

# Withholding Of Information As An Endogenous Entry Barrier

Juan Carlos BARCENA-RUIZ, Jesus RUBIO \*

**ABSTRACT.** – In this paper, we analyze the withholding of information from an agent by a principal for fear that the agent may set up his own business if he is informed. We focus on two points when studying this question: the power of the principal to control the information available to the agent, and the possibility that the agent may set up a new firm if he receives private information.

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## Occultation d'information comme une barrière à l'entrée endogène

**RÉSUMÉ.** – Ce papier analyse l'occultation d'information à un agent par un principal pour éviter l'installation par l'agent de sa propre entreprise. Nous faisons attention à deux points : le pouvoir du principal pour contrôler l'information disponible par l'agent et la possibilité par l'agent d'installer une nouvelle entreprise s'il reçoit l'information privée.

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\* J.C. BARCENA-RUIZ: Departamento de Fundamentos del Análisis Económico, Universidad del País Vasco ; J. RUBIO: Departamento de Fundamentos del Análisis Económico, Universidad del País Vasco.

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# 1 Introduction

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In this paper we analyze the factors that influence the withholding of information from an agent by a principal for fear that the agent may set up his own business if he is informed. We focus on two points when studying this question: the power of the principal to control the information available to the agent, and the fact that the agent can set up a new firm if he receives information (about the customers of the firm, for example). One point we would like to stress is the fact that, within an organization, the agent is sometimes able to establish a new firm (*i.e.* endogenous entry) by using the information received in the organization. If the agent receives information (which permits him to privately observe the state of nature), he can set up a new firm. Then, the principal will have to consider the possibility of deterring endogenous entry.

The motivation of this paper comes from having observed that in some small firms (for example, firms which maintain or repair machinery) when a group of workers observe relevant information about the firm (for example, who the customers are), they demand an increase in their wage to the owner of the firm. If the increase in the wage is not enough, in many cases, the group of workers themselves set up a new firm (and they capture a great number of the customers of the old firm).

In the literature on entry deterrence, the possibility of deterring the entry of potential rivals has mainly been studied assuming that rivals come from outside the firm. As in RUBIO [1996], STEWART [1994] and PAKES and NITZAN [1983], in this work a different type of entry is considered: endogenous entry; that is, the entrant comes from inside the firm and it is a worker or a coalition of workers who leave the incumbent firm in order to create a new rival enterprise.

The analysis will be carried out on the basis of a principal-agent model. In the present model, the principal has the power to control the information available to the agent. It is the principal who has the information and who may or not communicate this information. The agent is the only one who can adequately use the information in order to increase the probability of success of the firm (the principal is not an expert).

Most models in the principal-agent literature assume that the agent's information is exogenous and that the principal cannot alter that information (see, for example, HOLMSTRÖM [1979] or BARON and MYERSON [1982]). But, on the contrary, a principal often has some control over the information available to the agent. For example, a sales force manager can improve the information of her sales force by acquiring information on the product performance and on the activities of his rivals in the product market.

LEWIS and SAPPINGTON [1991a, 1991b] (LS) explicitly consider the possibility that the principal may have control over the information available to the agent. They point out that there exists a tradeoff: if the agent receives more accurate information, his productivity increases, although the rents the agent can get generally increase (these rents are obtained at the principal's expense). LS show that a risk-neutral principal communicates perfect information about

the state of nature to a risk-neutral agent or, on the contrary, that the principal prefers that the agent have no private information.

There are other papers related to the preceding idea. SOBEL [1983] shows that a risk-neutral principal will always prefer an informed agent to an uninformed one. This result can be reversed with a risk-averse principal, and in this case the principal may prefer that the agent share the principal's imperfect knowledge of the state of nature. DEMSKI and SAPPINGTON [1987] study the acquisition of information by an agent, but the principal must encourage the agent to acquire information at great cost. The analyses of RIORDAN and SAPPINGTON [1987] also consider the optimal supply of information in a principal-agent setting. In their model, there is an exogenous amount of information available and the question under study is whether the principal or the agent should receive this information.

