

Report for the MERIT – NWO MES Workshop

Bas ter Weel

- Title:* The diffusion of ICT and new industry and labour market dynamics
<http://www.merit.unimaas.nl/workshop>
- Organizers:* Luc Soete & Bas ter Weel
- Date:* 3 – 4 June 2004
- Venue:* Faculty of Economics and Business Administration, Maastricht University, Tongersestraat 53, 6211 LM, Maastricht, The Netherlands.
- Papers by:* Gerard van den Berg (Free University Amsterdam)
Eve Caroli (Université d'Artois)
Robin Cowan (Maastricht University)
Paul A. David (Stanford University)
Paul Stoneman (Warwick Business School)
Bas ter Weel (Maastricht University)
John Van Reenen (London School of Economics)
Bart Verspagen (Eindhoven University of Technology)
- Program:* Thursday, June 3
- 13.00 Registration and coffee
Registration takes place in the TS53 building
 - 14.00 Luc Soete (MERIT, Maastricht University)
Welcome and introduction
 - 14.15 Eve Caroli (Artois University, INRA-LEA and CEPREMAP)
(joint work with Patrick Aubert and Muriel Roger)
New technologies, workplace organisation and the age structure of the workforce: Firm-level evidence
Discussant: Lex Borghans (ROA, Maastricht University)
 - 15.15 Gerard van den Berg (Free University Amsterdam)
Revolutionary effects of new information technologies
Discussant: Ronald Peeters (Department of Economics, Maastricht University)
 - 16.15 Coffee break
Room 0.001c
 - 16.45 John Van Reenen (London School of Economics)
Is there a market for workgroup servers?
Discussant: Franz Palm (Department of Econometrics, Maastricht University)
 - 17.45 Adjourn
 - 19.00 Dinner

Friday, June 4

- 09.00 Bas ter Weel (MERIT, Maastricht University)
(joint work with Lex Borghans)
The division of labour, worker organisation, and technological change
Discussant: Adriaan van Zon (MERIT, Maastricht University)
- 10.00 Coffee break
Room 0.001c
- 10.30 Bart Verspagen (ECIS, Eindhoven University of Technology)
Innovation and jobs: A micro-to-macro perspective
Discussant: Pierre Mohnen (MERIT, Maastricht University)
- 11.30 Paul Stoneman (Warwick Business School)
(joint work with Alessandra Canepa and Giuliana Battisti)
The diffusion of E-business activities in the UK: Productivity, profitability, externalities and policy
Discussant: Jean-Pierre Urbain (Department of Econometrics, Maastricht University)
- 12.30 Lunch
Kruithuis (in the garden of TS53)
- 13.30 Paul A. David (Stanford University)
Zvi Griliches on diffusion, lags and productivity growth ... connecting the dots
Discussant: Bas ter Weel (MERIT, Maastricht University)
- 14.30 Robin Cowan (MERIT, Maastricht University)
(joint work with Nicolas Jonard)
Information technology and the dynamics of joint innovation
Discussant: John Hagedoorn (Department of Organization and Strategy, Maastricht University)
- 15.30 Luc Soete (MERIT, Maastricht University)
Concluding remarks
- 15.45 Adjourn

Report:

The adoption and rapid diffusion of the bundle of new information and communication technologies has been the most radical technological change of the past decades. Economists have been focussing on the economic consequences for education, wages, workplace organisation, markets and competition, networks and innovation of this technological revolution for quite some time now. The IT revolution has caused the costs of many kinds of interactions to drop by making a great many processes operate more efficiently. At first, revolutionary technologies are implemented in a rather mechanical way to make it less costly to produce the same level output. The main reason for Charles Babbage to manufacture and use a computer was to deal more accurately and efficiently with information (Babbage, 1832). Such “number crunchers” were the main appearance of computers until the late 1960s mainly used to carry out mathematical and statistical procedures, mass integrated data processing, and simulations of Bayesian decision making. Over time, a revolutionary technology

changes and amends (in an endogenous manner) to do entirely new things, such as to change the way in which markets are functioning and structured, demand and supply are brought together, or restructure the way in which a firm is organised and influence the way in which innovation activities are pursued. These latter consequences of new technologies are often hard to predict at first appearance but lie at the heart of the study of the economic consequences of technological change. For example, Klahr and Leavitt (1967) acknowledged that in the mid-1960s computer technology used in firms was being complemented by communication technology but did not fully understand the way in which computer technology would change decision making in firms:¹

