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MARKET STRUCTURE AND INNOVATION WITH MULTIPROJECT FIRMS. THE ROLE OF THE TIMING OF INNOVATION

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El Colegio de México**

Abstract

This paper studies a stochastic patent race in which firms are allowed to undertake several projects aimed at the same innovation. The main result of the study shows that the market portfolio of projects is not invariant to the number of firms in a game of timing. This result also has implications for the efficiency of the market outcome. The paper shows that the market undertakes more projects than the socially desirable number. However, each project is undertaken at an efficient level of effort.

Keywords: Multiproject firms; R and D; Patent Race

JEL classification: L10; L19; O30; O31

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1 INTRODUCTION

The issue of how firms invest in R and D in a strategic setting has been an active area of research in the literature of industrial organization since the seminal models of Loury (1979), Dasgupta and Stiglitz (1980), Lee and Wilde (1980) and Reinganum (1981) (1982)[1]. In his influential 1979 paper, Loury studied a stochastic patent race assuming an exponential probability distribution of discovery. Loury's model allowed firms to undertake only one R and D project and expenditures were independent of the duration of the race (the lump-sum cost model). Loury proved that for any market structure, the market allocated too much effort per firm to the R and D process in comparison with the socially desirable level.

Sah and Stiglitz (1987) pointed out a shortcoming of the pioneering works. They argued that the previous literature on R and D unrealistically restricted the firms investing in R and D to undertake a single project. The model proposed by Sah and Stiglitz assumes an economy in which firms can undertake several parallel projects aimed to the same innovation. The probability for any one project to achieve the innovation is a function of the firm's investment in that project. There is no time in their model and the probability that two or more projects will be successful is nonzero. Firms compete in a market characterized by Bertrand

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[1] For a general summary of this literature, the reader may consult the survey by Reinganum (1989).

competition. Hence, if two or more firms innovate, Bertrand competition will take away all the benefits from the innovation. "This assumption gives ..[the].. model a winner-takes-all feature similar to that in the patent race literature" (Sah and Stiglitz (1987) p.98). The main result of their paper is:

i. "The market portfolio of projects -the number of projects undertaken as well as the expenditures on each of them- is unaffected by the number of firms" (Sah and Stiglitz (1987) p.99).

Sah and Stiglitz called this result the invariance theorem.
With uncorrelated projects and symmetric equilibria they were able to show that:

ii. The level of effort at which each project is undertaken is efficient and independent of the size of the prize granted to the firm if it is the only winner.

iii. If social benefits are equal to private benefits, then the market portfolio of outcomes is socially efficient in the sense that both the level of effort and the number of projects undertaken by the market are equal to the level chosen by a social planner[2].

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[2] Sah and Stiglitz do not talk explicitly about this result. Instead, they assume that private benefits are smaller than social benefits because the innovator cannot appropriate all the consumer surplus. Consequently, the number of projects that the market undertakes is smaller than those undertaken by the social planner. However, in their model, the only reason for this result is the hypothesis that private benefits are smaller than social benefits.

The conclusions (i) and (iii) are sensitive to the assumptions of the Sah and Stiglitz model. In particular, the premise that the process of innovation is not a game of timing, and thus, the implication that two or more projects can be successful. Also, the conclusions reached by Loury are sensitive to the assumption that restricts the firms to undertake a single project.

This paper constitutes a comment on the role of the timing of innovation as a driving force that affects the incentives of firms to invest in R and D in a market environment. The paper studies a game of timing in which firms may undertake parallel projects aimed at the same innovation. In comparison with Sah and Stiglitz, the paper shows that the invariance theorem -result (i)- does not hold when the timing of innovation matters. The central result of the study is that market structure does affect the pace of innovation in a game of timing, even if firms are allowed to undertake several parallel projects[3].

