

# Does Motivation Trigger Autonomy, or Vice Versa?\*

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## Abstract

Do firms use autonomy to motivate workers, or do they give autonomous jobs to workers who are already especially motivated? A standard result in economics is that firms offer autonomous jobs to promote worker motivation. But surprisingly, little attention has been given to the details of this practice of giving autonomy to especially motivated workers. In contrast, findings from social psychology demonstrate that how people handle new information is closely related to what motivates them. Does autonomy in fact trigger motivation? I argue in this study that motivation may trigger autonomy, and thus that firms may benefit from screening for intrinsically motivated workers. I assume that workers differ in their degree of motivation, and that motivated workers have a lower cost of processing information than unmotivated ones. While motivated workers concentrate on searching for available information, unmotivated ones focus on ignoring certain information as irrelevant. Therefore, firms would gain efficiency from giving the more motivated workers a higher degree of autonomy. This link between autonomy and motivation also has implications for non-monetary aspects of the job, such as forms of leadership style and job design.

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# 1 Introduction

Do firms use autonomy to motivate workers? Or, do they give autonomy to workers who are already especially motivated?

Earlier studies on motivation and autonomy focus on the conflict between two opposite effects: autonomy stimulates workers to acquire information; while employers lose control over the outcome. This trade-off results in firms offering autonomous jobs as a nonmonetary incentive to promote worker motivation. But surprisingly, little attention has been given to the details of the practice of giving autonomy to especially motivated workers. In contrast, studies in social psychology show that job performance and how people handle new information reflect their motives, drives, and emotions.<sup>1</sup> One might think then that employees differ in their degree of motivation, and that employers are more likely to give the more motivated workers a higher degree of autonomy.

What motivates people is a question that has been present in the psychology literature for a long time. Deci (1971) developed the idea that people might be driven by motives that reflect their needs and goals. Deci called the resulting motivation intrinsic, in contrast with what is known as extrinsic motivation or externally driven (by material rewards) behavior. Intrinsic motivation (IM hereafter) has also been introduced to the management literature (see for example Galbraith, 1977 and Staw, 1989) as the motivation to perform a certain task, or achieve specific outcomes. For example, professional pilots enjoy flying, while environmental workers fight for clean nature. Galbraith and Staw argue that IM can be stimulated by developing a work environment where people can achieve their goals, and one way to do so is by providing autonomy. Autonomy, however, is a necessary, but not a sufficient condition to induce better performance. Workers have to be interested in the task, i.e., they have to be already motivated to do the job.

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<sup>1</sup>See, for example, Pyszczynski and Greenberg (1987), Baumeister and Newman (1994).

If workers are motivated or unmotivated, offering autonomous jobs to unmotivated workers will not necessarily stimulate them to be more motivated. Pyszczynski and Greenberg (1987) and Baumeister and Newman (1994) show that a motivated worker is driven to search, while an unmotivated worker is driven to ignore, i.e., motivated people have a lower cost of processing information than unmotivated ones. Suppose, for example, that a firm needs a study on the environmental impact of a new power plant. The firm has to decide whether Peter or John will perform the study. Both employees have equal qualifications and experience. Peter is not only interested in environmental problems, but also does not miss an opportunity to learn about the topic. His performance will be based on his motivation to search all available sources. John, however, is indifferent to those problems. He pays little attention to environmental discussions. His performance will be based on his motivation to ignore certain information as irrelevant. Therefore, the firm is better-off by delegating the assignment to Peter.

I claim in this study that motivation may trigger autonomy, and that firms may benefit from screening for intrinsically motivated workers by offering a choice between autonomous and non-autonomous jobs. Motivated people show enthusiasm for acquiring information that is useful for the production process. A motivated worker will believe that a certain way of doing the job is the one that would bring the best results. He would therefore be discouraged if asked to follow other alternatives. In an organization, where employees have no autonomy in decision making, a motivated worker would need stronger incentives to work than an unmotivated worker, who acquires no information about how best to get the job done. It follows that the employer may find it optimal to give autonomy to motivated workers, but not to the unmotivated ones.

The observation that it is more costly to make people work on someone else's idea than their own is not novel. Zabochnik (1998, 2002) introduces this type of cost associated with

centralization. However, he is not concerned with motivation, which is central here. My contribution is the identification of the effect that motivation has on the optimal level of decision-making authority, and the proposition of a screening device that firms can use to identify motivated workers.

The interplay of autonomy and motivation also has implications for nonmonetary aspects of the job, such as leadership style and job design. New evidence suggests that many US companies have adopted new policies, frequently including greater decentralization.<sup>2</sup> Non-monetary aspects of the job have only recently started to attract some attention in economics. In this light, the study contributes to the growing literature on personnel economics.

## 2 Related Studies

Workers' motivation is largely ignored in the economics literature. The most common reason is the standard assumption in microeconomics that effort is costly and brings disutility. But if intrinsically motivated people enjoy working, they will experience positive utility of effort. Such a result contradicts the aforementioned assumption.<sup>3</sup> In contrast, findings from psychology demonstrate that people may not always have an increasing cost of effort. Classic examples are experimental settings (Deci & Ryan, 1985) where participants perform tasks without being rewarded.

Economists, however, do not entirely reject the idea of IM. Kreps (1997), for example, writes in favor of IM and the stylized fact that monetary incentives may in fact have a negative effect on workers' performance because they destroy their IM. He argues that since strong empirical evidence in support of this fact is difficult to find, more research is needed

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<sup>2</sup>See, e.g., Osterman (1994). Dessein (2002) cites that among the firms that have initiated more delegation of decision rights in the 1990s are AT&T, General Electric, Eastman Kodak, Fiat, Motorola, United Technologies, Xerox, and Ford.

<sup>3</sup>See Fehr and Falk (2001) on some critiques of bringing IM into the utility function.

on the determinants of IM. The main critique is that it is hard to know whether what is called IM is not just motivation triggered by extrinsic but fuzzy motivators. This paper contributes by investigating the effect of workers' motivation on the firm's choice of how much autonomy employees should be given.