CREMER and KHALIL [1992] allow the risk-neutral agent to acquire a signal about the true state of nature either before or after signing the contract proposed by the principal. This information is not valuable for planning purposes because (in contrast to LS's assumption) the agent can ultimately observe the realization of the state of nature before acting. Thus, the fact of having better information about the state of nature only increases the agent's rents, consequently, the principal will always prefer the agent not to acquire *ex ante* information about the state of nature. CRASWEL [1988] studies a question which is related to this but he builds a model in which precontractual investigation is productive. Other papers reflecting a similar idea are those of LEE [1982] and MILGROM and WEBER [1982]; they study the incentives of agents to acquire information about the value of an object before it takes part in an auction and can so be sold.

In this paper we consider a situation in which the principal must decide whether it is useful to transmit information to the agent. If the principal communicates information to the agent, he privately observes the state of nature, which increases the probability of obtaining a successful product. But at the same time, if the agent receives information, he realizes that, in some configurations of the parameters of the model, he can establish a new firm (endogenous entry) with a fixed cost of entry, throwing the old firm out of the market and obtaining a higher income than if he worked for the principal.

The following example illustrates the problem. We consider a principal with an idea about a new product. Moreover, the principal knows of a potential buyer for the innovative product. The principal is not an expert in production, and in order to manage the production of the new product he needs to contract an expert, the agent. The principal must decide on whether to inform the agent of who the potential buyer is. If the agent is aware of who the buyer is, he can talk to the client and, as an expert, fit the design of the product to the preferences of the buyer optimally, thus increasing the probability of success. But in this case, the agent can also enter the principal's market by setting up a new firm (he becomes an endogenous potential entrant). In order to avoid this possibility, the principal can withhold the information and design the product according to his beliefs. But as he is not an expert, the probability of success is reduced.

The result obtained depends on the cost of entry the agent must bear to establish a new firm. If it is low enough, the principal will not communicate the information to the agent since it implies that the agent observes privately the

state of nature; if the agent observes privately the state of nature, this would increase his income more than the increase that could be obtained in the expected output value. If the cost of entry has an intermediate value, the principal will inform the agent, but he will have to pay him the higher of two values: his external value option or the informational rent that he can obtain due to his observing the state of nature privately. Finally, if the cost of entry is high enough, there is no effective threat of endogenous entry and, thus, the principal will inform the agent to increase the probability of success.

Summing up, the principal can avoid endogenous entry by preventing the agent from receiving information. This result could explain why in many firms the principal does not communicate the information he has to the members of the organization.

In section 2 we provide the model. Section 3 shows and discusses the results and, finally, section 4 draws the conclusions.

## 2 The Model

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We focus on an organization that consists of a principal and a agent, both risk neutral. The principal hires an agent that exerts unobservable effort  $e \in \{0, \dot{e}\}$  to obtain an observable output  $x \in \{0, \dot{x}\}$ . If the agent exerts low effort,  $e = 0$ , it is not possible to obtain  $\dot{x}$ . In the case of high effort,  $e = \dot{e}$ , outcome  $\dot{x}$  is obtained with probability  $K, K \in [0, 1]$ ; this value, given exogenously, is common knowledge.

There are two states of nature: the good state,  $\theta_A$ , and the bad state,  $\theta_B$ . *Prior* beliefs concerning the state of nature  $\theta \in \{\theta_A, \theta_B\}$ , which are common knowledge, are  $\theta_A$  with probability  $Q$  and  $\theta_B$  with probability  $(1 - Q)$ .

The principal has information about the state of nature but as he is not an expert he cannot observe it. The principal must contract an expert, the agent, to use the information properly.<sup>1</sup> Thus, the principal never observes the true state of nature but controls the information about it: if the principal decides to withhold information,  $a = 0$ , the agent never observes the state of nature (he observes  $\theta_0$ ); if the principal chooses to inform the agent,  $a = 1$ , the agent privately observes the state of nature.<sup>2</sup> The principal has to decide on  $a = 0$  or  $a = 1$  and communicate his decision to the agent before the agent either accepts the offer made by the principal, or simply rejects it, or rejects it by

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1. We consider that it is far too expensive to design separating contracts. If it were possible, the principal could obtain the information about the state of nature. DEMSKI and SAPPINGTON [1987] argue that it is not always possible for the agent to disclose his information; for instance, a divisional manager holds (or can receive) information valuable to the division and this information is not given to the head of the firm.