The model proposed here is the natural extension of the Loury model (1979) to the case where firms are not restricted to undertake a single project. This model is interesting in that it is the simplest framework that can offer intuition about the role of timing as a factor that invalidates the invariance result. The

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[3] For some industries there may be several alternative paths of R and D aimed at a single innovation. There is no reason to restrict a firm to follow just a single path. For example, in looking for the cure to a certain disease, a pharmaceutical firm may invest in alternative paths.

model is also helpful in explaining the reasons for Loury's result: firms in a market environment allocate excessive effort to a single project. According to the present paper, Loury's outcome was due to the arbitrary restriction on the number of projects -one- that a firm could undertake. In contrast with Loury, and similarly to Sah and Stiglitz, this study finds out that each project that the market undertakes is taken at the efficient level of effort.

Finally, the paper shows that result (iii) of Sah and Stiglitz no longer holds in a patent race. In a patent race there is an externality because each firm wants to be first, an externality which is neutralized in the Sah and Stiglitz model because each one of the projects has a positive probability of innovating. In the Sah and Stiglitz paper, a marginal project will generate profits for a firm, only if all the other projects undertaken by the market -including those already undertaken by the firm- fail. Therefore, the decision of a firm to initiate an additional project depends on the number of projects undertaken by the whole market, and not on how these projects are allocated across firms. If the social prize is equal to the private prize, the number of projects undertaken by the market is equal to those undertaken by the social planner.

In a patent race, firms do not care which project succeeds, but do want to have the winning project. An investment in an additional project by a given firm will reduce its expected date of innovation. Because each firm wants to be first, the expected date of discovery for the market is shorter than the one aimed by the social planner. Due to this feature, the market allocates more resources to innovate than the socially desirable level. This result has policy implications, since patent duration is an instrument that governments can use to encourage R and D, the government could reduce the term of the patent duration and thereby the level of expected benefits upon winning the race, to diminish the level of resources that the market allocates to R and D.

If the timing of innovation is an important dimension of the innovation process at study, market structure is still an important factor in determining the incentives to innovate. In the context of a game of timing, market strcuture affects the speed of development, an absent dimension of analysis in the timeless setting.

2 THE MODEL

The model studied in this paper is similar to Loury (1979). As in Loury, this model incorporates lump sum costs of R and D[4]. However, in contrast with Loury, firms can undertake several parallel projects aimed at the same innovation. The projects are

[4]The reader may notice that the assumption of lump sum costs makes the cost expenditures independent of the duration of the race. A trivial property in an economy without time.

statistically independent[5]. As in Loury, the timing of innovation, t', of any single project is distributed according to an exponential distribution function with parameter λ :

$$Prob(t' \leq t) = 1 - e^{-\lambda t}$$

Assume that the parameter λ is a function of c_{ij}, the investment by firm i on project j. Assume also that the function $\lambda(\cdot)$ satisfies the following conditions: $\lambda(0)=0$; $\lim_{c_{ij} \to \infty} \lambda'(c_{ij})=0$; $\lambda'(\cdot)>0$; and $\lambda''(c_{ij})>0$ if $c_{ij}<\hat{c}$, $\lambda''(c_{ij})=0$ if $c_{ij}=\hat{c}$ and finally $\lambda''(c_{ij})<0$ if $c_{ij}>\hat{c}$, with $\hat{c}>0$ [6].

The winner of the race gets a prize R , the loosers do not get anything. The assumption that the winner takes all is justified in this case by assuming that a patent right gives the winner the unique privilege of exploitation of the innovation.

Under the above assumptions the probability that the rivals of firm i

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[5]This assumption implies that the probability of success of any given project is independent of the firm's affiliation. As Sah and Stiglitz argue, this assumption may be reasonable if research groups are isolated from one another inside the firm. The management may desire this organizational structure for monitoring purposes.

