Private Information and Endogenous Entry

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We assume an organization made up of a principal and an agent in which the agent privately observes the state of nature. The agent can use his private information to set up a new firm (endogenous entry) with a positive fixed cost. We show that, in equilibrium, there is effective endogenous entry if the cost of entry the agent must bear to establish a new firm is low enough, as the agent has better information about the state of nature than the principal.

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I. Introduction

In the literature on entry deterrence, the possibility of deterring the entry of potential rivals has mainly been studied by assuming that rivals come from outside the firm (see, for example, Gilbert (1989)). In this paper a different type of entry is considered: endogenous entry; that is, the entrant comes from inside the firm. The problem facing the owner of a firm (the principal) is that production requires a second individual (the agent) and, over time,

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this individual will acquire private information about the firm and hence the ability to leave and set up a rival firm.

The literature on endogenous entry deterrence shows that the principal can deter endogenous entry, for example, by investing in capital before contracting with the agent (Stewart 1994) or by controlling the information the agent can get inside the organization (Bárcena-Ruiz and Rubio 2000). On the other hand, Pakes and Nitzan (1983) and Rubio (1996) show that there can be endogenous entry if the principal does not know the cost of setting up a new firm by the agent. However, in many cases both the principal and the agent know the cost of establishing a new firm, but the agent has better information on the environment than the principal. This private information, which is usually obtained by the agent after working for several years for the principal, can be used by the agent to set up a new firm.

The following example illustrates the problem we want to consider (*El País*, 2-25-1996). Lázaro Ituarte was a firm located in Amurrio (Basque Country), founded in the 1930s, that found a stronger rival in the 1980s in a firm created by the ex chairman of the company. This person left the firm, together with a group of lower level managers, and set up a rival company: HT Fluid Control. Lazaro Ituarte went into a crisis after the group of managers left. Although the sales of this firm were around 9 million euros, and two thirds of its output was sold abroad, it could not avoid going into receivership in 1992.

We consider a static model that reflects the example cited. There is an organization made up of a principal (the owner) and an agent (the manager). Only the agent observes the state of nature; the principal has *prior* beliefs concerning the state of nature. The principal offers a contract to the agent, who is able to break the contract without penalties and set up a new firm with a positive fixed cost; in that case, the old firm disappears. We show that, in equilibrium, there is endogenous entry if the cost of entry the agent must bear to establish a new firm is low enough. In this case, the agent can set up a new firm since he has better information about the state of nature than the principal. The agent knows the true value of the new firm while the principal values the firm in expected terms and thus in order to deter entry the principal has to pay a quantity greater than the expected profit she would obtain by deterring endogenous entry.

If the firm of the principal does not disappear in case of entry by the agent, there are two firms competing in the product market. In this case, there is endogenous entry for a lower value of the cost of entry the agent must bear to establish a new firm than when the firm of the principal disappears in case of entry since market competition implies that the outside option of the agent has a lower value. Moreover, if market competition is sufficiently strong in case of entry by the agent, it is not profitable for him to set up a new firm.

In section II we provide the model. Section III shows and discusses the results. Section IV extends the model to consider competition in the product market and, finally, section IV draws conclusions.

II. The Model

We focus on an organization that consists of a principal and an agent, both risk neutral. The principal hires an agent who exerts unobservable effort $e \in \{0, e_H\}$ to obtain an observable output $x \in \{0, x_H\}$. There are two states of nature: the good state, θ_H, and the bad state, θ_L. Prior beliefs concerning the state of nature $\theta \in \{\theta_H, \theta_L\}$, which are common knowledge, are θ_H with probability q and θ_L with probability $(1-q)$. Only the agent is able to observe the true state of nature.

The probability of obtaining x_H depends on both the effort of the agent and the state of nature. We assume that if the agent exerts a high level of effort, e_H, when he observes state of nature, θ, the probability of obtaining x_H is k_i $(i = H, L)$, $k_i \in [0,1]$, where $k_H > k_L$. In the case of low effort, $e = 0$, it is not possible to obtain x_H. Therefore, 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:

$$P(x_H / \theta_H, e_H) = k_H,$$

$$P(x_H / \theta_L, e_H) = k_L,$$

$$P(x_H / \theta, e = 0) = 0, \quad \theta \in \{\theta_H, \theta_L\}.$$

The agent can observe the state of nature because he is an experienced manager. However, the principal is not an expert in using the information available about the state of nature (*i.e.* she is not an experienced manager). The principal is an investor that it is not able to manage the firm and, thus, he needs to hire a manager (the agent) to do this work.

