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Abstract

We consider a competitive labor market with moral hazard and adverse selection where firms employ teams of two workers. There exist two types of workers: selfish workers and motivated workers. Selfish workers only respond to monetary incentives. Motivated workers not only respond to monetary incentives but their behavior is also driven by intrinsic motivation. However, if a firm chooses an output-based reward system, their intrinsic motivation is undermined. We obtain that self-selection into contracts separating workers based on their motivation is feasible, provided that the crowding out effect is powerful enough. More importantly, all firms have expected positive profits. Our model produces in this case heterogeneity at the firm level.

Keywords: intrinsic motivation, adverse selection, competition.

JEL codes: J33, D82, D86.

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1 Introduction

One of the most important tasks of a manager is to choose the right incentives for workers to provide effort. Linking pay to firm performance and fixed wages are two different incentive systems used among firms. Performance pay may provide incentives for workers to exert more effort and with workers with different skills it may attract the best workers by paying them a wage related to their productivity. On the other hand, performance pay may have a detrimental effect by crowding out intrinsic motivation on motivated workers (see Deci (1971) on a seminal work on this matter).

Choosing the right incentives is particularly challenging for teams since the pay system addressed to one worker may affect performance of the whole team negatively. In a labor market where motivated workers and selfish workers coexist and are matched into teams, the problem is even more troublesome if the manager does not know the type of workers he is hiring. Adopting a performance pay system may not yield the best outcome provided some of the members of the team are motivated. In the same way, a fixed wage system may also not yield the best outcome if some of the members of the team are selfish.

The purpose of this paper is to show how different incentive systems can arise in a labor market where motivated workers and selfish workers coexist. We consider a competitive labor market where firms employ teams of two workers. There exist two types of workers: selfish workers and motivated workers. Selfish workers only respond to monetary incentives. Motivated workers not only respond to monetary incentives but their behavior is also driven by intrinsic motivation. However, if a firm chooses an output-based reward system, their intrinsic motivation is undermined. Types and efforts are not observable for the firm. The model, thus, has both adverse selection and moral hazard. Competition between firms is introduced using Rothschild and Stiglitz's notion of a competitive equilibrium under adverse selection.

The size of the crowding out effect of performance pay on intrinsic motivation determines crucially the equilibrium. If the destruction of intrinsic motivation exceeds the costs of effort, there is no pooling equilibrium. There always exists a separating equilibrium in which firms offer two contracts. The contract addressed to selfish workers combines performance pay with fixed wage whereas the contract addressed to motivated workers has fixed wage and not performance pay. Motivated workers receive a lower wage than selfish workers. More importantly, all firms have positive expected profits. If the

destruction of intrinsic motivation does not exceed the costs of effort, there is no separating equilibrium. There always exists a pooling equilibrium in which the same contract is accepted by both types of workers. The contract addressed to all workers combines performance pay with fixed wage and all firms have zero expected profits.

Empirical evidence shows a great deal of heterogeneity in payment schemes for workers both at the firm level and at the industry level. For example, Kruse et al (2009) find that 47 percent of workers in US had some kind of group incentive scheme for 2006. Bloom and van Reenen (2010) show that 55 percent of UK establishments had contingent pay in 2004. Economics literature provides some explanations for this regularity. For example, Holmstrom and Milgrom (1991) emphasize the role of measurability of outputs. One explanation derives from heterogeneity of intrinsic motivation across sectors (see Akerlof and Kranton (2000, 2010) and Besley and Ghatak (2005)). In our paper, we emphasize the role of crowding out as a tool that may be used by firms to design a menu of contracts allowing workers to self-select.

Our results also provide an alternative explanation for the increase in performance pay wage systems in recent years (see Lemieux at al (2009) for example). The escalation of performance pay has been explained as a consequence of underlying changes in returns to skill inducing firms to offer performance pay contracts (Lemieux et at (2009)) or as a result of competition for skilled workers leading to an increase of performance pay and undermining of work ethics (Benabou and Tirole (2016)). Our results suggest that increase in performance pay may also have been consequence of a previous upward shift in selfish workers among the workforce. Supporting this claim, Twenge et al (2012) compare generational differences among American high school seniors and entering college students born between 1966 and 2008. Comparing the millennial generation (born after 1982) with other young generations in the past, they show that goals related to extrinsic values (money, image, fame) were more important for millennials than for previous young generations and those related to intrinsic values were less important for millennials than for previous young generations. Ng et al. (2010) examined career expectations and priorities data from more than 20,000 Canadian Millennial undergraduate university students. They obtained that commitment to social responsibility ranked at the bottom of their priorities.