The initial studies on IM are attempts to deal with the possibility that monetary incentives might crowd-out IM (Frey 1997, Frey and Oberholzer-Gee, 1997). The crowding effect has shifted the attention from defining IM toward observing the link between IM and monetary incentives.

An intuitive way of introducing IM is through disutility of effort. Delfgaauw and Dur (2002) model IM as an argument in the utility function. In equilibrium, motivated workers work harder and accept lower wages than unmotivated workers. Their model, however, has no implications for autonomy and the relation between autonomy and motivation.

A more elaborate study of motivation is Benabou & Tirole (2002), who offer an economic and cognitive perspective to IM. They propose a model where the employer has private information about the worker's ability or nature of the task. The worker receives a signal from observing the employer's decision. He interprets the signal and concludes what his own motivation is based on this interpretation.<sup>4</sup> Therefore, when the worker receives an autonomous job, he might think that the employer trusts him or values his work, and thus that he is highly motivated. The implication is that autonomy inspires motivation.

There are very few studies generating the prediction that autonomy is offered to workers who are already motivated. Murdock (2002) employs the idea that people are motivated by the outcomes of their work (Staw, 1989). Consider, for example, the personal satisfaction achieved from introducing a new medicine. Murdock calls these outcomes intrinsic returns

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<sup>4</sup>Formally, this approach is an application of the psychological theory of self-perception developed by Bem (1967, 1972). According to the self-perception theory individuals do not have information about their own motives. Instead, they have to infer them from the circumstances under which the activity takes place.

(for the worker). A motivated worker would choose to participate in a project with high intrinsic returns. Such a project might bring financial loss. The employer, however, can still gain because the worker would work harder on this and on other projects as well. What is important is that the total surplus (intrinsic plus financial return) from all projects is positive. The implication of this model, which is similar to my line of study, is that motivated workers are given autonomy to pursue intrinsic returns. In contrast to Murdock, I assume that there is heterogeneity in information processing among workers. Also, I model explicitly the process of autonomy delegation and show that it is optimal for the employer to screen for motivated workers.

I turn next to the literature on autonomy and decision rights. The main observation in this literature is that autonomy is determined by the structure of information. A study that is closely related to the present paper is Aghion and Tirole (1997), who investigate the two-way interaction between authority<sup>5</sup> and information. Authority gives autonomy, which in turn stimulates the initiative to acquire information, but usually comes with some costs. Employers lose control over decision making. Losses of information are also possible. Aghion and Tirole's model presents a general framework for introducing autonomy and has certain implications for delegation of decision rights. It does not, however, deal with motivation and heterogeneity in information processing.

My idea in this paper is closer to the innovative activities argument: a motivated worker in an autonomous job has the opportunity to work on his own idea and would be more certain of and have more faith in the outcome of the project. A motivated employee also has a lower cost of processing information. An unmotivated worker, on the other hand, is indifferent to the type of project he has to work on and has a higher cost of processing information. Therefore, it is more efficient for the employers to give more motivated people

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<sup>5</sup>Where "real authority" is defined as the "effective control over decisions in organizations."

a higher degree of autonomy. That is, offering autonomous jobs to unmotivated workers will not necessarily stimulate them to be more motivated: motivation triggers autonomy, but not vice versa.

### 3 Motivation May Trigger Autonomy

Studies from the literature on autonomy and delegation have developed the argument that autonomy triggers motivation. However, one might also think that employees just differ in their degree of IM, and that employers are more likely to give the more motivated workers a higher degree of autonomy. In this section, I present a theory to that effect. The model is an application of Zabochnik (1998, 2002),<sup>6</sup> whose original model I employ and extend for my study of motivation.

Consider a framework with a risk-neutral principal (she) and a risk-averse agent (he). The principal maximizes her expected profit and provides the agent with at least his reservation utility, zero by assumption. The agent's utility is additively separable in money and cost of effort,  $u(\text{wage}) - \text{cost of effort}$ , where  $u(\cdot)$  is strictly concave and differentiable,  $u'(\cdot) > 0$ ,  $u''(\cdot) < 0$ .

The agent is hired to work on one of two alternative projects,  $j = 1, 2$ , which are mutually exclusive. After a project is chosen, he decides on the provision of effort. Effort can be high ( $e_h$ ) or low ( $e_l$ ) and cannot be observed by the principal. The disutility of the high level of effort is denoted by  $H$ ,  $H > 0$ .

The payoffs of the project depend on the state of the world and the agent's effort. There are two equally probable states of the world,  $s = 1, 2$ . Project  $j$  is successful and brings payoff  $V > 0$  if and only if  $s = j$  and the agent provides sufficient effort. When  $s \neq j$  or effort is too low ( $e_l$ ), the payoff is normalized to zero. Another interpretation of this set-up

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<sup>6</sup>Zabochnik (1998) is an earlier version of Zabochnik (2002).

is that the appropriate technology of production has to be chosen for achieving a specific outcome.

The agent and the principal have different abilities to determine the correct way to complete the project. After Nature determines the state  $s$ , the principal and the agent receive independent signals (they do not observe each others' signals) about this particular state of the world,  $r_{principal}$  and  $r_{agent}$  respectively. Let  $\Pr(r_{agent} = s | s) = p$  and  $\Pr(r_{principal} = s | s) = q$ ,  $\frac{1}{2} < p, q < 1$ , be the probabilities that the agent and the principal receive a signal indicating the true state. Therefore, for any signal received, the agent believes that the true state is the one indicated by the signal with probability  $p$ :  $\Pr(s = j | r_{agent} = j) = \frac{\Pr(r_{agent}=j|s=j)}{\Pr(r_{agent}=j)} = \frac{p}{p+(1-p)} = p$ . Similarly, the principal's updated belief is  $q$ :  $\Pr(s = j | r_{principal} = 1) = \frac{\Pr(r_{principal}=j|s=j)}{\Pr(r_{principal}=j)} = \frac{q}{q+(1-q)} = q$ . The prior probability of  $\frac{1}{2}$  and the precision of the signals are common knowledge.

