The impact of ICT on Productivity Growth

Purpose of project:

The purpose of this project is to analyze the effects of information and communication technology (ICT) on productivity for Danish enterprises with a focus on possible joint effects of ICT, labor demand, and internationalization. In order to carry out this project we plan to develop a new source of data for research, a survey of ICT use in Danish firms recently collected by Statistics Denmark (source: "Use of ICT in Danish Enterprises"). We apply for funding of DKK 441,600 to carry out this research project. The project is expected to run through the calendar years 2007 and 2008. The aim of the project is to publish papers in leading field journals.

Data and method of the project:

The data in "Use of ICT in Danish Enterprises" are compiled by Statistics Denmark and are based on questionnaires (the 2006-questionnaire is enclosed in Danish). Data has been compiled over the period 1999 to 2006 with the number of firms responding ranging from 3,300 to 4,100. In the questionnaire each firm answers questions related to

- **General information on ICT use** such as the share of the workforce regularly using a PC on the job, if employees work from home accessing the firm's IT-system, etc.
- **Effects of firms ICT-projects** with respect to, for example, changing workplace organization and other innovations.
- **E-commerce**, both sales and purchases.
- **Applied IT-systems.**

In combining the survey data on ICT use with existing CEBR databases, it is possible to study the above-mentioned joint effects on productivity of ICT, labor demand, and internationalization for Danish enterprises. The CEBR databases are comprised of register data for labor input and workplaces (source: "IDA - Integrated Database for Labor Market Research", Statistics Denmark), accounting data for firms and data on workplaces linked to firms (source: "FIDA - Firm-IDA integration", Statistics Denmark), and data for external trade in firms ("External Trade", Statistics Denmark).

The combination of survey and register data is an important novelty of the database. Usually only survey data is available in studies of productivity and ICT at the firm level. The extension that we want to establish promises improvements in several directions compared to existing work in the area. First, we will be able to measure the skill level of labor input based on register-based "hard numbers" as opposed to managers' subjective evaluations of the qualifications of their employees which are often used in survey-based studies. Second, by combining external trade data and information on ICT use at the firm level we can analyze the relationship between ICT and internationalization. Third, the availability of register data over a number of years will allow us to take account of differences in timing in the relationships between ICT use, labor demand, and productivity. Finally, we want to investigate the potential longitudinal dimension of the ICT survey itself. For large firms in particular we expect to able to follow consistently the ICT use of individual firms over a period of several years.

Research questions and policy issues:

A number of important hypotheses will be addressed in this project. Most notable joint effects between productivity, new technology, and globalization are investigated. New technology and globalization have usually been considered competing explanations for recent economic developments in OECD countries. In combining survey and register data for Danish firms we will be able to investigate to what extent new technology and globalization are complements rather than competing explanations. One important hypothesis is that firms that "go global" also need additional ICT investments in relation to, for example, reorganizing management systems, sales systems, or overall business activities.[1] Using the detailed register-based information on labor and external trade in this project we expect to contribute further in sorting out the issue of causes and effects in the critical relationships between ICT, labor demand, and globalization.

It is important from a policy-perspective to understand how ICT affects productivity and how this impact relates to policies aimed at advancing the level of internationalization and skill-intensive production in Danish firms. Such knowledge can help identify the critical margins of policy formulations in an area that receives extensive attention from policy makers (for example Regeringens globaliseringsstrategi "Fremgang, fornyelse og tryghed", chapter 9).

Background:

It is generally believed that ICT has played an important role for economic development. Strictly speaking, ICT is a capital good affecting output through a higher quantity/quality of capital inputs. However, ICT has additional effects on output which distinguish it from most other capital inputs.

One of the distinguishing features of ICT is that it is associated with complementarities. Indeed, it seems plausible that the efficient use of ICT requires labor with certain skills. This has been confirmed empirically, since Autor, Katz, and Krueger (1998) find that increasing computer use has lead to skill upgrading in US industries. Hence, the increased demand for skilled labor in recent decades can at least partly be ascribed to the technological changes and increased use of ICT.

However, there is more to it than this. Researchers have recently become interested in the joint effects on productivity of ICT, labor demand and innovation. A number of US studies have empirically established that ICT and workplace reorganization have positive and significant effects on productivity, while at the same time increasing the demand for skilled labor.[2] The hypothesis put forward is that innovation of new ICT systems in itself is not sufficient to generate positive effects on productivity. Instead, a reorganization of the workplace is often required to use the new systems efficiently.

Another important issue in this relation is the implication of globalization and skill-biased technological change that to a high degree have been considered competing explanations for important labor market patterns in many developed economies. It has been hotly debated, which of the two developments that have had the most important effect for the shift in the labor demand towards skilled and educated labor — as indicated by observed patterns of increasing inequality in especially Anglo-Saxon countries such as the US and the UK.[3]

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[1] See Bloom, Sadun and van Reenen (2006) for a recent study of British firms.
[2] See Black and Lynch (2001), Brynjolfsson and Hitt (2000), and Bresnahan, Brynjolfsson and Hitt (2002) for details.
[3] See, e.g., Feenstra and Hanson (2003), Gottschalk and Smeeding (1997) and Welch (1999).

References

Autor, D. H., L. F. Katz, and A. B. Krueger (1998): "Computing Inequality: Have Computers Changed the Labor Market?", Quarterly Journal of Economics, 113, 1169-1214.

Black, S., and L. Lynch (2001): "How to Compete: The Impact of Workplace Practices and Information Technology on Productivity", Review of Economics and Statistics, 3, 434-445.

Bloom, N., R. Sadun and J. van Reenen (2006): “It ain’t what you do it’s the way that you do IT - Investigating the productivity miracle using the overseas activities of U.S. multinationals”, London School of Economics.

Brynjolfsson, E., and L. M. Hitt (2000): "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", Journal of Economic Perspectives, 14, 23-48.

Bresnahan, T. F., E. Brynjolfsson and L. M. Hitt (2002): "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence", Quarterly Journal of Economics, 117, 339-376.

Feenstra, R.C. and G.D. Hanson (2003): “Global Production Sharing and Rising Inequality: A Survey of Trade and Wages,” in Kwan Choi and James Harrigan (eds.): “Handbook of International Trade,” Basil Blackwell.

Gottschalk, P., and T. Smeeding (1997): "Cross-National Comparisons of Earnings and Income Inequality", Journal of Economic Literature, 35, 633-687.

Regeringen, “Fremgang, fornyelse og tryghed”, april 2006.

Welch, F. (1999): "In Defense of Inequality", American Economic Review, 89, 1-17.

Participants

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Anders Sørensen, Department of Economics, Copenhagen Business School, and Centre for Economics and Business Research. Expected use of research time during 2007/2008: 3 months.

NN, Student CEBR

Budget

Data – Purchase of survey data for IT use in Danish enterprises, 1999-2006, and possible updates of relevant CEBR data sets.	DKK 50,000
Student – 1 year salary	DKK 132,000
Wage for Hans Christian Kongsted – 3 months during 2007/8	DKK 166,000
Travel costs related to project (participation in conferences etc.)	DKK 20,000
Total amount, excl. overhead:	DKK 368,000
Overhead (20% of total amount)	DKK 73,600
Total amount, incl. overhead:	DKK 441,600