The Importance of R&D for Innovation: A Reassessment Using French Survey Data

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ABSTRACT. This paper compares the contribution of R&D to innovation in terms of the various innovation output measures provided by the third Community Innovation Survey (CIS 3) for French manufacturing firms and in terms of accounting for interindustry innovation differences.

Key words: R&D, innovation, patents

JEL Classification: C35, L60, O31, O33

1. Introduction

In this paper we want to pay tribute to Ed Mansfield for his pioneering research on the economics of technological change. We reassess the importance that R&D plays in the innovation process using the latest French data from CIS 3, the third Community Innovation Survey. We have a chosen a topic that would have been dear to Ed Mansfield since innovation, and in particular R&D, were at the center of his research for the greatest part of his career. He was also, as Mike Scherer mentions in his introductory paper to this issue, one of the first user (and producer) of survey data on R&D and innovation. Nowadays these survey data are collected in a systematic way for large samples in many countries.

Traditionally, the importance of R&D is evaluated by relating R&D and production (or cost, or profit) data, estimating the output elasticity or rate of return of R&D from an extended Cobb-Douglas production (or cost, or profit) function, where a stock of R&D knowledge enters as a separate input. Ed Mansfield himself contributed to this literature (Mansfield, 1964, 1965, 1980). Another way of evaluating R&D is by estimating the value attached to R&D investment by capital markets (see the original paper by Griliches, 1981 and recent work by Hall and Oriani, 2004). Instead of being related to measures of economic performance, R&D can also be related to innovation indicators through some kind of knowledge production function. The returns to R&D have been usually estimated in this line of work in terms of patent counts or innovation counts (see for instance the debate between Jaffe, 1989, and Acs *et al.*, 1992).

This last approach is the one we follow here. Instead of using count data, we use the five dichotomous indicators of innovation and patents, and the three shares in total sales of innovative and patent protected sales, which are provided by the third Community Innovation Survey. We can thus make the distinction between indicators related to product and process innovations, and among the former between indicators for products new to the firm only (but already known in the market) and products new to the market (new can also mean substantial modifications of existing products). And we can confront these indicators with indicators on patent applications during a given time period and on patent holdings, in a way reflecting the distinction between flows and stocks of patents.

Prior to the late eighties, innovation surveys were conducted in isolated ways. Mansfield, as already indicated, based much of his work on

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company survey data (e.g. Mansfield *et al.*, 1977). SPRU set up a database of innovations back in the mid 1970s, which was explored among others by Pavitt, 1984. In the early 1990s these surveys became institutionalized, in least in Europe, with the advent of the Community Innovation Surveys (CIS), which followed the guidelines of the Oslo Manual (OECD, 1992 and 1996). Up to now, there exist three official waves of CIS (CIS 1 for 1990–1992, CIS 2 for 1994–1996 and CIS 3 for 1998–2000). A few countries, notably France, Germany and the Netherlands, had actually an innovation survey prior to CIS 1. The fourth round of innovation survey is presently underway. The present study is based on the data of CIS3 for French manufacturing.

We assess the impact of R&D on innovation separately for high-tech and low-tech industries and in two ways. We first estimate the marginal effects of R&D on the various innovation output indicators, controlling for other co-determinant factors, and correcting for both the selectivity and endogeneity of R&D itself (Section 5). We then ask how much of the inter-industry difference in innovation performance can be imputed to R&D and to the other factors explicitly taken into account in the analysis and how much remains to be explained or could be attributed to innovativeness (Section 6). Before that, we give necessary explanations on our data and our model, and provide a short preliminary descriptive analysis.

2. Data

Our sample consists of French manufacturing enterprises that responded to the CIS 3 survey, covering the years 1998–2000, and that have also been surveyed by the EAE survey ("Enquête Annuelle d'Entreprise" or Annual Survey of Enterprises) in these three years.[1]

The CIS 3 survey, like the previous ones, is structured in such a way that specific filter questions lead to the selection of firms which are innovators as opposed to non-innovators. Only the former have to answer the full questionnaire. Firms are first asked whether they have introduced in 1998–2000 a new product or a new process, or whether they have had any ongoing or abandoned activities to do so during this period. If they answer positively to one of these questions (about 60% in our sample), they are asked additional information about their innovation outcomes, their R&D expenditures in 2000, and other characteristics. If they answer no to all the filter questions (about 40%), they are considered as non-innovators so to say, having to report chiefly on their size, group affiliation and industry of main activity.[2]

We are thus left with little information about the non innovating firms, and a severe selectivity problem. In particular we have the information on the R&D expenditures of the innovating firms for the year 2000, in case they have engaged in R&D, but not for the non innovating firms. We have thus been lead to consider that all R&D performers were innovators, and conversely that all non-innovators were non-R&D performers. By merging the French annual R&D survey for 2000 with CIS 3, we have been able to check that it was not far from being the case: only 2% of the R&D firms in the annual survey declare they were non-innovators in CIS 3, while about 60% of innovating firms in CIS 3 declare that they were R&D performers (on a continuous basis). Actually, in CIS 3 the innovating firms reporting R&D expenditures in 2000 are also asked whether they engaged in R&D continuously over the period 1998–2000 or only occasionally. While about 60% of them answered that they did R&D continuously and 25% occasionally, we preferred to restrict our attention here to the continuous R&D performers for two reasons. Ideally we would have like to have some measure of R&D stock. Since this is not possible without knowing past R&D expenditures for at least several years, we thought that the 2000 R&D flow number would be a much better proxy for the R&D stock in the case of the continuous R&D performers only. The second reason has to do with the timing problem. Being an innovator in CIS 3 refers to the period 1998–2000 whereas R&D expenditures are known for the year 2000 only. By focusing on continuous R&D performers we avoid attributing innovation in 1998–2000 to firms that had no R&D activity prior to the year 2000. To simplify, from now on R&D will refer to continuous R&D.

Overall, CIS 3 provides five indicators of innovation stricto sensu. The first three are dichotomous (or propensity) indicators,