Our article makes a contribution to the economic literature on the role of labor market sorting and compensation design when considerations of intrinsic motivation are introduced. Our model induces proper self-selection into

contracts under private information and, therefore, it is feasible to separate workers based on their motivation. Furthermore, we highlight the importance of the crowding out effect to induce self-selection of workers. Prendergast (2007), Delfgaauw and Dur (2008), Francois (2007), Kosfeld and Von Siemens (2009, 2011) and Besley and Ghatak (2016) are related to our work. Prendergast (2007), Francois (2007) and Delfgaauw and Dur (2008) focus on civil-service jobs. Prendergast (2007) show that it is optimal to hire workers who are either in empathy or hostile to their employers. Contrary to our results, they find that when there is private information about worker's types it is not feasible to induce proper self-selection into jobs. Francois (2007) and Delfgaauw and Dur (2008) investigate the screening of workers with intrinsic motivation. They obtain that performance incentives increase the probability of hiring workers with low levels of intrinsic motivation. Most closely related to our work is Kosfeld and Von Siemens (2009, 2011) and Besley and Ghatak (2016). In Kosfeld and Von Siemens (2009, 2011) a competitive labor market is considered in which workers differ in their intrinsic motivation for cooperation. They show that there always exists a separating equilibrium in which workers sort into firms that either involve high bonus and no cooperation or no bonus and cooperation. In their case, the existence of a separating equilibrium depends crucially on the existence of externalities between workers whereas in our case it depends on the size of the crowding out effect. Furthermore, they consider a multitask model in which workers choose between individual effort and cooperative effort whereas in our model effort has only one dimension. Finally, they assume that firms offers a single contract that applies to all members of the team whereas in our model firms can offer different contracts to all members of the team. On the other hand, Besley and Ghatak (2016) also consider a market in which firms hire teams of workers who vary in terms of intrinsic motivation. Contrary to our paper they do not consider a perfect competitive labor market and they focus on the dynamic coevolution of incentives and intrinsic motivation.

The remainder of the paper is organized as follows. In the next section we present the model. In section three we look at the results. Finally, section four contains concluding remarks.

2 The model

Suppose an economy comprising a range of firms and workers who produce in teams of two. There is a continuum of workers of unit one and two types of workers $\rho \in \{m, s\}$ where m stands for motivated and s for selfish. Let μ be the fraction of motivated workers in the population which is assumed to be common knowledge across firms and workers. Effort is binary $e_i \in \{0, 1\}$, costs c when $e_i = 1$ and 0 when $e_i = 0$.

Effort is not contractible whereas output is verifiable and, thus, contracts can depend on it. Output increases in effort and is symmetric in efforts. Let $v(1,1) = \overline{v}$ be the output when both workers exerts effort, $v(1,0) = v(0,1) = \underline{v}$ when only one worker exerts effort and $v(0,0) = 0$ when neither worker exerts effort. We assume that it is always efficient to put in effort, i.e., $\overline{v} > \underline{v} > c > 0$. Furthermore, we assume that when one team worker exerts effort is always efficient to exert effort for the other team worker, i.e., $\overline{v} - \underline{v} > c$.

Following Besley and Ghatak (2016), we assume that motivated workers enjoy a positive utility $\theta > 0$ from putting in effort. However, if motivated workers are paid for their effort they derive a negative utility $\gamma > 0$. We assume that $\theta - \gamma > c$, and, therefore, motivated workers always put in effort whether they are or not paid for their effort.

