat{e}/\partial I|_{I=I^n} - (1-E)aB\cdot\partial e^*/\partial I|_{I=I^n} \quad (14)$$

The last equality makes use of (9) and the resulting expression in (14) has a positive sign if:

$$\frac{\partial\hat{e}/\partial I|_{I=I^n}}{\partial e^*/\partial I|_{I=I^n}} > \frac{a(1-E)}{a-E} \quad (15)$$

Since the right-hand side of (15) exceeds one, P will train more under delegation if the positive impact of training on effort in this case is sufficiently larger than that under integration. To illustrate and gain further insight, we parameterize the model to generate a closed-form solution. Consider the training cost function $c(I)=\theta I^2/2$ and the effort cost function $g(e,I)=\rho e^2/2I$ (with $\theta>0$ and $\rho>0$), implying that the agent's marginal effort cost of being informed $(\rho e/I)$ decreases with training. Then, A's optimal effort choice given the level of training under integration is given by:

$$e^*(I)=\min\left\{\frac{(1-E)bI}{\rho},1\right\} \tag{16}$$

Solving P's profit-maximization problem yields the equilibrium training intensity, I^n, which is then substituted back into (16) to get the equilibrium effort level, e^n, implying:

$$\left(I^n,e^n\right)=\begin{cases}\left(\frac{\rho}{(1-E)b},1\right), \text{if } \theta\le\theta^*\equiv\frac{(1-E)^3aBb^2}{\rho^2}\\ \left(\frac{(1-E)^2aBb}{\theta\rho},\frac{(1-E)^3aBb^2}{\theta\rho^2}\right), \text{if } \theta\ge\theta^*\end{cases} \tag{17}$$

Similarly, we compute A's optimal effort function under delegation:

$$\hat{e}(I)=\min\left\{\frac{(1-\beta E)bI}{\rho},1\right\} \tag{18}$$

A straightforward comparison of (16) and (18) shows that, given the level of training, A provides more effort under delegation ($\hat{e}\ge e^*$) and that the positive impact of training on effort is greater under delegation ($\partial\hat{e}/\partial I\ge\partial e^*/\partial I$). As already said, P does not train ($I^d=0$) when $E\ge a$ and, for the current illustration, A responds by providing no effort ($e^d=0$). If $E\le a$, the equilibrium levels of training and effort under delegation are:

$$\left(I^d,e^d\right)=\begin{cases}\left(\frac{\rho}{(1-\beta E)b},1\right), \text{if } \theta\le\hat{\theta}\equiv\frac{(a-E)(1-\beta E)^2Bb^2}{\rho^2}\\ \left(\frac{(a-E)(1-\beta E)Bb}{\theta\rho},\frac{(a-E)(1-\beta E)^2Bb^2}{\theta\rho^2}\right), \text{if } \theta\ge\hat{\theta}\end{cases} \tag{19}$$

We assume $\theta\ge\max\{\theta^*,\hat{\theta}\}$ to focus on the interior solutions. Then, the equilibrium outcomes under integration and delegation can be summarized as:

$$\left(I^n, e^n\right) = \left(\frac{(1-E)^2 \alpha B b}{\theta \rho}, \frac{(1-E)^3 \alpha B b^2}{\theta \rho^2}\right) \tag{20}$$

$$\left(I^d, e^d\right) = \begin{cases} (0,0) \text{ , if } a \leq E \\ \left(\frac{(a-E)(1-\beta E) B b}{\theta \rho}, \frac{(a-E)(1-\beta E)^2 B b^2}{\theta \rho^2}\right), \text{if } a \geq E \end{cases} \tag{21}$$

The training and effort intensities derived in (20) and (21) can now be directly compared.

Proposition. *When formal authority is delegated, the equilibrium training and effort intensity can be either higher or lower than under integration. In particular:*

(i) $I^d < I^n$ *for all* $a \in (0, \hat{a})$ *and* $I^d > I^n$ *for all* $a \in (\hat{a}, 1]$

(ii) $e^d < e^n$ *for all* $a \in (0, \tilde{a})$ *and* $e^d > e^n$ *for all* $a \in (\tilde{a}, 1]$

where $0 < \tilde{a} \equiv \frac{E(1-\beta E)^2}{(1-\beta E)^2 - (1-E)^3} < \hat{a} \equiv \frac{E(1-\beta E)}{(1-\beta E) - (1-E)^2} < 1$

In general, when the congruence parameter α is sufficiently high – i.e. if the principal's benefit (αB) from the implementation of A's preferred project is close enough to the benefit (B) she reaps from the implementation of her own preferred project – P may face stronger training incentives under delegation and A may respond by providing a greater amount of effort. Since the threshold values are such that $\hat{a} > \tilde{a}$, however, we can also identify a parameter interval $[\tilde{a}, \hat{a}]$ where P provides relatively less training but A has stronger effort incentives under delegation.

The relationship between I^d and I^n is graphically depicted in the top panel of Figure 2 and the relationship between e^d and e^n is shown in the bottom panel of Figure 2. From (20) and (21) we get $\partial I^d / \partial a = B b (1-\beta E) / \theta \rho > \partial I^n / \partial a = B b (1-E)^2 / \theta \rho$ and $\partial e^d / \partial a = B b^2 (1-\beta E)^2 / \theta \rho^2 > \partial e^n / \partial a = B b^2 (1-E)^3 / \theta \rho^2$, implying that the positive impact of a higher congruence parameter α on training and effort is stronger under delegation than

under integration. Therefore, the curves $I^d(a)$ and $e^d(a)$ are steeper than $I^n(a)$ and $e^n(a)$ and the training and effort intensities under delegation exceed these under integration beyond the threshold congruence levels $\hat{a}$ and $\tilde{a}$, respectively. More generally, Figure 2 makes clear that the impact of delegation on training is ambiguous and depends on the critical congruence parameter, thus fueling our empirical estimates to identify the dominant empirical pattern.

4. Data and Empirical Methodology

In what follows we first detail our data and then present our methodology for examining the influence of delegation on the extent of establishment training. We stress the potential difficulties introduced by using linked data and the need to hold constant unmeasured establishment specific influences. We also emphasize the need to account for potential endogeneity and to rule out reverse causation.

4.1 WERS Data

We draw data from the 2004 and 2011 Workplace Employment Relations Survey. The survey randomly selected UK workplaces with five or more employees from the Interdepartmental Business Register, considered to be the highest quality available sampling frame. A smaller panel exists of establishments responding in both waves. The sampling stratifies by workplace size and industry with larger workplaces and some industries overrepresented [Chaplin *et al*. (2005)]. As a consequence, all estimates we present use workplace weights[4] (separate weights exist for each cross-section and the panel) to ensure that the resulting statistics reflect a nationally representative sample of British workplaces. The sampling weights adjust for a number of factors influencing the probability of selection, and the stratification by workplace size and industry [see Kersley *et al*. (2006)]. We exclude

[4] We have experimented with employee weights and the results remain robust.

establishments not in the trading sector (government and non-profit establishments) and those missing data on the critical dependent variable measuring training.

Nearly all data, including the training measure, come from the 'Management Questionnaire,' a face-to-face interview with the most senior manager with day-to-day responsibility for personnel matters. We rely, however, on the linked 'Employee Questionnaire' for our preferred delegation measure as described below. The response rates for 2004 and 2011 were 64% and 46% yielding 2295 and 2680 establishments respectively. Response rates are decreasing through time reflecting prevailing trends in business surveys [see van Wanrooy *et al*. (2013)].[5] After our restrictions, the resulting sample sizes are 994 in 2004, 1012 in 2011 and 474 in the panel.

Managers indicate the share of employees formally trained. The specific question asks (*COFFJOB*) "*What proportion of experienced people in the largest non-managerial occupational group have been given time from their normal daily duties to undertake training over the past 12 months.*" The responses include *None* (0%), *Just a few* (1-19%), *Some* (20-39%), *Around half* (40-59%), *Most* (60-79%), *Almost all* (80-99%) and *All* (100%). Table 1 provides the distribution of responses showing that around twenty four percent of the establishments trained none of their employees in 2004. This fell to nineteen percent in 2011 and was seventeen percent in the panel. About thirty percent of the establishments trained all employees in 2004. This increased to thirty-five percent in 2011 and was about thirty percent in the panel sample.

