

## **Innovations, Spill-over Effects and Economic Growth**

*Projektdeltagere: Kul Luintel (Brunel University) og Jakob Brøchner Madsen*

### *PROJEKTBEKRIVELSE*

#### *Purpose of the project*

This project seeks to examine the effects of innovations on growth in total factor productivity and on cross-border spill-over effects via trade and multinational companies using patent data for 22 OECD countries, including Denmark, over the period from 1870 to 2001.

#### *Background and motivation*

Although technological progress is important for total factor productivity growth in neoclassical growth models, these models do not systematically relate technical progress to the cumulated stock of ideas. Innovations, therefore, have only temporary effects on the growth in total factor productivity (TFP) in the standard neoclassical model. Innovations, however, play a critical role for economic growth in endogenous growth models because, by increasing the knowledge base of the economy, they increase the number of future innovations and, therefore, the future economic growth. The growth effects of innovations are particularly strong in the model of Romer (1990), where an expansion of R&D workers leads to a permanent increase in the growth in total factor productivity.

Despite the importance of innovations for macroeconomic growth and, therefore, which model of economic growth best describes the growth process, very little empirical research has been undertaken in this area. One of the few exceptions is Porter and Stern (2000), where the parameters of an 'ideas' production function are estimated for 16 OECD countries over the period from 1973 to 1993. However, Porter and Stern only consider patents granted by the US patent office to foreign establishments, which represents less than 10% of foreign patents. It is therefore unlikely that their estimates are unbiased.

The lack of empirical research in this area probably reflects the limited accessibility to data for research input (R&D) and output (patents). Data for R&D are only available from 1970 in most OECD countries, which limits the scope for long-term analysis using R&D data. Furthermore, R&D expenditure has important limitations as a measure of inputs to technological activities and is measured with a large error (Patel and Pavitt, 1995). Statistics on patents, however, are not measured with error and go back far into history. Although patents are not perfect measures of quality-adjusted innovations, research suggests that patents are one of the best empirical measures of technological progress that are currently available (Patel and Pavitt, 1995).

### *Advantages of the collected data set*

Against this background this project will study the effects of innovations on growth in total factor productivity and on cross-border spill-over effects via trade and multinational companies using patent data. Utilizing several national and international data sources, we have been able to find patent data for most of the OECD countries over the past 75-132 years. The data are highly detailed and contain domestic patents plus patents lodged with domestic patent office by foreign establishments.

The complexity and the geographical coverage of the patent data gives an excellent opportunity to examine the 'ideas' production function and the international transmission of ideas, because a large and sharply increasing share of patent applications to all countries' patent offices are from foreign residents (the majority of patent applications are currently from non-residents for most countries). Furthermore, it enables us to test the hypothesis that patents inhibit innovation and efficiency.

The detailed character of the data enables us to study the effects on total factor productivity growth of both the world and the domestic patent capital stock. Furthermore, it is possible to test the importance of various cross-border channels of transmission of innovations on domestic TFP growth. These channels are 1) trade in such way that the ideas are embodied in tradable goods; 2) world idea stock and innovations; and 3) foreign companies patenting via their affiliations in foreign countries.

### *Policy relevance*

This research has important implications for structural economic policies by identifying sources of economic growth, in particular the quantitative importance of innovations as a source of growth and the channels of transmission from foreign innovative activity to domestic TFP growth. The empirical findings from the project may also throw light on the policy debate on whether long periods of patent protection encourage or discourage innovation and growth, and the project may illuminate the factors determining a country's ability to import foreign know-how.

### *Time schedule and publication plans*

We plan to describe the results of the project in a working paper which should be available in the early fall of 2003. The working paper will serve as the basis for the preparation of an article which will be submitted to an international journal in the fall of 2003.

### **References**

Patel, Pari and Keith Pavitt, 1995, "Patterns of Technological Activity: Their Measurement and Interpretation," in Paul Stoneman (ed), *Handbook of the Economics of Innovation and Technological Change*, Oxford: Blackwell.

Porter, Michael E and Scott Stern, 2000, "Measuring the 'Ideas' Production Function: Evidence from International Patent Output," NBER Working Paper 7891.

Romer, Paul, 1990, "Endogenous Technological Change," *Journal of Political Economy*, 98: S71-S102.