A contract offered to worker i $w_i = (b_i(v), f_i)$ has two elements, a fixed wage f_i and a bonus $b_i(v)$ where $v \in \{0, \underline{v}, \overline{v}\}$. Bonus is positive only if maximum output $\overline{v}$ is achieved, that is, $b_i(v) = b_i \geq 0$ if $v = \overline{v}$ and $b_i(v) = 0$ otherwise. For a bonus b_i, the meaning of $\gamma(b)$ is the following: $\gamma(b) = 0$ if $b = 0$ and $\gamma(b) = \gamma > 0$ if $b > 0$. We assume that there is a limited liability constraint and, therefore, fixed wage and bonus must be weakly positive. Workers are randomly matched with firms who post employment contracts. We assume that workers are assigned to firms in the following way. Given the contracts posted by firms, workers apply to a set of firms posting a specific contract. If they apply to more than one firm, they are chosen randomly among the applicants. The type of a worker is private information for firms and it is revealed to the team worker he is matched to. We also assume that a team worker observes the contract offered and accepted by his team coworker.

The utility of worker i who is of type ρ, chooses effort $e_i = 1$ and is matched in a team with worker j who exerts effort e_j is defined as

$$u_{i\rho} = \begin{cases} b_i\left[v\left(e_i, e_j\right)\right] + f_i - c \text{ if } \rho = s \\ b_i\left[v\left(e_i, e_j\right)\right] + f_i + \theta - \gamma\left(b_i\left[v\left(e_i, e_j\right)\right]\right) - c \text{ if } \rho = m \end{cases} \quad (1)$$

where $b_i\left[v\left(e_i, e_j\right)\right] \geq 0$ if $v\left(e_i, e_j\right) = \overline{v}$ and $b_i\left[v\left(e_i, e_j\right)\right] = 0$, otherwise. Moreover, $\gamma\left(b_i\left[v\left(e_i, e_j\right)\right]\right) = 0$ if $b_i\left[v\left(e_i, e_j\right)\right] = 0$ and $\gamma\left(b_i\left[v\left(e_i, e_j\right)\right]\right) > 0$ if $b_i\left[v\left(e_i, e_j\right)\right] > 0$.

Selfish i's utility consists of two elements. The utility he enjoys from his wage $\left(b_i\left[v\left(e_i, e_j\right)\right] + f_i\right)$ and the costs from exerting effort (c). In addition, motivated i's enjoy intrinsic satisfaction $\theta > 0$ from putting it effort. This intrinsic satisfaction is partially destroyed if the motivated worker is in an output-based reward system $\left(\gamma\left(b_i\left[v\left(e_i, e_j\right)\right]\right)\right)$.

Firms sell output at a price normalized to one. Given contracts $w_i = (b_i, f_i)$ and $w_j = (b_j, f_j)$ and workers' efforts (e_i, e_j), where $i \neq j$, let

$$\pi\left(w_i, w_j; e_i, e_j\right) = v\left(e_i, e_j\right) - b_i\left[v\left(e_i, e_j\right)\right] - b_j\left[v\left(e_i, e_j\right)\right] - f_i - f_j$$

be the firm's profit generated by a team. Firm's profit is equal to the output generated by the team minus the firm's wage payments. A worker receives the bonus if and only if the team attains the maximum output.

We assume that there is no rationing for workers and, therefore, all firms have their labor demand satisfied. First, firms can employ any number of teams. Second, firms can employ any number of motivated or selfish workers they intend to.

We define a competitive equilibrium as follows. With regard to workers, we assume that equilibrium strategies form a perfect equilibrium given all possible sets of offered contracts. With regard to firms, they offer a common contract $w = \{f_s, b_s, f_c, b_c\}$. We follow Rothschild and Stiglitz (1976) and we require that contracts offered satisfy the following conditions given workers' equilibrium behavior. First, the equilibrium set of contracts contains no irrelevant contracts that are never accepted in equilibrium. Second, no firm offers a contract yielding expected losses in equilibrium. Third, no firm can enter the market by offering a new contract that attracts workers and yields strictly positive expected profits per team.

