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**Article**

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## The Economics of Information Technology Editorial

By Brigitte Preissl\*

Information technology (IT) is at the core of a new style in economic interaction. Terms like 'the information economy' or the 'information society' show how significantly new techniques in processing, storing and transmitting information affect the way we organise the economy and society. Information is apparently becoming a key element in the organisation of transactions and the dynamics of manufacturing and service industries, and it affects the configuration of markets. Hence, efficiency in its production, processing and transmission have become crucial for economic performance. The impact of IT can be clearly seen in two distinct areas. First, it is obvious in those industries which supply equipment, infrastructure and services that are necessary for or facilitate the use of IT. They are experiencing an accelerated pace of technological change and innovation and are seen as key drivers of the technological performance of the economy. Second, major changes have taken place and more are still to be expected on the adoption side. Here an enormous — and sometimes surprising — impact on processes of production, business practices, company configurations, innovation patterns and consumption can be observed. Simultaneously, IT diffusion stimulates the re-organisation of companies and markets, helps in responding to the challenges posed by new production paradigms and enhances the emergence of new products and markets, especially in the fields of multimedia and internet applications. It impels and encourages the internationalisation of transaction systems and life-styles.

The resulting changes in companies, markets and in society at large have far-reaching effects on labour markets, forms of employment and — in particular — on qualification needs. Rationalisation effects in traditional industries are compensated by the emergence of a whole range of IT-related services, but new questions arise concerning the order of magnitude of job creation, the speed of re-qualification processes and the net effect of job losses due to productivity gains and job creation in new activities.

Electronic communication puts the regional balance of economic activities in a new perspective. However, bold

predictions that this would result in a world where distance no longer matters have turned out to be over-simplified. It seems that electronic networks cannot completely wipe out the advantages of proximity, but that, nevertheless, a new set of variables has to be taken into account when combining local activities with access to world-wide resources. The boom in Internet transactions or Electronic Commerce raises new questions concerning relevant players, regulatory issues, taxation, impact on market mechanisms, internationalisation and employment.

This Special Issue of the Quarterly Journal of Economics takes up various aspects of the changes that accompany the transition to an economy which is based on information technology as one of its main drivers of change.

The eminent importance of IT and the major role it plays in the economy are not matched by high-quality statistical documentation of its production, diffusion and impact. Measuring the information economy has been a major concern of researchers in IT for a long time. Often, statistical categories seem inadequate to grasp the relevant phenomena because they are based on a conception of the economy which centres around manufacturing as the key sector and treats services as a mere residual; hence IT-related service industries, like multimedia and communication services or internet-related activities, are extremely badly represented in traditional statistics. For some time, 'the information economy' was defined by 'information-intensive activities', until it became obvious that there were very few occupations that were *not* information-intensive, since IT has the ability to deconstruct any physical activity into a stream of bits. Thus, the steering of a process of production in a computerised manufacturing (CAM) scenario automatically becomes an information-intensive activity. On the other hand, it seems essential to monitor the emergence and performance of an IT sector. The dynamics of growth and technological change of IT-

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related equipment and services have nurtured great hopes for their contribution to economic growth and employment. The relative position of a country with respect to the production, adoption and consumption of IT-related goods and services seems to be a popular indicator for its 'modernity', but also for its international competitiveness. *Wolfgang Seufert's* paper on the development of the German IT sector deals with problems of measurement and proposes a solution which is based on conceptual consistency and a sound statistical basis. The approach includes the provision of IT goods and services as well as the use of IT in information-intensive industries. The analysis for the German economy since 1970 offers some quite surprising results with respect to the contribution of the IT sector and IT-using industries towards GDP and employment.