2. Given that risk neutrality leads to the fact that  $a$  will only take two values (0 or 1), the principal will never choose an intermediate value of  $a$ . So we assume that  $a \in \{0, 1\}$ . We get the same result as LEWIS and SAPPINGTON [1991]; the reason is that the expected utility function of the principal is linear in  $a$ .

setting up a new firm. If  $a = 1$ , the agent knows that he will not observe the state of nature until the firm is at work: first, the firm has to be set up and, then, the information can be used; moreover,  $a = 1$  implies that the agent knows that he can set up a new firm (in the example in the introduction,  $a = 1$  means that the principal communicates to the agent who the customer is, however, the agent must decide whether he accepts or rejects the offer made by the principal before talking to the buyer). On the contrary, if  $a = 0$ , the agent knows that he will not observe the state of nature and that he cannot establish a new firm (he does not know who the customer is; it is the principal who sells the product).<sup>3</sup>

The probability of obtaining  $\dot{x}$  can be increased only if the agent observes the good state of nature  $\theta_A$ ; thus, if the agent exerts high effort,  $\dot{e}$ , when he observes the good state of nature,  $\theta_A$ , the probability of obtaining  $\dot{x}$  is  $K + D$ ,  $K + D \in [0,1]$ . We assume that the agent's effort, the probability of observing the state of nature by the agent and the state of nature generate the following probability structure:

$$P(\dot{x}/\theta_A, a = 1, \dot{e}) = K + D,$$

$$P(\dot{x}/\theta_B, a = 1, \dot{e}) = P(\dot{x}/\theta_0, a = 0, \dot{e}) = K,<sup>4</sup>$$

$$P(\dot{x}/\theta, a = 1, e = 0) = P(\dot{x}/\theta_0, a = 0, e = 0) = 0, \theta \in \{\theta_A, \theta_B\}, a \in \{0,1\},$$

where  $P(\dot{x}/\theta, a, e)$  denotes the probability of obtaining outcome  $\dot{x}$  when the agent's effort is  $e$ , and he observes the state  $\theta$  with probability  $a$ .  $K$  is the probability of obtaining  $\dot{x}$  due to the agent's effort; this probability (which can be interpreted as the agent's productivity) increases in quantity  $D$  only if the agent exerts effort  $\dot{e}$  when he observes the good state of nature.

The timing of the model is the following: (i) the principal decides whether to withhold ( $a = 0$ ) or disclose ( $a = 1$ ) the information; (ii) the principal designs the agent's incentive scheme,  $s(x)$ , where  $s(x) = \dot{x}$  and  $s(0) = \underline{s}$ ; (iii) the agent observes the incentive scheme and receives the information if the principal has decided so; then, the agent decides whether to accept the offer made by the principal, reject it, or reject it by setting up a new firm (endogenous entry); (iv) the agent observes the state of nature only if  $a = 1$  and exerts effort  $e \in \{0, \dot{e}\}$ , and (v) the outcome is obtained and payments are made. The equilibrium concept used is the Bayesian Perfect Equilibrium.

The agent can establish a new firm with a fixed cost  $F$ <sup>5</sup> only in the case of receiving private information ( $a = 1$ ); if  $a = 0$  we assume that the agent does not know that he can set up a new firm. In the case of the setting up of a new firm, the principal cannot operate in the market since we assume that there is a natural monopoly. If the agent sets up a new firm, he will act like a workers' enterprise and he himself will exert the effort.

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3. Alternatively, if we assume that the agent can observe the state of nature before accepting or rejecting the offer made by the principal, the result obtained is similar.