<< Table 1 around here>>

Our preferred delegation measure (we will examine alternatives) comes from the employee questionnaire. At each establishment up to 25 employees are randomly selected (every employee is questioned at establishments with less than 25) and asked "*In general, how much*

[5] The response rates of the employee questionnaire for 2004 and 2011 were 60% and 54% yielding 22451 and 21981 employees respectively.

influence do you have about the range of tasks you do in your job?" Responses are recorded on a four-point scale: 1 '*None*', 2 '*A little*', 3 '*Some*' 4 '*A lot*'. Following De Varo and Kurtulus (2010), we identify delegation as present when the modal response across an establishment's workers is '*A lot*' and absent when the modal response is '*Some*', '*A little*' and '*None*'. Thus, we take the most frequently occurring worker response to reflect the degree of *delegation* in that workplace.[6]

While this measure is subjective, it has been shown to provide a reasonable proxy for delegation to workers [see De Varo and Prasad (2015) and De Varo and Kurtulus (2010)]. Yet, it differs in critical ways from other measures of delegation. First, it need not reflect the decision of actual firm owners. While the WERS includes some owner managed establishments, most are not managed by owners. Thus, the delegation we observe may be from managers to workers, a point we return to in our robustness exercises. Second, it differs from measures that examine multi-plant firms to determine if decisions are made centrally or at the plant level [Meagher and Wait (2014)]. Despite these differences, it is appropriate for thinking about the provision of training. We need to determine whether or not delegating latitude and influence to workers increases the incentive for the firm to provide training.

Table 2 shows that the distribution of delegation responses displays significant variation across workplaces and over time. About one out of three workplaces delegated in 2004 while forty nine percent delegated in 2011 and almost forty percent delegated in the panel.

<< Table 2 around here>>

[6] We experimented with the mean and the median of this measure and results remain robust.

4.2 *Empirical Methodology*

We initially estimate a series of ordered probits in which the categorical measure of training depends on delegation. We begin with cross sectional estimates for each of the two years, using an increasingly complete set of covariates.[7] Since our delegation measure is built up from the separate employee questionnaire, we face a typical generated regressor problem [Pagan (1984), Murphy and Topel (1985)]. In response, we bootstrap the data using 1000 replications with replacement and report only bootstrapped standard errors for every estimate presented in the paper using the preferred delegation measure.

We first present the ordered probit of training against the delegation measure and a limited set of controls. We recognize that fixed costs in establishing training imply that larger organizations provide additional training more efficiently [Black *et al.* (1999), Barron *et al*. (1987), Booth (1991), Holtmann and Idson (1991)]. Moreover, such training programs may take time to develop and may reflect the permanence and scope of the establishment. Thus, we control for the (log) number of employees, if the workplace has been operating more than five years, whether the workplace is part of a larger organization (i.e. multi-workplace), or a single independent workplace (omitted category, sole UK workplace of a foreign organization).

In the second estimate, we add variables that capture workforce characteristics previously shown to influence training provision. These include the percentage of employees using computers, the percentage of female employees [Green and Zanchi (1997)], the percentage of part-time employees, and of trade union members [Boheim and Booth (2004), Green *et al*. (1999)]. Recognizing the connection between the incentive to train and the extent of labour mobility [Arulampalam and Booth (1998)], we control for the percentages of employees with a fixed term contract, of temporary agency employees, and of employees

[7]Appendix Table A1 reports the descriptive statistics of all variables used in the analysis.

who separate and quit in the previous year. We also add controls for the educational attainment of the workforce, the share of the workforce in each of eight occupational groups and include seven dummies identifying the largest non-managerial occupational group.

In a third estimate we capture variation of training across industries and regions by adding ten industry dummies and nine region dummies. The fourth estimate adds variables identified as theoretically important [see Bilanakos *et al.* (2016)] and represents our most complete set of controls. These additions are three indicators of performance pay (whether or not the establishment offers non-managerial workers payment by result, merit pay, profit related pay or share ownership schemes), the extent of competition in the product market (few competitors or many competitors) and indicators of change for the product market (growing, mature, declining). While Bilanakos *et al.* (2016) present UK evidence that dominant firms do more training, Meagher and Wait (2014) present Australian evidence that delegation itself is associated with more competitive product markets. Thus, while initially controlling for these critical variables, we ultimately tackle the implied concern with the endogeneity of delegation.

For comparison purposes we estimate our most complete specification using an OLS that treats training as a cardinal count value from 1 to 7. We do this both to get a quick estimate of the associated magnitudes and, more importantly, to set the stage for estimates that necessarily rely on linear estimates as the ordered probit becomes inappropriate.

The first of these estimates recognizes that there may be unmeasured invariant establishment characteristics that influence both the extent of training and delegation. Thus, superior management may both train and delegate. Our inability to control for management quality would bias the results from the cross-sections. We respond by estimating a series of establishment fixed effect models. These use the repeated observations in the panel to examine how the change in delegation influences changes in training. The resulting within

establishment variation eliminates the influence of all unmeasured time invariant determinants of training allowing a superior estimate of the role of delegation.

While the fixed-effect ordered probit holds constant time invariant establishment characteristics, it necessarily suffers from the incidental parameter problem associated with many nonlinear estimates [see Greene (2001)]. Thus, we supplement it with an OLS fixed effect estimate and a Poisson fixed effect estimate neither of which suffers from this problem [Hilbe and Greene (2008)]. We show the results across the estimates remain very similar.

We next recognize that while fixed effect estimates are an improvement, they do not eliminate the possibility of endogeneity or reverse causation. Thus, superior management may be new to the establishment generating a spurious correlation even in the fixed effect estimates. Moreover, training may determine delegation reversing the causation we have suggested. Thus, it could be that only once an establishment has trained its workforce will it have trust in its ability to meaningfully delegate authority. Accounting for such fears of endogeneity and reverse causation requires an instrumental variable strategy. We adopt a strategy based on industrial aggregation [Fisman and Svensson (2007), Lai and Ng (2014)] which we will describe in detail when presenting the results. We implement this both for the two cross-sectional estimates and for the fixed effect estimates in the panel. The available diagnostics seem reassuring and both the cross-section and the fixed effect results confirm the strong role for delegation in influencing training.

5. Empirical Results

5.1 *Ordered Probit Analysis*

The first column of Table 3 presents the initial estimate of the determinants of the extent of training in 2004. It reveals that the coefficient of employee delegation is positive and statistically significant fitting the contention that employee delegation increases the extent of

training. It also shows the traditional result that larger establishments do more training. Column 2 adds workforce characteristics indicating that when establishments have a larger share of females and their employees working with computers, in unions and working full-time, they do more training. It also shows that the magnitude of the estimated coefficient of delegation increases and becomes significant at the one percent level. Column 3 shows that the magnitude of the coefficient on delegation increases again after allowing the extent of training to differ across industries and regions. Finally, column 4 shows that dominant firms train more [see Bilanakos *et al*. (2016)] and that firms providing profit related pay train more. It also reveals that worker mobility is associated with less training. The coefficient on delegation retains size and significance. Across these specifications there exists no indication that more complete specifications reduce the role of delegation.

<<Table 3, around here>>

Column 5 provides estimates from the OLS model confirming the role of the controls and a positive and significant coefficient on delegation. The coefficient suggests that delegation is associated with an increase of 0.42 of a training category in the cardinal scale. As mentioned, we report the OLS estimates in order to make comparisons with the two stage least squares regressions we report later on.

In Table 4 we reproduce the series of estimates using the 2011 cross-section. The pattern of the controls and the size and significance of the delegation coefficient remain remarkably similar. Again, in column 5 we present an OLS estimate which here indicates that delegation is associated with an increase of 0.49 of a training category.

