

R&D investment, R&D cooperation and R&D subsidization: cross-country evidence

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Abstract

This research project starts by answering standard research policy questions such as "What determines R&D expenditure?" and "What is the effect of research joint ventures on R&D?" for Denmark. In order to shed further light onto these issues, it proceeds with a cross-country comparison between Denmark and Germany. The analysis is based on coherent data that has been collected by EU countries within the "Community Innovation Survey". Finally, this project studies the effects of the introduction of special tax allowances on R&D expenditures that Denmark established in 1992.

1 Motivation

That research and development (R&D) is the main driver of technological progress has been recognized by economic policy makers for decades and economists have embedded this common knowledge into "endogenous growth models" (e.g. Aghion and Howitt 1992). R&D leads to the creation of new products and to the invention of more efficient production technologies. Both, product innovation – the development of new or markedly improved products – and process innovation – the development of cost-reducing production technology – are the key sources of economic growth and social welfare.

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Policy makers as well as economists have found that expenditures for R&D is too low from a social point of view. Two main causes for this underinvestment in R&D are discussed in economic policy: (i) research spillovers and (ii) riskiness of R&D.

Research spillovers arise whenever a firm that performs R&D is unable to fully reap the whole benefit of its effort since the knowledge acquired in the R&D process is absorbed by a competitor. As an externality, research spillovers justify government intervention. That spillovers do exist and that they are significant has been documented very well in the literature (Kaiser 2002a). Government intervention is also justified if the riskiness of R&D leads to a lack of funds for R&D investment so that an incomplete information problem occurs, an issue that is particularly relevant for small and medium sized enterprises (Bond et al. 1999).

Two frequently used policy tools are (i) the promotion of joint research: Research Joint Ventures (RJVs) and (ii) R&D subsidization. The key question in both cases is: do these policy measures increase or decrease R&D spending?

The effects are unclear a priori since two opposing forces are at work. RJVs induce two opposing effects: the internalization of the external effect leads to an increase in R&D spendings but this effects could be counteracted by free-riding behavior of the cooperating partners. R&D subsidization raises the problem that government subsidies might crowd out private R&D efforts.

There is scarce empirical evidence on the effects of RJVs and of R&D subsidies on research efforts, especially at the firm level (where investment decisions actually take place). A general conclusion to be drawn from existing empirical studies is that RJVs and R&D subsidies tend to increase research efforts at least in high-tech industries where spillovers are high and appropriation possibilities are low.

By contrast, there is an abundant theoretical literature on the relationship between RJV formation and R&D spending. The literature is inconclusive since the results depend on the assumptions made in the models so that no sharp policy conclusions can be drawn.

2 Research questions

The aims of this research project are threefold. First, it will provide answers to standard topics in innovation economics such as the determinants of R&D, determinants of innovation and the effects of RJVs on R&D spending. Although standard and well explored

for example for Germany (Kaiser and Licht 1998; Kaiser 2002c), empirical evidence on the firm level within a structural and a proper econometric framework has, to the best of my knowledge, not been offered for Denmark. Second, it will conduct a cross-country comparison between Denmark and Germany. In particular, it will be looked at differences in the incentives to invest in R&D and in firms' propensity to innovate. Germany is Denmark's most important trade partner. At the same time, both countries differ markedly in (i) the use of R&D promotion by the governments and (ii) the sectoral structure so that Germany is an interesting country to compare Denmark with.

A third aspect that will be studied in this research project is an analysis of the effect of Denmark's introduction of special allowances on R&D expenditures.

The research questions to be answered hence are the following:

- What determines R&D expenditures of Danish firms?
- What characterizes innovating Danish firms?
- What are sector-specific differences of R&D expenditures in Denmark?
- What are the effects of RJVs on research spending?
- In what way do German and Danish firms differ in the determinants of R&D spending?
- In what way do German and Danish firms differ in their innovation strategy?
- In what way do the effects of RJV formation differ between German and Danish firms?
- What has been the effect of the introduction of the Danish tax allowance scheme on the R&D spendings of Danish firms?

3 Research framework

3.1 Theoretical basis

Part I and II of this proposal (the standard innovation economics questions and the German-Danish comparison) will be firmly based on existing theoretical frameworks such

as Kamien et al. (1992), Kamien and Zang (2000) and Kaiser (2002b). It is very important to combine economic theory and econometrics in such complex research settings in order to impose structure on the data. These models cannot be structurally estimated – meaning that it is not possible to explicitly estimate parameters of the theoretical model. Economic theory can, however, give guidance related to the set of variables to be included in the estimation and allows to derive empirically testable hypotheses.

Part III of this research proposal (the analysis of the effects of tax allowances on R&D) is purely empirical and will draw upon econometric evaluation models (Heckman et al. 1999).

3.2 Econometric approach

The key challenge in the econometric analysis is the endogeneity of the various variables that are involved in innovation and R&D investment. For example the decision to cooperate in R&D and the R&D investment decision are simultaneous. Kaiser (2002c), Bertschek and Kaiser (2002) as well as Kaiser and Licht (1998) derive suitable simultaneous equations techniques that are also appealing in the present context.

The evaluation of the tax allowances will use standard econometric evaluation methods. The evaluation problem is quite complex here since *all* firms receive "treatment" (all firms receive tax allowances) so that the fundamental evaluation problem – finding counterfactuals — is even more severe in the present context. The "Before–after" estimator will serve as a starting point. Other approaches will be to test for structural breaks in panel data and to make R&D forecasts until the start of the R&D allowance period so that it is possible to compare the forecast with the actual R&D spending (note that the data set comprises of large stock listed firms so that R&D is less stochastic as for small firms).

3.3 Data

Part I and II of this research proposal will use Community Innovation Survey (CIS) data for Germany and Denmark. The CIS is an internationally harmonized business survey covering a broad variety of innovation inputs and outputs as well as indicators on firm-specific structure of innovation activity.

I will get access to the first wave of the Danish CIS data through Danmarks Statistik

(DST). The data was originally assembled by Ålborg Universitet in 1992. It seems likely that I will also get a handle on CIS III data through Århus Universitet. This data is not yet available for researchers not involved in the data collection. The CIS III data refer to 2000. The CIS II data, which refer to 1996, were collected by PLS and have been moved to the Danish Ministry of Videnskab, Teknologi og Udvikling.

As a research professor with the Centre for European Economic Research, Mannheim, the German contractor of the CIS data, I already have access to all waves of the CIS data. I have used the German CIS data in a number of earlier publications (Kaiser 2000a,b; Kaiser 2001; Kaiser 2002a,b,c).

Part III of this research proposal will use the "Regnskabsdata for børsnoterede selskaber" data. I already have access to this data through the University of Southern Denmark. The data cover the period 1983 – 2003. It is a panel data set that contains information on main firm characteristics, in particular on R&D spendings. One difficulty here is that the data do not distinguish between "basic R&D" (that is eligible for tax allowances in Denmark) and "applies R&D" (that is not eligible to tax allowances). The data refer to all stock-listed firms in Denmark.

4 Time schedule

This research project will be carried out between March 2003 and February 2004. The first half year will be devoted to Part I and Part II of the proposal. The "Regnskabsdata for børsnoterede selskaber" data are not readily available in a suitable data format. They have to be manually read in from a text file into a data file. This work will be completed until July 2003.

5 Budget

Research assistance:	DKK 75,000
Data:	DKK 50,000
Total:	DKK 125,000

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