

## ***Proposal to the EPRN: Patenting behavior and the creation and diffusion of knowledge***

### ***Purpose of project:***

We want to pursue two related projects. Both will focus on the role of the patent system and the interactions between firms in the process of knowledge creation and knowledge diffusion in society. The first project will empirically investigate the use of strategic patenting behavior – as opposed to “pure” knowledge creation - among Danish firms and its potentially adverse effects on innovation. The second project asks if spill-overs to other firms of knowledge created by research and development (R&D) are mainly technological or pecuniary: Pecuniary spill-overs arise when workers possessing valuable information receive a wage increase either to attract or to retain them; technological spill-overs are “pure externalities” to other firms often cited as the key source of economic growth and social welfare in the long run.

We expect that the results from these projects will have clear policy relevance. For example, the potentially negative effects of current patent policies and practices could be a problem mainly for small and medium-sized firms (SMEs) and for start-ups. Similarly, new evidence on the nature of knowledge spill-overs is likely to carry implications for policy measures directed towards e.g. the formation high-tech clusters which enhance the possibilities for spill-overs between firms.

Both projects will be conducted from an updated and extended version of the CEBR patent-firm data base. The project is expected to run through the calendar years 2009 and 2010. We aim at publishing papers in leading economics journals.

### ***Data:***

Data for the project will be compiled from three main sources:

- The Danish part of the European-wide Community Innovation Surveys (CIS) which are harmonized across European Member States and constitute the source of the official European Innovation Statistics and Indicators. This survey data consists of a representative sample of the population of Danish firms and contains information on R&D expenditures, innovation strategies as well as quantitative information such as sales or employment. The database contains roughly 2,500 Danish firms per year in the period between 1997 and 2007.
- An updated version of the CEBR patent-firm database. It consists of all patents applied for at the European Patent Office (EPO) by Danish firms and provides links to Statistics Denmark’s register data on firms (FIDA) and workers (IDA). This data will be supplemented with detailed procedural and bibliographic information that will enable us to construct indicators of the value and strategic importance of the patents owned by the firms in the CIS survey.
- Information on Danish firms’ patents with the Danish Patent and Trademark Office.

We will need research assistance to link the different data sources and to retrieve and compute the relevant information for the project.

### ***Research questions, methods, and policy issues:***

#### ***1: Innovation and strategic patenting:***

Patent systems were originally instituted to create incentives for potential innovators to invest in knowledge creating processes such as R&D). However, there is suggestive evidence that patent systems are more and more used as strategic management instruments to block rivals or entrants in technology

markets. Famous examples are so-called patent “thickets” and “fences” (Ziedonis, 2004; Schneider, 2008), which consist of firms patenting a large number of marginal inventions bringing them into a position to sue other inventors for infringement. As a consequence, rival firms will have to acquire rights to outside technologies in industries where research is cumulative. This project aims at identifying whether the patent system creates incentives to conduct R&D in the business sector in the first place or whether R&D in the economy may be reduced due to growing patent thickets, and thus unknown returns of patent applications.

The project can be further divided along two dimensions:

- While there is growing evidence revealing the strategic use of patents (e.g. Noel and Schankerman, 2006; Hall and Ziedonis, 2001), there is little evidence of their effect on firms’ innovative performances. Our research along this dimension would therefore be an initial step in trying to assess whether strategic patents hamper a firm’s innovative potential.
- Second, the increasing demand for patents has created enormous backlogs at the EPO, which in turn created uncertainty on the market for technologies as to the validity of these patents. While there is preliminary evidence that longer grant lags retard efficient technology transfer (Gans, Hsu and Stern, 2008), we aim to contribute further evidence to assess the impact of uncertain property rights on the decision of firms to pursue R&D activities.

Our empirical strategy consists of estimating reduced form equations on alternative performance measures such as R&D, profits or sales generated from new products. Our purpose is to evaluate the effect of the potentially strategic patents and technological uncertainty on performance indicators. The richness of the linked databases will enable us to control for intrinsic attributes of firms and their competitive environment thereby allowing us to net out potential confounding factors.

The project contributes to the ongoing debate on reforms of the patent system. Recent policy reports by the European Commission (2008) and the Danish Board of Technology (2005) recognize the growing importance of strategic patenting and its possible impact on firms’ incentives to innovate. The results can serve as a baseline to inform policy and for further discussion on the potentially negative effects of current patent policies and practices in the corporate sector, notably on small and medium-sized firms (SMEs).