<<Table 4, around here>>

In Table 5 we report the full marginal effects of delegation from the final ordered probit estimates. Column 1 indicates that in 2004 delegation is associated with a decrease of 0.039 in the probability of offering no training, and an increase of 0.077 in the probability of

training all the workers. Column 2 indicates that in 2011 delegation is associated with a decrease of 0.030 in the probability of offering no training and an increase of 0.090 in the probability of offering training to all its employees. The marginal effects are broadly similar across the two surveys and suggest that the magnitudes of the statistical relationship are economically consequential. Workplaces that delegate offer more training, a relationship we now probe more deeply.

<<Table 5, around here>>

5.2 *Panel Estimates*

Despite the fact that our measure of delegation comes from the employee questionnaire, an innovation in the WERS allows us to retain our delegation measure in the workplace panel. Prior to the most recent panel, the WERS panel was a separate set of establishments and so could not be taken back to the linked employee data available in the cross-section. For the first time, the panel is now part of the cross-section and so linked to the employee data. Thus, for each establishment in the panel we have a measure of delegation for each year and can estimate its influence on training within establishment over time. Incorporating such workplace fixed effects removes time invariant unobserved heterogeneity.

We start by presenting a pooled ordered probit estimate without fixed effects on the panel samples of workplaces. This estimate is presented in column 1 of Table 6. The magnitude of the delegation coefficient is very close to the ones observed in the two cross sections suggesting that the workplaces in the panel are not a highly selected sample. Column 2 presents the OLS estimate which simply treats the ordered categories of training as cardinal. The coefficient from the pooled panel indicates that the establishments that delegate engage in 0.38 of a category more training.

<<Table 6, around here>>

While we could directly move to a fully comparable fixed-effect ordered probit estimate, it necessarily suffers from the incidental parameter problem associated with many non-linear estimates [see Greene (2001)]. The OLS model holds constant time invariant characteristics that might influence both the extent of training and firm delegation without the incidental parameter problem. Column 3 shows that the OLS fixed effect coefficient remains highly significant and has modestly larger magnitude than in the pooled OLS from column 2. Thus, there appears no evidence that unmeasured time invariant characteristics generate a downward bias. This may fit with the stepwise specification exercise in Tables 3 and 4 where we showed that adding further controls either increased or did not decrease the coefficient of interest. The column 3 estimate indicates that firms that delegate increase their training by 0.40 of a category.

As a robustness check, we estimate alternative functional forms for the fixed effects estimate. We recognize that the current dependent variable is a count variable allowing estimation of the fixed-effect Poisson regression. This is one of the few non-linear fixed effect estimators without incidental parameters concerns [Hilbe and Greene (2008)]. The results are presented in column 4 and show that the estimated coefficient retains an economically significant magnitude and statistical significance. We also estimated conditional fixed effect logits (which eliminate the incidental parameter problem) by dividing the categories of training into high and low, as well as fixed effect ordered probits (available as a canned routine in LIMDEP) that retain the incidental parameter problem. We show the results in the online Appendix Table OA1 to this paper and confirm the pattern of the two fixed effect estimates we show in Table 6. The pooled and fixed effect estimates of panel reveal remarkably similar estimates across establishments and within establishments. The latter indicate that when an establishment moves to delegate decisions it does more training.

5.3 Endogeneity and IV Estimates

We recognize that the positive correlation between delegation and the extent of training could still emerge endogenously. In this view, while the fixed effect estimates are reassuring, they do not settle the matter. As an illustration, superior management could arrive between the two observations. Upon arrival they could both delegate and increase the extent of training. Here a critical determinant is not time invariant. More dramatically, the causation could be reversed as the investments in training might create a workplace environment where the firm recognizes that employees can now be trusted to have more influence over their jobs.

To examine these related problems we undertake an IV strategy that also controls for workplace fixed effects in the panel sample. These estimates are supportive of an independent role of employee delegation. We adopt an instrumental variable strategy based on industrial aggregation [for examples see Fisman and Svensson (2007); Lai and Ng (2014)]. The strategy posits characteristics of an industry that help define the extent of delegation by workplaces within that industry. These industry characteristics influence the extent to which firms in the industry, other than the specific workplace, delegate. The empirical implementation generates an identifying variable that aggregates the indicator for delegation. This aggregate varies by workplace in the industry by excluding the workplace for which it is computed. Thus, the identifying variable is the proportion of workplaces in industry cells reporting "*A lot*" of delegation after removing the given workplace from the industry cell.

Table 7 provides the IV estimates from the two cross sections. The first stage regresses the establishment's delegation indicator against all the controls and the aggregated instrument in a linear probability model. The second stage returns the estimated value from the first stage to estimates on training and corrects the standard errors by clustering at workplace cells. The first stage shows a strong positive correlation between the industry average and the excluded establishment value. Moreover, there is no evidence of weak

instruments and the other diagnostics are also supportive. The second stage shows again that higher workplace delegation increases the extent of training with the estimates about 0.56 of a category in 2004 and 0.46 of a category in 2011.

<<Table 7, around here>>

Table 8 provides panel estimates and again contrasts an estimate that does not hold constant workplace fixed effects (columns 1 and 2) with one that does hold them constant (columns 3 and 4). The second stage panel estimate of delegation is very close to the ones reported for the two cross sections, again showing that the panel data is not a selected sample. Here the standard errors are clustered at the workplace cell. Columns 3 to 4 combine the instrumental variable strategy with a fixed effect estimate. We alter the procedure slightly from the pooled estimates by now clustering errors at industry cells as each pair of firms now contribute at most once to the fixed effect estimate. As in the second stage IV estimates without the workplace fixed effects (see column 2), the second stage IV estimate with fixed effects (column 4) is somewhat larger. The results indicate an increase of 0.55 of a category while the fixed effect without the IV was 0.40 of a category (see column 3 of Table 6). The diagnostics continue to be supportive.

<<Table 8, around here>>

These estimates suggest that plausibly independent movements of delegation are associated with the extent of training. When the IV is combined with the fixed effect estimates, they add confidence to our results and seem sensible.

5.4 Additional Robustness Tests and Discussion

We have undertaken a series of robustness tests that bolster the empirical results. First, we have identified alternative potential measures of delegation. They come from the Management Questionnaire and so provide an alternative view to that built up from the actual

workers. The first asks managers "*to what extent would you say that the largest occupational group here have discretion over how they do their work*? '*A lot*', '*Some*', '*Little*', '*None*'". We identify delegation as if the manager replies '*A lot*.' This response is limited to the largest occupational group but we use it as the critical measure in estimates that mimic the fixed effect IV estimate in Table 8 (columns 3 and 4).[8] The IV continues to perform well and suggests that delegation using this measure is associated with a significant 0.56 of a category increase in training.

A second alternative asks managers "*to what extent would you say that the largest occupational group have involvement in decisions over how their work is organised?* '*A lot*', '*Some*', '*Little*', '*None*'". Again, identify delegation as when the manager replies '*A lot*'. This is again limited to the largest occupational group and now emphasizes the role in decision making of workers over their own work. It may be only an aspect of delegation but it continues to show an association with training. In the fixed effect IV estimates it is associated with a significant 0.39 of a category increase in training. We have combined this measure with the previous one using principal components and used the resulting variable as a delegation measure.[9] It again takes a meaningfully large coefficient in the fixed effect IV estimates. All three of these estimates are presented in Table A2 of the Appendix.

As a second broad sensitivity test, we return to the recognition that in some establishments owner-managers make the training and delegation decisions while in other establishments hired-managers make the decisions. While we have simply been assuming that the hired-managers act in the owner's interest, this may not be the case. To examine the empirical pattern, we divide our sample by a question that asks "*Are the controlling owners*

[8] Pooled ordered probit and OLS panel estimates without fixed effects that mimic columns 1 and 2 of Table 6 are reported in Table OA2 in the online appendix.