Since the agent's effort is not observable, his wage depends on the outcome of the project. There are two possible arrangements of decision-making authority: centralization and decentralization. Let the wage be denoted with  $w_c^i$  under centralization and  $w_d^i$  under decentralization, where  $i \in \{f, s\}$  indicates failure ( $f$ ) and success ( $s$ ). The difference between  $w_k^s$  and  $w_k^f$ ,  $k \in \{c, d\}$  can be interpreted as a bonus paid when the project is successful, where  $w_k^f$  is a base salary.

The timing of the model is as follows. The principal proposes a contract that allocates the authority over the future choice of projects and the agent's compensation. The agent accepts or refuses the contract. The contract maximizes the principal's ex ante expected profit and provides the agent with an expected utility, which is at least his reservation utility. Nature determines the state of the world,  $s$ . The parties receive imprecise and independent signals about  $s$ . The controlling party chooses a project. If the project is successful, it brings a payoff  $V > 0$  for the principal and a payment  $w_k^s$ , where  $k \in \{c, d\}$ , for the agent. In case of

failure, the project's payoff is normalized to zero, and the agent receives payoff  $w_k^f$ .

### 3.1 Benchmark Model with No Moral Hazard

As a point of reference, I start the analysis with the benchmark model when the agent's effort is observed. In this case, the principal offers a constant wage  $w$ , conditional on the agent making a high effort;  $w$  satisfies the agent's participation constraint,  $w - H \geq 0$ . The principal will choose a wage that gives the agent exactly his reservation utility,  $w - H = u$ . Under decentralization, the agent will pick the project that the signal suggests is best suited for him. The probability of success being  $p$ , the principal's expected profit is  $\pi^d = pV - u - H$ . Using similar arguments, the probability of success is  $q$  under centralization, so that  $\pi^c = qV - u - H$ . A comparison between  $\pi^d$  and  $\pi^c$  shows that centralization is preferred to decentralization when the principal's signal is better than the agent's, i.e., when  $q > p$ . In the opposite case, when the agent receives a better signal,  $p > q$ , decentralization is preferred. I show next that this result does not hold when the principal cannot observe the agent's effort.

### 3.2 Analysis of Centralization and Decentralization

#### 3.2.1 Centralization

The principal is responsible for the choice of project under centralization. She does not consult with the agent and might incur a higher cost of enforcing her action if the agent's effort is unobservable. Upon observation of the principal's choice, the agent forms a posterior belief about the probability of success. He infers the principal's signal from observing the chosen project. Because of symmetry, I will limit the discussion to the case when the principal chooses project one,  $j = 1$ .

Two possible scenarios exist under centralization. If the agent and the principal receive the same signal, the agent's posterior belief is denoted by  $p(1, 1)$ , where  $p(1, 1) = \frac{pq}{pq+(1-p)(1-q)}$ . He feels optimistic and the principal does not need to provide additional incentives. When the signals are different, the agent's posterior belief is  $p(1, 2) = \frac{q(1-p)}{q(1-p)+p(1-q)}$ , where  $p(1, 1) > p(1, 2)$ , and  $p(1, 1) > p$ ; the agent is pessimistic and will need stronger incentives to provide high effort. Hence, the principal faces two different optimization problems.

When the principal and the agent receive different signals, the payment to the agent in case of success,  $w_c^s$ , needs to be high enough, so that he will provide effort regardless of his posterior belief. This scenario is named the full incentive scenario. The principal maximizes her expected profit  $\pi = q(V - w_c^s) - (1 - q)w_c^f$  subject to:

$$qu(w_c^s) + (1 - q)u(w_c^f) \geq H \quad (\text{IR1})$$

$$p(1, 2)u(w_c^s) + [1 - p(1, 2)]u(w_c^f) - H \geq u(w_c^f) \quad (\text{IC1})$$

where *(IR1)* is the agent's ex ante participation constraint. *(IC1)* is the incentive compatibility constraint.

When the two signals coincide, the agent will always provide effort, and this is the partial incentive scenario. The principal's optimization problem transforms to maximizing  $\pi = (pq)(V - w_c^s) - (1 - pq)w_c^f$  subject to:

$$(pq)u(w_c^s) + (1 - pq)u(w_c^f) \geq H \quad (\text{IR2})$$

$$p(1, 1)u(w_c^s) + [1 - p(1, 1)]u(w_c^f) - H \geq u(w_c^f) \quad (\text{IC2})$$

The profit function and the participation constraint depend on both the principal's and the agent's quality of information.

### 3.2.2 Decentralization

The principal delegates the decision-making authority to the agent under decentralization. The agent's belief  $p$  does not depend on the signal received by the principal. Thus, the problem arising under centralization when the agent develops pessimism does not occur here. However, the principal might sustain an information loss if she is better informed. She maximizes her expected profit  $\pi^d = p(V - w_d^s) - (1 - p)w_d^f$  subject to the following constraints:

$$pu(w_d^s) + (1 - p)u(w_d^f) \geq H \quad (\text{IR3})$$

$$pu(w_d^s) + (1 - p)u(w_d^f) - H \geq u(w_d^f) \quad (\text{IC3})$$

The main idea of the model is summarized in the following proposition.

**Proposition 1:** (Zabojnik 1998) Holding all other parameters fixed, there exists a value  $p^*$ ,  $p^* < q$ , such that decentralization is preferred to centralization for all  $p > p^*$ .

When the action taken by the agent can be observed, decentralization is offered if and only if the agent is better informed than the principal and  $p \geq q$ . Otherwise, centralization dominates. However, if the agent has to work on the principal's idea while he originally believes that his idea is the proper way to proceed, he will be more pessimistic about the outcome. The agent would then need a stronger incentive to participate in the employment agreement and the principal must offer a larger bonus. Since risk-aversion is assumed, the expected wage has to increase to compensate for the higher uncertainty. As a result, an additional cost is associated with centralized decision-making.

I present next an extension to Zabojnik's model that formally introduces motivation along with the problem of centralization and decentralization.

