Rewarding Idleness

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Abstract

Market wages reflect expected productivity, making use of signals of past performance and past experience. These signals are generated at least partially on the job, creating incentives for agents to choose high profile and highly visible tasks. When agents have private information about the profitability of different tasks, firms may wish to prevent over-investment in those that entail signaling, by increasing opportunity cost for these activities, for instance using employee perks. Heterogeneity in employee types induces substantial diversity in organizational and contractual choices, in particular regarding the extent to which signaling activities are tolerated or encouraged, the use of employee perks, and contingent wages.

JEL classification: D23, L22, M52

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1   Introduction

Firms differ substantially in their organizational choices, even within the same industry. This includes, for example, attitude towards idleness at work as embodied in corporate investments in perks. Employees at Google have at their disposal a wide variety of on site services and sports facilities, such as tennis courts, a swimming pool, a climbing wall, free catering in high profile restaurants and cafeterias, various entertainment facilities such as table football, and are allowed to use one workday per week for personal projects. Similarly, Microsoft and Yahoo! give access to substantial perks, including free cafeterias, a game room, massage service, or lake access. Computer game developers are known not only to

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provide their employees with free catering, but also with their own products and in some instances arcade games at work.[1]

Yet the provision of employee perks is by no means homogeneous. According to Google's funders,

> We provide many unusual benefits for our employees, [...] We believe it is easy to be penny wise and pound foolish with respect to benefits that can save employees considerable time and improve their health and productivity.[2]

On the other hand, according to Chad Little, a former Apple employee:

> [At Apple] The cafe costs, [...] Every floor has a vending machine, which also cost [...] The gym also isn't free, [...] I recall one person asked Steve why these benefits were so low, and the main response was "it's my job to make your stock go up so you can afford these things".[3]

This paper argues that employee perks that seem to encourage idleness do precisely this. Idleness can be desirable when, because of career concerns, employees have an incentive to over-invest in tasks that appear productive, in order to generate a payoff relevant signal. This is of particular concern in creative professions, where the return on different tasks may be private information to the agent, that is, the agent has expert knowledge.

Contracts, organizational form and investments in corporate infrastructure respond to employees' career concerns. In some cases, firms distort their organizational investment toward employee perks that are complementary to idleness, to balance employees' incentives to signal. Yet when generating a signal has high value for an agent, a principal may find this organizational form very costly to implement. Hence, sometimes signaling may be tolerated, and idleness discouraged, although this may lead to a task choice that does not maximize expected output. When agents differ in their propensity to signal, contractual and organizational heterogeneity arises. Firms that differ marginally in the types of employees they hire may differ substantially in organizational choice and the extent to which they tolerate and reward idleness.

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[1] The company Blizzard is widely supposed to outfit its employees with digital equipment for its online game World of Warcraft.

[2] Larry Page and Sergey Brin, *Letter from the Founders: "An Owner's Manual" for Google's Shareholders*, accessed from http://investor.google.com/corporate/2004/ipo-founders-letter.html

[3] Retrieved from http://www.quora.com/Apple-Inc-2/What-is-the-internal-culture-like-at-Apple

Intra-industry organizational heterogeneity has long been documented, mostly by measuring the dispersion in productivity within the same sector (see Gibbons, 2010, for a survey). In addition, the failure of mergers of firms in the same sector is often explained in terms of incompatible corporate cultures, pointing to organizational heterogeneity (the AOL - Time Warner merger is a case in point, see Appelbaum et al., 2009, who examine ten cases where corporate culture affected M&A outcomes). Finally, in some industries attitude toward leisure and working hours varies widely. The American Lawyer's 2006 Mid Level Associate Survey reports huge differences in weekly hours across law firms, ranging anywhere from 50 to 70. This variation is also present within major cities, e.g. in New York City mid level associates at Watchtell, Lipton, Rosen and Katz report working 69.1 hours per week, those at Carter, Ledyard and Milburn report working 50 hours per week (a similar observation holds for Chicago and Los Angeles).

Empirical support for the relevance of career concerns on employees' incentives to invest effort in visible tasks comes, for instance, from Perlow and Porter (2009). They report results of a four-years long experiment at several offices of the Boston Consulting Group, where "people believe that a 24/7 work ethic is essential for getting ahead, so they work 60-plus hours a week and are slaves of their BlackBerry."[4] The treatment administered consisted in forcing people to take time off. Each member of treatment teams had to leave the office without access to email or BlackBerry for a period of one full day or one evening per week, depending on the version of the treatment. The paper describes at length the strong resistance toward the project by the consultants, who would have preferred to continue working. The effect of the treatment was that participants reported "more open communication, increased learning and development, and a better product delivered to the client,"[5] That is, signaling incentives appeared to determine working behavior and task choice, not necessarily optimizing output.

To formalize this argument we use a model where an agent's productivity is unknown, but its expected value is commonly observable. In a firm an agent chooses to perform one of two tasks. One task is complex and generates a publicly observable signal, for instance starting a new project, initiating a merger, or launching a new marketing campaign. The outcome of this task is uncertain and may induce a monetary loss, which has to be born by the firm due to limited liability. The task's expected revenue is known to the agent but not to the principal. The other task is routine and does not generate additional information;

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[4] Perlow and Porter (2009) page 1.

[5] Ibid. page 4.

it may be interpreted as leisure. An agent lives for two periods. Choosing the visible task when young will affect the agent's productivity expected by the market and thus the payoff when old. Incentives to signal depend on the precision of the agent's prior and differ among young agents.

Firms invest in two types of corporate infrastructure: one that complements the visible task (*productive perks* such as large office space or a powerful computer) and one that complements leisure (*employee perks* such as a swimming pool or a free cafeteria). Moreover, firms choose to use one of two labor contracts: a *flexible contract* leaving the agent free to choose a task; or a *rigid contract* inducing the worker to choose a specific task (work) independent of the profitability of the task.

In equilibrium, the type of contract offered, as well as the level and composition of corporate infrastructure depend on the agent's market value and on the value of signaling. Perks are used to reward agents, but also to steer their task choice. For example, whenever the principal offers a flexible contract to a young and to an old agent of equal expected productivity, employee perks are higher and productive perks are lower for the young agent.

The model generates heterogeneity in contractual and organizational choice between agents of different productivity types, depending on their signaling incentives. Whereas all old agent receive flexible contracts, there are three different regimes for young agents. Highly productive young agents have high market value and relatively low signaling incentive. They receive a flexible contract, corporate investment composition is efficient, and signaling is discouraged by means of monetary payments conditioning on task choice. Intermediate productivity types derive high value from signaling. Hence, a firm may find rewarding idleness too costly and prefer to use a rigid contract inducing the visible task regardless of its return. This regime corresponds to organizations with strong emphasis on long working hours, where idleness is discouraged. Finally, low productivity agents have low incentives to signal and thus receive a flexible contract. The investment in perks is distorted in order to satisfy the participation constraint. Signaling is discouraged by means of an additional investment distortion, or by using monetary rewards that may take the form of a success bonus. The different regimes are determined by cut-off productivity levels, i.e. corporate investment in perks is discontinuous in employees' expected productivity. Therefore two organizations that use the same technology and employ very similar agents may differ substantially.

1.1 Related Literature

The usage of perks has been attributed to their productive characteristics, as in the case of high quality office equipment or access to corporate jets (see Marino and Zábojník, 2008, Rajan and Wulf, 2006). Perks have also been interpreted as non-monetary remuneration substituting for cash payments (see e.g. Rosen, 1986).[6] In addition to these explanations, this work emphasizes that the composition of perks is likely to affect an employee's optimal choice of task. Finally, perks have been attributed to managerial discretionary power over free cash flow (see e.g. Jensen, 1986, Bebchuk and Fried, 2004), which applies when decisions on perks are made by the ones who benefit, which is not the case in our setup.

This paper is related to the literature on career concerns, notably Gibbons and Murphy (1992) who find that monetary compensation increase in agent's age, and findings of distortions in principal-agent settings due to career concerns, such as excessive or too little risk taking (Hermalin, 1993, Hirshleifer and Thakor, 1992), over-investment in or under-usage of information (Scharfstein and Stein, 1990, Milbourn et al., 2001), over-provision of effort (Holmström, 1999), or distorted project choice (Holmström and Ricart i Costa, 1986, Narayanan, 1985). Kaarbøe and Olsen (2006) analyze effects of career concerns on optimal contracts in a multi-task setting where the principal knows the tasks' productivities. This paper is mainly concerned with the firm's organizational response. Harstad (2007) analyzes a similar setting where the firms' choice of organizational form affects the transparency of the managers' signals. By design firms can extract the full value of signaling and therefore find it profitable to increase transparency and charge the manager. In our model some firms discourage signaling, while others encourage it. Raith (2008) examines an agency setting with private information of the agent on task productivity and determines the optimal use of input and output monitoring without career concerns.

Oyer (2008) and Kvaløy and Schöttner (2011) also examine the use of non-monetary rewards to create incentives for workers. Oyer (2008) focuses on the use of benefit packages, and Kvaløy and Schöttner (2011) is concerned with "motivational effort": costly actions that decrease the worker's disutility of effort. Both use a single-task environment and remain silent on issues of task choice.

This paper also connects to the literature on delegation and experts. Closest is probably Prat (2005) who examines a setting where an expert may have an incentive to report

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[6] In a similar vein Holmström and Milgrom (1991) state that allowing for over-investment in less productive tasks in a multi-task environment can be optimal in the presence of risk aversion when the agent's participation constraint binds.

untruthfully, if this coincides with the prior and therefore signals that the expert is of high quality (see also Prendergast, 1993), and concludes that avoiding full transparency on the agent's action in agency settings may be desirable. This paper is concerned with investments complementary to tasks as a response to distortions of incentives by signaling.

The remainder of the paper is organized as follows. Section 2 introduces the theoretical framework, Section 3 solves for the partial equilibrium, Section 4 characterizes the general equilibrium in the economy, Section 5 discusses several extensions, and Section 6 concludes. All proofs not in the text are in the appendix.