[9] The eigenvalue of 1.4 between discretion and involvement exceeds the rule of thumb of 1.0. Moreover, the first principal component explains over 70% of the common variance of the two measures. In addition to principal component analysis, we also created an aggregate standardised measure of delegation by creating and adding together the associated Z-scores. The results remain and are available upon request.

actively involved in day-to-day management of this workplace on a full-time basis?" Using the affirmative responses identifies slightly more than one-fifth of the sample with an owner-manager and the remainder with a hired-manager. Table 9 repeats the ultimate fixed-effect estimate using the IV on the divided sample and using our original, preferred measure of delegation. The first column presents the results for owner-manager establishments revealing a very large and significant role for delegation. Indeed, the implied increase of virtually a full training category stands as the largest magnitude of any of our estimates. We see this as the tight fit with our original theoretical model as the delegation decision involves the owner.

The second column presents the results for the hired-manager establishments, revealing a smaller but still positive and significant influence for delegation. The implied increase remains about one-half of a training category. This attenuation in magnitude may flow from agency problems between owners and hired-managers but a full modelling of such a three tier hierarchy is beyond the scope of this paper. We, nonetheless, find it reassuring that the relationship remains intact as it suggests that the behaviour of hired-managers broadly follows the pattern of owner-managers.[10]

As a third robustness check, we revisit our assumption that the establishments in the trading sector are the appropriate sample. Our initial assumption was that only these establishments had a profit objective that was well established and could be used to identify the gains from delegation and training. Yet, it is possible that the government and non-profit agencies (hospitals, schools, etc.) that make up the remainder of the WERS may have a well-defined objective even if not profit. If so, they may face very similar issues when facing the decision to delegate. While we leave this theoretical question open, we do return to the full sample and re-estimate the series of specifications in Tables 3-8. In each case, the full sample behaves largely as anticipated from the trading subsample. The coefficients on

[10] The cross-section results confirm the pattern of both subsamples returning positive and significant influences but with the magnitude being larger among owner-managed establishments (available upon request).

delegation tend to be somewhat smaller but remain positive and statistically significant (available upon request).

These robustness exercises, together with the original results, inform the theoretical issue we initially isolated. If the firm delegates, it suffers a loss of control but might give stronger effort incentives to the agent. If training reduces the marginal cost of effort, the resulting increase in effort can justify the cost of additional training. Thus, one might anticipate that delegation generates greater employer-provided training and this anticipation turns out to be consistent with our empirical investigation.

6. Conclusion

Understanding the determinants of workplace training is of clear importance, since the generation of human capital enhances the productivity of organizations. We extend previous theoretical work by assuming that employer-provided training reduces the agent's marginal effort cost of becoming informed about the payoffs of alternative investment projects. We show that delegation of decision-making authority to the worker increases training if the preferences of the principal and the agent have sufficiently high congruence. When this holds, the principal anticipates that the positive impact of training on effort will be stronger under delegation and thus provides additional training.

We test the hypothesis of a positive relationship between delegation and training on two nationally representative cross sections and an associated panel of British establishments. Our preferred measure of delegation is built up from workers within each establishment and time period. It identifies delegation when the mode response of the workers is that they have a lot of influence over their tasks. Indeed, we confirm that establishments that delegate provide training to a larger share of their workers. This remains true in increasingly more complete specifications, when accounting for establishment fixed effects, using alternative functional forms and in a plausible instrumental variable approach that also controls for fixed

effects. The result also proves robust both to alternative measures of delegation coming from the management questionnaire and to a substantial change in the sample to include firms outside the trading sector.

This result argues that those workplaces where there may be particularly good information at the level of worker will want to delegate but they will also want to engage in more training than firms which do not delegate. Future "insider" econometrics might provide important insights that support or refute this argument. It would be wonderful to identify a specific establishment that devolves to workers tasks or choices previously done by the management. Our survey evidence would suggest that such devolution would be accompanied by increased worker training so that superior choices would be made. Also developing insights with survey data from other countries concerning delegation and training seems a sensible next step. In this regard, our work sets the stage for future research.

Finally, we recognize limitations of our examination. The measure of delegation is a subjective employee measure aggregated to the workplace level. While the alternative measures from the management survey provide some comfort, we recognize that an objective employee measure may be more appropriate. Also, we have not modelled a multi-level hierarchy of owners, managers and workers. We show that the empirical results remain in this case but are attenuated. Theoretical modelling of training in this multi-level hierarchy remains for future work. Also left for future work is detailed explanation for delegation in circumstances where profit is not the object of the establishment. Again, we show the broad results apply outside the trading sector but have not modelled the differences that firms outside this sector may imply. Despite these open questions, we have provided a number of alternative measures of delegation and confirmed the robustness of our results to a large number of sensitivity checks. Our robust evidence represents an important contribution on which further work can build.

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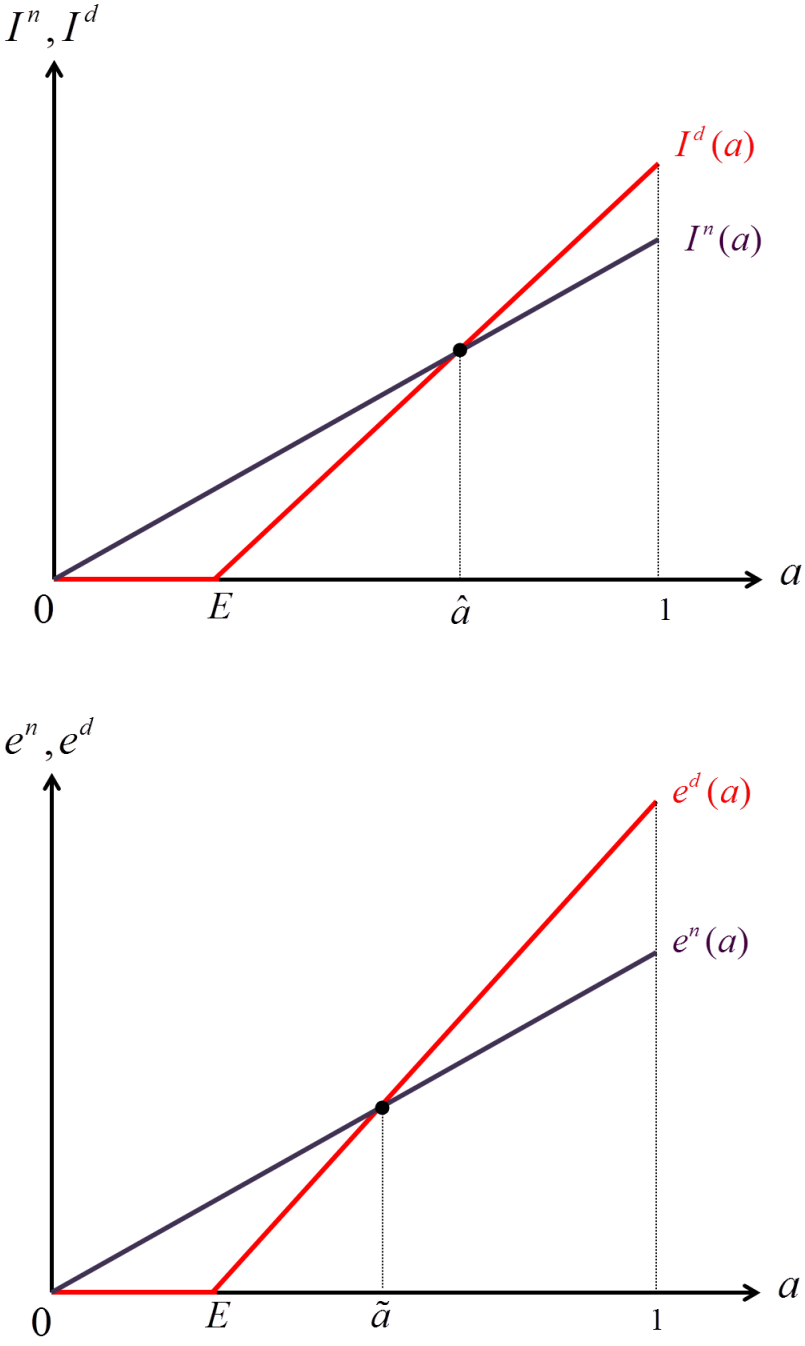

Figure 2. The top panel shows the training intensity with and without delegation and the bottom panel shows the agent's effort choice with and without delegation.