[6] As discussed later in the paper, the first order conditions imply that the optimal level of effort is set at a level in which the marginal increase in the probability of discovery is equal to the average probability of discovery. If the technology of innovation has global decreasing returns, this result implies that the optimal level of effort per project is infinitely small. Alternatively, if the technology has global increasing returns a firm will undertake only a single project. This assumption allows the study to make the analysis under the interesting case in which several projects are undertaken at a positive level of effort.

have not innovated by time t is given by:

$$\prod_{s \neq i} \prod_{k=1}^{k_s} e^{-\lambda(c_{sk})t}$$

where k_s represents the number of projects undertaken by firm s.

Given the symmetry of the technology, any firm will choose the same level of effort for all projects. Hence, the last condition can be simplified to:

$$e^{-\mu t}$$

where $\mu=\sum_{s \neq i} k_s \lambda(c_s)$. On the other hand the probability that firm i innovates before time t is given by:

$$1-e^{-k_i \lambda(c_i)t}$$

The probability that firm i innovates in t :

$$k_i \lambda(c_i) e^{-k_i \lambda(c_i)t}$$

Expected profits for firm i are equal to the following expression:

$$V^i(\mu, R, r) = \int_0^{\infty} e^{-\mu t} k_i \lambda(c_i) e^{-k_i \lambda(c_i)} e^{-rt} R dt - k_i c_i$$

The firm will win the prize R, only if it innovates before all the other rivals do. After integrating the last expression, the following expression for expected benefits is obtained[7]:

$$V^i(\mu,R,r)=[\frac{Rk_i\lambda(c_i)}{\mu+k_i\lambda(c_i)+r}-k_ic_i]$$

3 RESULTS

The study concentrates its analysis on symmetric Nash equilibria. The first order conditions with respect to k_i and c_i are[8]:

$$\begin{aligned}\frac{((n_m-1)k_m\lambda(c_m)+r)R\lambda(c_m))}{(n_mk_m\lambda(c_m)+r)^2}&=c_m\\ \frac{((n_m-1)k_m\lambda(c_m)+r)Rk_m\lambda'(c_m))}{(n_mk_m\lambda(c_m)+r)^2}&=k_m\end{aligned} \qquad (1)$$

Where n_m is equal to the number of firms in the market, c_m represents the optimal level of effort chosen by firm i, and k_m represents the optimal number of projects. From the last two conditions it can be verified immediately that:

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[7] Existence can be proved if it is assumed that $\lambda'(0)>0$ and that R is large enough. In this case, a representative firm will invest in R and D even if their rivals were not investing at all. Also, given the expression for expected profits, the larger the number of projects of the rivals, the larger μ and the smaller expected profits. For a very large μ, a representative firm will have less incentive to invest in R and D.

[8] In the first order conditions for k_i, k_i is regarded as a continuous variable. The analysis with k_i discrete still negates the invariance result. Loury (1979) and Lee and Wilde (1980) make their analysis on the assumption of a continuous number of firms (projects).

$$\frac{\lambda(c_m)}{c_m}=\lambda'(c_m)$$

The last expression implies the following proposition:

Proposition 1: All firms choose the efficient level of effort, regardless of the size of the prize and the number of firms.

The last proposition confirms result (ii) of Sah and Stiglitz and contradicts the conclusion reached by Loury [9].

The first order conditions also show that an increase in the size of the reward for innovating, R, increases the number of projects that the representative firm undertakes.

In order to check how the market structure affects the efforts allocated to R and D by a representative firm, the implicit function theorem is applied and the first order conditions are differentiated. By using the fact that $\frac{\partial c_m}{\partial n_m}=0$, the following result is obtained[10]:

[9] This result was mentioned in the introduction. According to that result, the level of effort allocated by a firm to its *single* R and D project is excessive in comparison with the level that minimizes costs. This property holds for any market structure.