2   A Simple Model

2.1   Agents

The economy is populated by a continuum of agents $i \in [0, 1]$ and a continuum of homogeneous principals $j \in [0, 1]$. Both agents and principals are endowed with measure 1. Agents are born with zero wealth, live for two periods, and are heterogeneous in their productivity type $p \in \{\underline{p}; \overline{p}\}$, with $0 < \underline{p} < \overline{p} < 1$. Productivity is unobservable to both agents and principals. Denote an agent's expected productivity in period 1 by

$$\tilde{p} = E[p].$$

2.2   Production

Principals and agents jointly generate output in firms of size 2. Solitary individuals obtain a payoff of 0. In a firm an agent decides on a task $d \in \{a, b\}$ to work on. Task b is a routine task that yields revenue 0 to the principal.[7] In contrast, task a is complex and may succeed (S) or fail (F), which is publicly observable as in Harris and Holmström (1982). The probability of success is the agent's productivity type p, the one of failure $1 - p$. In case of success revenue $R(s)$ accrues to the principal, with $s \in \{A, B\}$ denoting the state of the world and $R(A) > R(B)$. In case of failure the revenue is 0.

Task a is thus best interpreted as starting a new project, for instance developing a new product. In case the product development succeeds, the product is launched. Its profitability depends on the state of the world s. In particular, the output-maximizing task may depend on the state: $R(A) > 0 > R(B)$. This situation arises if product may flop and

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[7] The case of positive revenue is a straightforward extension generating similar results, but assigning a role to pooling on task b.

fail to break even, quality problems may hurt the firm's reputation, or design flaws trigger legal action and fines. In this case the agent has expert knowledge that is valuable to the principal, which is plausible for creative professions. Assume this is indeed the case. The state s is firm specific and drawn independently, assigning probability q to A and $1 - q$ to B.[8]

2.3 Corporate investments in infrastructure

When performing a given task a or b, the agent incurs a utility cost c depending on the task. As in Oyer (2008), this cost can be affected by the principal's investments denoted by k_a and k_b:

$$c_b(k_b) = -k_b \text{ and } c_a(k_a) = c - k_a.$$

That is, k_a is corporate infrastructure investment that is complementary to production, such as office space, powerful computers, nice office furniture, or access to a corporate jet, and can be interpreted as managerial perks. k_b is complementary to leisure, for instance swimming pools, climbing walls and game rooms, which is best interpreted as employee perks. Note also that k_a and k_b may also be interpreted as an investment in *corporate culture*, characterized for instance by the extent to which agents are rewarded by social esteem for performing a given task. Investment cost is convex in total infrastructure investment with cost function given by $(k_a^2 + k_b^2)/2$. That k_a and k_b are substitutes in the cost function is for expositional simplicity. Let

$$c > q.$$

This assumption guarantees that, in equilibrium, task a is costly for the agent.

2.4 Contractual and Informational Environment and Payoffs

In a firm (i, j) contracts specify investment by the principal (k_a, k_b) and payments w_I, w_F and w_S, which are contingent on the events that the agent chooses task b, chooses task a and a failure occurs, chooses task a and a success occurs, respectively. Payments w_S and w_F can be interpreted as a wage w_F for task a and a success bonus $w_S - w_F$; the bonus payment will have no role here, since we abstract from effort choice by the agent.[9] Absent effort choice

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[8] Note that this also consistent with interpreting s as an agent's physical state, for instance reflecting health or alertness, as long as this state can be treated as exogenous.

[9] Incorporating effort choice would not change our results substantially. Exploring the relation of incentive power and signaling behavior is likely to be of interest, but is left to future research.

and since principal and agent are risk neutral, any combination $\tilde{p}w_S + (1 - \tilde{p})w_S = const.$ induces the same payoffs for principal and agent. Abbreviate therefore $w_A = \tilde{p}w_S + (1 - \tilde{p})w_S$ with w_A denoting the expected wage going to an active agent (who chooses task a).

Agents are wealth constrained, so that contracts must induce non-negative payments.[10] Task choice and the outcome of task a, that is success or failure, are publicly observable by all firms, but revenue is not, for instance because revenue realizes with delay.[11] Individuals can only sign short term contracts (equivalently, parties can renegotiate any long term contract signed when young). Contracts may condition on whether an agent is young or old.

In each period, the payoff of an agent is thus given by $u = w_I + k_b$ if task b was chosen, and by $Eu = w_A - c + k_a$ if task a was chosen. Correspondingly the principal obtains payoffs $\pi = -w_I - \kappa$ if task b was chosen and otherwise $E\pi = \tilde{p}R(s) - w_A - \kappa$ with $\pi = -w_F - \kappa$ in case of failure and $\pi = R(s) - w_S - \kappa$ in case of success, with $\kappa = (k_a^2 + k_b^2)/2$, respectively. There is no discounting.

2.5   Timing of Events

In each period events in this economy unfold as follows.

1. A labor market matches principals and agents, who sign a binding short term contract.

2. Principals invest as specified in the contract.

3. Within each match (i, j) a state of nature $s \in \{A, B\}$ realizes.

4. The agent chooses a task a or b.

5. Success or failure realizes if the task is a, revenue accrues and payments are made and consumed.

An equilibrium in the labor market for agents is an individually rational stable allocation of pairs of principals and agents, such that there is no pair of principal and agent who are not matched in equilibrium and can obtain strictly higher joint payoff $u + \pi$ if they match and use a contract of the form (k_a, k_b, w_I, w_A).

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[10] This assumption includes old agents, though our qualitative results remain unchanged when all old agents obtain efficient contracts and perks, see Section 5.

[11] That revenue is unobservable is not crucial for our results because of limited liability, observability of the signal of success or failure is, however. Whether the contract signed in a match is publicly observable is not important when the task choice is observable.

3 Partial Equilibrium

Start by deriving the optimal behavior of a principal and an agent in a partial setting, treating the outside option $v_t(\tilde{p})$ of an agent of expected productivity $\tilde{p}$ and age $t \in y, o$ as exogenous. Given this the principal is residual claimant of the output. Section 4 will derive agents' outside options endogenously as market equilibrium payoffs.

3.1 Old Agents

Examine the case of an old agent first, since signaling has no value for an old agent. A match of principal and agent (i, j) can implement a task choice independent of the state of the world by using what we call a *rigid* contract, or implement different actions depending on the state using what we call a *flexible* contract.

Start with a flexible contract that induces the agent to choose a in state A and task b in state B (the reverse is not profit maximizing). Incentive compatibility requires the agent to be indifferent between tasks a and b, that is

$$w_A - c + k_a = w_I + k_b.$$

The participation constraint given the outside option when old $v_o(\tilde{p})$ is

$$q(w_A - c + k_a) + (1-q)(w_I + k_b) = v_o(\tilde{p}).$$

Therefore $w_I + k_b = v_o(\tilde{p})$. With incentive compatibility the principal's payoff is

$$\pi = q\tilde{p}(R(A) - c) - w_I - qk_b + qk_a - (k_a^2 + k_b^2)/2,$$

which decreases in w_I and k_b. Therefore $w_A = c - k_a + v_2(\tilde{p})$. Since $c \geq q$ it is optimal and feasible to set $k_a = q$. The choice of k_b will depend on $v_o(\tilde{p})$ since $w_I + k_b = v_o(\tilde{p})$ with $w_I \geq 0$. Hence, $k_b = v_2(\tilde{p})$ if $v_o(\tilde{p}) < 1 - q$ and $k_b = 1 - q$ otherwise.

That is, in a flexible contract productive perks will be set efficiently, $k_a = q$, matching the expected cost savings of the agent. Employee perks k_b depend on the agent's market value $v_o(\tilde{p})$ and are determined by the participation constraint. As an old agent's market value increases so do perks, until monetary payments become a more efficient means of payment, i.e. when $k_b = 1 - q$. Therefore the efficient investment level is independent of the agent's type, $k_b = 1 - q$. Hence, for old agents with low market value the non-negativity constraint on w_I binds and employee perks are under-provided.

A rigid contract implements a task independently of the state of the world. As task b returns 0 and agents are wealth constrained, a rigid contract implementing b is equivalent to no production. We focus therefore on rigid contracts implementing task a. Incentive compatibility requires

$$w_A - c + k_a \geq w_I + k_b.$$

Individual rationality is satisfied if

$$w_A - c + k_a = v_o(\tilde{p}).$$

Therefore $k_b = 0$ since the principal's payoff decreases in k_b and $w_I \leq v_o(\tilde{p})$. Hence, the principal's payoff is

$$\pi = \tilde{p}(qR(A) + (1-q)R(B)) - c - v_o(\tilde{p}) + k_a - k_a^2/2.$$

Since $w_A \geq 0$ and $c > q$, the principal will set $k_a = c + v_o(\tilde{p})$ if $v_o(\tilde{p}) < 1 - c$ and $k_a = 1$ otherwise.

That is, a rigid contract inducing a discourages idleness, $k_b = 0$, the investment in k_a is used to satisfy the agent's participation constraint, and perks increase in the agent's outside option. The following lemma sums up the results, the remaining details are in the appendix.

Lemma 1. *Contracts for old agents:*
A flexible contract specifies $w_I = v_o(\tilde{p}) - k_b$, $w_A = c - q + v_o(\tilde{p})$, and $k_a = q$ and $k_b = \min\{1 - q, v_o(\tilde{p}_i)\}$. The principal has payoff

$$\pi_o^f = q(\tilde{p}_i R(A) - c + q/2) - v_o(\tilde{p}) + (1-q)k_b - k_b^2/2.$$

A rigid contract implementing a has $w_I \leq v_o(\tilde{p})$, $w_A = c - k_a + v_o(\tilde{p})$, and $k_a = \min\{1, c + v_o(\tilde{p})\}$ and $k_b = 0$. The principal has payoff

$$\pi_o^r = \tilde{p}(qR(A) + (1-q)R(B)) - c - v_o(\tilde{p}) + k_a - k_a^2/2.$$

If $R(B) \leq 0$, a flexible contract induces higher surplus than a rigid contract for all $v_o(\tilde{p})$, so that production occurs if

$$q(\tilde{p}R(A) - c + q/2) - qv_o(\tilde{p}) - (v_o(\tilde{p}))^2/2 \geq 0.$$

Hence, when $R(B) > 0$ agents without career concerns obtain a flexible contract that specifies a monetary bonus $w_A > 0$ in case they work on task a and receive a base wage $w_I < w_A$ otherwise. Corporate investments in infrastructure complementary to task A (that is, productive perks such as office equipment) are chosen efficiently. Investments complementary to leisure (that is, employee perks such as free swimming pools or gaming rooms) may be under-provided, however. Employee perks are used as non-monetary compensation in contracts for old agents. Hence, for agent's with low market value ($v_o(\tilde{p}) < 1 - q$) the marginal utility of employee perks still exceeds the marginal cost of provision. This is very plausible, for instance when tariff regulations impede companies from lowering wages below the tariff wage (here the outside option of 0) or if company-wide wage schedules are used.