Table 1. Distribution of Training

	WERS 2004			*WERS 2011*			*Panel 2004-2011*		
	Mean	*Std. Dev.*	*Obs.*	*Mean*	*Std. Dev.*	*Obs.*	*Mean*	*Std. Dev.*	*Obs.*
None (0%)	0.237	0.426	131	0.190	0.393	112	0.174	0.380	53
Just a few (1-19%)	0.152	0.359	163	0.149	0.356	127	0.191	0.394	80
Some (20-39%)	0.010	0.300	127	0.099	0.299	109	0.087	0.282	55
Around half (40-59%)	0.099	0.298	99	0.069	0.254	90	0.099	0.298	54
Most (60-79%)	0.058	0.234	80	0.051	0.219	79	0.075	0.264	39
Almost all (80-99%)	0.063	0.243	118	0.093	0.290	130	0.081	0.274	50
All (100%)	0.291	0.454	276	0.349	0.477	365	0.293	0.455	143
Total Observations		994			1012			474	

Notes: The training question reads as follows: "*What proportion of experienced employees in the largest occupational group have been given time off from their normal daily work duties to undertake training over the past 12 months?*" Means are weighted using workplace weights and sum to 100 percent. The two cross section samples consist of private trading sector workplaces and exclude workplaces where the largest occupational group is managerial/senior official staff as the training question does not apply to this group. For the panel dataset we apply the same restriction as in the two cross sections and keep workplaces we observe twice. Thus, the panel is balanced and we observe 237 workplaces that generate 474 observations.

Table 2. Distribution of Delegation

	WERS 2004			*WERS 2011*			*Panel 2004-2011*		
	Mean	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*	*Obs*
None	0.114	0.318	114	0.051	0.221	54	0.054	0.226	41
A little	0.169	0.375	118	0.067	0.250	42	0.117	0.322	36
Some	0.417	0.493	461	0.396	0.489	417	0.437	0.496	229
A lot	0.300	0.459	301	0.485	0.500	499	0.392	0.488	168
Total Observations		994			1012			474	

Notes: The delegation question is obtained from the employee questionnaire and reads as follows: "*In general, how much influence do you have about the range of tasks you do in your job?*" Responses are recorded on a four-point scale: 1 '*None*', 2 '*A little*', 3 '*Some*' 4 '*A lot*'. We code all responses of 'Don't know' as missing. We aggregate the worker responses to the workplace level by taking the modal worker response, *ala* De Varo and Kurtulus (2010). We code employee *delegation* to take the value of 1 if the modal response is '*A lot*' and zero if the modal response is '*Some*', '*A little*', '*None*'. Means are weighted using workplace weights and sum to 100 percent.

Table 3: Dependent Variable: Categorical Measure of Share Trained (WERS 2004)

	(1) Ordered probit	(2) Ordered probit	(3) Ordered probit	(4) Ordered probit	(5) OLS
Delegation	0.184**	0.213***	0.242***	0.236***	0.422***
	(0.073)	(0.079)	(0.081)	(0.082)	(0.142)
Log number of employees	0.079***	0.071**	0.098***	0.083***	0.153***
	(0.021)	(0.029)	(0.030)	(0.031)	(0.052)
Workplace operates more than 5 years	-0.119	-0.182	-0.188	-0.160	-0.208
	(0.130)	(0.144)	(0.147)	(0.150)	(0.259)
Part of a larger organisation	0.328*	0.311	0.221	0.192	0.398
	(0.180)	(0.190)	(0.208)	(0.219)	(0.393)
Single independent workplace	0.041	0.148	0.100	0.069	0.252
	(0.191)	(0.202)	(0.221)	(0.233)	(0.410)
UK owned	-0.109	-0.180*	-0.232**	-0.236**	-0.433**
	(0.088)	(0.103)	(0.108)	(0.108)	(0.192)
% of employees using computers		0.389***	0.420***	0.360**	0.651***
		(0.140)	(0.141)	(0.146)	(0.242)
% of female employees		0.747***	0.824***	0.808***	1.439***
		(0.206)	(0.239)	(0.243)	(0.406)
% of part time employees		-0.754***	-0.818***	-0.847***	-1.281***
		(0.210)	(0.223)	(0.230)	(0.368)
% union membership		0.432***	0.389**	0.444**	0.729**
		(0.158)	(0.171)	(0.179)	(0.306)
% of employees with a fixed term contract		0.341*	0.401*	0.379*	0.673*
		(0.205)	(0.221)	(0.225)	(0.395)
% of employees with a temporary contract		-0.155	-0.212	-0.342	-0.469
		(0.461)	(0.491)	(0.503)	(0.792)
% of employees who quitted last year		-0.153	-0.207	-0.264	-0.345
		(0.252)	(0.255)	(0.262)	(0.438)
% of employees dismissed/redundant last year		-0.700	-0.570	-0.818*	-1.792**
		(0.430)	(0.457)	(0.458)	(0.806)
Payment by result				0.012	0.081
				(0.095)	(0.166)
Merit pay				0.010	0.065
				(0.113)	(0.205)
Profit related pay				0.218**	0.400***
				(0.088)	(0.153)
Employee share schemes				0.119	0.201
				(0.106)	(0.188)
Few competitors				-0.285*	-0.292*
				(0.147)	(0.165)
Many competitors				-0.342**	-0.357**
				(0.144)	(0.163)
Market growing				0.175*	0.339*
				(0.106)	(0.185)
Market mature				0.031	0.058
				(0.118)	(0.208)
Market declining				-0.238	-0.350
				(0.160)	(0.274)
Cutoff 1	-0.697***	-0.065	-0.331	-0.287	
	(0.228)	(0.371)	(0.432)	(0.488)	
Cutoff 2	-0.101	0.596	0.346	0.399	
	(0.228)	(0.372)	(0.432)	(0.488)	
Cutoff 3	0.255	0.993***	0.752*	0.812*	
	(0.228)	(0.373)	(0.431)	(0.488)	
Cutoff 4	0.526**	1.298***	1.064**	1.128**	
	(0.229)	(0.374)	(0.433)	(0.489)	
Cutoff 5	0.723***	1.518***	1.287***	1.354***	
	(0.229)	(0.374)	(0.432)	(0.488)	
Cutoff 6	1.044***	1.867***	1.642***	1.712***	
	(0.230)	(0.375)	(0.434)	(0.490)	
Constant					1.079
					(0.841)
Observations	994	994	994	994	994
R-squared					0.248
Educational Composition	No	Yes	Yes	Yes	Yes
Occupational Composition	No	Yes	Yes	Yes	Yes
Largest Occupational Groups	No	Yes	Yes	Yes	Yes
Industry Dummies	No	No	Yes	Yes	Yes
Region Dummies	No	No	Yes	Yes	Yes
Missing Dummies	Yes	Yes	Yes	Yes	Yes

Notes: Bootstrap standard errors using 1000 replications with replacement are clustered at workplace cells and are reported in parentheses. Estimates use workplace weights. Levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Dependent Variable: Categorical Measure of Share Trained (WERS 2011)