### 3.3 Motivated and Unmotivated Workers

In the above model, the agent receives a signal that improves his information about which project is likely to be successful. In what follows, this is the motivated worker, who pays attention to new information, forms ideas, etc. One may think that there is heterogeneity in information processing. I define an unmotivated worker as someone who does not process any new information about the project. Under decentralization, an unmotivated worker forms a posterior belief equal to  $1/2$ , while under centralization he only knows that the principal is right with probability  $q$ .

To focus on the effect of heterogeneity in information processing, I assume equal costs of effort. Both motivated and unmotivated agents have the same ability to acquire information and place the same cost on effort once they know the project. The only difference between them is how they process information. While a motivated worker concentrates on searching for available information, an unmotivated one focuses on ignoring certain information as irrelevant.<sup>7</sup> I set up next the principal's optimization problem when she deals with an unmotivated agent.

Under centralization, the principal maximizes her expected profit  $\pi_c^e = q(V - w_c^s) - (1 - q)w_c^f$  subject to the constraints:

$$qu(w_c^s) + (1 - q)u(w_c^f) \geq H \quad (\text{IR1ext})$$

$$qu(w_c^s) + (1 - q)u(w_c^f) - H \geq u(w_c^f) \quad (\text{IC1ext})$$

The above optimization problem is equivalent to minimizing the agent's expected wage

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<sup>7</sup>The assumption that both agents have the same cost effort does not contradict the fact that they process information differently. In this model, an unmotivated agent holds the same probability of success of the project even after observing the signal. One interpretation of this effect is that the agent effectively gets no signal, or a poor signal. This interpretation, however, seems to contradict the assumption that the two agents have the same ability. Alternatively, he might receive the signal, but ignore the new information as irrelevant.

$E(w) = w_c^* = qw_c^s + (1 - q)w_c^f$ . The incentive compatibility constraint (*IC1ext*) implies the participation constraint (*IR1ext*). In addition, (*IC1ext*) should be binding. Otherwise,  $w_c^s$  can be decreased, and thus increasing the objective function, without jeopardizing the constraint. If (*IR1ext*) were not binding, both  $w_c^s$  and  $w_c^f$  could be decreased, which would keep (*IC1ext*) unaffected. Thus, (*IR1ext*) has to be binding as well. Since both constraints are binding at the optimum, the equilibrium conditions are:

$$\begin{aligned} u(w_c^f) &= [1 - \frac{q}{q}]H = 0 \\ u(w_c^s) &= [1 + \frac{1 - q}{q}]H = \frac{H}{q} \end{aligned}$$

The expected utility of an unmotivated agent is  $EU_c^e = q\frac{H}{q} + (1 - q)0 - H = 0$ .

Consider next what happens if the principal gives autonomy to an unmotivated agent. She maximizes  $\pi_d^e = \frac{1}{2}(V - w_d^s) - (1 - \frac{1}{2})w_d^f$ , subject to:

$$\begin{aligned} \frac{1}{2}u(w_d^s) + \frac{1}{2}u(w_d^f) &\geq H && \text{(IR2ext)} \\ \frac{1}{2}u(w_d^s) + \frac{1}{2}u(w_d^f) - H &\geq u(w_d^f) && \text{(IC2ext)} \end{aligned}$$

This is equivalent to the above maximization problem with  $q = \frac{1}{2}$ . In other words, decentralization is a special case of centralization, where the principal receives an uninformative signal and assigns equal probabilities of success regardless of the state that occurs.

The equilibrium conditions are  $u(w_d^f) = 0$  and  $u(w_d^s) = \frac{H}{1/2}$ . The agent's expected utility is  $EU_d^e = \frac{1}{2}\frac{H}{1/2} + \frac{1}{2}0 - H = 0$ . Therefore, an unmotivated agent gets the same expected utility under both centralization and decentralization and would be indifferent between these two set-ups.

It is reasonable to think that the principal would delegate centralization to an unmotivated agent. Since  $q > 1/2$  and an unmotivated agent is not a subject to developing

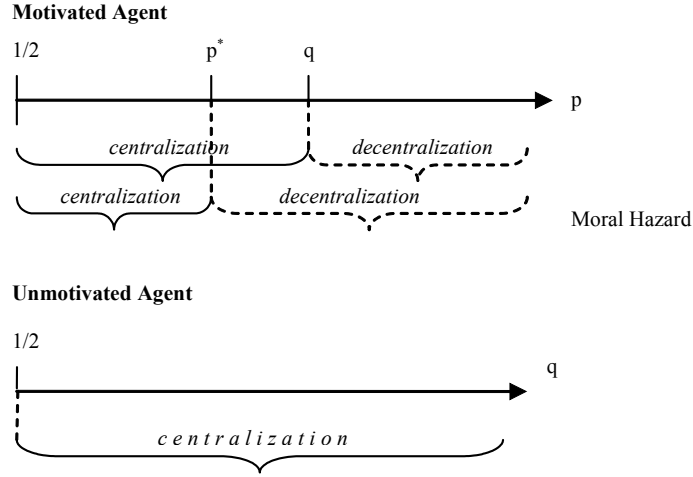


Figure 1: Optimal Contracts

pessimism, centralization dominates decentralization because it improves the quality of information and thereby the probability of success.

**Proposition 2:** Let  $V$  ( $V > 0$ ) be the principal's payoff in case of success and  $\{w_u^s, w_u^f, \delta_u = C\}$  be the contract offered to an unmotivated agent, where  $w_u^s$  and  $w_u^f$  are the wages under success and failure and  $\delta_u = C$  indicates centralization. The principal's profit:  $\pi(q) = q(V - w_c^s) - (1 - q)w_c^f$  is an increasing function of  $q$ .

**Corollary:** Let  $q^D = 1/2$  and  $q^C > 1/2$  be the values of  $q$  for an unmotivated agent under decentralization and centralization respectively. Centralization always dominates decentralization.

