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Reassessing patent propensity: Evidence from a dataset of R&D awards, 1977–2004

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ABSTRACT

It is well known that not all innovations are patented, but the exact volume of innovative activities undertaken outside the coverage of patent protection and, relatedly, the actual propensity to patent an innovation in different contexts remain, to a major degree, a matter of speculation. This paper presents an exploratory study comparing systematically patented and unpatented innovations over the period 1977–2004 across industrial sectors. The main data source is the 'R&D 100 Awards' competition organized by the journal *Research and Development*. Since 1963, the magazine has been awarding this prize to the 100 most technologically significant new products available for sale or licensing in the year preceding the judgments. We match the products winners of the R&D 100 awards competition with USPTO patents and we examine the variation of patent propensity across different contexts (industries, geographical areas and organizations). Finally we compare our findings with previous assessments of patent propensity based on several sources of data.

1. Introduction

Within the Economics of Technical change and Innovation Studies (ETIS) literature it is today widely acknowledged that many innovations are not patented. In principle, there may be three types of explanation accounting for the inventor's decision of not taking a patent (Basberg, 1987). The first explanation is that the innovation is simply not patentable. In this case, the inventor believes that the innovation in question does not represent suitable patent matter (e.g. the patentability of 'pure' software program was still a matter of contention in many jurisdictions not so long ago). Alternatively, the innovation is in principle patentable but the inventor may anticipate that the inventive step embodied in her innovation is not 'high' enough to be deemed worthy of patent protection by patent examiners. In both these two examples the decision of not patenting is determined by the fact that this is not actually possible (or believed possible). The third possibility is that the inventor, even when conceiving taking a patent as a fully feasible course of action, decides not to patent the innovation because she actually prefers to do so. In this case, even though the innovation is patentable and worth patenting, the inventor prefers industrial secrecy or other alternative strategies to extract some economic returns from her innovation. This third case is the most interesting one from the viewpoint of innovation scholars.

The existence of 'appropriability strategies' that are alternative to patenting was initially documented by early economists of innovation (Kuznets, 1962; Schmookler, 1966; Taylor and Silberston, 1973). Later on, the survey studies by Mansfield (1986) and Levin et al. (1987) during the 1980s highlighted that, in most industries, patent protection was not the typical tool adopted by firms for the extraction of economic returns from innovations, a finding further corroborated by subsequent research both in US (Cohen et al., 2000) and Europe (Arundel and Kabla, 1998). All these research results are frequently cited and surely represent important pieces of evidence discussed in the innovation literature. However, as aptly noted by De Rasenfosse (2010), on closer inspection, it is difficult to avoid the impression that the major implication of these findings (i.e. that a sizeable share of innovations is *never* patented) has gone completely neglected. To be sure, many empirical investigations acknowledge the limitations of patents as innovation indicators. However, once these limitations are gauged against their advantages (i.e. availability and richness of information they provide)

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the final choice is to rely on patents if anything because of the sheer difficulty of constructing suitable indicators using alternative sources.[1]

This state of affairs is deeply unsatisfactory as we incur the risk that even the most carefully designed empirical studies will provide us with a partial, and sometimes even distorted, representation of innovative activities. Furthermore, since our understanding of patent propensity in different contexts is still rudimentary, in many cases, it is also difficult to formulate a sound assessment of the margin of error and of the biases involved in the adoption of patents as innovation indicators. Consider, for instance, the concept of 'propensity to patent' usually defined in the literature as the ratio between patents and R&D expenditures (Scherer, 1983; Hall and Ziedonis, 2001). Though surely legitimate, we should note that this definition of patent propensity is simply describing the overall relationship between patents and innovative efforts and it is only indirectly linked to the actual decision to patent or not a specific innovation (see De Rasenfosse, 2010 for a more extensive discussion).

Interestingly enough, economic historians and historians of technology have instead adopted a more 'straightforward' definition of patent propensity, namely the share of patented innovations in the total number of innovations occurring in a given time period (Sullivan, 1989; Moser, 2005, 2012).[2] This conceptualization of patent propensity, although intuitively appealing, is not of immediate empirical operationalization because it requires some form of direct assessment of the total amount of innovations occurring in a given time period. Still, historians have displayed considerable ingenuity both in the identification of sources (alternative to patents) that could be used for formulating quantitative assessments of overall innovative output in different contexts and periods, and in connecting these sources with the patent evidence for constructing estimates of patent propensity. In this respect, the recent contributions of Moser (2005, 2012) can be regarded as among one of the most successful examples of this approach.