The agent can break the contract he has signed, without penalties, after observing the state of nature. This is the same as assuming that he can observe the state of nature before signing the contract.[1] This assumption seeks to model the fact that some managers, after working several years in a firm, leave and set up a new rival firm that competes with the old one.

There is a fixed cost C which can be understood as the expected cost of contracting a team of workers to exert a productive effort. This cost is the wage of the team of workers and thus is a cost that must be paid by firms to be able to produce. This cost is the same regardless of whether the firm is established by the principal or by the agent. In order to simplify the model, and without loss of generality, we consider this fixed cost instead of introducing a third individual (or a team of workers) in the organization.

If the agent establishes a new firm, he must pay a fixed entry cost F. In order to simplify the exposition of the results, we assume that the agent can set up a new firm only if he observes the good state of nature.[2] 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 be both the owner and the manager of the firm.

The reservation utility level of the agent is denoted as $\underline{U}$, and depends on the value of his outside option, when this value is positive. If it is not profitable for the agent to set up a new firm, his reservation utility level is normalized to zero. The principal's utility function is $x-s(x)-C$. The agent's utility function, if he accepts the offer made by the principal, is $s(x)-e$, where $-e$ is the

[1]If the agent observes the state of nature after signing the contract the principal must provide incentives for the agent not to break the contract after observing the state of nature. Otherwise, the contract would not guarantee that the agent will stay in the firm of the principal after observing the state of nature.

[2]It can be shown that the main result of the model holds if the agent can also set up a new firm in the bad state of nature.

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 $x-e-C-F$.

We assume that the expected income derived from the effort made by the agent is greater than the cost of this effort, $k_L x_H > e_H$. This assumption ensures that the expected utility of the principal is always positive (never positive) when the agent exerts high (low) effort. In this way we can ignore the problem of how much effort to choose when solving the problem of the principal, as the latter will always want the agent to exert high effort.

The timing of the model is the following: (i) the agent observes the true state of nature; (ii) the principal designs the agent's incentive scheme, $s(x)$, where $s(x_H)=s_H$ and $s(0)=s_L$;[3] (iii) the agent observes the incentive scheme and decides whether to accept the offer made by the principal, reject it, or reject it by setting up a new firm; (iv) the agent exerts effort $e\in\{0,e_H\}$; and (v) the outcome is obtained and payments are made. The equilibrium concept used is the Bayesian Perfect Equilibrium.

III. Results

Let V denote the principal's expected utility: $V=q[k_H x_H - k_H s_H - (1-k_H)s_L] + (1-q)[k_L x_H - k_L s_H - (1-k_L)s_L] - C$. The principal's problem lies in choosing s_H and s_L, to maximize V, which is subject to the following constraints.

First, as the agent privately observes the state of nature, there are two participation constraints. The agent must receive at least his reservation utility level in both states of nature to accept the contract.

[3]We assume 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. Only the agent is an expert in using the information available to observe the state of nature. They also argue that the information that the agent holds privately is not always communicated to the principal since the skill and training necessary to use the information (*i.e.* to observe the state of nature) have a great cost. For instance, a divisional manager holds information valuable to the division and this information is not given to the head of the firm.