The principal will always choose centralization with an unmotivated worker. The contract offered would be  $\{w_u^s, w_u^f, \delta_u = C\}$ , where  $w_c^s = g(\frac{H}{q})$ ,  $w_c^f = g(0)$ , and  $g = u^{-1}(\cdot)$ . See proofs of Proposition 2 and Corollary in Appendix.

I have determined the optimal contracts when motivation is observable. The results are presented on Figure 1. An unmotivated agent will be offered centralization for all parameter

values of  $q$ . For a motivated agent, based on the observability of effort, there are two cases. When effort is observable, he will be offered decentralization for all parameter values of  $p$  such that  $p > q$ . When effort is not observable, he will be offered decentralization for all parameter values of  $p$  such that  $p > p^*$ , where  $p^* < q$ . Or, the principal offers decentralization to a motivated agent even if she is better informed than the agent. The elements of the contracts are summarized below.

$$\begin{aligned}
DEC(\mathbf{M}) &= \left\{ w_d^s = u^{-1}\left(\frac{H}{p}\right), w_d^f = u^{-1}(0), D \right\} \\
CENT_{full}(\mathbf{M}) &= \left\{ w_c^s = u^{-1}\left(\left(1 + \frac{1-q}{p(1,2)}\right)H\right), w_c^f = u^{-1}\left(\left(1 - \frac{q}{p(1,2)}\right)H\right), C \right\} \\
CENT_{partial}(\mathbf{M}) &= \left\{ w_c^s = u^{-1}\left(\left(1 + \frac{1-pq}{p(1,1)}\right)H\right), w_c^f = u^{-1}\left(\left(1 - \frac{pq}{p(1,1)}\right)H\right), C \right\} \\
CENT(\mathbf{U}) &= \left\{ w_c^s = u^{-1}\left(\frac{H}{q}\right), w_c^f = u^{-1}(0), C \right\}
\end{aligned}$$

In the next section, I discuss delegation of autonomy when motivation is unobservable.

### 3.4 Screening Among Motivated and Unmotivated Workers

The principal may not observe the agent's level of motivation. Still she may want to take advantage of the difference in information processing. This is true especially when the agent is well informed. The principal may use the revelation principle by designing a menu of contracts  $\{(w_m^s, w_m^f, \delta_m), (w_u^s, w_u^f, \delta_u)\}$ , where  $\delta_m, \delta_u \in \{C, D\}$ .<sup>8</sup>

The contracts derived under full information about agents' types would not screen when the type is not observable. Two observations are sufficient. First, a motivated agent would always choose the contract designed for an unmotivated agent. After observing the principal's decision of a project, a motivated agent has the benefit of determining his action. The extra choice increases his utility. Thus, the agent's expected utility is always higher than

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<sup>8</sup>C stays for centralization, and D for decentralization,

his reservation utility. Second, he will expend effort only if his signal coincides with the principal's signal. Under a centralized contract, he can choose when to expend effort. The principal needs another solution to the adverse selection problem. Two main options of a screening mechanism exist:

*Option 1:* Offer only centralized contracts. This option can be executed by: i) inducing high effort under full incentives; ii) inducing high effort under partial incentives; or iii) inducing high effort for a motivated agent, but make an unmotivated agent participate as well.

*Option 2:* Offer one centralized and one decentralized contract.

If the principal chooses to induce high effort under full incentives, the incentive constraint is based on  $p(1, 2)$ , and both types of agents expend high effort. For a motivated agent, this contract coincide with  $CENT(M_{full})$ , which is designed such that he provides effort and gets his zero reservation utility. An unmotivated agent provides effort because  $q > p(1, 2)$ , and he also gets his zero reservation utility.

If the principal chooses to induce high effort under partial incentives, such that an unmotivated agent always expends effort, but a motivated agent expends effort only if his signal coincides with the principal's signal, her expected profit is  $\pi_c^e = q\phi(V - w_c^s) - (1 - q\phi)w_c^f$ , where  $\phi = \frac{1}{2} + \mu p$ , and  $\mu$  is the proportion of motivated workers. The constraints are:

$$qu(w_c^s) + (1 - q)u(w_c^f) \geq H \quad (IR4)$$

$$pqu(w_c^s) + (1 - pq)u(w_c^f) \geq [pq + (1 - p)(1 - q)]H \quad (IR4.1)$$

$$qu(w_c^s) + (1 - q)u(w_c^f) - H \geq u(w_c^f) \quad (IC4)$$

(IR4.1) is equivalent to  $pqu(w_c^s) + (1 - pq)u(w_c^f) \geq H$ , since  $[pq + (1 - p)(1 - q)]H \leq H$ . (IC4) holds for  $p(1, 1)$  as well, since  $q < p(1, 1)$ . Using similar logic as in the previous section, the two constraints (IR4) and (IC4) hold with equality at the optimum. Therefore,

the equilibrium conditions are:  $u(w_c^s) = \frac{H}{q}$  and  $u(w_c^f) = 0$ .

Finally, the principal may choose to induce high effort for a motivated agent under partial incentives, but make an unmotivated agent participate with low effort. Her expected profit is  $\pi_c^e = \phi q(V - w_c^s) - (1 - \phi q)w_c^f$ , and the constraints are:

$$qu(w_c^s) + (1 - q)u(w_c^f) \geq H \quad (\text{IR5})$$

$$p(1, 1)u(w_c^s) + (1 - p(1, 1))u(w_c^f) - H \geq u(w_c^f). \quad (\text{IC5})$$

An unmotivated agent would not provide effort since (IC5) holds for  $p(1, 1)$  and the agent's belief is  $q < p(1, 1)$ . The equilibrium conditions are:  $u(w_c^s) = [1 + \frac{1-pq}{p(1,1)}]H$  and  $u(w_c^f) = [1 - \frac{pq}{p(1,1)}]H$ .

The equilibrium outcomes under Option 1 coincide with the wages paid under the three centralized contracts designed under full information about the agent's type. It is unclear which contract is optimal because the principal's profit depends on the proportion of motivated agents. I have shown in the previous section that a menu of these contracts cannot be employed as a screening mechanism.