3 The results

We first describe workers' equilibrium behavior within firms. Each worker knows his own type and the one of the team coworker before choosing between contracts (f_s, b_s) and (f_m, b_m). Moreover, after observing both choices, they independently choose an effort $e_i \in \{0, 1\}$. Let $e^*(b, \rho)$ be the optimal effort decision by ρ-type worker when bonus is b in a generic subgame associated with types $\{(m,m),(m,s),(s,m),(s,s)\}$. Motivated workers always put in effort no matter what the bonus is since the benefits of exerting effort are always greater than the costs. Therefore, $e^*(b, m) = 1$ for any $b \geq 0$. As in Besley and Ghatak (2016), selfish workers exert effort only if the bonus is at least equal[1] to the costs of effort. Then, $e^*(b, s) = 1$ for any $b \geq c$ and $e^*(b, m) = 0$ for any $b < c$.

We now show which bonus should be specifically offered to each type of workers in any optimal contract. The bonus offered to a selfish worker must cover at least the costs of effort and the bonus offered to a motivated worker must be equal to zero.

Lemma 1 *Any optimal contract (f_s, b_s) specifically targeted for selfish workers has a bonus $b_s \geq c$.*

Proof. Suppose a firm offers a contract (f'_s, b'_s, f'_m, b'_m) where $b'_s < c$ which is accepted by both types of workers. We show that we can find and alternative contract targeted for selfish workers yielding higher profits to the firm. In this case, firm's profits are $\pi'(s,s) = -2(f'_s + b'_s)$, if matched with two selfish workers or $\pi'(s,m) = \underline{v} - f'_s - b'_s - f'_m - b'_m$, if matched with a selfish worker and a motivated worker. Consider the alternative contract $(f^*_s, b^*_s, f'_m, b'_m)$, where $f^*_s = f'_s + b'_s - c$ and $b^*_s = c$. Firm's profits when matched with two selfish workers are $\pi^*(s,s) = \overline{v} - 2(f^*_s + b^*_s) = \overline{v} - 2(f'_s + b'_s) > \pi'(s,s)$. On the other hand, firm's profits when matched with a selfish worker and a motivated worker are $\pi^*(s,m) = \overline{v} - f^*_s - b^*_s - f'_m - b'_m = \overline{v} - f'_s - b'_s - f'_m - b'_m > \pi'(s,m)$. ■

Lemma 2 *Any optimal contract (f_m, b_m) specifically targeted for motivated workers has a bonus $b_m = 0$.*

[1] In order to ensure a unique solution of the subgame where coworkers choose effort, we assume that workers choose to exert effort when the bonus is equal to the cost of efforts.

Proof. Suppose a firm offers a contract (f'_s, b'_s, f'_m, b'_m) where $b'_m > 0$ and $b'_s \geq c$ (by Lemma 1) which is accepted by both types of workers. We show that we can find and alternative contract targeted for motivated workers yielding higher profits to the firm. In this case, firm's profits are $\pi'(m,m) = \overline{v} - 2(f'_m + b'_m)$, if matched with motivated workers or $\pi'(s,m) = \overline{v} - f'_s - b'_s - f'_m - b'_m$, if matched with a selfish worker and a motivated worker. Motivated worker's utility is $U'_m(f'_m, b'_m) = f'_m + b'_m + \theta - \gamma - c$. Consider the alternative contract $(f'_s, b'_s, f^*_m, b^*_m)$ where $f^*_m = f'_m + b'_m - \varepsilon$ and $b^*_m = 0$. Motivated worker's utility is $U^*_m(f^*_m, b^*_m) = f'_m + b'_m - \varepsilon + \theta - c > U'_m(f'_m, b'_m)$ for $\varepsilon < \gamma$ and firm's profits are $\pi^*(m,m) = \overline{v} - 2(f^*_m + b^*_m) = \overline{v} - 2(f'_m + b'_m) + 2\varepsilon > \pi'(m,m)$, if matched with two selfish workers or $\pi^*(s,m) = \overline{v} - f'_s - b'_s - f^*_m - b^*_m = \overline{v} - f'_s - b'_s - f'_m - b'_m + \varepsilon > \pi'(s,m)$, if matched with a selfish worker and a motivated worker. ■

3.1 Complete information allocation

As a benchmark we first describe the efficient allocation under complete information in a competitive setting. By Lemma 1, a selfish worker would have to be given a bonus of at least c and by Lemma 2, a motivated worker should be given no bonus. In general, motivated workers want to be separated from selfish workers, as selfish workers will choose no effort in a contract specifically targeted for motivated workers.

