Patent Data Project - NSF Proposal

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February 2005

Brief Literature Review

A very large number of research papers and doctoral dissertations have already been produced using the previous patent database constructed by Hall, Jaffe, and Trajtenberg (2001), in a number of disciplines including economics, management, law, and sociology. The appendix lists the papers and projects that we are aware of via author communication and/or citation on the Web of Science (ISI) and Google Scholar; there are likely to be more users that we do not know about, since the data is freely available in at least two places and registration is not required to use it. It is also likely that more of the research done with these data has been published than is indicated on the table, because researchers tend to get in touch with us early in the project. Of the approximately 100 projects of which we are aware, about 40 are thesis projects, mostly doctoral dissertations. One quarter are conducted by researchers outside the United States. In this section of the proposal we give a brief overview of the questions analyzed by these papers and some of the creative uses to which the data have been put. We emphasize the areas where enhancing the data along the lines we suggest will enable researchers to push beyond the large body of work that has already been accomplished.

The reason for all this interest in our data is easy to explain. The growth in importance of the knowledge economy worldwide has lead to an increased interest in methods of measuring knowledge accumulation and knowledge flow on the part of researchers in a number of disciplines. Given the intangible nature of knowledge and information, few readily quantifiable measures of these concepts exist. As was noted long ago by such pioneers in the field as Griliches (1990 survey), Scherer (1965), and Schmookler (1966), patent data can be used to construct such measures. The primary advantage of patent data are that they are available over a wide range of countries and years, for detailed technology classes, and they contain information on inventor, geographic area, and owner (if there is one other than the inventor). Together, these data provide information on the locus and type of newly created knowledge. The second advantage is that they provide information on links between different quanta of knowledge via the citations to other patents and non-patent documents that they contain (see Jaffe, Trajtenberg, and Fogarty 2000 for further justification of the use of patent citations to model knowledge flow and for the limitations of the measure). With the possible exception of data on scientific paper publication, no other data source comes even close to providing this level and quantity of information about the creation and dissemination of new knowledge.

Thus data on patents have been used in many contexts, wherever researchers are searching for a way to describe and quantify measures of knowledge. Common uses include counts as a measure of innovation output over region, time, and technology area, forward citations as a measure of the value of individual patents, or as a measure of a knowledge spillover from one patentholder to another, inventor-patent owner data as a measure of scientist mobility, litigation, patent opposition, or patent renewal as indicators of individual patent value, and so forth.

The use of patent data as a proxy for innovation output in the economic analysis of technological change stretches back to the pathbreaking analyses of Schmookler (1966) and Scherer (1965). The availability of information from the U.S. patent office in machine-readable form in the late 1970s spurred greater interest in analyses using these data; much of the resulting early work is reported in Griliches (1984) and then surveyed by Griliches, Pakes, and Hall (1987) and Griliches (1990). Also in the late 1970s Mark Schankerman and Ariel Pakes pioneered the use of renewal data from the European patent office to estimate the value distribution of patents. In the late 1980s, patent citation information began to be available in computerized form, which led to a second wave of research, utilizing the citation information to increase the information content of the patent data themselves, as well as to investigate an additional set of questions related to the flow of knowledge across time, space and organizational boundaries.

Patent citations can be seen as providing direct, albeit noisy, observations of technological impact and knowledge spillovers, in that one technological innovation explicitly identifies several others as constituting the technological state-of-the-art on which it builds. Some authors have used these data to explore questions involving spatial spillovers (e.g., Jaffe, Trajtenberg, and Henderson 1993), knowledge flows among firms in a research consortium (e.g., Ziedonis, Ziednois, and Silverman 1998), and spillovers from public research (e.g., Jaffe and Trajtenberg 1996; Jaffe and Lerner 1999). In using citations as evidence of spillovers, or at least knowledge flows, from cited inventors to citing inventors, it is clearly a problem that many of the citations are added by the inventor's patent attorney or the patent examiner, and may represent inventions that were wholly unknown to the citing inventor. On the other hand, in using citations received by a patent as an indication of that patent's importance, impact or even economic value, the citations that are identified by parties other than the citing inventor may well convey valuable information about the size of the technological "footprint" of the cited patent.

Beginning with Trajtenberg's (1990) study of the welfare impact of CAT scanners, there are by now number of studies that "validate" the use of citations data to measure economic impact, by showing that citations are correlated with non-patent-based measures of value. Hall, Jaffe, and Trajtenberg (2005) investigated the use of citations as an indicator of private invention value in a large sample of publicly traded U.S. manufacturing firms and confirmed that although patent yield conveys little information beyond that conveyed by R&D spending, citation-weighted patents are strongly related to market value in a nonlinear way, with very highly cited patents worth a great deal more than those with less than average citation.

Work by Lanjouw and Schankerman (2004a) also uses citations, together with other attributes of the patent (number of claims and number of different countries in which an invention is patented) as a proxy for patent quality. They find that a patent "quality" measure based on these multiple indicators has significant power in predicting which patents will be renewed, and which will be litigated. They infer from this that these quality measures are significantly associated with the private value of patents. With respect to university patents, Shane (1999a, 1999b) finds that more highly cited M.I.T. patents are more likely to be successfully licensed, and also more likely to form the basis of starting a new firm. Sampat (2001) and A. Ziedonis (1999) explored the relationship between citations and licensing revenues from university patents. Harhoff et al (1999) surveyed the German patentholders of 962 U. S. invention patents that were also filed in Germany, asking them to estimate at what price they would have been willing to sell the patent right in 1980, about three years after the date at which the German patent was filed. They find both that more valuable patents are more likely to be renewed to full term and that the estimated value is correlated with subsequent citations to that patent. The most highly cited patents are very valuable, "with a single U.S. citation implying on average more than $1 million of economic value" (Harhoff, et al 1999).

Knowledge Spillovers

One of the most important uses of patent citation data has been as a proxy or indicator of knowledge flows between two inventors, firms, or regions. In fact, one of the first papers written using an early version of our data was the highly cited paper by Jaffe, Trajtenberg, and Henderson (1993) on the geographic localization of knowledge spillovers. Among the many papers that use citations as an indicator of knowledge spillovers, recent investigations into the relationships between trade, technology transfer, and international spillovers are noteworthy (Branstetter et al 2003; Macgarvie 2004).

Policy Issues

The growth of the knowledge economy has had another consequence: it has increased the strategic use of patents and led to an enormouse increase in patenting (Hall and R. Ziedonis 2001, Kortum and Lerner 2001). This phenomenon in turn has led some observers to question the quality of patents being issued and the design of the current patent system itself. Some of the research that has made use of our data has been addressed to such questions, such as Graham et al (2002) comparing the US and European post-grant patent challenge systems, Schankerman and Lanjouw (2004) on the litgation threat to small firms, and Landes and Posner (2004) on the effects of the introduction of a specialized patent court.

A closely related policy question is the effect of the Bayh-Dole Act and the subsequent growth in university patenting on the rate and direction of university research. A number of papers have used our data to address the question of whether university patent quality declined, and whether patenting has slowed to diffusion of university-created knowledge. Much of this work has been collected in a recent book by Mowery, Nelson, Sampat, and Ziedonis (2004). Murray and Stern (2004) examined the “anticommons effect” hypothesized by Heller and Eisenberg (1998) by looking at citations to scientific papers both before and after related patents were granted. Markiewicz (2004) shows that knowledge exploitation by private firms slowed in areas where university patenting has recently increased.

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