If the principal chooses centralization, she can always induce a motivated agent to expend high effort by offering full incentives. In this case, however, she would pay a higher wage to an unmotivated agent than under partial incentives. When the proportion of unmotivated workers is large, the cost increases even more. Nevertheless, offering only centralized contracts has one benefit: when the principal is better informed than the agent, she can use her information. If the principal's benefit from using her own information is high enough, it may be able to outweigh the cost of paying a higher wage to an unmotivated agent. The principal faces a trade-off between achieving better utilization of information and paying higher wages.

I proceed further by showing that screening is possible only under Option 2. Proposition

3 follows with a formal proof provided in Appendix.

**Proposition 3:** Let  $\left\{ \left( w_j^s, w_j^f, \delta_j \right), j \in \{m, u\}, \delta_j \in \{C, D\} \right\}$  be a contract designed for a motivated agent when  $j = m$  and for an unmotivated agent when  $j = u$ . There exist a menu of incentive compatible contracts  $\left\{ \left( w_m^s, w_m^f, D \right), \left( w_u^s, w_u^f, C \right) \right\}$ .

When the menu offers only centralized contracts, the only difference between them is in the wages. Hence, the agents would mimic each other and choose the contract that offers a higher wage. This behavior will result in a pooling equilibrium. Therefore, two centralized contracts won't help the principal in the process of screening between motivated and unmotivated agents.

Let us suppose that the principal offers one centralized and one decentralized contract, where the latter is designed for a motivated agent. Also, let the wages depend on the agents' information  $p$  such that both agents get utility  $\frac{H}{p}$  when the project succeeds and a zero utility when it fails.<sup>9</sup>

Although  $p > 1/2$ , an unmotivated agent does not receive any new information under centralization and  $p = 1/2$  for him. Thus, when the project succeeds, an unmotivated agent gets a higher utility  $\left( \frac{H}{1/2} > \frac{H}{p} \right)$  than a motivated agent. Since under centralization the agent's expected utility depends on the principal's information  $q$ , and  $q > 1/2$ , an unmotivated agent's expected utility is positive. His incentive constraint requires that the difference between the two utilities, under success and failure, be at least  $\frac{H}{p}$  (see IC1ext). With the current contract this difference is  $\frac{H}{1/2}$  and the incentive constraint is satisfied.

To assure that screening occurs, the principal should provide incentive for a motivated agent to choose the decentralized contract. The principal may offer a small increase in the wage,  $\varepsilon$ , to both agents, such that  $\varepsilon > 0$  if the agent is strictly better informed than the principal ( $p > q$ ) and  $\varepsilon = 0$  otherwise. Formally, the small increase would be a part of

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<sup>9</sup>This is the equilibrium outcome under  $DEC(\mathbf{M})$ .

the wage for both agent. However, for an unmotivated agent, the condition that assures a positive increase never holds, and thus such an increase would be given to a motivated agent only. In addition,  $\varepsilon$  has to be specified such that a motivated agent gets a higher expected utility under the decentralized contract than under the centralized one. Thus, it insures that a motivated agent would pick the contract designed for him.

## 4 Conclusions

The interplay of autonomy and motivation affects the output and division of labor. Autonomy, however, is a necessary but not a sufficient condition on improved performance. I assume that workers differ in their degree of motivation, they are just motivated or unmotivated. Offering autonomous jobs to unmotivated workers will not necessarily stimulate them to be more motivated. I further assume that motivated people have a lower cost of processing information than unmotivated ones. Based on these assumptions, I argue that motivation may trigger autonomy, and thus that firms would benefit from screening for intrinsically motivated workers by offering autonomous jobs.

One other concern that deserves a detailed discussion is the relation between motivation and ability. Is it possible that what I call motivation is actually ability? If motivated people like to work on their own ideas, then it is relevant to ask whether motivation depends on ability. Unfortunately, both motivation and ability are unobservable characteristics. In cases like this, economics can only benefit from a new type of data that asks questions about the work environment, workers' habits and motivation, norms of the workplace, and network effects.

The relation between autonomy and motivation also has implications for nonmonetary aspects of the job, such as leadership style and job design. Some evidence from the business literature demonstrates that managers treat autonomy as a job dimension that promotes

high internal work motivation. If it is true that autonomy complements motivation, more experimental evidence is needed.

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## 5 Appendix

### Proof of Proposition 2:

It follows from (*IC1ext*) that  $q[u(w_c^s) - u(w_c^f)] \geq H$ , or  $w_c^s > w_c^f$ . The (*IR1ext*) constraint must be binding. Assume it does not bind, and decrease both  $w_c^s$  and  $w_c^f$  by some small amount  $\varepsilon > 0$ . Since  $w_c^s > w_c^f$ , and  $u$  is concave, (*IC1ext*) is relaxed by this decrease and the principal's expected profit has increased. Thus, both (*IR1ext*) and (*IC1ext*) are binding and  $u(w_c^s) = \frac{H}{q}$ ,  $u(w_c^f) = 0$ . Let  $g = u^{-1}(\cdot)$ , and  $w_c^s = g(\frac{H}{q})$ ,  $w_c^f = g(0)$ .

The principal's profit is  $\pi(q) = q(V - w_c^s) - (1 - q)w_c^f = q(V - g(\frac{H}{q})) - (1 - q)g(0)$ . The first derivative of the profit function is  $\frac{\partial \pi}{\partial q} = V - [g(\frac{H}{q}) - \frac{H}{q}g'(\frac{H}{q})] + g(0) = V - [g(\frac{H}{q}) - g(0)] + \frac{H}{q}g'(\frac{H}{q})$ . From the Lagrange's theorem, if  $g$  is continuous in  $[0, \frac{H}{q}]$  and differentiable in  $(0, \frac{H}{q})$ , then there is a value  $\eta$ ,  $\eta \in [0, \frac{H}{q}]$ , such that  $g'(\eta) = \frac{g(\frac{H}{q}) - g(0)}{\frac{H}{q} - 0}$ . Thus,  $g(\frac{H}{q}) - g(0) = \frac{H}{q}g'(\eta)$  and  $\frac{\partial \pi}{\partial q} = V - \frac{H}{q}g'(\eta) + \frac{H}{q}g'(\frac{H}{q}) = V + \frac{H}{q}[g'(\frac{H}{q}) - g'(\eta)]$ . Since  $g = u^{-1}(\cdot)$ ,  $g'(\frac{H}{q}) - g'(\eta) > 0$ . Thus,  $\frac{\partial \pi}{\partial q} > 0$  for all parameter values of  $q$ .