3.2   Young Agents

The contracting problem for young agents is complicated by the possibility of signaling. Failing or succeeding in task a provides an informative signal about the agent's productivity p_i, while remaining idle - either choosing task b or remaining unmatched - does not. Correspondingly, denote the posterior expectation of an old agent's productivity by $p_I(\tilde{p}_i)$ if the agent remained idle in period 1, by $p_F(\tilde{p}_i)$ if the agents failed at task a, and by $p_S(\tilde{p}_i)$ if the agent succeeded. Applying Bayes' formula (see appendix for details) yields the following statement.

Lemma 2. *Expected productivity when old is $p_S(\tilde{p}_i) = \overline{p} + \underline{p} - \frac{\overline{p}\underline{p}}{\tilde{p}_i}$ after observing a success in task a, $p_F(\tilde{p}_i) = \frac{\tilde{p}_i(1 - \underline{p} - \overline{p}) + \overline{p}\underline{p}}{1 - \tilde{p}_i}$ after observing a failure in task a, and $p_I(\tilde{p}_i) = \tilde{p}_i$ otherwise.*

Clearly, $p_F(\tilde{p}_i) < p_I(\tilde{p}_i) = \tilde{p}_i < p_S(\tilde{p}_i)$. This will determine an agent's market payoff when old, $v_2(p_h(\tilde{p}_i))$, depending on history $h = I, S, F$.

A flexible contract for a young agent of expected productivity $\tilde{p}$ has to satisfy incentive compatibility

$$w_A + s(\tilde{p}) - c + k_a = w_I + k_b,$$

where $s(\tilde{p})$ denotes the value of signaling for a young agent with expected productivity $\tilde{p}$ defined as

$$s(\tilde{p}) = \tilde{p}v_2(p_S(\tilde{p})) + (1 - \tilde{p})v_2(p_F(\tilde{p})) - v_2(\tilde{p}).$$

Individual rationality requires

$$q(w_A + s(\tilde{p}) - c + k_a) + (1 - q)(w_I + k_b) = v_y(\tilde{p})$$

where $v_y(\tilde{p}_i)$ denotes a young agent's outside option. This implies that $w_I + k_b = v_y(\tilde{p})$. With incentive compatibility this is

$$w_A + s(\tilde{p}) - c + k_a = w_I + k_b = v_y(\tilde{p}).$$

Since $s(\tilde{p})$ can be positive, $w_A \geq 0$ may imply that $k_a < q$. Hence, $k_a = q$ if $v_y(\tilde{p}) \geq s(\tilde{p}) + q - c$ and $k_a = v_y(\tilde{p}) + c - s(\tilde{p})$ otherwise. As above, $k_b = v_y(\tilde{p})$ if $v_y(\tilde{p}) < 1 - q$ and $k_b = 1 - q$ otherwise.

The possibility of signaling biases the agent's choice toward the visible task a; a flexible contract has to balance this by providing adequate incentives for b using an appropriate mix of investments k_a and k_b, and monetary incentives. For young agents with low outside options provision of employee perks satisfies the participation constraint. To ensure incentive compatibility the principal finds it profitable to reduce investment k_a below the efficient level q and make task a relatively more costly than b: *idleness is rewarded* relatively to work in order to reduce signaling.

To implement a in a rigid contract for young agents incentive compatibility requires

$$w_A + s(\tilde{p}) - c + k_a \geq w_I + k_b.$$

Individual rationality requires

$$w_A + s(\tilde{p}) - c + k_a = v_y(\tilde{p}).$$

Therefore $k_b = 0$ and $w_I \leq v_y(\tilde{p})$. Analogously to the old-agent case, optimally $k_a = c + v_y(\tilde{p})$ if $v_y(\tilde{p}) < 1 - c$ and $k_a = 1$ otherwise. The following lemma sums up these results.

Lemma 3. *Contracts for young agents:*
(i) a flexible *contract specifies* $k_a = \min\{q, v_y(\tilde{p}) - s(\tilde{p}) + c\}$, $k_b = \min\{1 - q, v_y(\tilde{p})\}$, $w_A = v_y(\tilde{p}) + c - s(\tilde{p}) - k_a$, *and* $w_I = v_y(\tilde{p}) - k_b$. *The principal's payoff is*

$$\pi_y^f = q(\tilde{p}R(A) - c) + qk_a + (1 - q)k_b + qs(\tilde{p}) - v_y(\tilde{p}) - (k_a^2 + k_b^2)/2.$$

(ii) A rigid *contract implementing* a *specifies* $w_I \leq v_y(\tilde{p})$ *and* $k_b = 0$, $k_a = \min\{1, v_y(\tilde{p}) - s(\tilde{p}) + c\}$, *and* $w_A = v_y(\tilde{p}) + c - s(\tilde{p}) - k_a$. *The principal has payoff*

$$\pi_y^r = \tilde{p}(qR(A) + (1 - q)R(B)) + s(\tilde{p}) - c + k_a - k_a^2/2 - v_y(\tilde{p}).$$

Determine now whether a rigid or a flexible contract is more profitable given that an agent of expected productivity $\tilde{p}$ obtains a payoff of $v_y(\tilde{p})$ and has signaling value $s(\tilde{p})$.

Proposition 4. *For every $\tilde{p} \in [\underline{p}, \overline{p}]$, there is a cutoff $\hat{v}(\tilde{p})$ such that a young agent will obtain a flexible contract if $v_y(\tilde{p}) \leq \hat{v}(\tilde{p})$,*

$$\hat{v}(\tilde{p}) = \begin{cases} (1-q)/2 - \tilde{p}R(B) & if \ -2\tilde{p}R(B) \geq 1 - q \\ \sqrt{2(1-q)(-\tilde{p}R(B))} & otherwise. \end{cases}$$

If $v_y(\tilde{p}) > \hat{v}(\tilde{p})$, there is a function $\hat{s}(v)$ such that a young agent obtains a flexible contract if $s(\tilde{p}) \leq \hat{s}(v_y(\tilde{p}))$ and a rigid contract otherwise. $\hat{s}(v)$ is decreasing in its argument and approaching $c - q - \tilde{p}R(B)$ as v grows out of bounds.

This means that a minimum rent for the agent is needed to make rigid contracts viable. The reason for this is that the rent from signaling goes exclusively to the agent, while the cost, in form of foregone revenue $R(A) - E[R(s)]$ is born by the principal. Limited liability and agents' wealth constraints prevent them from paying for the opportunity to signal. The following corollary sums up the comparative statics of corporate investments and the signaling value, the last statement follows from the definition of $s(\tilde{p})$.

Figure 1 shows three distinct contractual and organizational regimes. Agents who have high market value and high signaling value (the area above the green line) will receive a rigid contract, discouraging idleness and emphasizing task a. Note that this is not the output-maximizing task choice, but principals are compensated for the output loss by extracting part of the value of signaling. This corresponds to competitive organizations where there is a lot of emphasis on long working hours.

Second, agents who have low market value and high signaling value (the area above the red and under the green line) receive a flexible contract and corporate investments are distorted to discourage signaling. In particular, efficient investment in employee perks in conjunction with under-investment in productive perks is possible. This corresponds to organizations where idleness is emphasized and signaling actively discouraged.

Finally, agents who have low signaling value (the area below the red and under the green line) receive a flexible contract. Idleness is tolerated, but not explicitly rewarded. Investment in productive infrastructure is efficient, and employee perks are used to reward the agent, not to affect task choice. This corresponds to organizations where monetary rewards on hours worked are enough to induce the optimal task choice.

4   Labor Market Equilibrium

To close the model, the value of signaling $s(\tilde{p})$ and market rents $v_t(\tilde{p})$ need to be derived endogenously. In the labor market in a period t measure 1 of principals compete for mea-
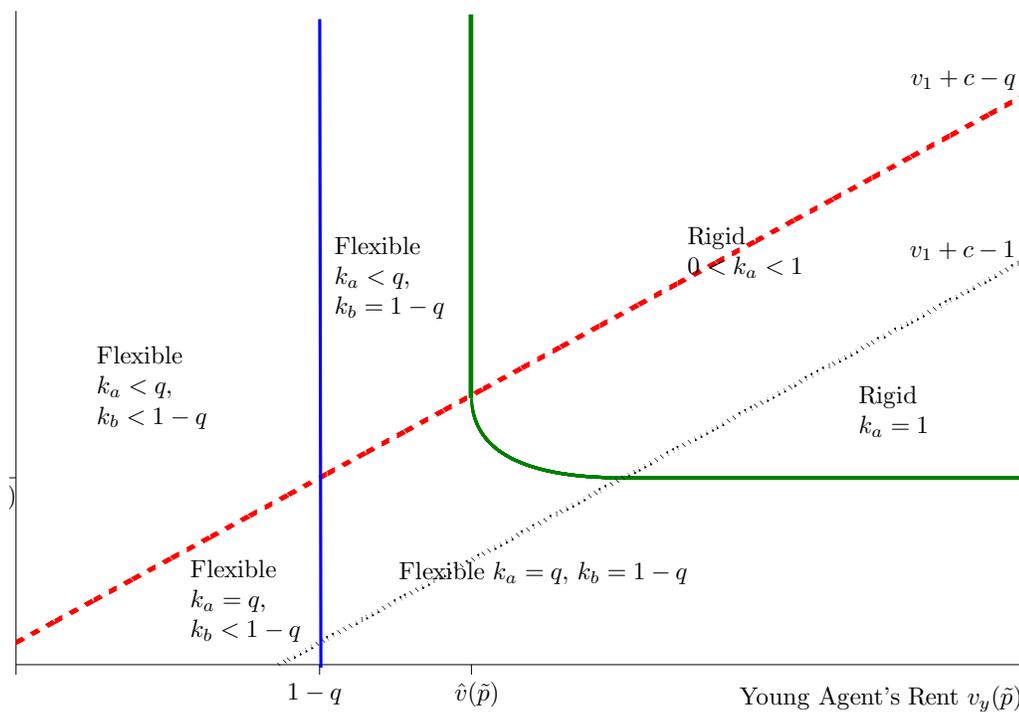
Fig. 1: Contractual and organizational regimes depending on signaling value $s(\tilde{p})$ and agent's market payoff when young $v_y(\tilde{p})$.

sure 1 of agents, with measure $1/2$ of young and old agents each. The distribution of young agents' expected productivities $\tilde{p}$ has full support on $[\underline{p}, \overline{p}]$. This assumption suffices to guarantee stationarity of our simple labor market. Old agents are characterized by the conditional expectation of their productivity given the work history when young, $p_S(\tilde{p})$, $p_F(\tilde{p})$, or $\tilde{p}$. Hence, the distribution of old agents' expected productivities, and therefore market prices and signaling values, depend on the amount of signaling induced by organizational and contractual choice in the first period.