[10] In the following expression λ is evaluated at c_m. To save space the argument is omitted.

$$\frac{\partial k_m}{\partial n_m}=\frac{-[(n_m^2-2n_m)k_m^3\lambda^2+2(n_m-1)k_m^2\lambda r+k_m r^2]}{[(n_m^3-n_m^2)k_m^2\lambda^2+(n_m+1)r^2+2n_m^2 k_m\lambda r]}$$

From the last expression we notice immediately that for $n_m \geq 2$, the partial derivative is unambiguously negative. As the number of firms in the market increases, the representative firm reduces its number of projects aimed to the innovation. The number of firms does affect the resources allocated to R and D. Furthermore, the impact of the increase of the number of firms on the number of projects undertaken by the representative firm becomes smaller as the number of firms grows without limit. In particular, the limit of the expression $\frac{\partial k_m}{\partial n_m}$ is zero when $n_m \rightarrow \infty$. In the case of $n_m=1$, the number of projects increases as the number of firms increases. This result is intuitive because the monopolist solution is being compared with a noncooperative environment. When the noncooperative environment emerges, the market duplicates efforts because each firm wants to be first.

The fact that $\frac{\partial k_m}{\partial n_m}<0$ for $n_m \geq 2$ does not imply a later introductory date for the innovation. Expected introductory date is equal to the inverse of the following expression, $n_m k_m \lambda(c_m)$. The derivative of this expression with respect to n_m is equal to the following[11]:

[11] See footnote 10.

$$\frac{\partial n_m k_m \lambda(c_m)}{\partial n_m}=\lambda\left(\frac{n_m^2 k_m^3 \lambda^2+k_m r^2+2n_m k_m^2 \lambda r}{(n_m^3-n_m^2)\,k_m^2\lambda^2+(n_m+1)\,r^2+2n_m^2 k_m \lambda r}\right)$$

The last expression is positive for $n_m \geq 1$. Thus, as the number of firms increases, the expected date of innovation is reduced.

Notice that the change in the expected date of innovation is due to the fact that the number of projects undertaken by the market changes with the number of firms -remember that $\frac{\partial c_m}{\partial n_m}=0$ -. Thus, the market number of projects is not invariant to the number of firms.

This reasoning can be summarized in the following proposition:

Proposition 2: The number of projects that the market undertakes is not invariant to the number of firms. As the number of firms increases, a representative firm undertakes a smaller number of projects. An increase in the number of firms leads to an earlier expected introduction date.

Next, the market outcome is contrasted with the social optimum. Define S as the social prize of innovation. A quick survey of the literature on innovation will show that the difference between the private prize and the social prize, $R-S$, may be negative or positive. If the innovation substitutes an existing product, then social prize is less than private prize. Alternatively, due to the incapability of the private producer to extract the whole consumer surplus, private benefit may be lower than social benefit. For simplicity this paper assumes that $R=S$. Since the social planner does not care which project succeeds, he is only concerned with $n_s\lambda(c_s)$, the aggregate probability of innovation in the next instant of time. The symbol n_s in the last expression represents the number of projects undertaken by the social planner. Expected benefits for the social planner become:

$$V^s(R,r)=[\frac{n_s\lambda(c_s)R}{n_s\lambda(c_s)+r}-n_sc_s]$$

The first order conditions for n_s and c_s are:

$$c_s=\frac{Rr\lambda(c_s)}{(n_s\lambda(c_s)+r)^2} \qquad \frac{1}{\lambda'(c_s)}=\frac{Rr}{(n_s\lambda(c_s)+r)^2} \tag{2}$$

From the last conditions it is immediately noticed that $c_s=\hat{c}=c_m$. Next, the number of projects undertaken by the social planner are compared with those undertaken by the market. By combining conditions (1) and (2) :

$$\frac{(\overline{n}_m-k)\lambda(\hat{c})+r}{(\overline{n}_m\lambda(\hat{c})+r)^2}=\frac{r}{(n_s\lambda(\hat{c})+r)^2}$$

Here, $\overline{n}_m$ represents the total number of projects undertaken by the market (i.e. $\overline{n}_m=n_mk_m$). The inequality $\overline{n}_m>n_s$ is derived from the last equation. Consequently, regardless of the number of firms, the noncooperative market solution undertakes more projects than the socially desirable number of projects. This result is not surprising, in a market environment firms care about their own success. In contrast, for the social planner, it does not matter who is the successful winner of the patent.