### Proof of Corollary:

The principal's expected profit under centralization is  $\pi^C = q(V - g(\frac{H}{q})) - (1 - q)g(0)$ , while under decentralization  $\pi^D = \frac{1}{2}(V - g(\frac{H}{q})) - (1 - \frac{1}{2})g(0)$ . Since  $\pi(q)$  is an increasing function of  $q$  from Proposition 2,  $\pi^C - \pi^D = \pi(q) - \pi(\frac{1}{2}) > 0$ , where  $q > \frac{1}{2}$ .

### Proof of Proposition 3:

Let  $\{(w_m^s, w_m^f, C), (w_u^s, w_u^f, C)\}$  be a menu of contracts such that both contracts are designed under centralization. If the principal wants to induce a motivated agent to choose  $(w_m^s, w_m^f, C)$  and an unmotivated agent to choose  $(w_u^s, w_u^f, C)$ , her optimization problem is to maximize her expected profit ( $\mu$  is the proportion of motivated workers):

$$\mu[pq(V - w_m^s) - (1 - pq)w_m^f] + (1 - \mu)[q(V - w_u^s) - (1 - q)w_u^f],$$

subject to the following constraints:

$$qu(w_m^s) + (1 - q)u(w_m^f) - H \geq 0 \quad (\text{IR}(M) \quad (1))$$

$$p(1, 2)u(w_m^s) + (1 - p(1, 2))u(w_m^f) - H \geq u(w_m^f) \quad (\text{IC1}(M) \quad (2))$$

$$p(1, 1)u(w_m^s) + (1 - p(1, 1))u(w_m^f) - H \geq u(w_m^f) \quad (\text{IC2}(M) \quad (3))$$

$$qu(w_m^s) + (1 - q)u(w_m^f) - H \geq \quad (\text{IC3}(M) \quad (4))$$

$$pqu(w_u^s) + (1 - pq)u(w_u^f) - [pq + (1 - p)(1 - q)]H$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq 0 \quad (\text{IR}(U) \quad (5))$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq u(w_u^f) \quad (\text{IC1}(U) \quad (6))$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq \quad (\text{IC2}(U) \quad (7))$$

$$qu(w_m^s) + (1 - q)u(w_m^f) - H$$

$IR(M)$  and  $IR(U)$  are the participation constraints for a motivated and an unmotivated worker respectively.  $IC1(M)$  and  $IC2(M)$  are the standard incentive constraints for a motivated agent, while the  $IC3(M)$  constraint ensures that a motivated agent chooses  $(w_m^s, w_m^f, C)$ . In a similar way,  $IC1(U)$  is the standard incentive constraint for an unmotivated agent, while  $IC2(U)$  ensures that he chooses  $(w_u^s, w_u^f, C)$ . I assign numbers (1) through (7) to the constraints for convenience. It is easy to notice that (1) and (7) together imply (5), and that (2) implies (3). Further, from (4) and (7) together it follows that  $u(w_u^s) - u(w_u^f) \geq \frac{H}{p(1,2)}$  for an unmotivated agent to choose  $(w_u^s, w_u^f, C)$ . From (6),  $u(w_u^s) - u(w_u^f) \geq \frac{H}{q}$ , but since  $q > p(1, 2)$  (4) and (7) together imply (6). Therefore, the new

set of constraints becomes:

$$qu(w_m^s) + (1 - q)u(w_m^f) - H \geq 0 \quad (\text{IR(M)} \quad (1))$$

$$p(1, 2)u(w_m^s) + (1 - p(1, 2))u(w_m^f) - H \geq u(w_m^f) \quad (\text{IC1(M)} \quad (2))$$

$$qu(w_m^s) + (1 - q)u(w_m^f) - H \geq \quad (\text{IC3(M)} \quad (4))$$

$$pqu(w_u^s) + (1 - pq)u(w_u^f) - [pq + (1 - p)(1 - q)]H$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq \quad (\text{IC2(U)} \quad (7))$$

$$qu(w_m^s) + (1 - q)u(w_m^f) - H$$

IC1(M) implies that  $u(w_m^s) - u(w_m^f) \geq \frac{H}{p(1,2)}$  for a motivated agent to choose  $(w_m^s, w_m^f, C)$ .

I will next proof that the expected utilities of the two types of agents are the same. Using this observation, I will show that  $u(w_u^s) - u(w_u^f) \geq \frac{H}{p(1,2)}$  and that  $u(w_m^s) - u(w_m^f) \geq \frac{H}{p(1,2)}$  holds with equality. Or, that  $(w_u^s, w_u^f, C)$  and  $(w_m^s, w_m^f, C)$  contracts coincide, and the optimization problem is characterized by a pooling equilibrium.

Assume that a motivated and an unmotivated agent have different expected utilities. Since both contracts are specified under centralization, the only difference is in the wage. Therefore, an unmotivated agent would always prefer to mimic a motivated agent when the latter gets a higher wage, and vice versa. A motivated agent prefers to present himself as unmotivated if he would receive a higher wage. As a result, the two expected utilities are equivalent, or  $EU = qu(w_m^s) + (1 - q)u(w_m^f) - H = qu(w_u^s) + (1 - q)u(w_u^f) - H$  and (7) is binding.