As above, a labor market equilibrium is a stable assignment of principals and agents into pairs or singletons, given young agents' rational expectation of the wage schedule when old.

Start therefore by deriving the equilibrium wage schedule $v_o(\tilde{p})$ for old agents in any period. As above, because $R(B) \leq 0$ the optimal contract for an old agent is flexible.[12]

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[12] Focusing on flexible contracts for old agents facilitates exposition but does not drive the results.

Using Lemma 1, a principal and an old agent with expected productivity $\tilde{p}$ have positive expected surplus from production using a flexible contract if

$$q(\tilde{p}R(A) - c + q/2) - qv - v^2/2 \geq 0 \text{ for } v \geq 0.$$

That is, with an old agent production occurs only if

$$\tilde{p} \geq (c - q/2)/R(A) := p_o.$$

Assume that for high productivity $\overline{p}$ agents production using task a is profitable, but not for low productivity $\underline{p}$ agents:

$$\underline{p} < p_o < \overline{p}.$$

Hence, all old agents with $\tilde{p} \leq p_o$ are unemployed obtaining zero payoff, and principals compete for agents who enable strictly positive expected surplus in a match. This in turn implies that principals obtain zero payoff in equilibrium, the same as their outside option of not matching. By Lemma 1 equilibrium payoffs for old agents and principals are thus

$$\pi = 0 \text{ and } v_o(\tilde{p}) = \begin{cases} 0 & \text{if } \tilde{p}_i \leq p_o \\ \sqrt{2q(\tilde{p}R(A) - c + q)} - q & \text{if } p_o < \tilde{p} < \frac{1 + 2q(c-q)}{2qR(A)} \\ q(\tilde{p}R(A) - c + q/2) + (1 - q)^2/2 & \text{otherwise.} \end{cases} \quad (1)$$

Since $\underline{p} < p_o$ principals are oversupplied in any period so that the wage schedule for old agents $v_o(\tilde{p})$ above is indeed time invariant and determines the value of signaling for young agents. For $\tilde{p}$ sufficiently high so that $p_F(\tilde{p}) > p_o$ the value of signaling is zero as

$$p_F(\tilde{p}) = \frac{\tilde{p}}{1 - \tilde{p}}(1 - p_S(\tilde{p}))$$

by Lemma 2. The value of signaling for young agents is given by

$$s(\tilde{p}) = \begin{cases} \tilde{p}v_o(p_S(\tilde{p})) & \text{if } \tilde{p} < p_o < p_S(\tilde{p}) \\ \tilde{p}v_o(p_S(\tilde{p})) - v_o(\tilde{p}) & \text{if } p_F(\tilde{p}) < p_o < \tilde{p} \\ 0 & \text{otherwise.} \end{cases}$$

Differentiating $v_o(\tilde{p})$ implies that $s(\tilde{p})$ strictly increases on $\tilde{p} < p_o < p_S(\tilde{p})$ and strictly decreases on $p_F(\tilde{p}) < \tilde{p}_o < \tilde{p}$.

This suffices to determine the difference in the composition of corporate investment for young agents who have an incentive to signal and old agents who do not, which is stated in the following proposition. The proof is in the appendix.

Proposition 5. *Consider a young agent and an old agent of equal expected productivity $\tilde{p}$, both obtaining a flexible contract. Investment in employee perks k_b is higher for the young agent than for the old agent, and strictly so if $k_b < 1-q$ for the old agent with $\tilde{p}$. Investment in productive perks k_a is higher for the old agent than for the old agent, and strictly so if $k_a < q$.*

That is, incentives to signal for young agents bias corporate investment toward employee perks whenever they receive a flexible contract. In such contracts monetary and non-monetary incentives for task a need to be balanced by an appropriate reward for idleness, here in form of employee perks k_b.

To determine whether flexible contracts are used for young agents, and if so in which matches, the labor market equilibrium outcome has to be computed. To do so start by identifying the young agents who are employed, i.e. who obtain a contract that implements task a with positive probability. Since principals receive $\pi = 0$ and transfers cannot be negative, a young agent with $\tilde{p}$ is employed whenever this generates positive expected output using an optimal contractual arrangement. By Lemma 3 the output-maximizing contract is flexible. Moreover, joint surplus under flexible contract increases in productivity $\tilde{p}$. Therefore there is a cutoff productivity p_y, such that only young agents with $\tilde{p} > p_y$ are employed. The marginal agent's payoff under a flexible contract is

$$v_y(p_y) = q(p_y R(A) + k_b + s(p_y) - c) - q - k_b^2/2 + qk_a - k_a^2/2,$$

with $k_a = q$ if $s(p_y) \leq c - q$ and $k_a = c - s(p_y)$ otherwise. As indeed $v_y(p_y) = 0$, p_y can be calculated from the above expression, as stated in the following proposition.

Proposition 6. *There is p_y such that all young agents with $\tilde{p} \geq p_y$ are hired by a principal. For $\tilde{p}$ close to p_y this contract is flexible. Moreover, $p_y < p_o$, i.e. young agents are hired by principals at lower productivity than old agents.*

Proof: Establish first that $v_y(\tilde{p})$ strictly increases in $\tilde{p}$ when implementing task a at least some of the time. For this we need that $\frac{\partial s(\tilde{p})}{\partial \tilde{p}} > -R(A)$, which is easily verified using the definitions of $s(\tilde{p})$ and $v_o(\tilde{p})$, which increases in $\tilde{p}$ as does $p_S(\tilde{p})$. For flexible contracts,

$$v_y(\tilde{p}) = \begin{cases} \frac{1}{2}[\sqrt{4\tilde{p}qR(A) - (c - s(\tilde{p}))^2} - (c - s(\tilde{p}))] & \text{if } v_y(\tilde{p}) < 1 - q, q + s(\tilde{p}) - c \\ \sqrt{2q(\tilde{p}R(A) + s(\tilde{p}) - c + q)} - q & \text{if } q + s(\tilde{p}) - c < v_y(\tilde{p}) < 1 - q \\ \sqrt{2[(1-q)(c - s(\tilde{p})) + q\tilde{p}R(A)]} - (1 - q + c - s(\tilde{p})) & \text{if } 1 - q < v_y(\tilde{p}) < q + s(\tilde{p}) - c \\ q(\tilde{p}R(A) - c + s(\tilde{p}) + q/2) + (1-q)^2/2 & \text{if } v_y(\tilde{p}) > 1 - q, q + s(\tilde{p}) - c. \end{cases}$$

For rigid contracts,

$$v_y(\tilde{p}) = \begin{cases} \sqrt{2\tilde{p}R(A)} - (c - s(\tilde{p})) & \text{if } v_y(\tilde{p}) < 1 + s(\tilde{p}) - c \\ \tilde{p}R(A) - c + s(\tilde{p}) + 1/2 & \text{if } v_y(\tilde{p}) > 1 + s(\tilde{p}) - c. \end{cases}$$

In all cases the first derivative with respect to $\tilde{p}$ is positive.

Suppose that $s(p_y) > c$. Then there is $p'_y < p_y$ with $s(p'_y) > c$ so that $v_y(p'_y) = q(p'_y R(A) + s(p'_y) - c) + (1 - q)k_b - k_b^2/2 > 0$ for $k_b \in [0, 1 - q]$, a contradiction. Hence, $c \geq s(p_y)$. Then $0 = v_y(p_y) < 1 - q$ and $0 = v_y(p_y) < \hat{v}(\tilde{p})$, implying a flexible contract is chosen. Hence, either $v_y(\tilde{p}) < 1 - q, q + s(\tilde{p}) - c$ or $q + s(\tilde{p}) - c < v_1(\tilde{p}) < 1 - q$ must be the case. Setting $v_y(p_y) = 0$ then yields

$$p_y R(A) = (c - s(p_y))^2/2q \text{ if } s(p_y) > c - q \text{ and}$$
$$p_y R(A) = (c - s(p_y) - q/2) \text{ otherwise.}$$

This immediately implies $p_y \leq p_o = (c - q/2)/R(A)$, with a strict inequality if $s(p_o) > 0$. This also implies that $s(p_y) = p_y v_o(p_S(p_y))$, which ensures that $s(\tilde{p})$ is increasing at p_y. Using the definition of $s(.)$ yields the cutoff productivity in terms of the primitives.   □

Note first that young agents are employed at lower productivity than old agents, because young agents derive signaling value from task a, which partly compensates their effort cost c for task a. Therefore young agents are willing to work for less remuneration than are old agents, making them less costly at the same productivity. A second observation is more subtle: young agents who are just productive enough to obtain a contract that allows them to signal, are employed using a separating contract rather than a pooling contract, which would maximize the opportunity to signal. Similar to the partial setting this is because only young agents with sufficiently high signaling and market value receive a rigid contract. The reason for the latter is that the principal needs to be compensated for the decrease in expected revenue (since $E[R(s)] < qR(A)$).

Turn now to the question of whether firms find it optimal to use rigid contracts at all. This depends on the value of signaling. It is possible to express the cutoff value $\hat{s}(v_y(\tilde{p}))$ from Proposition 4 as a cutoff value depending on $\tilde{p}$, $\hat{s}(\tilde{p})$. The following Lemma summarizes its properties, its proof uses standard arguments and is in the appendix.

