Gathering Information before Signing a Contract: a New Perspective

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November 2003

Abstract

A principal has to choose among several agents to fulfill a task and then provide the right incentives to perform it. Agents do not a priori know how they fit to the task. It is shown that the principal should propose a contract that lead the agents to gather information about their type *prior* to signing the contract. This insight is in sharp contrast with Cremer and Khalil (1992). It emerges because, unlike in the one-agent setting previously considered, when *several* agents can possibly fulfill the task, information acquisition accompanied by a proper screening device increases the chance that the principal will pick a competent agent.

1. Introduction

A job is being vacant, and the employer is about to offer a job contract to fill the job. Should the contract be such that the potential candidates find it valuable to assess their adequacy to the job requirements before the job contract is signed or is it preferable that the employee discovers how competent he is for the job only after being employed?

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Relatedly, should the employer give a detailed description of the job before the contract is being signed so as to facilitate the candidates' assessment of how their skills fit to the job or is it preferable that these details are delivered afterwards when the contract is already signed?

Cremer and Khalil (1992) have studied a Principal-Agent situation in which (i) prior to the contract the agent does not know his type but may learn about it at some cost, and (ii) after the contract is signed he learns about it freely. Important insights in Cremer and Khalil (1992) are: 1) the principal should not induce the agent to seek information prior to signing the contract, and 2) the principal is better off when information acquisition is more costly.

Roughly, the intuition for Cremer-Khalil's results is as follows: Take any contract that would induce the agent to acquire information before signing the contract. The principal can do better by replicating the output scheme as a function of the type,[1] and taking away the information acquisition cost from the wage scheme. In so doing she avoids the wasteful information acquisition costs and increases her payoff. Besides, since the information acquisition possibility only plays the role of a constraint in Cremer and Khalil's model, the higher the information acquisition costs the better for the principal.

Applied to our Employer/employee problem, Cremer and Khalil(1992) suggests that the answer to our two questions is "No". That is, the contract should not induce the employee to assess his competence for the job before the contract is signed and the employer should avoid giving a detailed description of the job before the contract is signed.

The main insight of this paper is that when *several* potential candidates compete for the job the answers to our original questions may be reversed. That is, the employer will in general improve the performance of his firm by having the candidates assess their competence before signing the job contract (through an appropriate choice of contracts).

[1] This includes setting output to zero for those types who do not sign the contract.

And, the employer will (at least in some cases) be better off when candidates can more easily assess their competence, which is for example the case when the description of the job is more accurate.

In essence, our result follows from the following observation: when several agents are in competition for the contract, information acquisition accompanied by a proper screening device is socially desirable because it increases the chance that the principal will pick the most appropriate agent.

The rest of the paper is organized as follows. In Section 2, we describe the model. Section 3 provides the main insights. Section 4 briefly reviews the literature on information acquisition in Principal-Agent models. Some missing proofs appear in the Appendix.

2. The model

The task that the principal wants performed consists of the production of either one or two units of output. The principal attaches a value of $V(q)$ to the production of q units of output. Without loss of generality, we assume that $V(0) = 0$, and let $V = V(2)$ and $v = V(1)$.

There are n agents who may perform this task. For each agent i, the disutility of producing q units is equal to $\beta_i q$, $\beta_i > 0$. Utility is transferable. If q units are produced and the principal pays t to agent i, the payoff to the principal is $V(q) - t$ and the net benefit to agent i is $t - \beta_i q$. Returning to our initial employer/employee example, a lower β_i indicates that the job candidate i fits the job requirements better.

All the parameters of the problem are known to all parties, except for the disutilities of production $\beta_1, ..., \beta_n$. We assume that each β_i can take two values, $\beta_i \in \{\underline{\beta}, \bar{\beta}\}$, $0 < \underline{\beta} < \bar{\beta}$, and we assume that these parameters are drawn from identical and independent distributions. We let Q denote the probability that agent i is a low cost agent: $Q = \Pr\{$

$\beta_i = \underline{\beta}\}$, and we assume that $0 < Q < 1$.