Let  $A \equiv u(w_u^s) - u(w_u^f)$  and  $B \equiv u(w_m^s) - u(w_m^f)$ . Consider the following possibilities: i)  $A > \frac{H}{p(1,2)}$  and  $B = \frac{H}{p(1,2)}$ . If  $A$  is decreased and the expected utility,  $EU$ , is kept constant, all constraints are satisfied. (7) is satisfied because the  $EU$  is constant, (4) slacks, (1) and (2) are not affected by the change and are satisfied as well. Therefore, the principal's expected

profit increases and the original mechanism is not optimal; ii)  $A = \frac{H}{p(1,2)}$  and  $B > \frac{H}{p(1,2)}$ . If  $B$  is decreased and the  $EU$  is kept constant, (2) and (4) slack and the principal's profit increases; and iii)  $A > \frac{H}{p(1,2)}$  and  $B > \frac{H}{p(1,2)}$ . Using a similar argument, the principal's expected profit increases.

The above proof shows that  $A = \frac{H}{p(1,2)}$  and  $B = \frac{H}{p(1,2)}$ , or that the difference in the utilities under success and failure is the same for a motivated and an unmotivated agent. Since the expected utilities are the same as well, it follows that the wages are the same and the contracts coincide resulting in a pooling equilibrium.

Let  $\{(w_m^s, w_m^f, D), (w_u^s, w_u^f, C)\}$  be a menu of contracts such that  $(w_m^s, w_m^f, D)$  is designed for a motivated agent and  $(w_u^s, w_u^f, C)$  for an unmotivated agent. The principal's optimization problem is to maximize her expected profit ( $\mu$  is the proportion of motivated workers):

$$\mu[p(V - w_m^s) - (1 - p)w_m^f] + (1 - \mu)[q(V - w_u^s) - (1 - q)w_u^f]$$

subject to the following constraints:

$$pu(w_m^s) + (1 - p)u(w_m^f) - H \geq 0 \quad (\text{IR(M)} \quad (1'))$$

$$pu(w_m^s) + (1 - p)u(w_m^f) - H \geq u(w_m^f) \quad (\text{IC1(M)} \quad (2'))$$

$$pu(w_m^s) + (1 - p)u(w_m^f) - H \geq \quad (\text{IC2(M)} \quad (3'))$$

$$pqu(w_u^s) + (1 - pq)u(w_u^f) - [pq + (1 - p)(1 - q)]H$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq 0 \quad (\text{IR(U)} \quad (4'))$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq u(w_u^f) \quad (\text{IC1(U)} \quad (5'))$$

$$qu(w_u^s) + (1 - q)u(w_u^f) - H \geq \quad (\text{IC2(U)} \quad (6'))$$

$$\frac{1}{2}u(w_m^s) + (1 - \frac{1}{2})u(w_m^f) - H$$

(1') and (4') are the participation constraints for a motivated and an unmotivated agent respectively. (2') is the standard incentive constraint for a motivated agent, while (3') ensures

that a motivated agent chooses  $(w_m^s, w_m^f, D)$ . In a similar way, (5') is the standard incentive constraint for an unmotivated agent, while (6') ensures that he chooses  $(w_u^s, w_u^f, C)$ .

Let  $\left\{ \left( g\left(\frac{H}{p} + \varepsilon\right), g(0), D \right), \left( g\left(\frac{H}{1/2}\right), g(0), C \right) \right\}$  be a menu of contracts such that  $\varepsilon > \frac{2(1-p)(2q-1)}{p}$  if  $p > q$  and  $\varepsilon = 0$  otherwise; and  $g = u^{-1}(\cdot)$ . The first contract  $\left( g\left(\frac{H}{p} + \varepsilon\right), g(0), D \right)$  is designed for a motivated agent such that the difference in utilities under success and failure for a motivated agent is  $u(w_m^s) - u(w_m^f) = \frac{H}{p} + \varepsilon$ . Hence, this contract differs from the contract designed for a motivated agent under full information about the agent's motivation by the increase in the wage in case of success,  $\varepsilon$ . Constraint (1') holds with equality when  $\varepsilon = 0$ . Constraint (2') holds since  $u(w_m^s) - u(w_m^f) = \frac{H}{p} + \varepsilon \geq \frac{H}{p}$ . The additional wage, which exists only when the agent is strictly better informed than the principal, serves as an incentive that prevents a motivated agent from choosing the centralized contract. The condition  $\varepsilon > \frac{2(1-p)(2q-1)}{p}$  is derived such that a motivated agent gets a higher expected utility under the decentralized contract and constraint (3') is satisfied.

The second contract  $\left( g\left(\frac{H}{1/2}\right), g(0), C \right)$  is designed for an unmotivated agent. The payment in case of success can also be interpreted as  $g\left(\frac{H}{p}\right)$ , and with  $p = \frac{1}{2}$  for an unmotivated agent,  $g\left(\frac{H}{p}\right) = g\left(\frac{H}{1/2}\right)$ . The difference in utilities for an unmotivated agent is  $u(w_u^s) - u(w_u^f) = \frac{H}{1/2}$ . In (4')  $q\frac{H}{1/2} - H = (2q-1)H > 0$  since  $q > \frac{1}{2}$ . In (5')  $u(w_u^s) - u(w_u^f) \geq \frac{H}{q}$ , but  $u(w_u^s) - u(w_u^f) = \frac{H}{1/2} > \frac{H}{q}$ . (6') holds from  $q > \frac{1}{2}$ . Thus, all constraints (4')-(6') are satisfied.

If all agents are motivated and  $\mu = 1$ , the principal pays  $\left( g\left(\frac{H}{p} + \varepsilon\right), g(0), D \right)$ . Under this contract a motivated agent gets a higher wage only when he is better informed. Otherwise, the outcome coincides with the outcome under the contract designed for a motivated agent under full information about the agent's motivation.

In the case when all agents are unmotivated and  $\mu = 0$ , the principal pays  $\left( g\left(\frac{H}{1/2}\right), g(0), C \right)$ , which offers a higher expected wage than the contract designed for an unmotivated agent under full information about the agent's motivation. This result suggests that in industries

where the principal expects to choose from a pool of predominantly unmotivated agents, she might be better off by offering  $\left(g\left(\frac{H}{q}\right), g(0), C\right)$  only.