Lemma 7. *There exists a function $\hat{s}(\tilde{p})$ such that a rigid contract is preferred to a flexible contract whenever $s(\tilde{p}) > \hat{s}(\tilde{p})$. $\hat{s}(\tilde{p})$ strictly decreases for $\tilde{p} \in [p_y, p_1]$ for some $p_1 > p_y$ and strictly increases for $v_y(\tilde{p}) \geq 1 - q - \tilde{p}R(B)$. If $q/2 > (2q - 1)(c - q)$ then $\hat{s}(\tilde{p})$ is convex and has a unique minimum.*

A rigid contract is preferable to a flexible contract for agents with productivities $\tilde{p}$ such that $v_y(\tilde{p}) > \hat{v}(\tilde{p})$ and $s(\tilde{p}) > \hat{s}(v_y(\tilde{p}))$. Using Lemma 7 and going through the cases yields a proposition on the labor market outcome. Its proof can be found in the appendix.

Proposition 8 (Labor Market Outcome). *In a labor market equilibrium, there are values $\underline{p} < \tilde{p}_y < \tilde{p}_o < \overline{p}$ such that old agents obtain a flexible contract if $\tilde{p} \geq p_o$ and no contract otherwise, while young agents obtain some contract if $\tilde{p} \geq p_y$.*
If $R(B)$ is sufficiently close to 0 and c sufficiently close to q there are thresholds $p_y < p_1 < p_2 \leq p_3 < p_4 < \overline{p}$ such that the optimal contract for a young agent is:
    (i) flexible for $p_y < \tilde{p} < p_1$ with $w_A = 0$ and $0 < k_a \leq q$ and $0 < k_b \leq 1 - q$,
    (ii) rigid for $p_1 < \tilde{p} < p_2$ and $p_3 < \tilde{p} < p_4$ with $w_A \geq 0$ and $q < k_a \leq 1$ and $k_b = 0$, or
    (iii) flexible for $p_3 < \tilde{p} < \overline{p}$ with $w_A > 0$ and $k_a = q$ and $0 < k_b \leq 1 - q$.
If $q/2 > (2q-1)(c-q)$ then $p_2 = p_3$.
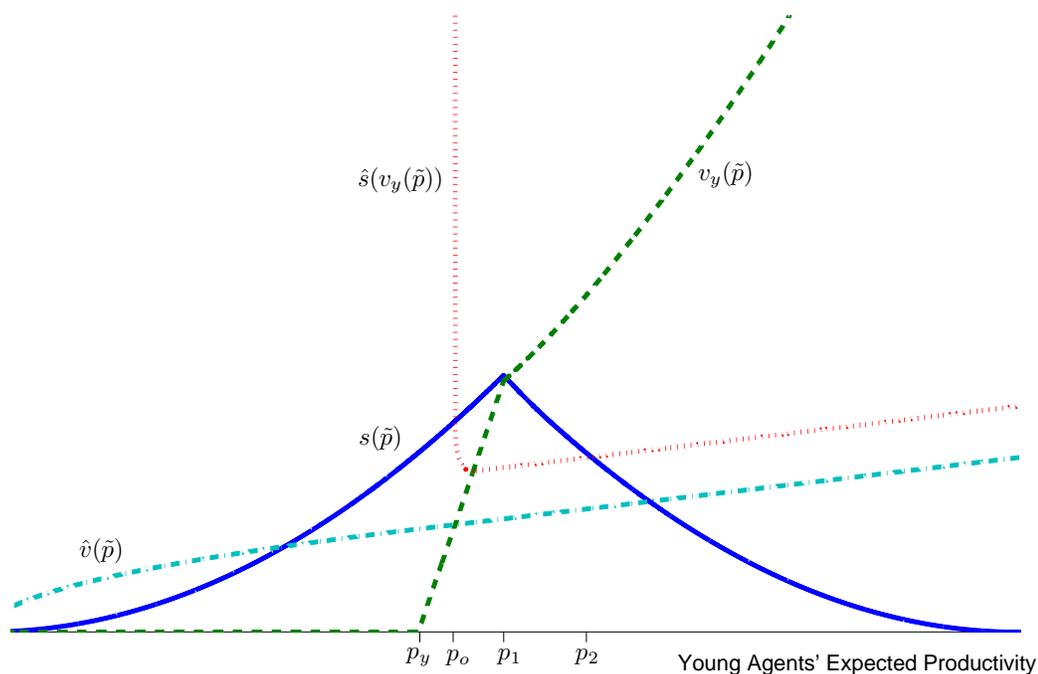
Fig. 2: Contractual and organizational regimes depending on expected productivity $\tilde{p}$.

Recall that when $R(B) < 0$, only flexible contracts are used for old agents. Organizational and contractual heterogeneity arises for young agents, however, as firms may find

it optimal to react to the agent's desire to signal in one of three ways. For agents whose productivity is low, $p_y < \tilde{p} < p_1$, signaling incentives are strong but the associated market payoff is low, so that a flexible contract with under-investment in k_a. In this case, k_b serves as payment to the agent whereas k_a is used to discourage choosing task a. Agents with $p_1 < \tilde{p} < p_2$ have high signaling values in conjunction with intermediate market values. They are thus able to compensate the principal for the shortfall in expected revenue $qR(A) - E[R(s)]$ by reducing the wage w_A. Hence a rigid contract is used. Finally, agents whose productivity is high have weak signaling incentives and high market value, and obtain a flexible contract with efficient investment in k_a, and possibly in k_b. This is summarized in Figure 2, which shows the regimes in the labor market equilibrium for young agents.

Note further that contracts for agents with $p_y < \tilde{p} < p_o$ can also be interpreted as contacts that threaten to fire an agent who chooses task a, an extreme form of rewarding idleness. This is particularly true when $v_y(p_1) > 1 - q$ since in this case $w_I > 0$ whereas $w_A = 0$. Taking task a the agent obtains no wage but a signal, and either will not get no contract in case of failure, or a different contract with possibly a different employer in case of success.
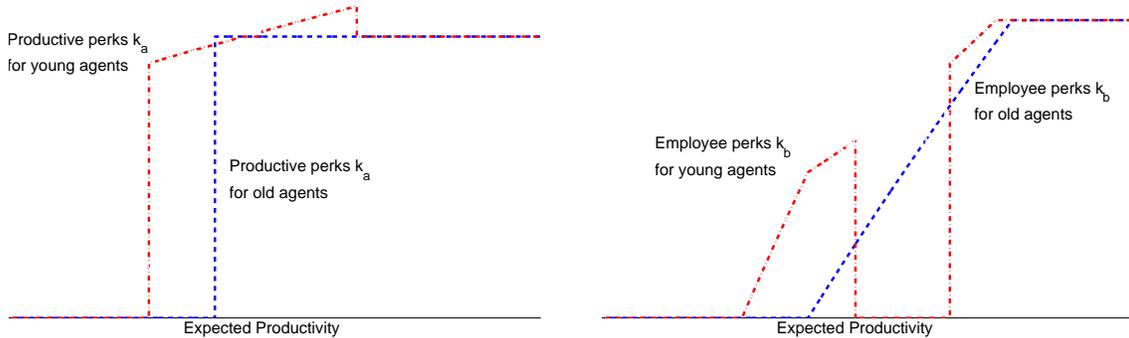
Fig. 3: Investment in k_a (left) and k_b (right), for given agent's productivity and age.

Figure 3 depicts the equilibrium corporate infrastructure investment for old and young agents at different productivity levels. For young agents, the investment is discontinuous whenever the contractual regime changes. A young agent receiving a flexible contract enjoys higher k_b (e.g. sports facilities or game rooms) and lower k_a (e.g. office equipment or corporate jets) relative to an old agent having the same productivity. Young agents who

receive rigid contracts enjoy lower k_b than old agents with the same productivity.

Efficiency

Turn now to the constrained efficient allocation: the surplus-maximizing organizational and contractual choice, derived under the assumption that workers' productivity is not observable.[13] Joint surplus is given by

$$q(\tilde{p}R(A) - c + s(\tilde{p})) + qk_a - k_a^2/2 + (1-q)k_b - k_b^2/2$$

implying that the efficient investment is $k_a = q$ and $k_b = 1 - q$. Using a rigid contract, joint surplus is

$$\tilde{p}(E[R(s)] - c + s(\tilde{p})) + k_a - k_a^2/2$$

implying that the efficient investment is $k_a = 1$. Hence, in any cohort, for low values of $\tilde{p}_i$ the equilibrium investments will be lower than the efficient investments. A rigid contract is efficient if

$$s(\tilde{p}) \geq c - q - \tilde{p}R(B).$$

with strict inequality for $v_y(\tilde{p}) < 1 - q - \tilde{p}R(B)$. Otherwise a flexible contract is efficient.

The main difference between second best and decentralized allocation is that, in the second best, the investment in perks depends exclusively on the type of contract offered, and not on the type agent matched. This implies that perks are never used as reward, or induce incentive compatibility in a flexible contract by making action b relatively more attractive. Idleness is never rewarded relatively to work, since the principal can charge the agent for the opportunity to signal if a rigid contract is second best efficient. For the same token, idleness is never discouraged, since the principal can set the efficient level of perks and then use negative monetary transfers to satisfy the participation constraint.

Note also that the distortion in the investment implies a distortion in the incentive to signal, since investment when old affects the incentive to signal when young. This, in turns, will affect the second best contractual choice when young.

For old agents, under the assumption $R(B) < 0$, a flexible contract maximizes joint surplus. It follows that old agents will be matched if

$$\tilde{p} \geq \frac{qc - 1/2 + q(1-q)}{qR(A)} := p^* < p_o.$$

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[13] In a first best, when the social planner has full information there is, of course, no need for signaling and only flexible contracts are used.

Hence, their payoff in the second best is

$$v_o^*(\tilde{p}) = q(\tilde{p}R(A) - c + q) + (1-q)^2/2 \text{ if } \tilde{p} \geq p^*,$$

and 0 otherwise. Therefore $v_o^*(\tilde{p}) \geq v_o(\tilde{p})$, with strict inequality if $p^* < \tilde{p} < (1 + 2q(c - q))/(2qR(A))$, (see equation 1). The social value of signaling in a second best is therefore

$$s^*(\tilde{p}) = \begin{cases} \tilde{p}v_o^*(p_S(\tilde{p})) & \text{if } \tilde{p} \leq p^* \leq p_S(\tilde{p}) \\ \tilde{p}v_o^*(p_S(\tilde{p})) - v_o^*(\tilde{p}) & \text{if } \tilde{p} \geq p^* \geq p_F(\tilde{p}) \\ 0 & \text{otherwise.} \end{cases}$$

Comparing $s^*(\tilde{p})$ to the market equilibrium value of signaling $s(\tilde{p})$ yields

$$s^*(\tilde{p}) \geq s(\tilde{p}) \text{ if } \tilde{p} \leq p^* \text{ and } s^*(\tilde{p}) \leq s(\tilde{p}) \text{ if } \tilde{p} \geq p^0.$$

That is, the second best value of signaling exceeds the decentralized value of signaling for low productivities and falls short of it for high productivities. However, the distortion in the signaling value solely derives from the distortion in the investment in k_b: in the decentralized equilibrium the private value of signaling coincides with the social value of signaling. The following proposition summarizes these results.