$$k_H s_H + (1 - k_H) s_L - e_H \geq \underline{U}, \tag{1}$$

$$k_L s_H + (1 - k_L) s_L - e_H \geq 0. \tag{2}$$

Secondly, the agent exerts high effort if his expected utility in this case is higher than if he were to exert low effort; in the latter case, he would obtain a low salary. As the agent observes the state of nature before exerting the effort, there are two incentive constraints,

$$k_H s_H + (1 - k_H) s_L - e_H \geq s_L, \tag{3}$$

$$k_L s_H + (1 - k_L) s_L - e_H \geq s_L. \tag{4}$$

Finally, the agent cannot be fined since incentive schemes for managers do not usually include fines (see Jensen and Murphy (1990)),

$$s_L \geq 0. \tag{5}$$

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 he observes θ_H, he himself exerts the effort. He then gets: $k_H x_H - e_H - C - F$, and his reservation utility level is $\underline{U} = \max\{0, k_H x_H - e_H - C - F\}$. Therefore, it is profitable for the agent to set up a new firm (endogenous entry) if the cost of entry, F, is low enough; *i.e* when $F < k_H x_H - e_H - C$. Let $\Delta k = k_H - k_L$ which can be interpreted as the increase in the probability of obtaining x_H when the agent observes the good state of nature, θ_H. In this case, the agent obtains all the income due to the increase in productivity when he privately observes the good state of nature, $\Delta k x_H$, and the income generated by his effort, $k_L x_H$. But he must pay the cost of his effort, e_H, and the fixed costs C and F. If $F \geq k_H x_H - e_H - C$, the agent will never set up a new firm since he will not obtain positive expected profits; in this case his reservation utility level is normalized to zero.

If we denote $\Delta s = s_H - s_L$ and $F_1 = k_H x_H - e_H - C$, we can write the principal's problem as:

$$\underset{s_H, s_L}{\text{Max}}\ V=\{(k_L+q\,\Delta k)(x_H-\Delta s)-s_L-C\}$$

subject to: (1) $k_H\Delta s+s_L-e_H\geq \max\{0,F_1-F\}$

(2) $k_L\Delta s+s_L-e_H\geq 0$

(3) $k_H\Delta s-e_H\geq 0$

(4) $k_L\Delta s-e_H\geq 0$

(5) $s_L\geq 0$

As constraint (3) is redundant due to (4), 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, $F\geq F_1$; the agent will never set up a new firm since he cannot expect positive profits and, thus, $\underline{U}=\max\{0,F_1-F\}=0$. Constraints (2) and (4) hold with equality, implying that $s_L=0$ and $s_H=e_H/k_L$. Then, $V=(k_L+q\,\Delta k)((x_H-(e_H/k_L))-C$, and the agent obtains $(\Delta k/k_L)e_H$ when he observes θ_H and 0 when he observes θ_L. Therefore, under θ_H the agent gets $(\Delta k/k_L)e_H$, the informational rent that he obtains by observing the good state of nature.

The second case occurs when the value of F is low enough, $F<F_1$, and then $\underline{U}=\max\{0,F_1-F\}=F_1-F$. In this case, under θ_H, the agent gets $\max\{(\Delta k/k_L)e_H,F_1-F\}$; *i.e.* he gets an informational rent or the value of his outside option. Let $F_2=k_Hx_H-e_H-C-(\Delta k/k_L)e_H$. We have two possibilities. First, if F is such that $F_2\leq F<F_1$, then $\max\{(\Delta k/k_L)e_H,F_1-F\}=(\Delta k/k_L)e_H$ and the agent does not set up a new firm since he is better off with the informational rent. Constraints (2) and (4) hold with equality, implying that $s_L=0$ and $s_H=e_H/k_L$; then, $V=(k_L+q\,\Delta k)(x_H-(e_H/k_L))$, the agent obtains $(\Delta k/k_L)e_H$ under θ_H and 0 under θ_L. Second, if $F<F_2$, then $\max\{(\Delta k/k_L)e_H, F_1-F\}=F_1-F$ 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 income he would obtain if he established a new firm. Constraints (1) and (4) hold with equality, implying that $s_L=0$ and $s_H=x_H-(F+C)/k_H$, and the principal gets $V=(k_L+q\,\Delta k)((F+C)/k_H)-C$ $=[F(k_L+q\,\Delta k)-(1-q)\,\Delta kC]/k_H$; therefore, $V<0$ if $F<((1-q)\,\Delta kC)/(k_L+q\,\Delta k)=F_3$. As a result, if $F<F_3$, the principal cannot deter endogenous entry since she would obtain negative expected profits. If $F_3\leq F<F_2$, the principal deters endogenous entry, and the agent

obtains $F_1 - F$ in the good state of nature and $k_L x_{II} - e_{II} - (k_L(F + C)/(k_L + q\Delta k))$ in the bad state of nature.