4. For the sake of simplicity, we assume that the probability of obtaining outcome  $\dot{x}$  is the same whether the agent has knowledge about the bad state of nature or whether he has no knowledge about the state of nature.

5. Following DIXIT [1979], we introduce a fixed cost of entry to study the possibility of deterring endogenous entry.

The reservation utility level of the agent is denoted as  $\underline{U}$  and its value depends on the information received by the agent. If  $a = 0$ , the reservation utility level of the agent is normalized to zero; it is the market value of a manager without information. But, if he can observe  $\theta$ , his market value increases since he can set up a new firm. If  $a = 1$ , the reservation utility level of the agent is the value of his outside option when this value is positive.

The principal's utility function is  $x - s(x)$ . The agent's utility function, if he accepts the offer made by the principal, is  $s(x) - e$ , where  $-e$  is the level of disutility given by the effort; if the agent sets up a new firm, he himself exerts effort and, thus, his utility function is  $x - e - F$ .

We assume that  $K\dot{x} > \dot{e}$ , *i.e.* the expected income derived from the effort made by the agent is greater than the cost of this effort. This assumption ensures that the expected utility of the principal be always positive (never positive) when the agent exerts high (low) effort. In this way we can ignore the problem of which effort to choose when solving the problem of the principal, as the latter will always want the agent to exert high effort.

### 3 Results

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The agent's expected utility differs according to his knowledge of the state of nature. Let  $U(\theta_i) = U_i$  denote the agent's expected payment if  $\theta_i$  ( $i = A, B, 0$ ) is observed. Then,

$$U_A = U(\theta_A) = (K + D)\dot{s} + (1 - K - D)\underline{s}$$

$$U_i = U(\theta_i) = K\dot{s} + (1 - K)\underline{s}, i = B, 0.$$

Let  $V_1$  and  $V_0$  denote the principal's expected utility when transmitting information ( $a = 1$ ) and when withholding information ( $a = 0$ ), respectively:

$$V_1 = Q[(K + D)\dot{x} - U_A] + (1 - Q)[K\dot{x} - U_B],$$

$$V_0 = K\dot{x} - U_0$$

Similarly, let  $U_1$  and  $U_0$  denote the agent's expected utility when transmitting information and when withholding information, respectively.

Now let us first consider the case of transmission of information ( $a = 1$ ), this implies that the agent will privately observe the state of nature. The principal's problem when transmitting information is choosing  $\dot{s}$  and  $\underline{s}$  to maximize  $V_1$ , which is subject to the participation constraint, the incentive constraints and the constraint according to which the agent cannot be fined.

First, the agent must receive, at least, his reservation utility level in the expected terms to be able to participate. Note that the agent cannot privately observe the state of nature until he has signed the contract.

As a result, there is only one participation constraint when transmitting information ( $a = 1$ ),

$$(1) \quad QU_A + (1 - Q)U_B - \dot{e} \geq \underline{U}.$$

Secondly, the agent exerts high effort if his expected utility in this case is higher than if he exerted low effort; in the latter case, he would obtain a low salary. If the principal transmits the information, the agent will observe  $\theta_A$  or  $\theta_B$ . Then, the incentive constraints are

$$(2) \quad U_A - \dot{e} \geq \underline{s},$$

$$(3) \quad U_B - \dot{e} \geq \underline{s}.$$

Finally, the agent cannot be fined since the incentive schemes of the workers or managers do not usually include fines (see, JENSEN and MURPHY [1990])

$$(4) \quad \underline{s} \geq 0$$

We must now obtain the reservation utility level of the agent,  $\underline{U}$ . If the agent sets up a new firm, which can only happen if  $a = 1$ , he himself exerts the effort. He then gets

$$Q(K + D)\dot{x} + (1 - Q)K\dot{x} - \dot{e} - F = (K + QD)\dot{x} - \dot{e} - F$$

and his reservation utility level is  $\underline{U} = \max\{0, (K + QD)\dot{x} - \dot{e} - F\}$ .