Proposition 9 (Efficiency). *In a competitive allocation, relatively to the constrained efficient allocation, for old agents investment in k_a is efficient but there is under-investment in k_b for low productivity types. Too few old agents are hired. For young agents there can be under-investment both in k_a and k_b. Some young agents obtain a separating contract with efficient k_b but too low k_a. High productive young agents get flexible contracts with efficient investment. There is too little signaling for young agents with $\tilde{p}$ around p_1, there is too much signaling around p_2.*

Hence, comparing the market equilibrium to the second best allocation, there are two notable differences. First, taking the value of signaling as given, too few young agents receive rigid contracts, since the principal cannot charge the agent for signaling. Second, the second best value of signaling is higher for low productivity types, and lower for high productivity types than the value of signaling in the laissez faire market allocation. This has implications for the measure of young agents that will be hired, and for the types of contract offered. Figure 4 shows the differences between second and decentralized allocation. First best outcomes are marked by stars.
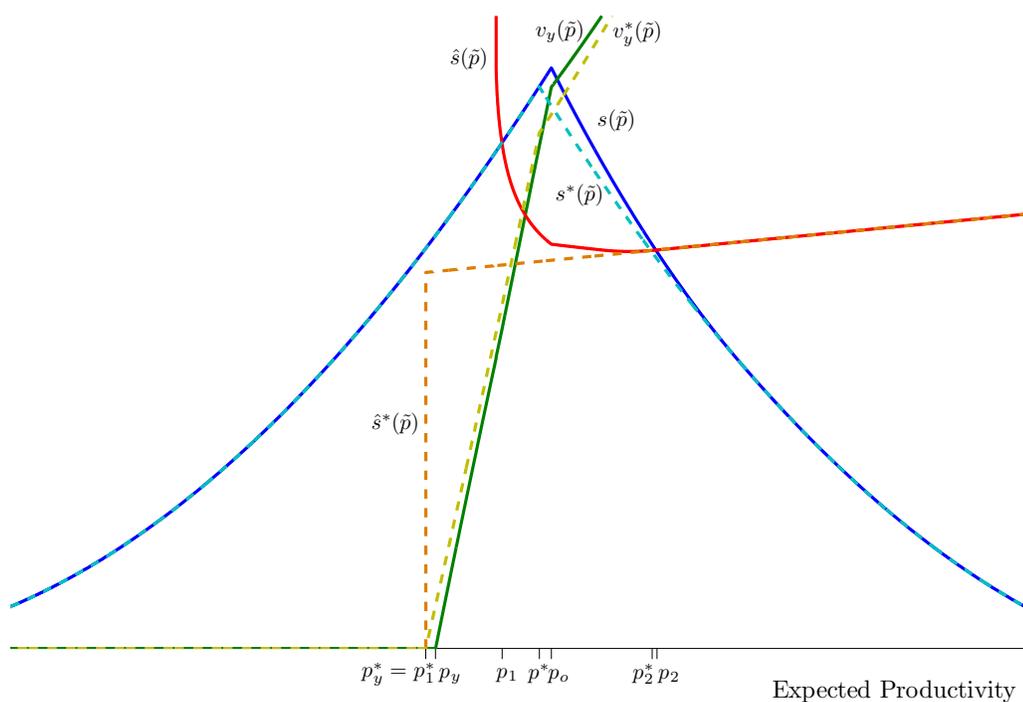
Fig. 4: Equilibrium (solid) versus first best (dashed) outcomes.

5 Discussion

When the Agent Is Not an Expert

This paper has assumed throughout that the agent's private information matters for task choice, in the sense that the task maximizing expected output is state dependent, $R(A) > 0 > R(B)$. This means the agent has idiosyncratic expertise, which corresponds best to creative professions. When $R(B)$ is strictly positive and sufficiently high there is no tension between the agent's and the principal's preferred task choice: both prefer task a. Therefore, a rigid contract will be used for both young and old agents, and investment in employee perks is zero. In this case limited liability does not bind and the downside risk of task a can be born by the agent. This corresponds to non-creative professions, where the value of output generated by a given action is highly predictable. In these professions, the worker no flexibility over what task to choose, idleness is always punished, and investment in employees perks k_b is zero.

Long Term Contracts

The analysis above remains qualitatively unchanged if long term contracts can be used that specify wages and investment levels when young and when old, conditioning the latter on whether the agent experienced a success or failure, or remained idle when young. In this case whenever the liquidity constraint binds for a young agent, such that $k_a < q$, a flexible contract will give higher rent to the agent when young thereby increasing k_a and k_b when young and decreasing k_b when young compared to the case of short term contracting.

This has an effect on the value of signaling, which is now determined by the principal's choice of contract, in particular by the choice of continuation payoff for the agent after observing a success, failure or idleness. For agents with low market value the value of signaling under long term contracting is lower than under short term contract, since part of the second period rent is redistributed to the first period increasing investments. For agents with sufficiently high productivity such that investments are efficient the value of signaling under long term contracting coincides with the one under short term contracting. There is still the possibility of rigid contracts implementing task a being preferable if $R(B)$ sufficiently high and c sufficiently small.

Technological Change

Technological change may have an interesting effect on the dynamics of the labor market when different productivity types are affected differentially, i.e. technological change is skill biased. A simple way to model this is to let high productivity $\overline{p}$ increase, implying that highly productive agents are affected but not low productive agents. As a consequence, old agents' market values increase and the wage schedule for old agents becomes more convex. low productivity $\underline{p}$ is still not sufficient to make task a profitable) This increases the value of signaling for young agents, increasing the desirability of rigid contracts and exacerbating under-investment in productive perks. This is partially compensated for by an increase in young agents' market values as expected surplus increases due to technological change. Overall, however, the use of rigid contracts that encourage signaling will increase.

Dynamics of Signaling

When moving from a two period model of an agent's economic life to allow for more periods, the pattern described above largely carries over. The value of signaling decreases over the lifetime of an agent, mirroring Gibbons and Murphy (1992). This reflects the diminishing

net present value of future earnings and therefore the option value of a success as the
agent grows older. This in turn implies that the expected productivity of the marginal
agent, who generates an expected joint surplus of 0 increases in an agent's age. Hence,
the organizational choice described above functions as screening mechanism that becomes
increasingly demanding as agents grow older when selecting agents who will get a contract
that allows to perform task a with positive probability.

6 Conclusions

This paper has examined the organizational response to career concerns when agents have
private information on the profitability of different tasks. Principals' choices of contracts
and ex-ante investment in corporate infrastructure are discontinuous in agents' attributes:
firms that employ similar types of agents may optimally choose very different organizational
forms, one that rewards idleness or one that rewards signaling activities. The reason is that
rewarding idleness reduces an agent's incentive to engage in signaling activities that may
be costly for the principal. However, if the value of signaling is very high the principal may
find that discouraging the agent is too costly. This corresponds to empirical phenomena
such as wide variety in the use of employee perks and principals' expectations on employees'
willingness to do overtime work.

In a labor market equilibrium assigning heterogeneous agents to principals three dif-
ferent regimes of organizational choice emerge: for low productivity types incentives to
signal are balanced by rewarding idleness, though corporate investment are under-provided
as a result of limited liability by the agent. In a second regime employed for intermediate
productivities organizational choice encourages activities generating signals about agents'
types and discourages idleness, biasing corporate investment composition toward invest-
ments complementary to signaling. For agents of high productivity, who have low value
from signaling, organizational choice balances signaling incentives by rewarding idleness
through employee and corporate investments are efficient.

In our model, the incentive to signal also depends on the degree of convexity in future
rewards. More convexity implies a higher benefit from generating a signal by choosing
a visible task. Hence, for more convex wage schedules firms will increasingly choose an
organizational form discouraging idleness. This corresponds to the well-known negative
empirical relationship between worse market conditions (higher unemployment rate) and
sick-days leave. In addition, this observation could be relevant in other contexts such as

the design of grading system in education.

To derive these points in a tractable manner the model employed has been chosen for simplicity rather than generality. For instance, effort choice by the agent is discrete. An extension could consider continuous effort deriving results on the relationship of organizational choice and the power of monetary incentives used. Another extension that appears promising could allow for heterogeneity among principals. This would introduce the possibility of externalities from signaling activities and raise the question of whether a labor market equilibrium comes close to the constrained optimal amount of experimentation.

Finally, this model has implications for job turnover and for the analysis of internal labor markets. Whenever an agent chooses a signaling activity this triggers an update of expected productivity likely leading to job change. Therefore a rigid contract corresponds in some sense to an 'up or out' work environment, where employees are either promoted or fired. In a flexible contract there is instead the possibility of staying idle, which will not change the expected productivity, and thus remaining on the same job in the following period corresponding to lower turnover in firms that use employee perks.

A   Mathematical Appendix

Proof of Lemma 1

To establish the last statement suppose $v_o(\tilde{p}) < 1 - c$ first. This implies $v_o(\tilde{p}) < 1 - q$. A flexible contract is profitable if

$$(1 - q)c + q^2/2 + (1 - q)v_o(\tilde{p}) - (v_o(\tilde{p}))^2/2 > (1 - q)pR(B) + c + v_o(\tilde{p}) - (c + v_o(\tilde{p}))^2/2.$$

After some rearranging this becomes

$$(c - q)^2/2 + (c - q)v_o(\tilde{p}) > (1 - q)pR(B),$$

where the LHS is strictly positive. Let now $1 - c < v_o(\tilde{p}) < 1 - q$. Then a flexible contract is profitable if

$$(1 - q)c + q^2/2 + (1 - q)v_o(\tilde{p}) - (v_o(\tilde{p}))^2/2 > (1 - q)\tilde{p}R(B) + 1/2.$$

This becomes

$$c - (1 + q)/2 + v_o(\tilde{p})(1 - v_o(\tilde{p})/(2(1 - q))) > \tilde{p}R(B).$$

Since $1 - c < v_o(\tilde{p}) < 1 - q$ by assumption, the LHS is bounded below by $(c - q)/2 > 0$. Finally, in case $v_o(\tilde{p}) > 1 - q$ the condition becomes

$$(1 - q)c + q^2/2 + (1 - q)^2/2 > (1 - q)\tilde{p}R(B) + 1/2 \Leftrightarrow c - q > \tilde{p}R(B).$$

This establishes the statement.