	(1) Ordered probit	(2) Ordered probit	(3) Ordered probit	(4) Ordered probit	(5) OLS
Delegation	0.236***	0.229***	0.245***	0.245***	0.488***
	(0.070)	(0.073)	(0.075)	(0.077)	(0.135)
Log number of employees	0.070***	0.063**	0.076**	0.069**	0.141**
	(0.021)	(0.032)	(0.034)	(0.035)	(0.059)
Workplace operates more than 5 years	-0.014	-0.045	-0.045	-0.045	-0.179
	(0.151)	(0.157)	(0.163)	(0.166)	(0.278)
Part of a larger organisation	0.258	0.205	0.221	0.207	0.471
	(0.204)	(0.204)	(0.212)	(0.214)	(0.395)
Single independent workplace	-0.085	-0.077	-0.063	-0.056	0.104
	(0.217)	(0.220)	(0.228)	(0.232)	(0.425)
UK owned	-0.097	-0.189*	-0.195*	-0.210*	-0.460**
	(0.096)	(0.112)	(0.114)	(0.117)	(0.209)
% of employees using computers		0.445***	0.464***	0.430***	0.857***
		(0.145)	(0.149)	(0.152)	(0.255)
% of female employees		0.568***	0.443**	0.453**	0.824**
		(0.201)	(0.220)	(0.224)	(0.398)
% of part time employees		-0.432**	-0.524***	-0.532***	-1.206***
		(0.182)	(0.194)	(0.194)	(0.329)
% union membership		0.783***	0.848***	0.860***	1.590***
		(0.183)	(0.206)	(0.214)	(0.359)
% of employees with a fixed term contract		0.741***	0.737***	0.747***	1.226***
		(0.208)	(0.211)	(0.212)	(0.305)
% of employees with a temporary contract		0.227	0.161	0.122	0.032
		(0.413)	(0.452)	(0.466)	(0.773)
% of employees who quitted last year		-0.632*	-0.463	-0.473	-0.941
		(0.357)	(0.369)	(0.375)	(0.617)
% of employees dismissed/redundant last year		-0.526	-0.520	-0.680*	-0.695*
		(0.340)	(0.374)	(0.390)	(0.412)
Payment by result				0.021	0.124
				(0.101)	(0.181)
Merit pay				0.099	0.169
				(0.106)	(0.184)
Profit related pay				0.175**	0.336**
				(0.087)	(0.151)
Employee share schemes				0.072	0.095
				(0.129)	(0.233)
Few competitors				-0.428**	-0.498**
				(0.213)	(0.250)
Many competitors				-0.439**	-0.502**
				(0.214)	(0.247)
Market growing				0.195**	0.338**
				(0.098)	(0.166)
Market mature				0.196*	0.337*
				(0.113)	(0.195)
Market declining				-0.148	-0.281
				(0.129)	(0.226)
Cutoff 1	-0.894***	0.223	0.450	0.692	
	(0.264)	(0.474)	(0.532)	(0.567)	
Cutoff 2	-0.351	0.825*	1.063**	1.312**	
	(0.265)	(0.475)	(0.531)	(0.566)	
Cutoff 3	0.043	1.274***	1.518***	1.772***	
	(0.264)	(0.475)	(0.530)	(0.566)	
Cutoff 4	0.269	1.529***	1.778***	2.032***	
	(0.263)	(0.476)	(0.530)	(0.565)	
Cutoff 5	0.482*	1.763***	2.017***	2.271***	
	(0.262)	(0.475)	(0.530)	(0.565)	
Cutoff 6	0.832***	2.142***	2.402***	2.657***	
	(0.261)	(0.476)	(0.531)	(0.567)	
Constant					-0.195
					(0.994)
Observations	1012	1012	1012	1012	1012
R-squared					0.240
Educational Characteristics	Yes	Yes	Yes	Yes	Yes
Occupational Composition	No	Yes	Yes	Yes	Yes
Largest Occupational Group Dummies	No	Yes	Yes	Yes	Yes
Industry Dummies	No	No	Yes	Yes	Yes
Region Dummies	No	No	Yes	Yes	Yes
Missing Dummies	Yes	Yes	Yes	Yes	Yes

Notes: Bootstrap standard errors using 1000 replications with replacement are clustered at workplace cells and are reported in parentheses. Estimates use workplace weights. Levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Marginal Effects

	WERS 2004		*WERS 2011*	
	(1)		*(2)*	
	Delegation		*Delegation*	
Training	*M.E.*	*Std. Err.*	*M.E.*	*Std. Err.*
Cutoff 1: None	-0.039***	0.012	-0.030***	0.010
Cutoff 2: Just a few	-0.037***	0.013	-0.034***	0.011
Cutoff 3: Some	-0.016***	0.006	-0.024***	0.008
Cutoff 4:Around half	-0.003	0.002	-0.008***	0.003
Cutoff 5: Most	0.004**	0.002	0.002*	0.001
Cutoff 6: Almost all	0.014***	0.005	0.008***	0.002
Cutoff 7: All	0.077***	0.027	0.090***	0.028

Notes: 1. Entries are marginal effects obtained from a weighted ordered probit model based on the estimates reported in column 4 of Table 3 (WERS 2004) and in column 4 of Table 4 (WERS 2011) respectively.
2. We only report the marginal effects of the variable of interest. Marginal effects for all the other covariates are available upon request.
3. Robust standard errors are obtained using a bootstrap exercise with 1000 replications with replacement and are clustered at workplace cells.
4. Levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Panel Data 2004-2011

	(1) Ordered Probit without FE	(2) OLS without FE	(3) OLS with FE	(4) Poisson with FE
Delegation	0.214**	0.379**	0.402***	0.250**
	(0.092)	(0.164)	(0.189)	(0.119)
Log-likelihood	-658.424	---	---	-189.825
R-squared	---	0.341	0.782	---
Observations	474	474	474	474
Industry dummies	Yes	Yes	No	No
Region dummies	Yes	Yes	No	No
Workplace characteristics	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes
Largest occupational group dummies	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes

Notes: For information on the sample and on the variables of interest, see Notes in Tables 1 and 2. The dependent variable is the proportion of experienced employees in the largest occupational group who have been given time-off from their normal daily work to undertake training over the last 12 months. For reasons of brevity we only present estimates of the variable of interest. Other controls are those shown in column 4 of Table 3, as well as a year dummy. The estimates for the rest of the covariates are available upon request. Bootstrap standard errors using 1000 replications with replacement and clustered at workplace cells, accounting for the use of generated regressor, are reported in parentheses. Estimates are weighted using workplace weights. Levels of significance: *** p<0.01, * *p<0.05, * p<0.1.

Table 7. Instrumental Variable (IV) Results from the two Cross-Sections

	WERS 2004		WERS 2011	
	First Stage	Second Stage	First Stage	Second Stage
	(1)	(2)	(3)	(4)
	Delegation	Training	Delegation	Training
Delegation	---	0.557***	---	0.459**
		(0.152)		(0.228)
Instrument for delegation	0.061**	---	0.105**	---
	(0.007)		(0.040)	
F-test of excluded instrument	75.10	---	66.68	---
	p-val.=0.000		p-val.=0.023	
Angrist-Pischke multivariate F-test of excluded instruments	75.10	---	66.68	---
	p-val.=0.000		p-val.= 0.023	
Underidentification test (Kleibergen-Paap rk LM statistic)	---	5.009	---	4.605
		p-val.=0.025		p-val.=0.031
Weak identification test (Kleibergen-Paap Wald rk F statistic)	---	75.099	---	65.456
Observations	994		1012	
Industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Workplace characteristics	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes
Largest group occupational dummies	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes

Notes: For information on the sample and on the training and delegation variables see Tables 1 and 2. In the first stage "delegation" is the dependent variable and the "instrument for delegation" is the main variable of interest. The instrument is the proportion of workplaces in industry cells reporting a "lot of" delegation after removing the given workplace from the industry cell. In the second stage, training is the dependent variable and instrumented "delegation" is the control variable. The estimation method is a 2SLS. Bootstrap standard errors using 1000 replications with replacement and clustered at industry cells, accounting for the use of generated regressor, are reported in parentheses. Estimates are weighted using workplace weights. For reasons of brevity we only report estimates of the variables of interest. Levels of significance: ***p<0.01, **p<0.05, *p<0.1. "---" not included or relevant.