In a competitive environment in which no firm can make positive profits, by Lemma 1 and Lemma 2 we define the set of optimal selfish contracts and the set of optimal motivated contracts as, respectively

$$(f^c_s, b^c_s), \text{ where } f^c_s = \frac{\overline{v}}{2} - b^c_s \text{ and } b^c_s \in \left[c, \frac{\overline{v}}{2}\right] \quad (\textit{selfish contracts})$$

$$(f^c_m, b^c_m), \text{ where } f^c_m = \frac{\overline{v}}{2} \text{ and } b^c_m = 0 \ (\textit{motivated contracts})$$

We obtain the following result under complete information.

Lemma 3 *(Complete information equilibrium) When workers' preferences are observable there always exists a competitive equilibrium characterized as follows:*

(a) Selfish workers accept a contract (f^c_s, b^c_s) and exert effort.

(b) Motivated workers accept a contract (f_m^c, b_m^c) *and exert effort.*

(c) All firms make zero profit.

The proof is straightforward. With complete information each type of worker chooses the contract a firm has targeted for him. There will be heterogeneity in firms' team composition. Some firms will hire only motivated workers, other firms will hire only selfish workers and some firms will hire a motivated worker and a selfish worker, depending on the matching outcome. In all cases, firms make zero profit.

3.2 Incomplete information: separating equilibrium

With private information, the complete information allocation is no longer an equilibrium. In this case, selfish workers have an incentive to accept the contract addressed to motivated workers. They obtain the same wage as in the contract addressed to them but since the motivated workers contract does not include a bonus they can save the costs of effort by not exerting effort.

We first describe the Pareto-efficient separating contracts $w' = \left\{f_s', b_s', f_m', b_m'\right\}$. Selfish workers and motivated workers are offered, respectively, a contract that maximizes their utility and satisfies the self-selection, incentive-compatibility and limited-liability constraints.

The contract offered to a selfish worker must satisfy the following conditions:

$$\max_{\left(f_s', b_s'\right)} f_s' + b_s' - c$$

satisfying the constraints

$$\frac{\overline{v}}{2} - f_s' - b_s' \geq 0 \tag{2}$$

$$f_s' + b_s' - c \geq f_m' \tag{3}$$

$$\theta - \gamma\left(b_s'\right) + f_s' + b_s' - c \leq \theta + f_m' - c \tag{4}$$

$$f_s' + b_s' - c \geq f_s' \tag{5}$$

$$f_s^{'} \geq 0,\ f_m^{'} \geq 0,\ b_s^{'} \geq 0,\ b_m^{'} \geq 0 \tag{6}$$

The zero profit constraint (2) ensures that a firm makes no losses offering a contract $\left(f_s^{'}, b_s^{'}\right)$ to a selfish worker. The output generated by the team is $\overline{v}$ and, therefore, the maximum wage a firm can offer to a selfish contract without incurring in losses is $\frac{\overline{v}}{2}$. (3) and (4) are the screening constraints which ensure that each type of worker prefer their respective contracts to the contracts for the other type. Constraint (5) is the incentive-compatibility constraint by which the selfish worker always exerts effort. Finally, Constraint (6) is the limited liability constraint.

On the other hand, the contract offered to a motivated worker must satisfy the following conditions:

$$\max_{\left(f_m^{'}, b_m^{'}\right)} f_m^{'} - c$$

satisfying the constraints

$$\frac{\overline{v}}{2} - f_m^{'} \geq 0 \tag{7}$$

$$\theta + f_m^{'} - c \geq \theta - \gamma\left(b_s^{'}\right) + f_s^{'} + b_s^{'} - c \tag{8}$$

$$f_m^{'} \leq f_s^{'} + b_s^{'} - c \tag{9}$$

$$f_s^{'} \geq 0,\ f_m^{'} \geq 0,\ b_s^{'} \geq 0,\ b_m^{'} \geq 0 \tag{10}$$

By Lemma 2, $b_m^{'} = 0$ and, therefore the zero profit constraint (7) reduces to $f_m^{'} \leq \frac{\overline{v}}{2}$. On the other hand, a motivated worker always exerts effort since $\theta - \gamma \geq c$ and, therefore, there is no incentive-compatibility constraint. The other constraints are the screening constraints (8), (9) and the limited compatibility constraint (10).