Proof of Lemma 2

Denote by τ the prior belief over the distribution of $\underline{p}$ and $\overline{p}$, so that $\tilde{p} = \tau\overline{p} + (1 - \tau)\underline{p}$. Then

$$p_S(\tilde{p}) = \frac{\tau\overline{p}}{\tau\overline{p} + (1 - \tau)\underline{p}}\overline{p} + \left(1 - \frac{\tau\overline{p}}{\tau\overline{p} + (1 - \tau)\underline{p}}\right)\underline{p}.$$

Using $\tilde{p} = \tau\overline{p} + (1 - \tau)\underline{p}$ yields the expression in the lemma. An analogous argument yields $p_F(\tilde{p})$. Since all agents are ex ante identical both if an agent chose b in the first period or remained unmatched generates no new information, hence $p_I(\tilde{p}) = \tilde{p}$.

Proof of Proposition 4

Given optimal investments in Lemma 3 we need to distinguish several cases. Start by supposing that $v_y(\tilde{p}) \leq s(\tilde{p}) + q - c$. A flexible contract is more profitable than a rigid contract given that an agent of expected productivity $\tilde{p}$ obtains a payoff of $v_y(\tilde{p})$ and has signaling value $s(\tilde{p})$ if

$$q\tilde{p}R(A) - (1 - q)v_y(\tilde{p}) + (1 - q)k_b - k_b^2/2 > \tilde{p}(qR(A) + (1 - q)R(B)).$$

This can be rearranged, using $k_b = \min\{1 - q, v_y(\tilde{p})\}$, to yield the condition

$$v_y(\tilde{p}) < \hat{v}(\tilde{p}) =: \begin{cases} (1 - q)/2 - \tilde{p}R(B) & \text{if } -2\tilde{p}R(B) \geq 1 - q \\ \sqrt{2(1 - q)(-\tilde{p}R(B))} & \text{otherwise.} \end{cases}$$

Turn now to the case $s(\tilde{p}) + q - c \leq v_y(\tilde{p}) \leq s(\tilde{p}) + 1 - c$. Surplus is higher under a flexible than under a rigid contract if

$$q(s(\tilde{p}) - c) + \frac{q^2}{2} - v_y(\tilde{p}) + (1 - q)k_b - \frac{k_b^2}{2} > \tilde{p}(1 - q)R(B) - \frac{(v_y(\tilde{p}) - s(\tilde{p}) + c)^2}{2}.$$

Solving for $s(\tilde{p})$ this yields a quadratic equation. Its determinant is positive if and only if $v_1(\tilde{p}) \geq \hat{v}(\tilde{p})$. Supposing this is the case the condition becomes

$$s(\tilde{p}) < \hat{s}(v_1(\tilde{p})) := v_1(\tilde{p}) + c - q - \begin{cases} \sqrt{2(1 - q)(v_y(\tilde{p}) + \tilde{p}R(B) - (1 - q)/2)} & \text{if } v_y(\tilde{p}) \geq 1 - q \\ \sqrt{(v_y(\tilde{p}))^2 + 2(1 - q)\tilde{p}R(B)} & \text{otherwise.} \end{cases}$$

This defines $\hat{s}(v)$ for $v \geq \hat{v}$ and $\hat{s}(v) + q - c \leq v \leq \hat{s}(v) + 1 - c$. Since $\hat{s}(v) \leq v + c - q$ holds for the expression above, only the upper bound has a bite and becomes

$$(1-q)^2 - 2(1-q)\tilde{p}R(B) \geq \begin{cases} 2(1-q)(v-(1-q)/2) & \text{if } v \geq 1-q \\ v^2 & \text{otherwise.} \end{cases}$$

Since $(1-q)^2 - 2(1-q)\tilde{p}R(B) > (1-q)^2$ the condition $\hat{s}(v) + q - c \leq v \leq \hat{s}(v) + 1 - c$ holds if and only if $\hat{v} \leq v \leq 1 - q - \tilde{p}R(B)$. Differentiating yields that $\hat{s}(v)$ is strictly decreasing on this interval.

Finally, let $v_y(\tilde{p}) > s(\tilde{p}) + 1 - c$. A flexible contract is now profitable if

$$q(s(\tilde{p}) - c) + \frac{q^2}{2} + (1-q)k_b - \frac{k_b^2}{2} > \tilde{p}(1-q)R(B) - c + s(\tilde{p}) + 1/2.$$

That is,

$$s(\tilde{p}) < c - \tilde{p}R(B) - \begin{cases} q & \text{if } v_y(\tilde{p}) \geq 1-q \\ ((1+q)/2 - v_y(\tilde{p})(1 - v_y(\tilde{p})/(2(1-q)))) & \text{otherwise.} \end{cases}$$

This defines $\hat{s}(v)$ for $v > 1 - q - \tilde{p}R(B)$, since by assumption $\hat{s}(v) - v - c + 1 < 0$, which in turn becomes $1 - v - \tilde{p}R(B) < q$ since $(1-q)^2 - 2(1-q)\tilde{p}R(B) < v^2 < (1-q)^2$ yields a contradiction. That is,

$$\hat{s}(v_y(\tilde{p})) = c - q - \tilde{p}R(B) > 0$$

for $v_y(\tilde{p}) > 2(1 - q - \tilde{p}R(B))$. This establishes the proposition.

Proof of Proposition 5

The statement is obvious for k_a by Lemmata 1 and 3. For k_b note that whenever $k_b < 1 - q$ in a flexible contract for young and old agents, it must hold that $k_b = v_y(\tilde{p})$ and $k_b = v_o(\tilde{p})$ respectively. Since $\pi = 0$ in a flexible contract a young agent obtains

$$v_y(\tilde{p}) = q(\tilde{p}R(A) - c + k_a + s(\tilde{p})) + (1-q)v_y(\tilde{p}) - \frac{k_a^2 + v_y(\tilde{p})^2}{2},$$

with $k_a = \min\{q; v_y(\tilde{p}) + c - s(\tilde{p})\}$ and $v_y(\tilde{p}) \leq 1 - q$. An old agent obtains

$$v_o(\tilde{p}) = q(\tilde{p}R(A) - c + q) + (1-q)v_o(\tilde{p}) - \frac{q^2 + v_o(\tilde{p})^2}{2},$$

while $v_o(\tilde{p}) \leq 1 - q$. That is,

$$v_o(\tilde{p}) = \sqrt{2q(q + \tilde{p}R(A) - c)} - q.$$

Clearly, $v_o(\tilde{p}) < v_y(\tilde{p})$ whenever $k_a = q$. Suppose therefore $k_a = v_y(\tilde{p}) + c - s(\tilde{p})$. Then

$$v_y(\tilde{p}) = -\frac{c - s(\tilde{p})}{2} + \frac{1}{2}\sqrt{4q\tilde{p}R(A) - (c - s(\tilde{p}))^2}.$$

Then $v_o(\tilde{p}) < v_y(\tilde{p})$ if

$$0 < \frac{q}{2}\left(\tilde{p}R(A) + q - c + s(\tilde{p})\right) + s(\tilde{p}) + (2q - c + s(\tilde{p}))\sqrt{4q\tilde{p}R(A) - (c - s(\tilde{p}))^2}.$$

This must be true for $\tilde{p}$ if an old agent with $\tilde{p}$ obtains a flexible contract, since to generate positive joint surplus $q(\tilde{p}R(A) + q/2 - c) > 0$.

Proof of Lemma 7

Note that $\hat{v}(\tilde{p}) \le v_y(\tilde{p})$ implies that $\tilde{p} \ge p_1$ for some $p_1 > 0$ since $\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} > \frac{\partial \hat{v}(\tilde{p})}{\partial \tilde{p}}$.
  Suppose that $\hat{v}(\tilde{p}) \le v_y(\tilde{p}) < 1 - q$ first. Then

$$\frac{\partial \hat{s}(v_y(\tilde{p}))}{\partial \tilde{p}} = \frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} - \frac{v_y(\tilde{p})\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} + (1 - q)R(B)}{\sqrt{(v_y(\tilde{p}))^2 + 2(1 - q)\tilde{p}R(B)}}. \tag{2}$$

Note that $\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} = \frac{qR(A)}{v_y(\tilde{p}) + q} > 0$ (see proof of Proposition 6). If $s(\tilde{p})$ is convex, $\frac{\partial^2 v_y(\tilde{p})}{\partial \tilde{p}^2} < 0$. $\frac{\partial \hat{s}(v_y(\tilde{p}))}{\partial \tilde{p}} < 0$ as $v_y(\tilde{p})$ approaches $\hat{v}(\tilde{p})$ if

$$\frac{\hat{v}(\tilde{p})}{v_y(\tilde{p}) + q}qR(A) + (1 - q)R(B) > 0,$$

as the nominator tends to zero. Plugging in the expressions for $\hat{v}(\tilde{p})$ and $v_y(\tilde{p})$ this condition becomes

$$\tilde{p}E[R(s)]R(A) > (1 - q)R(B)(c - q - s(\tilde{p})),$$

which must hold under the assumption $R(B) \le 0$ and $v_y(\tilde{p}) > \hat{v}(\tilde{p})$. Therefore $\hat{s}(v_y(\tilde{p}))$ is strictly decreasing in $\tilde{p}$ for $\tilde{p}$ such that $v_y(\tilde{p})$ close to $\hat{v}(\tilde{p})$ not requiring convexity of $s(\tilde{p})$. Differentiating (2) once, the second derivative is positive if

$$\frac{\left(v_y(\tilde{p})\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} + (1 - q)R(B)\right)^2}{(v_y(\tilde{p}))^2 + 2(1 - q)\tilde{p}R(B)} - \left(\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}}\right)^2 > \left(v_y(\tilde{p}) - \sqrt{(v_y(\tilde{p}))^2 + 2(1 - q)\tilde{p}R(B)}\right)\frac{\partial^2 v_y(\tilde{p})}{\partial \tilde{p}^2}.$$

If $s(\tilde{p})$ is convex, the right hand side is negative and a sufficient condition for convexity of $\hat{s}$ in $\tilde{p}$ is

$$\left(v_y(\tilde{p})\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} + (1 - q)R(B)\right)^2 > \left((v_y(\tilde{p}))^2 + 2(1 - q)\tilde{p}R(B)\right)\left(\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}}\right)^2.$$

Using $\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} = \frac{qR(A)}{v_y(\tilde{p})+q}$ and noting that $R(B) \leq 0$ yields a sufficient condition,

$$\tilde{p}qR(A) > v_y(\tilde{p})(v_y(\tilde{p}) + q).$$

Since $q + s(\tilde{p}) - c \leq v_y(\tilde{p}) \leq 1 - q$ this holds whenever $q > 1/2$. Hence, the second derivative of $\hat{s}$ with respect to $\tilde{p}$ exists and is positive.