Table 8. Instrumental Variable (IV) Results from the Panel 2004-2011

	Without workplace fixed effects		With workplace fixed effects	
	First stage	Second stage	First stage	Second stage
	(1)	(2)	(3)	(4)
	Delegation	Training	Delegation	Training
Delegation	---	0.504**	---	0.550***
		(0.243)		(0.186)
Instrument for delegation	0.068***	---	0.060***	---
	(0.004)		(0.012)	
F-test of excluded instrument	250.90	---	21.86	---
	p-val.= 0.0000		p-val.= 0.0016	
Angrist-Pischke multivariate F-test of excluded instruments	250.90	---	21.86	---
	p-val.= 0.0000		p-val.= 0.0016	
Underidentification test (Kleibergen-Paap rk LM statistic)	---	57.858	---	5.515
		p-val.= 0.0000		p-val.= 0.0188
Weak identification test (Kleibergen-Paap Wald rk F statistic)	---	250.900	---	21.865
Observations	474		474	
Industry dummies	Yes	Yes	No	No
Region dummies	Yes	Yes	No	No
Workplace characteristics	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes
Largest group occupational dummies	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes

Notes: For information on the sample and on the training and delegation variables see Tables 1 and 2. In the first stage "delegation" is the dependent variable and the "instrument for delegation" is the main variable of interest. The instrument is the proportion of workplaces in industry cells reporting a "lot of" delegation after removing the given workplace from the industry cell. In the second stage, training is the dependent variable and instrumented "delegation" is the control variable. The estimation method is a 2SLS. Bootstrap standard errors using 1000 replications with replacement and clustered at industry cells, accounting for the use of generated regressor, are reported in parentheses. Estimates are weighted using workplace weights. For reasons of brevity we only report estimates of the variables of interest. Levels of significance: ***p<0.01, **p<0.05, *p<0.1. "---" not included or relevant.

Table 9. Instrumental Variable (IV) Results, Owner-Manager vs Hired-Manager Workplaces, Panel 2004-2011 With Workplace Fixed Effects

	Owner-Manager		Hired -Manager	
	First stage	Second stage	First stage	Second stage
	(1)	(2)	(3)	(4)
	Delegation	Training	Delegation	Training
Delegation	---	0.985**	---	0.469**
		(0.497)		(0.237)
Instrument for delegation	0.062***	---	0.071***	---
	(0.016)		(0.039)	
F-test of excluded instrument	14.98	---	16.52	---
	p-val.= 0.0061		p-val.= 0.0502	
Angrist-Pischke multivariate F-test of excluded instruments	15.98	---	16.52	---
	p-val.= 0.0061		p-val.= 0.0502	
Underidentification test (Kleibergen-Paap rk LM statistic)	---	4.652	---	4.716
		p-val.= 0.0415		p-val.= 0.0299
Weak identification test (Kleibergen-Paap Wald rk F statistic)	---	14.979	---	16.024
Observations	101		373	
Industry dummies	No	No	No	No
Region dummies	No	No	No	No
Workplace characteristics	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes
Largest group occupational dummies	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes

Notes: This Table replicates columns 3 and 4 of Table 8. Columns 1 and 2 apply to private sector companies where the owner is actively involved in day-to-day management on a full-time basis. Columns 3 and 4 apply to all other workplaces. In the first stage "delegation" is the dependent variable and the "instrument for delegation" is the main variable of interest. The instrument is the proportion of workplaces in industry cells reporting a "lot of" delegation after removing the given workplace from the industry cell. In the second stage, training is the dependent variable and instrumented "delegation" is the control variable. The estimation method is a 2SLS. Bootstrap standard errors using 1000 replications with replacement and clustered at industry cells, accounting for the use of generated regressor, are reported in parentheses. Estimates are weighted using workplace weights. Due to the lower number of observations in columns 1 and 2 as these specifications are restricted to private sector companies some controls do not enter the specification. For reasons of brevity we only report estimates of the variables of interest. Levels of significance: ***p<0.01, **p<0.05, *p<0.1. "---" not included or relevant.

APPENDIX

Table A1. Descriptive Statistics of All Control Variables

	WERS 2004		WERS 2011		Panel 2004-2011	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Log number of employees	2.640	0.918	2.667	0.885	3.403	0.942
Workplace operates more than 5 years	0.844	0.363	0.867	0.340	0.955	0.207
Part of a larger organisation	0.589	0.492	0.508	0.500	0.552	0.498
Single independent workplace	0.390	0.488	0.473	0.500	0.438	0.497
UK owned/controlled (predominantly UK owned 51% or more)	0.861	0.346	0.874	0.332	0.894	0.308
% of employees using computers	0.523	0.403	0.607	0.398	51.762	39.023
% of female employees	0.524	0.324	0.525	0.319	0.573	0.314
% of part-time employees	0.330	0.302	0.304	0.301	0.406	0.312
% union membership	0.083	0.214	0.037	0.134	0.057	0.157
% of employees on fixed term contract	0.040	0.157	0.066	0.206	0.047	0.163
% of employees on temporary contract	0.015	0.069	0.014	0.077	0.011	0.045
% of employees who quitted last year	0.179	0.215	0.112	0.145	0.153	0.191
% of employees dismissed/redundant last year	0.027	0.069	0.029	0.069	0.038	0.094
% of employees with 'O' levels, grades D-E	0.108	0.155	0.122	0.194	0.131	0.175
% of employees with 'O' levels, grades A-C	0.197	0.201	0.325	0.290	0.251	0.214
% of employees with 'A' levels	0.107	0.150	0.113	0.156	0.117	0.169
% of employees with first degree (BA, BSc, BEd, etc.)	0.093	0.143	0.137	0.197	0.105	0.132
% of employees with higher degree (MSc, MA, MBA, PhD)	0.025	0.088	0.042	0.113	0.022	0.063
% of employees with other academic qualification	0.281	0.226	0.190	0.228	0.243	0.203
% of managers/senior officials	0.142	0.108	0.168	0.117	0.113	0.075
% of professional staff	0.046	0.132	0.082	0.182	0.059	0.142
% of technical staff	0.057	0.148	0.094	0.197	0.062	0.153
% of sales staff	0.244	0.348	0.180	0.300	0.228	0.344
% of operative and assembly staff	0.091	0.212	0.072	0.191	0.076	0.187
% of clerical and secretarial staff	0.131	0.200	0.112	0.178	0.112	0.187
% of craft and skilled staff	0.098	0.226	0.077	0.182	0.077	0.170
% of personal service staff	0.077	0.232	0.116	0.280	0.160	0.315
Largest occupational group: Professional	0.048	0.215	0.082	0.274	0.059	0.236
Largest occupational group: Technical	0.063	0.244	0.116	0.321	0.079	0.270
Largest occupational group: Administrative	0.106	0.308	0.098	0.298	0.088	0.284
Largest occupational group: Skilled	0.125	0.330	0.106	0.308	0.112	0.315
Largest occupational group: Caring, leisure	0.098	0.297	0.144	0.351	0.193	0.395
Largest occupational group: Sales	0.296	0.457	0.234	0.424	0.256	0.437
Largest occupational group: Operatives	0.129	0.336	0.102	0.303	0.097	0.296
Payment by result	0.280	0.449	0.194	0.395	0.217	0.413
Merit pay	0.077	0.267	0.135	0.342	0.097	0.296
Profit related pay	0.343	0.475	0.314	0.464	0.318	0.466
Employee share schemes (SIP, SAYE, EMI, CSOP, other)	0.120	0.325	0.091	0.288	0.122	0.328
Few competitors	0.334	0.472	0.396	0.489	0.355	0.479
Many competitors	0.602	0.490	0.578	0.494	0.598	0.491
Current state of the market: growing	0.467	0.499	0.309	0.462	0.388	0.488