It is profitable for the agent to set up a new firm (endogenous entry) if  $(K + QD)\dot{x} - \dot{e} - F > 0$ , *i.e.* if the cost of entry,  $F$ , is not too high. In this case, the agent obtains all the expected income due to the increase in the productivity when he privately observes the good state of nature,  $QD\dot{x}$ , and the income generated by his effort,  $K\dot{x}$ . But he must pay the cost of his effort,  $\dot{e}$ , and the cost of setting up a new firm,  $F$ . Note that if  $F \geq (K + QD)\dot{x} - \dot{e}$ , the agent will never set up a new firm since he will not be able to obtain positive expected profits; in this case his reservation utility level is normalized to zero.

If we denote  $\Delta s = \dot{s} - \underline{s}$ , we can write the principal's problem when  $a = 1$  as:

$$\text{Max}_{\dot{s}, \underline{s}} V_1 = \{[K + QD](\dot{x} - \Delta s) - \underline{s}\}$$

subject to:

$$(1) \quad [K + QD]\Delta s + \underline{s} - \dot{e} \geq \max\{0, (K + QD)\dot{x} - \dot{e} - F\},$$

$$(2) \quad (K + D)\Delta s - \dot{e} \geq 0,$$

$$(3) \quad K\Delta s - \dot{e} \geq 0,$$

$$(4) \quad \underline{s} \geq 0.$$

As constraint (2) is redundant due to (3), we have two cases depending on the value of the fixed cost of entry,  $F$ .

The first case occurs when the value of  $F$  is high enough,  $F \geq (K + QD)\dot{x} - \dot{e}$ , consequently, the agent will never set up a new firm since he cannot expect positive profits and, thus,

$$\underline{U} = \max\{0, (K + QD)\dot{x} - \dot{e} - F\} = 0.$$

Constraints (3) and (4) hold with equality, implying that  $\underline{s} = 0$  and  $\dot{x} = \frac{\dot{e}}{K}$ .

Then,  $V_1 = [K + QD](\dot{x} - \frac{\dot{x}}{K})$  and  $U_1 = QD\frac{\dot{e}}{K}$ . As the agent will observe the state of nature, he gets  $QD\frac{\dot{e}}{K}$ , the expected rent that the agent obtains due to the fact that he cannot be fined and that he will privately observe the state of nature.

The second case occurs when the value of  $F$  is low enough,  $F < (K + QD)\dot{x} - \dot{e}$ , and then

$$\underline{U} = \max\{0, (K + QD)\dot{x} - \dot{e} - F\} = (K + QD)\dot{x} - \dot{e}.$$

In this case the agent gets  $\max\{QD\frac{\dot{e}}{K}, (K + QD)\dot{x} - \dot{e} - F\}$ ; *i.e.* he gets an information rent by observing the state of nature or the value of his outside option. We have two possibilities. First, if  $F$  is such that

$$(K + QD)(\dot{x} - \frac{\dot{e}}{K}) \leq F < (K + QD)\dot{x} - \dot{e}$$

then  $\max\{QD\frac{\dot{e}}{K}, (K + QD)\dot{x} - \dot{e} - F\} = QD\frac{\dot{e}}{K}$  and the agent does not create a new firm since he is better off with the positive expected rent he earns by working for the principal; constraints (3) and (4) hold with equality, implying that  $\underline{s} = 0$  and  $\dot{s} = \frac{\dot{e}}{K}$ . Then,  $V_1 = [K + QD](\dot{x} - \frac{\dot{e}}{K})$  and  $U_1 = QD\frac{\dot{e}}{K}$ . Second, if  $(K + QD)(\dot{x} - \frac{\dot{e}}{K}) > F$ , then

$$\max\{QD\frac{\dot{e}}{K}, (K + QD)\dot{x} - \dot{e} - F\} = (K + QD)\dot{x} - \dot{e} - F$$

and the agent obtains a higher income by setting up a new firm; because of this, the principal will have to pay him the same expected income he would obtain if he established a new firm; constraint (3) holds with equality, implying that the agent must receive  $(K + QD)\dot{x} - \dot{e} - F$  to participate. Thus, in this case the principal has only the cost of entry  $F$ ,  $V_1 = F$  and  $U_1 = (K + QD)\dot{x} - \dot{e} - F$ . Therefore, the expected rent the agent obtains when he observes the state of nature is the higher of two values: the expected profit of the outside option or the information rent he can obtain.

