



info@ebusiness-watch.org * www.ebusiness-watch.org

Sectoral e-Business Watch Workshop Drivers and Impacts of ICT Adoption

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1 Summary

Background

The adoption of information and communication technologies (ICT) by businesses can be spurred by different drivers and have consequences for innovation dynamics, productivity and growth, the development of market structures, firm performance, and the composition of the demand for labour. However, drivers and impacts differ between sectors.

The central study of the Sectoral e-Business Watch (SeBW) in 2007/08 focuses on these issues. It explores, by means of econometric models and other analytical statistical tools, what drives ICT adoption in different industries, and –vice versa– the impact of ICT at the firm and sector level. Some assumptions are tested, for instance regarding the impact on total factor productivity, on employment dynamics, on the role of ICT for innovation, and on how market structure and value chain characteristics of sectors influence ICT adoption patterns.

This workshop was attended by about 30 participants, gathering researchers (mostly from economics and innovation research), industry representatives, consultants and policy makers. The workshop was jointly organised by DIW Berlin and empirica as part of the Sectoral e-Business Watch project. Its main objective was to present and discuss preliminary findings of the economic study on drivers and impacts of ICT. The final study report is expected for Spring 2008.

Programme overview

The workshop was opened by **Christian Wey**, Head of Department Information Society and Competition, DIW Berlin. The first speaker, **Hasan Alkas**, e-Business Watch programme manager at the European Commission, DG Enterprise and Industry, gave an overview of the SeBW programme, emphasising its importance as a tool for formulating both overall and sectoral industrial policy at EU level. He also underlined the importance of the ICT sector for the European economy, both as a production sector in its own right, and as an element in the overall business chain.

The first session, which was chaired by **Claudia Keser**, DIW Berlin, focused on "ICT, productivity and the skills base". **Georg Erber**, DIW Berlin, presented selected results of a macro-economic analysis of the ICT impact on total factor productivity, and the complementary role of skills in the industry. This analysis was mostly based on the EU KLEMS Growth Accounts database. Study results were then discussed by **Kaushalesh Lal**, United Nations University UNU-MERIT, Maastricht University, and **Graham Vickery**, Head of the Information Economy Group, OECD.

The second session, which was chaired by **Hannes Selhofer**, empirica, focused on the role of ICT for innovation, implications of market structure and value chain characteristics. **Daniel Nepelski** from DIW Berlin presented a comparative assessment for different sectors based on firm-level data from the e-Business Watch Survey of 2007, using statistical instruments such as discrete choice models, linear models and descriptive statistics. These study results were then discussed by **Tony Clayton**, Director of Economic Analysis at the UK Office for National Statistics, and by **Axel Pols**, Head of Department Market Research and International Trade at BITKOM (German Association for IT, Telecommunications and New Media).

2 Main points presented and discussed

2.1 Part I: Assessing ICT impact through macro-data analysis

After a brief introduction by Claudia Keser to the objectives of the study and the EU KLEMS database, Georg Erber presented the research by DIW on the links between ICT, productivity and employment.

He presented three hypotheses to be tested based on the EU KLEMS data. For this analysis he used three analytical tools: simple descriptive analysis of employment growth and of working hours per employee in various EU countries, growth accounting of gross value added, and econometric estimations of stochastic possibility frontiers of gross production values. He showed results of the three approaches for the Financial Intermediation Services Sector and provided the following conclusions.

- ICT capital is an important enabler for higher labour productivity growth.
- There are significant complementarities between ICT capital and medium-skilled labour.
- Organizational changes play an important role.
- Thus, it needs at least three components to enjoy the full benefits of higher productivity growth from ICT: higher ICT-capital investment, higher investment in the complementary skills, adjustment of the organizational structure.

However, it has to be noted that

- the data show significant heterogeneity across industries, countries and time periods,
- benefits of ICT investments are not immediate.

Kaushalesh Lal from Merit, Maastricht, discussed some data issues and commented on the results, saying that technological change led by adoption of ICT in financial intermediation sector firms is skill biased. The finding is very much similar to that of manufacturing sector. However, he says, the complexity of ICT tools in both the sectors is very different. ICT tools in manufacturing sector (especially in electrical and electronics) are complex and reprogrammable equipment that necessitate high skilled persons to use them effectively and efficiently. That is not the case in financial intermediation sector firms. Rather ICT tools in this sector might result in deskilling. However, in order to exploit full potential of ICT in financial intermediation sector firms multi-skilled persons are needed who can handle more tasks. Hence skill biased-ness in this sector may be interpreted with care.

Graham Vickery from the OECD, Paris, expressed scepticism against the growth accounting approach which he considers as exhausted for the analysis of ICT impact. He suggested new conceptual frameworks and welcomed the estimation of stochastic possibility frontiers.

In the subsequent **open discussion** the following issues were raised:

- Tony Clayton pointed out that some difficulties resulting from the econometric analysis of the financial intermediation industry in the UK are related to data problems uncovered recently in the British statistics system. He recommended re-estimation of the SPF-model with more recent data of EUKLEMS which might include the revisions made by the UK Statistical Office.
- There was some debate concerning the measurement of ICT-skills over time compared to the skills used in the analysis of EUKLEMS. EUKLEMS used a skill classification scheme based on the maximum formal educational level obtained by employees. Instead it would be better for measuring ICT-skill-complementarity by defining the specific ICT-skills at any time period to define the actual mismatch between supply and demand on the labour market. This kind of measurement, however, would need a major effort to collect such data and develop an analytical approach. This is out of reach of the current project, but would be welcome for future research in this area.
- The topic was raised how one could better link the analysis of the firm level data with the more aggregate level of industry data. One short-coming is that there is no access to firm level data across a significant number of EU-member countries which could be used to study the ICT-impacts on firm-level productivity in a similar fashion like Brynjolfsson and his colleagues did for the US. It would be most welcome if such datasets could be created and made publicly available similar to the panel data for households by Eurostat. However, this is a recommendation beyond the current scope of the actual project.