Turn now to the case $1 - q \leq v_y(\tilde{p}) < 1 - q - \tilde{p}R(B)$. Differentiating $v_y(\tilde{p})$ in this case yields

$$\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} = q\left(R(A) + \frac{\partial s(\tilde{p})}{\partial \tilde{p}}\right).$$

Differentiating $\hat{s}(v_y(\tilde{p}))$ with respect to $\tilde{p}$ yields

$$\frac{\partial \hat{s}(v_y(\tilde{p}))}{\partial \tilde{p}} = q\left(R(A) + \frac{\partial s(\tilde{p})}{\partial \tilde{p}}\right) - \sqrt{1-q}\frac{q\left(R(A) + \frac{\partial s(\tilde{p})}{\partial \tilde{p}}\right) + R(B)}{\sqrt{2(v_y(\tilde{p}) + \tilde{p}R(B) - (1-q)/2)}}. \qquad (3)$$

The second derivative is clearly positive as $s(\tilde{p})$ is convex:

$$\frac{\partial^2 \hat{s}(v_y(\tilde{p}))}{\partial \tilde{p}^2} = q\frac{\partial^2 s(\tilde{p})}{\partial \tilde{p}^2}\left(1 - \frac{\sqrt{1-q}}{\sqrt{2(v_y(\tilde{p}) + \tilde{p}R(B) - (1-q)/2)}}\right)$$
$$+ \sqrt{1-q}\frac{\left(q\left(R(A) + \frac{\partial s(\tilde{p})}{\partial \tilde{p}}\right) + R(B)\right)^2}{2(v_y(\tilde{p}) + \tilde{p}R(B) - (1-q)/2)} > 0. \qquad (4)$$

Note that as $v_y(\tilde{p})$ approaches $1 - q$ both $\hat{s}(.)$ and its first derivative converge both from below and from above.

That is, $\hat{s}$ is strictly convex for $\tilde{p}$ such that $\hat{v}(\tilde{p}) \leq v_y(\tilde{p}) \leq 1 - q - \tilde{p}R(B)$, initially decreasing and increasing at the upper bound as can be quickly verified using (3), $\frac{\partial \hat{s}(1-q-\tilde{p}R(B))}{\partial \tilde{p}} = -R(B) > 0$.

In case $v_y(\tilde{p}) > 1 - q - \tilde{p}R(B)$ $\hat{s}(.)$ is linear, increasing function of $\tilde{p}$ with slope $-R(B)$, which does not require convexity of $s(\tilde{p})$. This establishes the lemma.

Proof of Proposition 8

The statement on p_y follows from Proposition 6. A rigid contract is preferable for some productivity $\tilde{p}$ if and only if $s(\tilde{p}) \geq \hat{s}(\tilde{p})$. By Proposition 6 the optimal contract for young agents with $\tilde{p} \geq p_y$ close to p_y is flexible. Hence, there is $p_1 > p_y$ such that flexible contracts are optimal for $p_y \leq \tilde{p} \leq p_1$. Clearly, $\lim_{\tilde{p}\to\overline{p}} s(\tilde{p}) = 0$. Therefore there is $p_4 < \overline{p}$ such that flexible contracts are optimal for $p_4 \leq \tilde{p} \leq \overline{p}$.

Derive a sufficient condition for existence of rigid contracts next. To do so focus on p_o. By definition $p_o R(A) = c - q/2$ and therefore

$$v_y(p_o) = \begin{cases} qs(p_o) + (1-q)^2/2 & \text{if } s(p_o) \geq (1-q^2)/(2q) \\ \sqrt{2qs(p_o) + q^2} - q & \text{otherwise.} \end{cases}$$

A rigid contract is desirable for p_o if $v_y(p_o) > \hat{v}(p_o)$ and $s(p_o) > \hat{s}(p_o)$. Using the definition of $\hat{s}(v_y(\tilde{p}))$, a sufficient condition for the first is $s(p_o) > v_y(p_o) + c - q$, which translates into

$$s(p_o) > \begin{cases} (1-q)/2 + (c-q)/(1-q) & \text{if } s(p_o) \geq (1-q^2)/(2q) \\ c - q + \sqrt{2q(c-q)} & \text{otherwise.} \end{cases} \tag{5}$$

Note that $s(p_o) \geq (1-q^2)/(2q)$ implies the first condition and the second condition implies $s(p_o) \geq (1-q^2)/(2q)$, if $c < (1+q^2)/(2q)$. Otherwise $s(p_o) > (1-q)/2 + (c-q)/(1-q)$ implies $s(p_o) > (1-q^2)/(2q)$. Note that $s(p_o) < (1-q^2)/(2q)$ implies $s(p_o) < c - q + \sqrt{2q(c-q)}$ whenever $c > (1+q^2)/(2q) - (1-q) > 1$. $v_1(p_o) > \hat{v}(p_o)$ translates into

$$s(p_o) > \begin{cases} (1-q)/2 - p_o R(B)/q & \text{if } s(p_o) \geq (1-q^2)/(2q) \\ \frac{1-q}{q} p_o R(B) + \sqrt{2(1-q)(-p_o R(B))} & \text{otherwise.} \end{cases} \tag{6}$$

Note that the first condition implies $s(p_o) \geq (1-q^2)/(2q)$ as $\hat{v}(\tilde{p}) > 1 - q$ implies $1 - q < -2\tilde{p}R(B)$. Otherwise $s(p_o) \geq (1-q^2)/(2q)$ implies $s(p_o) > (1-q)/2 + p_o R(B)/q$. Summarizing, rigid contracts are chosen in case

(i) $c < \frac{(1+q)^2}{2q} - (1-q)$ if $s(p_o) > (1-q)/2 - p_o R(B)/q$ for $1 - q < -2p_o R(B)$, or $s(p_o) > \frac{1-q}{q} p_o R(B) + \sqrt{2(1-q)(-p_o R(B))}$ and $s(p_o) > c - q + \sqrt{2q(c-q)}$ for $1 - q \geq -2p_o R(B)$,

(ii) $\frac{(1+q)^2}{2q} - (1-q) < c < \frac{(1+q)^2}{2q}$ if $s(p_o) > (1-q)/2 - p_o R(B)/q$ if $1 - q < -2p_o R(B)$ and $s(p_o) > (1-q^2)/(2q)$ if $1 - q \geq -2p_o R(B)$,

(iii) $c > \frac{(1+q)^2}{2q}$ and $s(p_o) > (1-q)/2 + (c-q)/(1-q)$ and, if $1 - q < -2p_o R(B)$, $s(p_o) > (1-q)/2 - p_o R(B)/q$.

All these conditions become slacker as $R(B)$ increases and c decreases. A single sufficient condition for rigid contracts is for instance $s(p_o) > (1-q)/2 + -p_o R(B)/q$ and $c < (1+q)^2/(2q)$. Since $s(p_o)$ has a maximum in $R(A)$ at $(c-q/2)/\sqrt{\overline{p}\underline{p}}$ rigid contracts are favored by higher $R(A)$ if $p_o > \sqrt{\overline{p}\underline{p}}$.

$\hat{s}(\tilde{p})$ is first strictly decreasing then strictly increasing by Lemma 7. Since $s(\tilde{p})$ is first strictly increasing then strictly decreasing and has a unique maximum, existence of rigid contracts implies there are $\underline{p} < p_a < p_b < \overline{p}$ such that rigid contracts are optimal for $p_a < \tilde{p} < p_b$. If $q/2 > (2q-1)(c-q)$ $\hat{s}(\tilde{p})$ has a unique minimum by Lemma 7, which implies that $\hat{s}(\tilde{p})$ and $s(\tilde{p})$ intersect twice at most and therefore $p_a = p_1$ and $p_b = p_4$. Otherwise, there may be more intersection points. Optimality of flexible contracts for $p_y \le \tilde{p} \le p_1$ and $p_4 \le \tilde{p} \le \overline{p}$ implies then existence of $p_2 \le p_3$ such that rigid contracts are preferred for $p_1 \le \tilde{p} \le p_2$ and $p_3 \le \tilde{p} \le p_4$.

For flexible contracts $k_b = \min\{1-q; v_y(\tilde{p})\}$. Therefore $0 < k_b \le 1-q$ for $\tilde{p} > p_0$. For rigid contracts $k_b = 0$. Rigid contracts are optimal only if $s(\tilde{p}) > \hat{s}(\tilde{p})$. This implies $v_y(\tilde{p}) + c - s(\tilde{p}) > q$ (see proof of Lemma 7). This means $q < k_a \le 1$ in rigid contracts. For $s(\tilde{p}) < \hat{s}(\tilde{p})$ a flexible contract is optimal, with $k_a = \min\{v_y(\tilde{p}) + c - s(\tilde{p})\}$. Since $v_y(\tilde{p}) + c - s(\tilde{p}) > q$ for $p_1 < \tilde{p} < p_2$ and $\frac{\partial v_y(\tilde{p})}{\partial \tilde{p}} > \frac{\partial s(\tilde{p})}{\partial \tilde{p}}$ for $q > 1/2$, $v_y(\tilde{p}) + c - s(\tilde{p}) > q$ and $k_a = q$ for $\tilde{p} > p_2$.

Finally, a sufficient condition for rigid contracts not to occur is $s(\tilde{p}) < c - q - \tilde{p}R(B)$. This is implied by $s(p_o) < c - q - p_o R(B)$.

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