This paper argues that these historical investigations suggest a framework of inquiry that can, and should, be fruitfully extended within the field of ETIS. In the paper we present an application of this method using a database of 'important' industrial innovations occurred between 1977 and 2004. Our source of data is the 'R&D 100 Awards' competition organized by the journal *Research and Development*. Since 1963, this journal (which at that time was called *Industrial Research*) has been awarding a prize to 100 most technologically significant new products available for sale or licensing in the year preceding the judgement. The potential of this source was already reckoned by Carpenter et al. (1981) and Scherer (1989). This source has also been more recently used by Block and Keller (2009) to document the increasing role of public institutions and public funding in the generation of innovations in the US economy in the period 1971–2006.

Though recent and therefore not 'historical' in a strict sense, the database covers 30 years of innovations, several manufacturing industries, and different types of economic actors, both corporations and Universities and Public Research Organizations (PROs). These data seem particularly appropriate for studying the propensity to patent for the following reasons: (i) the data consider innovations that have been recognized by a jury of experts as significant and they should be commercially feasible at the time of the awards; (ii) most of the awards have been granted to large corporations accounting for a sizeable amount of total R&D investments; (iii) the data cover a relatively long time period allowing us to take into account changes in the determinants of the propensity to patent over time. Using these data we are able to assess systematically the relative influence of sector, organization, and inventor specific characteristics on the actual decision of taking or not a patent.

Our study is based on a sample of about 3000 innovations that have received an award. For each innovation in our dataset we have retrieved information concerning: years of the award, description of the innovation, type and name of applicant organization(s), application domain of the innovation, country, and name of inventor(s). The first step of our analysis is to match awarded innovations with patents using the search engine of the USPTO website. Then, on the basis of the invention description contained in the journal, we classify all the awarded innovations in thirty different sectors of activity. In this way, the data allow a thorough comparison between patented and not patented innovations across different industrial sectors, countries, types of organization and types of innovation. Our results highlight the following patterns. First, a large share of innovations is not protected by means of patents. Second, we are able to point out the existence of systematic significant differences in patenting propensity across sectors, geographical areas, types of organization and types of innovation.

The structure of the paper is as follows. Section 2 reviews the empirical literature on the effectiveness of patents as appropriability tools. Section 3 describes in detail our data source, our matching procedure and the limitations of the dataset. Section 4 presents our analysis of patent propensity across different dimensions. Section 5 compares our findings with those of previous assessments of patent propensity carried out using different types of data. Section 6 concludes and draws some methodological implications with particular reference to the possibility of extending the framework of inquiry adopted by economic historians and historians of technology to contemporary studies of patent propensity.

2. Patents as indicators of innovation and their limitations

Scholars within the ETIS tradition have relied intensively on patents to investigate the sources, nature, and the effects of innovative activities. Innovative activities are inherently elusive phenomena which almost by definition are bound to defy systematic attempts of (quantitative) measurement. It is not surprising then that the existence of patent records has been regarded for a long time, mostly by economists, but also by other scholars of innovation with different disciplinary backgrounds, as an almost unique source of insights into the nature of inventive activities. The main merits of patent records as a source for measuring innovation are easy to summarize: (i) they are by definition related to innovative activities;[3] (ii) they are readily available (allowing to economize efforts of data collection);[4] (iii) they are available for relatively long periods of time; (iv) they contain a significant depth of information (inventors' names and addresses, ownership of the

[1] In this respect, we would argue that a large bulk of the most recent research on innovation seems implicitly to apply to patents Winston Churchill's famous quip on democracy: "Democracy is the worst form of government, except all the others". In the case of patents, the jibe would probably sound like: "patents are the worst innovation indicator, except all the others".

[2] Moser (2005, 2012) uses the term 'patenting rate' to define the share of patented inventions in the total number of inventions.

[3] In the words of Griliches (1990, p. 1169): "[A] patent represents a minimal quantum of invention that has passed both the scrutiny of the patent office as to its novelty and the test of the investment of effort and resources by the inventor and his organization into the development of this product or idea, indicating thereby the presence of a non-negligible expectation as to its ultimate utility and marketability".

[4] The 'accessibility' of patent as a source has greatly increased over the last 20 years or so thanks to the creation of on line search engine such as ESPACENET and the efforts of construction of data-bases containing information gathered by patent records such as the NBER-US patent data-set (Hall et al., 2001) and the OECD-PATSTAT dataset.