## *2: Knowledge spill-overs and the wages of high-skilled labor*

R&D and knowledge creation are powerful engines of growth: Once a firm has made an innovation, the knowledge created can - in principle - be used by other firms as an input to the production of goods or further innovations. Knowledge is the prototypical example of a public good although the full economic value of knowledge is only realized if it is shared. There has to exist channels through which knowledge travels and “spills over” from one firm to another. These technology spillovers play an important role in linking R&D to growth, and they have received a lot of attention in the theoretical literature.

A prominent source for technology spill-overs is the movement of employees from one firm to another. Kaiser, Kongsted and Rønne (2008) used data on applications by Danish firms at the EPO in combination with FIDA and IDA data to measure the effect of labor mobility on firms’ patenting activity. They identified a group of “R&D workers” (workers with BSc, Master’s, PhD in a relevant technical field) who had large and significant impacts on firms’ patenting activity when moving between employers. The paper provides the first quantitative evidence showing that labor mobility increases the aggregate rate of innovation in the economy.

However, it is still an open question if these mobility effects represent a pure externality as envisioned in the economic growth literature. If the firms end up paying for knowledge in the form of higher wages, knowledge resembles a regular rival input (machines, man-hours, etc.) more than an externality. Specifically, we ask if the spill-overs are technological or pecuniary: Pecuniary spillovers arise when workers possessing valuable information receive a wage increase either to attract or to retain them whereas technology spillovers arise when another firm is able to acquire the knowledge paying a low wage premium (see, Fosfuri, Motta and Rønne, 2001). If spillovers are primarily pecuniary, this will reduce the potential gains from inter-firm mobility. The reason is that workers capture a large share of the gains from R&D, which reduces firms' incentives to do R&D (Fosfuri and Rønne, 2004).

The "R&D workers" identified by Kaiser *et al.* remain the focus of the present project. Since we have information on wages, we will be able to study the importance of pecuniary spillovers by tracking R&D workers across firms. We will ask if the workers experience a wage increase after having worked in a patenting firm and how this increase relates to value of the knowledge that they bring (number and value of additional patents that they generate). To address this issue we need to look at wages over a number of years. We also need to control for the role of previous R&D experience. Combining the patent data with CIS data on firms' R&D activities we will have improved measures of the learning process of a researcher within her present firm or with previous employers. We will also include information on Danish firms' patents at the Danish Patent and Trademark Office in order to have a more comprehensive measure of patenting activity by current or previous employers.

The answer to questions of technological *versus* pecuniary spill-overs is not only of theoretical interest but will also have profound implications for public policy. This holds for measures directed towards individual firm R&D (what kind of spill-overs can be expected on other firms) and for policy measures directed towards e.g. the formation high-tech clusters (which directly or indirectly enhances the inter-firm mobility of high-skilled labor).

### **Participants**

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### **References**

- Danish Board of Technology – Teknologi Rådet (2005), "Recommendations for a Patent System of the Future", Report by the Danish Board of Technology 2005/7.
- European Commission, "Strategic use of patents and implications for enterprise and competition policies", DG Enterprise (ENTR 05/82)
- Fosfuri, A., M. Motta, and T. Rønne, 2001. Foreign Direct Investments and Spillovers through Workers' Mobility. *Journal of International Economics* 53, 205-222.
- Fosfuri, A. and T. Rønne, 2004. High-tech Clusters, Technology Spillovers, and Trade Secret Laws. *International Journal of Industrial Organization* 22, 45-65.
- Gans, J., Hsu, D. and Stern, S. (2008), "The Impact of Uncertain IP Rights on the Market for Ideas: Evidence from Patent Grant Delays," *Management Science*, 54, 982 - 997.
- Hall, B. H. and Ziedonis, R. H. (2001), "The Determinants of Patenting in the U.S. Semiconductor Industry, 1980-1994", *Rand Journal of Economics*, 32, 101-128.
- Kaiser, U., Kongsted, H.C., and Rønne, T: Labor mobility and patenting activity, CEBR Discussion Paper October 2008.
- Noel, M. and Schankerman, M. (2006), "Strategic Patenting and Software Innovation", *CEPR DP* no. 5701.
- Schneider, C. (2008), "Fences and Competition in Patent Races", *International Journal of Industrial Organization*, 26(6), 1348-1364.
- Ziedonis, R. H. (2004), "Don't Fence Me In: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms" *Management Science*, 50(6), 804-820.