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Long-run versus short-run decisions: R&D and market structure in Spanish firms

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ABSTRACT

I present new econometric evidence on the relation between market structure and R&D using data on Spanish firms. I adopt a different approach from previous studies by distinguishing between long-run and short-run decisions of firms regarding R&D. I assume that the long-run or strategic decision is whether to conduct R&D or not, and the short-run choice is how much to invest once the firm decides to be innovative. I argue that market structure affects long-run R&D decisions but does not affect short-run ones. A Heckman-type selection model is used to test such a relation. The results are robust to several specifications and measures of monopoly power.

1. Introduction

The relation between R&D and market concentration has been widely studied in the Industrial Organization literature, perhaps because of the contradictory evidence found when using different data, variables, and econometric models. For this reason, a strong case should be made before embarking in a new study of R&D and market structure.

In this paper I present new evidence on such relation using a panel of Spanish manufacturing companies. Several factors make the effort worthwhile. I adopt a different approach from previous studies by distinguishing between long-run and short-run decisions of firms regarding R&D. I assume that the long-run or strategic decision is whether to conduct R&D or not and the short-run choice is how much to invest once the firm decides to be innovative. I argue that market structure affects long-run R&D decisions but does not affect short-run ones. A Heckman-type selection model is used to test such a relation. The advantage of this model compared to the usual OLS or Tobit models is that it allows us to gain information from the fact that the decision of whether to innovate or not and how much to expend on R&D once the firm decides to innovate are different but, depend, to a certain extent on related market and firm characteristics. Most of the previous literature in which a significant relation is found to exist between market power and innovation activities focuses on a particular measure of market power. I include up to five different measures and show that including just one does not fully capture market power and could be misleading. Finally, our rich database makes it possible to control at the same time for many of the characteristics of companies and markets that previous studies have found to be important, including technological opportunities, appropriability and demand conditions, and industry characteristics.

In a paper that uses several measures of market power Geroski (1990) finds no evidence of the effect of these variables on innovation. My results show that concentration and other measures of monopoly power have a significant effect on the decision to innovate but not on the intensity of R&D. This result is robust to several specifications and measures of monopoly power.

In addition, my results provide insight on several policy issues: more monopoly power is associated with more firms choosing to innovate, but on the other hand, innovative firms could, as a result, innovate less. If the decision to innovate depends in part on characteristics of the firm that do not affect R&D intensity, as is the case in our study, then, policy measures affecting those parameters would lead to more firms undertaking R&D without affecting R&D intensity of already innovative firms.

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The remaining sections of the paper are organized as follows. In Section 2, I review the relevant literature. In Section 3, I present the econometric methods. In Section 4, I discuss the data and measurement issues. I offer the main results in Section 5. I devote Section 6 to extensions and robustness checks. Finally, Section 7 concludes.

2. Literature review

Schumpeter (1942) argued that firms with greater monopoly power have a greater incentive to innovate because they can better appropriate the returns of their R&D investment. This simple argument has given rise to a vast literature, both theoretical and empirical, assessing Schumpeter's predictions. The theoretical literature provides arguments to support both a negative effect of competition on R&D and a positive effect. As I will briefly outline in the next paragraphs, the different conclusions come from different model assumptions regarding property rights (exclusive or non-exclusive), the type of innovation (cost reducing or demand enhancing), or the market structure in which firms operate before and after the innovation (monopoly, duopoly, perfect competition).

In an early paper, assuming that innovators enjoy perfect protection (monopoly power) of their property rights over the invention, Arrow (1962) argued that firms in competitive markets benefit more from process innovations than firms in monopolistic markets. Porter (1990) from a different perspective argues that monopoly discourages innovation because firms do not need to innovate to stay in business.

In a model of patent races, Gilbert and Newbery (1982) maintain the hypotheses of exclusive property rights and cost-reducing innovations but consider a different market structure setting in which old and new firms race to obtain patents over new technologies. They find that monopolistic firms have greater incentives to invest on R&D than competitive ones because they can still enjoy duopolistic profits if they lose the race. A key assumption of Gilbert and Newbery (1982) model is that the winner of the race is the firm that invests the most on R&D. If uncertainty over invention is added to the duopoly model, as in Reinganum (1983), firms in competitive markets have more incentives to innovate.[1]

Dasgupta and Stiglitz (1980) consider the case of non-exclusive property rights but maintain the assumption that innovations are cost reducing. They find that competition is harmful to R&D because it results in redundant R&D expenditures. In particular they find that firms' incentives to invest on R&D depend on how competitive markets are before and after the invention.