“[p]resumably the organizational impact of this wave may be broader and may move into somewhat higher levels of the organizational pyramid. One effect of this new thrust seems to be the binding together of several subparts of the total structure, often severely modifying some in the process. Another is to move the locus of large amounts of information to some central point; and, in some cases, to change the locus of certain decisions from one part of the structure to another. The still speculative part of real-time information systems forecasts the provision of instantaneous information to top executives at their will - though no one is quite sure what they should will, or how such innovations will affect present structures.” (p. 108).

This symposium consist of a collection of seven original papers intended to provide an overview of the industry and labour market effects of IT diffusion over the past decades. There are four major themes: (i) technological development, education and matching, (ii) competition and market structure, (iii) workplace organisation, and (iv) innovation.

Gerard van den Berg’s theory paper ‘Revolutionary Effects of New Information Technologies’ explores the market consequences of IT further by focussing on the interaction between IT and differences in the composition of production technologies across firms. In his model the adoption of IT improves the realisation of good matches at the individual level, and at the market level this may entail the removal of inefficient production technologies. The key feature of the model is that due to information frictions there exists an equilibrium in which inferior and superior production technologies coexist, but a decrease in the amount of information frictions results in firms using inferior production technologies to disappear from the market. The role of IT is

¹ Another intriguing example of forecasting the way in which computer technology was likely to change the world is Leavitt and Whistler’s (1958) essay on how firms would deal with computer technology in the 1980s. Their view was that most of the work would be automated and managers would control firms by pushing buttons.

to improve the technology of information processing and reduce the amount of frictions in the market. This in turn may result in the adoption of new production technologies and affect the composition of different technologies in use. The model is able to explain a number of recent phenomena such as trends in growth rates, stock prices, mergers and takeovers and lack of inflation.

In ‘Information technology and the dynamics of joint innovation’ Robin Cowan and Nicolas Jonard investigate in greater detail the cooperation between firms (in R&D activities) as the costs of IT use decrease and explore the consequences of different knowledge distances between partners. They focus on the changes to the industry structure with special attention drawn at the architecture of the network that emerges from the market of collaborative agreements and the market structure as the costs of IT falls. Their model posits that the complementarity between the knowledge of partners and public knowledge as a research input to production becomes more important as the costs of IT fall, which affects network architecture and market structure. They use this setup to show that in a framework in which matching repeatedly takes place, matching changes over time depending on the way in which the knowledge of the participants is pooled to reduce costs. This way of modelling externalities comes close to the market frictions considered by van den Berg and both papers yield predictions about market structure; van den Berg by focussing on differences in production technologies and Cowan and Jonard by exploring the changing character of knowledge and firms’ evaluation of potential alliances.

John Van Reenen analyses a specific example of changing markets as a result of IT and his focus in ‘The Economics of the Network Server Market’ is especially on market power and interoperability in the network server market. Since the late 1980s computing architecture went through a paradigm shift, in which mainframe-orientated systems were replaced by PC client/server architecture. Instead of computer intelligence being centralised and users interacting via terminals, processing power was more decentralised, distributed between PCs with their own operating systems and servers linking these PCs together. This market for servers has become a major antitrust concern in recent years and the paper is concerned with empirically investigating these antitrust issues with respect to hedonic prices and demand substitutability between work group and enterprise servers.² The main finding of the paper is that hedonic prices for network servers have fallen dramatically and that demand is highly inelastic leading a monopolist to raise prices and reduce welfare.