We also assume that for a low cost agent, the social surplus is largest when two units are produced, and that for a high cost agent, the social surplus is largest when one unit is produced, that is:

$$V - 2\underline{\beta} > \max\{v - \underline{\beta}, 0\}, \text{ and } v - \bar{\beta} > \max\{V - 2\bar{\beta}, 0\}.$$

Note that these conditions are equivalent to

$$\bar{\beta} > V - v > \underline{\beta} \text{ and } v > \bar{\beta}.$$

After signing a contract, the agent will learn at no cost if he is a high cost or a low cost agent. He can also observe β immediately after being offered a contract, but at cost $c > 0$. Following Cremer Khalil (1992), we interpret this cost as the difference in cost between acquiring information in the precontractual and postcontractual phases.

Our objective is to show that when there are several agents potentially interested in signing a contract ($n > 1$), the principal may be better off offering contracts that induce information acquisition (by some of the agents at least).

3. Results

As a benchmark, let us briefly consider the case in which the principal would induce no information acquisition. Then it is irrelevant which candidate is selected, since they are assumed to be ex ante identical. The maximum surplus S generated by any match is then obtained when the employee produces two units of output if low cost and one unit of output if high cost. It is thus given by:

$$S = Q(V - 2\underline{\beta}) + (1 - Q)(v - \bar{\beta}).$$

Since agents have the option to refuse any contractual offer, they cannot obtain an expected payoff below 0. Thus, S is an upper bound on the payoff obtained by the principal when he does not induce information acquisition.

Proposition 1. *The expected payoff obtained by the principal if he does not induce information acquisition is at most equal to S.*

Note that in general though, the payoff obtained by the principal will be strictly smaller than S, because the principal has to provide agents with incentives not to acquire information prior to signing the contract. The analysis of these incentives is the main focus of Cremer Khalil (1992).

We now turn to the case in which the principal induces information acquisition. We assume that the principal makes a sequence of contractual offers to agent 1, $2, ..., n$, until one agent accepts. Other formats for selecting the agent are possible, but this one will be sufficient for our purpose. We have:

Proposition 2. *Assume that the principal always offers the contract C^{acq}, defined as follows: "Produce two units and receive a transfer equal to $P = 2\underline{\beta} + c^+/Q$". There exists $c^* > 0$ such that if $c < c^*$, then (i) any agent who is offered this contract acquires information and accepts the contract if and only if he is a low cost agent, and (ii) expected payoff to the principal exceeds S if n is large enough.*

To check Proposition 2, observe that the agent obtains a positive expected payoff when he acquires information and signs the contract whenever he learns he is a low cost agent. (This follows from $Q(P - 2\underline{\beta}) > c$.) If the agent does not acquire information and yet signs the contract, he gets $P - 2E\beta$, which is negative for c small enough.[2] So the agent prefers acquiring information.

[2] More precisely, for $c < c^{**}$ where

$$c^{**} = 2Q(1 - Q)(\overline{\beta} - \underline{\beta})$$

We also have that $P - 2\bar{\beta} < 0$ for c small enough.[3] In such a case, agent i only accepts the contract in the event $\beta_i = \underline{\beta}$. It follows that the principal expected payoff is equal to

$$(1 - (1 - Q)^n)(V - P)$$

which exceeds S when n is large enough and c small enough (this is because $(1 - (1 - Q)^n)(V - P)$ converges to $V - 2\underline{\beta}$ as $n \to \infty$, $c \to 0$ and because $S < V - 2\underline{\beta}$ since $v - \bar{\beta} < V - 2\underline{\beta}$).[4]

Proposition 2 can easily be generalized to more general distributions over types. In essence, it says that with enough competition, and so long as information acquisition is not too costly, the principal is better off when he tries to induce information acquisition and contract with an agent who has a lower cost.

We now turn to our second claim about the principal's interest in facing agents with lower information acquisition costs. Intuitively, if the principal aims at inducing information acquisition, he should be better off if information acquisition is not too costly. We present below a result that captures this intuition.