We get the following result.

Proposition 4 *(Separating equilibrium)*

If $\gamma \geq c$, there is always a separating equilibrium characterized as follows:

(a) *Selfish workers accept a contract from $\left(f_s^{'}, b_s^{'}\right)$, where $b_s^{'} \in \left[c, \frac{\overline{v}}{2}\right]$ and $f_s^{'} = \frac{\overline{v}}{2} - b_s^{'}$ and they exert effort.*

(b) *Motivated workers accept a contract from* $\left(f_m^{'}, b_m^{'}\right)$*, where* $b_m^{'} = 0$ *and* $f_m^{'} = \frac{\overline{v}}{2} - c$ *and they exert effort.*

(c) *All firms make positive expected profits.*

Proof. We first show that in any separating equilibrium $\gamma \geq c$. By Lemma 1, $b_s^{'} \geq 0$ and (4) and (8) can be rewritten as

$$f_s^{'} + b_s^{'} \leq f_m^{'} + \gamma$$

On the other hand, (3) and (9) can be rewritten as

$$f_s^{'} + b_s^{'} \geq f_m^{'} + c$$

Screening constraints hold if $f_m^{'} + c \leq f_s^{'} + b_s^{'} \leq f_m^{'} + \gamma$. If $\gamma < c$, these conditions do not hold and at least one type of worker has incentives to accept a contract addressed to the other type.

Next, we show that in any separating equilibrium, selfish workers receive a contract from $\left(f_s^{'}, b_s^{'}\right)$ and motivated workers receive a contract from $\left(f_m^{'}, b_m^{'}\right)$. Since the selfish workers have an incentive to accept a contract addressed to motivated workers (3) and (9) would be binding and

$$f_m^{'} = f_s^{'} + b_s^{'} - c \tag{11}$$

Using zero profit condition for selfish workers (2), $f_s^{'} + b_s^{'} \leq \frac{\overline{v}}{2}$. Replacing this expression in (11) we obtain $f_m^{'} \leq \frac{\overline{v}}{2} - c$. Therefore, zero profit condition for motivated workers is not binding (7) and $f_m^{'} = \frac{\overline{v}}{2} - c$. On the contrary, zero profit condition for selfish workers is binding and $f_s^{'} + b_s^{'} = \frac{\overline{v}}{2}$. Finally, using the incentive compatibility constraint for the selfish workers $b_s^{'} \geq c$. Then, $b_s^{'} \in \left[c, \frac{\overline{v}}{2}\right]$ and $f_s^{'} = \frac{\overline{v}}{2} - b_s^{'}$.

Finally, we show that the separating equilibrium described in the proposition exists by showing that there is no profitable market entry. We first obtain the expected profits of a firm that offers the separating equilibrium contracts $w' = \left\{f_s^{'}, b_s^{'}, f_m^{'}, b_m^{'}\right\}$. In this case, all firms offer the same contract and, therefore, they have the same probability of being matched with a selfish or a motivated worker. Since each firm, hires two workers there are three possibilities: (i) a firm hires two motivated workers who accept the contract $\left(f_m^{'}, b_m^{'}\right)$, (ii) a firm hires two selfish workers who accept the contract $\left(f_s^{'}, b_s^{'}\right)$ and (iii) a firm hires a motivated worker and a selfish worker, the former accepts the contract $\left(f_m^{'}, b_m^{'}\right)$ and the latter accepts the contract $\left(f_s^{'}, b_s^{'}\right)$.

The expected profits of a firm that offers the contract w' is

$$\pi(w') = \mu^2\left[\overline{v} - 2\left(\frac{\overline{v}}{2} - c\right)\right] + (1-\mu)^2\left[\overline{v} - 2\left(\frac{\overline{v}}{2}\right)\right] + 2\mu(1-\mu)\left[\overline{v} - \left(\frac{\overline{v}}{2} - c\right) - \frac{\overline{v}}{2}\right]$$
$$\pi(w') = 2\mu c$$

Notice first that there cannot be profitable market entry by firms that attract only selfish workers. First, it cannot offer a higher wage than $\left(f_s', b_s'\right)$ without incurring in losses. Suppose that a firm offers the contract $\widetilde{w} = \left\{f_s', b_s', \varnothing\right\}$ to attract only selfish workers. This firm would not attract any selfish worker since it is offering a contract that is already offered by another firm, and workers cannot increase their utility by switching to the new firm. In this case profits would be $\pi(\widetilde{w}) = 0 < 2\mu c$.