Thus, there is an externality in the market environment generated by the fact that each firm wants to be first in achieving the innovation. The following proposition summarizes this reasoning:

Proposition 3: If $R=S$, the noncooperative market outcome yields an excessive number of projects as compared with the social planner solution.

Propositions 1 and 3 illustrate the restrictiveness of the specification of the Loury (1979) model. The externality present in the market outcome was translated into too much effort per project. However, when firms are not restricted to choose only one project, the inefficiency is translated into too many projects working at the optimal level.

4 CONCLUDING REMARKS

The primary conclusions of the Sah and Stiglitz model are based on assumption of an economy without time. This assumption implies that the probability that two or more projects innovate is non-zero. A firm will undertake an additional project by comparing its expected benefits with the costs of undertaking it. "This project yields a benefit only if the other projects undertaken by the firm fail, as well as if all of the other projects undertaken by other firms fail. The marginal decisions are thus influenced by the total number of projects undertaken in the market and not by how these projects are partitioned between the firms" (Sah and Stiglitz (1987) p. 101).

In contrast, in the setting proposed in this paper, the firm that innovates wins the race. A firm increases its number of projects with the aim of reducing the expected date of innovation. The probability that two projects innovate at the same time is zero. A firm will undertake an additional project only if the reduction on the expected date of innovation is such that the increase in expected benefits compensates for the additional costs of undertaking the project. Due to the fact that in a strategic environment -two or more firms- each firm wants to be first, the expected date of innovation is lower than the expected date of innovation for the social planner solution. The way noncooperative firms reduce the expected date of discovery is by each undertaking more projects.

In Sah and Stiglitz, the fact that other projects undertaken by a firm have a positive probability of being successful, undermines the incentive to undertake the marginal project. This project will yield a benefit only if the other projects in the market -including those undertaken by the firm- fail.

This paper highlights the role of timing in the innovation process. The fact that each firm wants to be first yields an inefficient outcome. When we relax the restriction that forces each firm to undertake a single project, we eliminate one inefficiency present in the work by Loury (1979), the fact that each firm works at an excessive level of effort in a single project. However, we still get too many resources allocated to R and D when we compare the market outcome with the social planner solution.

Loury´s (1979) seminal study showed that there is a positive relationship between the pace of innovation and market structure -the number of firms-. The work by Sah and Stiglitz undermined this conclusion by arguing that the crucial difference between their model and the earlier literature was the implicit assumption in the earlier models that restricted the firms to undertake just a single project. This paper shows that when timing matters, market structure does have an impact in the pace of innovation, even if firms are allowed to undertake several projects.

REFERENCES

Dasgupta, P. and J. Stiglitz 1980, Uncertainty, industrial structure and the speed of R and D, Bell Journal of Economics 11, 1-28.

Lee, T., and L. Wilde 1980, Market structure and innovation a reformulation, Quarterly Journal of Economics, 94, 429-436.

Loury, G. 1979, Market structure and innovation, Quarterly Journal of Economics, 93, 395-410.

Reinganum, J. 1981, Dynamic games of innovation, Journal of Economic Theory, 25, 21-41.

Reinganum, J. 1982, A dynamic game of R and D: Patent protection and competitive behavior, Econometrica, 50, 671-688.

Reinganum, J. 1989, The Timing of innovation: Research and development, and diffusion, in: R. Schmalensee and R.D. Willig, eds., Handbook of Industrial Organization, Volume 3 (North-Holland, Amsterdam) 849-908.

Sah, R.K. and J. Stiglitz, 1987, The invariance of market innovation to the number of firms, Rand Journal of Economics, 18, 98-108.

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