In times in which it seems more and more difficult (at least in most European countries) to create enough new jobs to compensate for the effects of labour-saving technical progress, the question of the employment impact of IT cannot be avoided. Despite the fact that in the past, phases of rapid technological change have set in motion innovation and investment cycles that eventually generated more jobs than those lost due to a decrease in the necessary labour inputs per unit produced, fears persist with respect to the employment-creation potential of IT and with respect to a possible mismatch in qualifications, which would deteriorate the employability of certain groups of the labour force and the prospects of employers to find adequately qualified personnel. On the other hand, officials in administrations at the EU and national levels have continued to emphasize that the employment miracle that IT is widely expected to create is just around the corner. *Hannes Selhofer* provides evidence for the thesis that — at least in the short run — the employment contribution of IT will not match the optimistic forecasts. In a detailed analysis, the job creation potential is estimated and illustrated with ample reference to statistical material. However, the author moves beyond the sober analysis of the limitations of IT's ability to produce a 'job miracle' and suggests policy measures to exploit the existing employment potentials and to deal with possible skill shortages. Selhofer refers to Seufert's approach and integrates it into a broader European context.

A paper by a team of authors from the United Kingdom and Germany (*Christine Bruniaux, Kirstine Hansen, Hilary Steedman, Anna Vignoles and Karin Wagner*) takes up the debate on employment and IT skills from a different angle. The supply of qualified IT personnel is analysed by looking at the numbers of students that enter university IT courses in Europe and their qualifications. Given the shortage of IT personnel and the excitement about new technological developments in electronics and Internet technology, one would expect that a large number of the most qualified and promising young people are keen to

enter an IT career path by taking a university degree in IT. However, results are more differentiated. The space available for new students in relevant university departments as well as the number of students seem to go through a cyclical movement not unlike other subjects such as medicine or economics. Here, comparing the situation in different countries seems particularly useful, since education policies and higher education systems differ considerably. Their relative performance with respect to providing the necessary labour supply in terms of quantity and quality points to significant unused potentials for growth and employment opportunities. And, indeed, the countries examined in the article on entrants to computer science courses present a picture of both similarity and difference in the quality of computer science entrants, which is not always compatible with the obvious relevance of the field for the future performance of national economies.

The Internet and globalisation seem to be two sides of the same coin. It has almost been taken for granted that a standardised universal communication platform will give significant impulses to the generation of an integrated global market. However, at a closer look, the picture becomes much more differentiated. A technology that provides global access to information and thus to new business opportunities is not enough to automatically turn regional or national business strategies into global ones. Neither did IT alone cause international trade to increase significantly (as far as its impact can be measured), nor has physical closeness lost its significance for business networks. The integration of the workforce in remote areas into the labour markets of the economic centres via electronic links is still a popular element of Internet scenarios, but whether it will become more than a microscopical phenomenon in reality remains to be seen.

Three articles deal with the spatial and trade dimension of IT. In the first of these, *Björn Alecke and Gerhard Untiedt* discuss the theoretical explanations of international trade and try to position IT as a driver of internationalisation. Their analysis finds little support for a significant role of IT in neoclassical trade theory. However, new growth theories and new economic geography seem to offer some insights which explain the mechanisms that make IT an important factor in international trade. Thus, the authors conclude, the IT sector might need special attention from economic policy in order to enhance competitiveness. In the second article, *Gerhard Fuchs* takes up the example of the multimedia sector to analyse the impact of IT on the geography of labour markets. Fuchs discusses the validity of both regionalisation theses, which have diagnosed an increasing importance of (mostly regional) networking, and globalisation theses, which emphasise the 'disembedding' of economic activities from any regional context. Providing a thorough analysis of the factors that contribute to regional choices in the multimedia sector, Fuchs argues that in the case of

multimedia, the central economic rationale for agglomeration will not be overturned by IT, although the opportunities of electronic communication do complement the business strategies of multimedia firms. In the third of these articles, *Peter Leisink* concentrates on the multimedia sector as well, analysing both processes of networking in the related firms and industries, and the spatial distribution of these networks. He deals with the apparent paradox that although IT makes regional agglomeration irrelevant, local authorities nevertheless strive to become multimedia centres by attracting networks of multimedia actors to their region. Referring to multimedia agglomerations in the Netherlands, Leisink points out the importance of joint action of multimedia service suppliers in order to strengthen their position and to promote issues of common interest. Here regional agglomeration is an important factor for success.