In a model that integrates both positive and negative effects, Loury (1979), building on Kamien and Schwartz (1972, 1976), assumes technological and market structure uncertainty, and focuses on the strategic interdependence of duopolistic firms regarding the optimal timing decision on when to invest. He finds an inverted U-shape relation between competition and R&D. In a recent model of growth, Aghion et al. (2005) also show that more competition will initially cause greater R&D effort because of the higher incremental profits of innovation in competitive markets. But innovative intensity will decrease above a certain level of competition due to the smaller incentive to innovate faced by laggards.

A vast array of empirical studies provides evidence on which of the two different competing effects (positive or negative) of market structure on innovation is predominant in real data.[2] Some papers find a positive relation between monopoly power and R&D, e.g. Kraft (1989), Crépon et al. (1998), Blundell et al. (1999), others find a negative relation, Geroski (1990), Harris et al. (2003), Okada (2004) or Nickel (1996), an even others, the inverted U-shape predicted in Aghion et al. (2005) as well as in some of the early studies, e.g. Aghion et al. (2005), Tingvall and Poldahl (2006). Most of them find that after controlling for demand, appropriability conditions and technological opportunities, the effect of market structure on innovation is very small if any (e.g. Levin et al., 1985).

This inconclusiveness has been attributed to the different measures of innovation and market power and to problems with the estimation techniques and databases. To name only a few, innovation has been measured by R&D to sales (Levin et al., 1985), R&D employment (Scherer, 1967), R&D capital per worker (Crépon et al., 1998), patent counts (Aghion et al., 2005; Geroski, 1990), sales from innovative products (Mairesse and Mohnen, 2001), or innovation dummies (Pohlmeier, 1992 or Harris et al., 2003). Market structure has been measured by price-cost margins (Okada, 2004; Nickel, 1996; Aghion et al., 2005), Herfindahl index (Tingvall and Poldahl, 2006), concentration ratio (Scherer, 1967; Culbertson and Mueller, 1985; Levin et al., 1985), number of competitors (e.g. Kraft, 1989), number of new companies, market shares or market growth (Geroski, 1990 includes all this three). Even papers that use the same measures of R&D and competition reach different conclusions.

Few papers, however, use more than one variable to capture market structure. Data on market structure show that the correlation among the different possible measures of monopoly power (e.g. concentration ratio or profit margins) is low. Therefore the debate could benefit from a study that uses many of the possible variables. Geroski (1990) includes up to five different measures in the same paper and finds that monopoly power does not affect the number of innovations.

In this paper I reach a different conclusion showing evidence that provides support to Schumpeter's arguments. I also include many different measures of monopoly power but adopt a different approach by distinguishing between long-run and short-run decisions of firms regarding R&D. I assume that the long-run or strategic decision is whether to conduct R&D or not and the short-run choice is how much to invest once the firm decides to be innovative. I argue that market structure affects long-run R&D decisions but does not affect short-run ones. I adopt this focus based on the fact that firms' R&D policy is usually a long-run one due to the length and uncertainty of the innovative process.[3] Conducting R&D activities requires high fixed costs that cannot be changed on the short-run (see, for example, Hall, 1992 or Sutton, 1998). Therefore, when a company decides to invest in R&D, it takes into account expectations over market conditions over a long period of time and only considers short-run fluctuations if they are sizable and likely to be permanent. Moreover, at the same time the decision of whether to conduct R&D is made, the "level" or average amount of innovative effort has also to be determined in order to compute if expected profits derived from this average level, given expected market structure, are worth the effort. As the usual data on R&D are observed over a short period of time, standard linear regression or time series analysis is not useful to measure the effect of stable or relatively permanent market conditions on firms R&D decisions.

I use a two-stage selection model. In the first-stage I use a panel probit analysis of the decision of companies of whether to undertake R&D. I combine it with a choice of covariates that captures

[1] Her result depends on the modeling of the discovery process but is robust to extending the model to a more complex market structure with more than two companies.

[2] See Kamien and Schwartz (1982), Cohen and Levin (1989) and Gilbert (2006) for a review of this literature.

[3] The uncertainty inherent to innovation activities (the time of the discovery is difficult to predict) requires a long run effort from the firm for the expectations over the returns of the innovations to hold.