The principal's problem when withholding information ( $a = 0$ ) is choosing  $\dot{s}$  and  $\underline{s}$  so as to maximize  $V_0$ , subject to the following constraints:

i) the participation constraint

$$(5) \quad U_0 - \dot{e} \geq 0$$

ii) the incentive constraint (the agent observes  $\theta_0$ )

$$(6) \quad U_0 - \dot{e} \geq \underline{s}$$

iii) the agent cannot be fined: constraint (4).

We assume, in this case, that the agent will never be able to set up its own firm. It is easy to see that, when withholding information ( $a = 0$ ), the incentive scheme selected by the principal is  $\underline{s} = 0$  and  $\dot{s} = \frac{\dot{e}}{K}$ . We then have that

$$V_0 = K\dot{x} - \dot{e} \text{ and } U_0 = 0.$$

If the principal does not transmit the information to the agent ( $a = 0$ ), the probability of obtaining is always  $K$  (*i.e.* the agent's productivity does not increase in the good state of nature) and the reservation utility level of the agent is zero since he has no outside option. The agent participates and exerts effort by getting his reservation utility level in the expected terms; this implies that the only cost the principal must pay is the cost of the effort made by the agent.

Now we must compare both cases. An advantage when withholding information ( $a = 0$ ) is that the agent does not obtain an informational rent and, therefore, his productivity never increases. On the other hand, the advantage of communicating the information to the agent ( $a = 1$ ) is the increase in his productivity in the good state of nature, though the agent can set up a new firm. By using the preceding results, we obtain the following proposition.

PROPOSITION 1: The principal prefers to withhold information ( $a = 0$ ) rather than transmit it ( $a = 1$ ) if and only if  $F < K\dot{x} - \dot{e}$ .

We have several cases depending on the cost of establishing a new firm. If  $F$  is high enough,  $F \geq K\dot{x} - \dot{e}$ , the principal will always report all the information to the agent ( $a = 1$ ) since he will never establish a new firm. As we have seen in this case, the agent must receive the expected rent  $QD\frac{\dot{e}}{K}$  or the expected income he can obtain if he establishes a new firm.

On the contrary, if  $F$  is low enough,  $F < K\dot{x} - \dot{e}$ , the principal will never report the information to the agent ( $a = 0$ ) since setting up a new firm is cheap. The income the principal must pay the agent is so high that the former is better off withholding information. As a result, the agent will never observe the state of nature. For instance, if  $F = 0$ , the agent can obtain  $(K + QD)\dot{x} - \dot{e}$  if he can set up a new company, and this is the quantity the principal must pay him to avoid endogenous entry; the principal obtains zero profits. Then, the principal prefers not to report the information to the agent since, in this case, the principal gets  $K\dot{x} - \dot{e}$ , which is higher than zero.

A corollary of this proposition is that the principal can always deter endogenous entry, even if the agent can establish a more efficient organization than the principal by obtaining higher profits and thus reduce social welfare. The principal can always decide to withhold information and so avoid the possibility of endogenous entry.

## 4 Conclusion

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In this paper we have studied the power the principal has to deter endogenous entry due to his control over the information available to the agent. We have focused on two points when studying this question: the power of the principal to control the information available to the agent and the possibility that the agent may set up a new firm if he receives private information. The result obtained depends on the cost of entry the agent must bear to establish a new firm. If it is low enough, the principal will not communicate the information to avoid endogenous entry. If the cost of entry has an intermediate value, the principal will inform the agent, but he will have to pay him the higher of two values: his external value option or the informational rent that he can obtain due to his observing the state of nature privately. Finally, if the cost of entry is high enough there is no effective threat of endogenous entry and the principal will inform the agent to increase the probability of success.

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