Assume there are two agents with the cost characteristics as considered above. The best economic outcome is that when one of the two agents has a low cost he is selected to produce two units of output and otherwise one unit of output is being produced. Since the first event has probability $Q + (1 - Q)Q$, the corresponding expected surplus

[3] More precisely, for $c < \widetilde{c}$ where

$$\widetilde{c} = 2(\overline{\beta} - \underline{\beta})Q$$

[4] More precisely, we need $c < c^*$ where

$$c^* = Q(1 - Q)(V - 2\underline{\beta} - (v - \overline{\beta})).$$

It is readily verified that $c^* < c^{**} < \widetilde{c}$ (thus any $c < c^*$ will induce the conclusion of Proposition 3).

is given by

$$[Q + (1 - Q)Q](V - 2\underline{\beta}) + (1 - Q)^2(v - \bar{\beta}), \tag{3.1}$$

which can be written as

$$S + \bar{c}$$

where S is the highest surplus obtained with one agent (or without information acquisition, see above) and

$$\bar{c} = Q(1 - Q)(V - 2\underline{\beta} - (v - \bar{\beta})).$$

Intuitively, the additional candidate induces an efficiency gain of $(V - 2\underline{\beta}) - (v - \bar{\beta})$ whenever he happens to be a good type ($\underline{\beta}$) and the first candidate happens to be a bad type ($\bar{\beta}$).

When one agent acquires information, the maximum surplus net of acquisition costs is thus equal to $S + \bar{c} - c$. When $c < \bar{c}$, it exceeds the maximum surplus S that can be generated when no agent acquires information.[5]

We now let C^1 denote the contract that maximizes the principal's expected payoff when he faces a single candidate. When the information acquisition cost c is too low, the principal does not achieve a payoff as high as S, because of the constraint that the agent should have no incentive to acquire information prior to signing the contract (see Cremer-Khalil 1992). For higher values of c however, this constraint becomes non-binding and the principal can achieve a payoff as high as S. We show in the appendix that the threshold value of the cost is $\underline{c} = Q(1 - Q)(\bar{\beta} - \underline{\beta})$.

The following Proposition shows that when the cost c falls in the range $(\underline{c}, \bar{c})$,[6] the Principal can make contractual offers that gives him an expected payoff equal to $S+\bar{c}-c$, the maximum surplus net of acquisition costs:

[5]Note that having both agents acquire information may only lower the maximum surplus net of acquisition costs.

[6]Note that $\underline{c} < \bar{c}$.

Proposition 3. *Assume that $c \in (\underline{c}, \bar{c})$ and $n = 2$. Offering contract C^{acq} to agent 1 (see Proposition 2 for the definition of C^{acq}), and contract C^1 to agent 2 in case agent* 1 *rejects C^{acq} yields the principal an expected payoff equal to $S + \bar{c} - c$.*

Since, as mentioned above, when $c < \bar{c}$, $S + \bar{c} - c$ is also the maximum surplus net of acquisition costs, there are no other contract offers (sequential or simultaneous) that could provide a higher expected payoff to the principal. Hence $S+\bar{c}-c$ is the maximum expected payoff the principal can obtain, and it increases when acquisition costs gets smaller. To summarize:

Corollary 1. *When $c \in (\underline{c}, \bar{c})$, the principal's best contract payoff is $S + \bar{c} - c$. Thus, she benefits from smaller information acquisition costs.*

4. Related literature

Our paper is related to the literature on information acquisition in Principal-agent models.

We already mentioned Cremer and Khalil (1992) who study (as we do) a case where after signing, and before producing, the agent obtains the relevant information at no cost. In this case, it is optimal for the Principal to deter the agent from acquiring information.

In Cremer, Khalil and Rochet (1996) and in Lewis and Sappington (1997), information is as costly to acquire, whether acquisition is made prior to or after signing the contract. In both papers, information acquisition *prior to production* is socially useful, either because it permits the agent to better adjust effort, or, because it permits the principal to make better investments. In both frameworks, the optimal contract may entail information acquisition by the agent prior to production. However, in these models, it is irrelevant whether information acquisition occurs before or after signing the contract. If information was less costly to acquire after signing a contract, then the analysis of Cremer and Khalil (1992) would apply again, and the optimal contract would never entail information acquisition prior to signing, but only possibly prior to production.