We can summarize the above results in the following proposition.

***Proposition* 1**

When the agent observes the good state of nature, qH, in equilibrium there is endogenous entry if $F < F_3$; it is not profitable for the agent to set up a new firm if $F \geq F_3$. In this last case, the agent gets the value of his outside option if $F_2 > F \geq F_3$ and an informational rent if $F \geq F_2$.

When the fixed cost of entry is high enough, $F \geq F_2$, there is no endogenous entry. In this case entry is blockaded since the principal's behavior is not affected by the possibility of endogenous entry. If $F \geq F_2$, the agent prefers to work for the principal when the agent observes θ_H, and get an informational rent by privately observing the state of nature. It must be noted that if $F \geq F_1$ (being $F_1 > F_2$), the agent cannot get a positive utility by setting up a new firm.

Nor is there endogenous entry when the fixed cost of entry takes an intermediate value, $F_2 > F \geq F_3$,. In this case, the principal has to pay the agent the value of his outside option, which is greater than the informational rent. Thus, the principal is able to deter endogenous entry.

Finally, when the fixed cost of entry is low enough, $F < F_3$, the principal cannot deter endogenous entry since she would obtain negative expected profits. As the agent knows the true value of the new firm while the principal values the firm in expected terms in order to deter entry, the principal would have to pay a quantity greater than the expected profit she would obtain by deterring entry.

IV. Competition in the Product Market

In this section we extend the model to consider the case in which the firm of the principal does not disappear in case of entry by the agent. In this case market structure is a duopoly instead a monopoly. The x_P and x_A denote the incomes of the firms of the principal and the agent, respectively. As competition decreases the

rents to be divided between the principal and the agent, $x_M > x_P + x_A$ (*i.e.* the rents in a duopoly are lower than in a monopoly). The values of x_P and x_A could arise from different types of competition. We could have Cournot competition on quantities if firms choose their output levels simultaneously. We could also consider that either of the firms has an advantage which would permit its to become a Stackelberg leader on quantities. For instance, the agent could have an advantage and choose quantities first (and thus be the leader) since the most skilled workers of the principal's firm have left and now work for the agent. Similarly, the principal could be the leader since its firm was in the market first.

In this case, the reservation utility level of the agent is $\underline{U} = \max\{0, k_M x_A - e_M - F\}$. Therefore, it is profitable for the agent to set up a new firm if $F < k_M x_A - e_M - C$. Given that market competition implies that $x_A < x_M$, under a duopoly market structure the outside option of the agent has a lower value than under a natural monopoly (*i.e.* the profits of the firms are lower if market structure is a duopoly rather than a monopoly). This means that the payment that the principal has to give to the agent to avoid endogenous entry is lower when there is competition in the product market. As a result, market competition reduces the range of values of parameter F for which there is endogenous entry.[4] Moreover, if market competition is sufficiently strong (*i.e.* if x_M is sufficiently greater than x_A) in case of entry by the agent, he does not find it profitable to set up a new firm since the value of his outside option is lower than the informational rent he obtains by working for the principal.

V. Conclusion

In this paper we consider the possibility of deterring entry by the principal when the agent has better information on the environment (state of nature) than the principal. This private information can be used by the agent to set up a new firm. The principal offers a contract to the agent, but the agent is able to break the contract without penalties and set up a new firm with a positive fixed cost, so that the old firm disappears. We show that, in equilibrium, there is endogenous entry if the cost of entry the agent must bear

[4]The proof is available from the authors on request.

to establish a new firm is low enough. The agent will set up a new firm since he knows the true value of the new firm while the principal values the firm in expected terms.

If there is competition in the product market, *i.e.* if the firm of the principal does not disappear in case of entry by the agent, there is endogenous entry for a lower value of the cost of entry the agent must bear to establish a new firm than when the firm of the principal disappears in case of entry since market competition implies that the outside option of the agent has a lower value.

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