2.2 Part II: Assessing ICT impact through micro-data analysis

After a brief introduction by Hannes Selhofer to the surveys conducted by the SeBW in 2007, which constituted the source for the analysis, Daniel Nepelski presented the research by DIW on the links between ICT and innovation, and the implications of market structure and value chain characteristics.

Regarding the methodology, he described the sectoral focus of the study and the econometric tools used to analyse the hypotheses. He emphasised that the results allow for conclusions on marginal effects of selected firm characteristics on the probability of occurrence of dependent characteristics/behaviour, but not on causality effects.

With this caveat, he presented, inter alia, the following findings:

- **Relationship between ICT-enabled innovations, their facilitators and implications for company performance:** there are sector-specific differences with respect to the links between skills and ICT-enabled innovative activity. Whereas in manufacturing sectors only IT-related skills tend to increase firms' propensity to conduct ICT-enabled innovations, in other sectors both specific and general skills were shown to be positively correlated with ICT-enabled innovation.
- **Impact of ICT on firm performance and organisational transformation:** ICT-enabled innovative activity and ICT endowment positively affect the likelihood of a firm reporting a turnover increase and introducing changes to corporate strategy, marketing concepts or organisational transformation.
- **Links between the intensity of market competition and ICT adoption:** the micro-data analysis leads to the conclusion that increasing competition drives innovation and ICT adoption, as companies seek to escape competition by introducing new products and/or cutting costs. The importance of increasing market rivalry was, however, only confirmed for the retail and transport & logistic sectors. Similarly, regarding the impact of ICT on a firm's market share, the analysis revealed advantages for companies only from some sectors.

- **Complementary assets:** results indicate that firms maintaining close relationships with suppliers and customers are more likely to use technologies supporting inter-firm collaboration.

Tony Clayton from the UK Office for National Statistics discussed the study results and presented current work in this field using data from official statistics. He raised, inter alia, the following points:

- Technical / **methodological issues:** whether and how a possible non-response bias in the surveys was considered, how multi-national enterprises were treated in surveys and which weighting scheme was applied in the regression analysis.
- The **causality problem:** the regressions do not allow to establish causality, i.e. to directly identify cause and effect
- **Complementary assets:** the challenge how to define and measure "ICT capital"

Axel Pols from BITKOM was the second discussant. He raised, inter alia, the following points:

- The importance of a coherent **conceptual framework** for the analysis of ICT impact (he said that the study results in their current, rather fragmented form lacked a framework, and recommended to place emphasis on developing such a framework, also for future research)
- Comments on some of the **variables** used: "ICT skills" is a very broad concept, ideally this should be broken down into different types of skills; for the index on "ICT endowment", it was recommended to consider whether some component variables could be more relevant in certain sectors than in others.
- As suggestions for **future research**, A. Pols recommended to look also at non-ICT enabled innovation. He suggested to consider the development of a model to quantitatively measure the role of ICT for innovation. Finally, he encouraged e-Business Watch to explore new aspects of ICT impact which have not yet been researched. The current study was a bit conservative in the sense that large parts of it appeared to focus on confirming existing research.

The subsequent discussion focused in particular on the aspects of **causality**, how to **present study results** in a coherent, easily comprehensible way, and how to draw **policy-relevant conclusions** from the analysis conducted.

With regard to the establishment of causality in the statistical analysis, there were different views. Some participants, including **Brigitte Preissl**, recommended that the hypotheses should be clear in terms of what is cause and effect. It was also proposed to consider employing multivariate analysis to control for different variables. Others argued that the study should simply avoid making the impression that causality could be established with the statistical instruments used.

With regard to the presentation of results, **Heinz Hollenstein** from KOF Swiss Economic Institute at ETH Zurich, proposed to consider whether the study results could be presented in a different structure (i.e. not structured by the five dimensions "productivity", "employment" etc.), but following an "ICT value chain" with four segments: ICT adoption > ICT use (intensity) > innovation > firm performance. Hypotheses could possibly be allocated to these sections or to the transition between sections.

3 Further information

Further information, including the agenda and proceedings, are available at the Sectoral e-Business Watch Web site (www.ebusiness-watch.org) in the "eBiz Events" section.

For specific questions and feed-back, please contact: Hannes Selhofer, Project Manager, empirica GmbH – Hannes.selhofer@empirica.com



About the Sectoral e-Business W@tch

The "Sectoral e-Business Watch" (www.ebusiness-watch.org) is based on a Framework Contract (No. ENTR/2006-019) and Specific Contract (No. SI2.451854) between the European Commission, Enterprise and Industry Directorate General, and empirica GmbH. The implementation of the contract involves, besides empirica GmbH, the following main service providers: Altran Group, Databank, DIW Berlin, GOPA-Cartermill, IDC EMEA, Ipsos GmbH and Rambøll Management.

Contact: [info \(at\) ebusiness-watch.org](mailto:info(at)ebusiness-watch.org)

Imprint: empirica GmbH, Oxfordstr. 2, 53111 Bonn, Germany; Tel. (+49) 228 – 98530-0;

e-Mail: [info \(at\) empirica.com](mailto:info(at)empirica.com)