Our paper is also related to the literature on information acquisition in auctions. A seller (the principal) wishes to sell an object to one of the buyers (the agents) at the best possible terms. Is the principal better off when (some) agents acquire information? Should he make information easier to acquire?

Milgrom-Weber (1982) provides a partial answer to these questions when they analyze whether the seller benefits from disclosing information about the object for sale. Disclosing information can be viewed as an extreme reduction in cost of information acquisition. They find that in a symmetric affiliated setting, the seller benefits from such a drastic reduction.[7]

While affiliation is key to Milgrom-Weber's argument, the result that a seller may benefit from information acquisition by the buyers can be obtained in a simple private value environment, using an argument very similar to the one used in Proposition 2: If the environment is competitive enough, a seller benefits from information acquisition, because it is very likely that there will be at least a few bidders who will learn that their valuation is large, hence that the seller will end up with a large revenue. Compte and Jehiel (2000) combines this simple observation with the observation that in a competitive environment, ascending price auctions provide more incentives to acquire information than second price auction, thereby showing a benefit to using the former format.

[7] see also Persico (2000), who, in the symmetric affiliated setting, compares incentives to acquire information in first and second price auctions. (Revenues to the seller are not compared however.)

References

[1] O. Compte and Ph. Jehiel: "Auctions and Information Acquisition: Dynamic or sealed-bid format?", mimeo CERAS, 2000.

[2] J. Cremer and F. Khalil: "Gathering information before signing a contract", *American Economic Review*, **82**, 1992, 566-578

[3] J. Cremer, F. Khalil, and J.-C. Rochet, "Contracts and Productive Information Gathering", *Games and Economic Behavior*, **25**, 1998, 174-193

[4] T.R. Lewis and D.E.M. Sappington, "Information Management in incentive Problems", *Journal of Political Economy* **105**, 1997, 796-821

[5] P. Milgrom and Weber, "A Theory of Auctions and Competitive Bidding", *Econometrica*, **50**, 1982, 1089-1122.

[6] N. Persico "Information Acquisition in Auctions", *Econometrica*, **68**, 2000, 135-148.

Appendix

The proof of Proposition 3 relies on the following Lemma:

Lemma 1. *When $c \in (\underline{c}, \bar{c})$, the contract C^1 yields the principal an expected payoff equal to S.*

Proof. Let $\varepsilon > 0$, and define a contract C as follows: Either produce one unit at price $p = E\beta + \varepsilon$, or two units at price $P = p + \underline{\beta} + \varepsilon$. By construction, we have

$$P - 2\underline{\beta} > p - \underline{\beta} \text{ and } P - 2\bar{\beta} < p - \bar{\beta}.$$

Hence an agent who would accept this contract without acquiring information would produce two units when low-cost, and one unit when high-cost, hence he would obtain an expected payoff G^{agent} that satisfies

$$G^{agent} = Q(P - 2\underline{\beta}) + (1 - Q)(p - \bar{\beta}) = p - E\beta = \varepsilon,$$

which is positive by construction. Besides, for $c > \underline{c}$, we have $E\beta > \bar{\beta} - c/(1 - Q)$. Hence we have $p > \bar{\beta} - c/(1 - Q)$, so we also have

$$G^{agent} > Q(P - 2\underline{\beta}) - c,$$

which implies that the agent prefers signing without acquiring information.

The expected payoff that the principal obtains when offering the contract is equal to $S - G^{agent}$, which completes the proof of Lemma 1. ■

Proof of Proposition 3:

When the principal offers C^{acq} to agent 1 (and since $c < \bar{c} < 2\underline{c}$), agent 1 acquires information, and rejects the contract in the event he is a high cost agent. In the latter case, he offers C^1 to agent 2, and obtain an expected payoff equal to S. Overall, his expected payoff is thus equal to

$$G^{principal} = Q(V - P) + (1 - Q)S,$$

where $P = 2\underline{\beta} + c/Q$. Since $Q(V - 2\underline{\beta} - S) = \bar{c}$, we have

$$\begin{aligned} G^{principal} &= Q(V - 2\underline{\beta}) - c + (1 - Q)S \\ &= S + \bar{c} - c, \end{aligned}$$

which concludes the proof of Proposition 3. ■