The papers by Lex Borghans and Bas ter Weel, and Patrick Aubert, Eve Caroli and Muriel Roger complement the studies discussed above by investigating the interplay between IT, workplace organisation and

² “The Microsoft case” is without any doubt the most prominent example.

the demand for labour within firms. In 'Computer Technology and Workplace Organisation' Borghans and ter Weel investigate the relationship between the adoption computer technology and workplace organisation from both a theoretical and empirical point of view. The model is based on a density function of a continuum of tasks, representing the work that has to be done in a firm. The way a firm assigns these tasks to workers describes the organisational structure of a firm. This organisational structure is determined by the trade-off between the benefits of specialisation and communications costs. Computer technology might affect both the time needed for each task (production effect) and the costs of communication with fellow workers (communication effect). They show that both forms of technological change increase the demand for higher educated workers. The impact on the organisational structure might go two ways, however. The productivity effect will decrease the benefits of specialisation, leading to smaller team sizes, and educational segregation. The communication effect will induce more cooperation and hence increase specialisation. Hiring workers with different skill levels will become more beneficial. Based on a panel of Dutch firms their results suggest that the productivity effect dominates the communication effect with respect to the overall pattern of organisational change in the 1990s, associated with the diffusion of computer technology. This means that improvements in productivity associated with the stand-alone character of computer technology have been more important than the increased possibilities of communication. The empirical evidence also suggests that there exists heterogeneity in the way computer technology improves productivity. Especially for firms in the commercial services sector competing on the basis of quality improved communication possibilities seem to be the dominant factor of computer adoption, while in manufacturing the productivity effect dominates.

Aubert, Caroli and Roger investigate the impact of IT and workplace organisation on the age structure of the French workforce using firm-level data. Their findings suggest that the usage of different IT applications and innovative organisational practices have a negative effect on the employment growth of older workers and a positive effect on the employment growth of younger workers. This correlation seems to be particularly strong for skilled workers. In addition, they examine the role of IT and innovative workplace practices in hiring and firing decisions. With regard to hiring decisions, their results suggest a negative correlation between age and innovation. The results with respect to firing decisions are less clear and seem to point towards a need for more experienced workers to ensure coordination of work in French firms.

The final two papers of this symposium deal with innovation. Both papers explore data from the Community Innovation Study (CIS). The first by Alessandra Canepa, Guiliana Battisti and Paul Stoneman with innovation and productivity and the second by Bart Verspagen with

innovation and employment. In 'IT, Productivity, Profitability, and Policy' Canepa, Battisti and Stoneman consider the issue of how IT impacts upon productivity emphasising four observations crucial to measurement and interpretation but largely ignored until now. In particular they emphasise the objectives of innovation, innovation indicators, inter- and intra-firm technology diffusion and whether further diffusion of IT will induce productivity gains.

Verspagen's paper 'Innovation and Jobs: A Micro-to-Macro Perspective' is concerned with the relationship between technological change and employment levels. In doing so he tries to connect the micro-econometric evidence, which suggests that firms differ to the extent they are willing or able to innovate, with the macroeconomic models of innovation and employment using the representative agent framework to make it easier to analyse the economy at the aggregate level. The starting point is the econometric analysis of the relationship between innovation and employment demand at the microeconomic level for the Netherlands. The next step is to aggregate the estimated model to arrive at the effect of innovation on employment. The discussion of the results will focus on a comparison of the macroeconomic and microeconomic effects of innovation on employment.

Together these seven papers add to the substantial and increasing body of papers in this research area and yield a consistent understanding of how the IT revolution has had an impact and still affects the returns to education and economic development, the market structures in contemporary economics, competition and the need for insight on how IT has generated market power for some parties, workplace organisation and the demand for labour, and innovation.

References

- Babbage, C. (1832). *On the Economy of Machinery and Manufactures*, Frank Cass: London.
- Klahr, D. and Leavitt, H. J. (1967). 'Tasks, organizational structures, computers', in (C.A. Myers, ed.) *The Impact of Computers on Management*, Cambridge MA: MIT Press.
- Leavitt, H. J. and Whisler, T. L. (1958). 'Management in the 1980's', *Harvard Business Review*, vol. 36 (6), pp. 41-48.