Continued…

Continued…

Current state of the market: mature	0.238	0.426	0.200	0.400	0.197	0.398
Current state of the market: declining	0.136	0.343	0.152	0.359	0.113	0.317
Manufacturing	0.130	0.336	0.111	0.314	0.079	0.270
Utilities (electricity, gas, water)	0.000	0.021	0.000	0.019	0.000	0.000
Construction	0.047	0.213	0.053	0.224	0.038	0.193
Wholesale and retail	0.296	0.457	0.263	0.441	0.340	0.474
Hotels and restaurants	0.081	0.273	0.094	0.292	0.070	0.255
Transport and communication	0.049	0.216	0.037	0.190	0.028	0.165
Financial services	0.057	0.232	0.004	0.063	0.000	0.000
Other businesses	0.161	0.368	0.196	0.397	0.136	0.343
Education	0.009	0.096	0.048	0.213	0.021	0.145
Health	0.108	0.311	0.133	0.340	0.214	0.411
North East	0.045	0.208	0.048	0.214	0.075	0.263
North West	0.111	0.315	0.099	0.298	0.215	0.411
East Midlands	0.075	0.263	0.071	0.258	0.046	0.209
West Midlands	0.122	0.328	0.110	0.313	0.123	0.328
East Anglia	0.048	0.215	0.053	0.223	0.030	0.170
South East	0.302	0.460	0.310	0.463	0.284	0.451
South West	0.078	0.268	0.119	0.324	0.099	0.299
Wales	0.033	0.178	0.031	0.172	0.017	0.128
Scotland	0.092	0.289	0.089	0.285	0.052	0.223
Owner-manager firm	0.204	0.403	0.245	0.430	0.209	0.407
Dummy for missing firm age	0.042	0.200	0.026	0.160	0.013	0.113
Dummy for missing % union membership	0.039	0.193	0.049	0.215	0.073	0.260
Dummy for missing % of employees on fixed term contract	0.009	0.095	0.000	0.000	0.000	0.000
Dummy for missing % of employees on temporary contract	0.006	0.077	0.000	0.021	0.000	0.013
Dummy for missing % of employees quitted last year	0.040	0.197	0.023	0.149	0.034	0.181
Dummy for missing % of employees dismissed/redundant last year	0.041	0.199	0.019	0.138	0.022	0.147
Observations	994		1012		474	

Notes: Means and standard deviations for each variable are reported for the two cross sections and the panel samples. Means are weighted using workplace weights. Means for variables with missing observations are estimated on non-missing observations.

Table A2. IV Estimation - Panel Data 2004-2011 – Alternative Measures of Delegation

	(1)	(2)	(3)	(4)	(5)	(6)
	DISCRETENESS		INVOLVEMENT		PRINCIPAL COMPONENT ANALYSIS	
	With workplace fixed effects		With workplace fixed effects		With workplace fixed effects	
	First stage	Second stage	First stage	Second stage	First stage	Second stage
Delegation	---	0.558**	---	0.393**	---	0.288**
		(0.239)		(0.197)		(0.129)
Instrument for delegation	10.883***	---	8.918***	---	6.248***	---
	(2.247)		(1.157)		(1.346)	
F-test of excluded instrument	23.44	---	59.35	---	21.55	---
	p-val.=0.001		p-val.=0.001		p-val.=0.0017	
Angrist-Pischke multivariate F-test of	23.44	---	59.35	---	21.55	---
excluded instruments	p-val.=0.001		p-val.=0.001		p-val.=0.0017	
Underidentification test (Kleibergen-Paap rk	---	4.612	---	4.797	---	4.532
LM statistic)		p-val.=0.032		p-val.=0.029		p-val.=0.041
Weak identification test (Kleibergen-Paap	---	23.440	---	59.350	---	---
Wald rk F statistic)						
Observations	474	474	474	474	474	474
Industry dummies	No	No	No	No	No	No
Region dummies	No	No	No	No	No	No
Workplace characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes	Yes	Yes
Largest occupational group dummies	Yes	Yes	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: For information on the sample and on the variables of interest, see Notes in Tables 1 and 2 in the main paper. The dependent variable is the proportion of experienced employees in the largest occupational group who have been given time-off from their normal daily work to undertake training over the last 12 months. In columns 1 and 2 delegation is measured from the management questionnaire from the following question: "*Using the scale on this card, to what extent would you say that the largest occupational group here have discretion over how they do their work?* '*A lot*', '*Some*', '*Little*', '*None*'". We code as delegation if managers replied 'A lot'. In columns 3 and 4 delegation is measured from the management questionnaire from the following question: "*Using the scale on this card, to what extent would you say that the largest occupational group have involvement in decisions over how their work is organised?* '*A lot*', '*Some*', '*Little*', '*None*'". We code as delegation if managers replied 'A lot'. In columns 5 and 6 delegation is constructed using the first principal component of discretion and involvement. For reasons of brevity we only present estimates of the variable of interest. Other controls are those shown in column 4 of Table 3, as well as a year dummy. The estimates for the rest of the covariates are available upon request. Standard errors are clustered at industry cells. Estimates are weighted using workplace weights. Levels of significance: *** p<0.01, * **p<0.05, * p<0.1.

ONLINE APPENDIX

Table OA1. Panel Data 2004-2011 – Alternative Functional Forms

	(1) Conditional Logit FE	(2) Ordered Probit FE
Delegation	0.699**	0.597***
	(0.350)	(0.230)
Log-likelihood	-74.553	-456.061
Observations	474	474
Industry dummies	No	No
Region dummies	No	No
Workplace characteristics	Yes	Yes
Workforce characteristics	Yes	Yes
Occupational composition	Yes	Yes
Largest occupational group dummies	Yes	Yes
PRP dummies	Yes	Yes
Competition dummies	Yes	Yes
Market state dummies	Yes	Yes
Missing dummies	Yes	Yes

Notes: For information on the sample and on the variables of interest, see Notes in Tables 1 and 2 in the main paper. For reasons of brevity we only present estimates of the variable of interest. Other controls are those shown in column 4 of Table 3 in the main paper, as well as a year dummy. The estimates for the rest of the covariates are available upon request. Bootstrap standard errors using 1000 replications with replacement and clustered at workplace cells, accounting for the use of generated regressor, are reported in parentheses. Estimates are weighted using workplace weights. Levels of significance: *** p<0.01, * *p<0.05, * p<0.1. The fixed effect ordered probit model is estimated in LIMDEP.

Table OA2. Panel Data 2004-2011 – Alternative Measures of Delegation

	(1)	(2)	(3)	(4)	(5)	(6)
	DISCRETION		INVOLVEMENT		PRINCIPAL COMPONENT ANALYSIS	
	Ordered Probit without FE	OLS without FE	Ordered Probit without FE	OLS without FE	Ordered Probit without FE	OLS without FE
Delegation	0.430**	0.572**	0.298**	0.480**	0.232**	0.251**
	(0.185)	(0.289)	(0.142)	(0.237)	(0.093)	(0.123)
Log-likelihood	-731.786	---	-766.156	---	-717.167	---
R-squared	---	0.397	---	0.339	---	0.824
Observations	474	474	474	474	474	474
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Workplace characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Workforce characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Occupational composition	Yes	Yes	Yes	Yes	Yes	Yes
Largest occupational group dummies	Yes	Yes	Yes	Yes	Yes	Yes
PRP dummies	Yes	Yes	Yes	Yes	Yes	Yes
Competition dummies	Yes	Yes	Yes	Yes	Yes	Yes
Market state dummies	Yes	Yes	Yes	Yes	Yes	Yes
Missing dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: For information on the sample and on the variables of interest, see Notes in Tables 1 and 2 in the main paper. The dependent variable is the proportion of experienced employees in the largest occupational group who have been given time-off from their normal daily work to undertake training over the last 12 months. In columns 1 and 2 delegation is measured from the management questionnaire from the following question: "*Using the scale on this card, to what extent would you say that the largest occupational group here have discretion over how they do their work*? '*A lot*', '*Some*', '*Little*', '*None*'". We code as delegation if managers replied 'A lot'. In columns 3 and 4 delegation is measured from the management questionnaire from the following question: "*Using the scale on this card, to what extent would you say that the largest occupational group have involvement in decisions over how their work is organised?* '*A lot*', '*Some*', '*Little*', '*None*' ". We code as delegation if managers replied '*A lot*'. In columns 5 and 6 delegation is constructed using the first principal component of discretion and involvement. For reasons of brevity we only present estimates of the variable of interest. Other controls are those shown in column 4 of Table 3, as well as a year dummy. The estimates for the rest of the covariates are available upon request. Standard errors are clustered at workplace cells. Estimates are weighted using workplace weights. Levels of significance: *** p<0.01, * *p<0.05, * p<0.1.