Second, there cannot be profitable market entry by firms that attract only motivated workers. First, it cannot offer a higher wage than $\left(f_m', b_m'\right)$ without attracting selfish workers. Suppose that a firm offers the contract $\widehat{w} = \left\{\varnothing, f_m', b_m'\right\}$ to attract only motivated workers. This firm would not attract any motivated worker since it is offering a contract that is already offered by another firm, and workers cannot increase their utility by switching to the new firm. In this case profits would be $\pi(\widehat{w}) = 0 < 2\mu c$.

Finally, suppose a firm enters the market with a pooling contract $w^* = \left\{f^*, b^*\right\}$ where $b^* = 0$ and $f^* = \frac{\overline{v}}{2} - c + \lambda$, where $\lambda \in (0, c)$. This contract would be accepted by both types of workers although the selfish workers would choose not to exert effort. In this case, profits would be

$$\pi(w^*) = \mu^2\left[\overline{v} - 2\left(\frac{\overline{v}}{2} - c + \lambda\right)\right] + (1-\mu)^2\left[-2\left(\frac{\overline{v}}{2} - c + \lambda\right)\right] + 2\mu(1-\mu)\left[\underline{v} - 2\left(\frac{\overline{v}}{2} - c + \lambda\right.\right.$$
$$\pi(w^*) = 2c - 2\lambda - \overline{v} + \mu^2\left(\overline{v} - 2\underline{v}\right) + 2\mu\underline{v}$$

There is not profitable market entry by firms offering the pooling contract w^* since $\pi(w^*) < \pi(w')$. To check this consider the function $g(\mu) = \pi(w^*) - \pi(w')$. We need to prove that $g(\mu) < 0$ for $\mu \in [0,1]$. First, notice that when $\mu = 0$, $g(\mu) = -2\left(\frac{\overline{v}}{2} - c + \lambda\right) < 0$. Next, $\frac{\partial g(\mu)}{\partial \mu} = 2\mu\left(\overline{v} - 2\underline{v}\right) + 2\left(\underline{v} - c\right)$. If $\overline{v} \geq 2\underline{v}$, $\frac{\partial g(\mu)}{\partial \mu} > 0$ for $\mu \in [0,1]$ and if $\overline{v} < 2\underline{v}$, $\frac{\partial \pi(w^*)}{\partial \mu} > 0$ for $\mu < \mu' = \frac{\underline{v}-c}{2\underline{v}-\overline{v}}$. Since by assumption $\overline{v} - \underline{v} > c$, $\mu' > 1$ and, therefore, $\frac{\partial \pi(w^*)}{\partial \mu} > 0$ for $\mu \in [0,1]$. Then, the function $g(\mu)$ is increasing for $\mu \in [0,1]$ and, hence, $g(\mu)$ attains

its maximum when $\mu = 1$. Since $g(\mu) = -2\lambda < 0$ at $\mu = 1$, we can conclude that $g(\mu) < 0$ for $\mu \in [0, 1]$. ■

When $\gamma \geq c$, a firm is always better off offering a different contract for each type of worker. If a selfish worker accepts the contract addressed to motivated workers, he does not exert effort and the output would be either $\underline{v} < \overline{v}$ when matched with a motivated worker or $0 < \overline{v}$ when matched with a selfish worker. As a consequence, motivated workers receive a lower wage. The difference between the wage received by motivated and selfish workers is equal to the costs of effort, c, which is exactly the additional benefit a selfish worker would receive by accepting the motivated workers' contract. On the other hand, since the motivated worker receives a lower wage than the selfish one it could happen that he prefers to accept the contract addressed to the selfish worker. Since this contract has a positive bonus, a motivated worker would have a disutility of γ by accepting it. However, when $\gamma \geq c$ the motivated worker would obtain a lower utility by accepting the selfish workers' contract and prefers the contract addressed to him. If, on the contrary, $\gamma < c$, a separating equilibrium does not exist since a motivated worker would prefer the contract addressed to the selfish worker.

A separating equilibrium exists even if the fraction of motivated workers becomes arbitrarily large. The intuition is the following. Even if the fraction of selfish workers is relatively low, offering a pooling contract with bonus $b < c$ implies that the selfish workers will exert no effort and the output obtained by firms will be lower. It is always more profitable for firms to offer a separating contract in which selfish workers receive a bonus $b = c$ and exert effort and motivated workers receive no bonus. Therefore, in this case there is no pooling equilibrium.

3.3 Incomplete information: pooling equilibrium

In this section we show the conditions for a pooling equilibrium to exist. Our main result is that a pooling equilibrium always exists when $\gamma < c$.

Proposition 5 *(Pooling equilibrium)*

If $\gamma < c$, there is always a pooling equilibrium characterized as follows:

(a) *All firms offer the contract $\left(\widetilde{f}, \widetilde{b}\right)$, where $\widetilde{b} \in \left[c, \frac{\overline{v}}{2}\right]$ and $\widetilde{f} = \frac{\overline{v}}{2} - \widetilde{b}$.*

(b) *Selfish workers and motivated workers accept the contract* $\left(\widetilde{f},\widetilde{b}\right)$ *and exert effort.*

(c) *All firms make zero expected profits.*

Proof. We first show that there is no separating equilibrium when $\gamma < c$ since screening constraints do not hold. Screening conditions (3), (4), (8) and (9) hold when

$$f_m^{'} + c \leq f_s^{'} + b_s^{'} \leq f_m^{'} + \gamma$$

If $\gamma < c$, these conditions do not hold and at least one type of worker has incentives to accept a contract addressed to the other type.

Next, we characterize the pooling contract. First, notice that any pooling contract (f^*, b^*) in which $f^* + b^* < \frac{\overline{v}}{2}$ has profitable market entry. Second, any pooling contract (f'', b'') in which $b'' < c$ is subject to profitable market entry. In this contract, selfish workers do not exert effort. We can always find an alternative contract (f''', b''') in which $b''' = c$ and $f''' = f'' + c - b''$ yielding higher profits to a firm.

Therefore, the pooling contract with no profitable market entry is $\left(\widetilde{f},\widetilde{b}\right)$, *where* $\widetilde{b} \in \left[c, \frac{\overline{v}}{2}\right]$ *and* $\widetilde{f} = \frac{\overline{v}}{2} - \widetilde{b}$. In this case, both types of workers accept the contract and exert effort and all firms make zero profits. ■

The intuition is the following. If a firm wants to skim off motivated workers from selfish workers should offer the former ones lower wages. The difference between each type's contract has to be at least equal to the costs of effort, c. However, since $\gamma < c$ a motivated worker is better off accepting the contract addressed to the selfish worker than the contract addressed to him. Therefore, it is not possible for a firm to separate both types of workers. Competition between firms leads them to offer a contract accepted by both types of workers in which they obtain zero profits.

4 Conclusion

This paper points out the potential role of the crowding out effect of explicit incentives in intrinsic motivation as a tool that may be used by firms to design a menu of contracts in which workers with intrinsic motivation and selfish workers are separated by self-selecting the contract addressed to them.

Self-selection of workers is only possible if the crowding out effect is powerful enough.

We consider a competitive labor market with both adverse selection and moral hazard where firms employ teams of two workers which differ in their intrinsic motivation. If the crowding out is powerful enough there is a separating equilibrium in which each type of worker self-select the contract addressed to him. More importantly, all firms have expected positive profits. Our model produces in this case heterogeneity at the firm level. In the case of payment schemes, some firms have fixed wages, others have both fixed wages and performance pay. In the case of the type of workers firms hire, some firms have only motivated workers, other firms have only selfish workers and, finally, some firms have both motivated workers and selfish workers.

In future work, we intend to investigate the role of the crowding out effect on markets with imperfect competition. It will be interesting to explore whether the sorting role of the crowding out effect can be extended in markets with different degrees of competition.

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