The performance of the German software industry can be seen as an indicator of how well the economy is able to respond to the challenges of providing up-to-date service for the information economy. The analysis provided by *Mark Lehrer* shows the sometimes difficult struggle to keep up with the key players in international IT industries. Lehrer's paper provides an interesting perspective by discussing the development of the software industry in three distinct ways: by looking at German specialisation patterns, by studying business strategies adopted in the industry and by discussing the national innovation system as a framework for the operation of the software sector. The paper discusses the implications of a shift from (mainly) in-house software provision to a software market, by looking at the approaches of the dominant industry association and of policy makers to supporting the performance of the German software industry as a key player in world software markets.

Investment in new technology traditionally leads to an increase in productivity, not only in the processes of production of single firms or industries, but for the economy as a whole. The resulting reduction in the prices of products and the availability of resources set free in innovating sectors pushes growth rates up. However, much to the surprise of many observers, substantial investment in IT did not produce the expected rise in productivity. This so-called productivity paradox has been discussed at various levels (firm, industry, or the national economy). A whole set of explanations has been produced, and recently, the discovery of a 'new economy' seemed to set an end to the debate. Regardless of the question of whether IT has finally produced productivity increases to an extent that induces analysts to talk of the 'end of business cycles' and ever-flourishing labour markets, the analyses of the existence, dimension and explanations of a productivity paradox have shown that only an in-depth study of IT use and implementation can give a clue to how IT affects economic performance. In this Special

Issue, the IT paradox is discussed in two articles, the first one looking at the impact of management performance on the effects of IT in the firm, the second taking a comparative approach to productivity in the service industries of different countries. *Stuart Macdonald*, *Dieter Kimbel* and *Pat Anderson* identify two strands of thought in the IT-paradox literature: on the one hand, there are those contributions which are concerned with problems of accurate measurement of productivity effects and on the other, there are those which suggest that the failure of management to exploit the full potential of IT is the reason for a lack of productivity increases. The paper does not produce yet another explanation, but interprets and comments on the existing arguments, thus shedding new light on the usefulness and purpose of discussions about a productivity paradox. It concludes that management issues could play a more significant role than generally assumed, although no single rationale behind the paradox can elucidate every aspect of it. Productivity analyses in service industries are particularly difficult, because output units are often hard to define. Therefore, measuring the impact of IT on productivity requires in-depth studies of processes of service provision and its organisational background. *Geoff Mason*, *Karin Wagner*, *David Finegold* and *Brent Keltner* have made banking and hotels in the U.S., Germany and Great Britain the object of their research and conducted detailed case studies to provide empirical evidence on the impact of IT on productivity in service firms. They deny the 'end of the paradox' and present a more differentiated picture, which emphasises the importance of usage patterns. With respect to the earlier debate, their findings confirm some arguments and find little support for others. The main determining factors of the existence and significance of a productivity paradox seem to be time lags, changes in service quality, and investment in complementary goods and services.

Much has been said in the economics and business administration literature about the impact of e-commerce on firms' networking strategies, their value chains and business relations. However, most of the literature attributes effects to the characteristics of the technology itself without considering the actual strategic choices of firms in the use of e-commerce and their readiness to adapt business relations to a new set of options. The paper by *Søren Hjarup* and *Anders Henten* contributes to filling this gap. The authors discuss whether the use of extremely efficient information and communication devices leads to more volatile business relations due to higher market transparency and better information on potential new partners, or whether tighter links occur due to closer relationships in networks. Theoretically the analysis is based on an intensive discussion of transaction cost theory and its relevance for e-commerce analyses. The empirical evidence is taken from the Danish textile industry. Hjarup and

Henten conclude that the development of business relations and value chains in an e-commerce scenario have to be seen in the wider context of competition and geography in the textile industry. IT is to be seen as an instrument that supports strategies which are based on more general business considerations.

Many services are considered as being 'information-intensive'. In these services, the widespread use of IT is not surprising. However, IT is also becoming an important feature of service provision in so-called non-informational services. *Faridah Djellal's* contribution deals with the reasons for this phenomenon. She outlines the core characteristics of non-informational services and analyses recent changes in the nature of these services. Increasing complexity of service products and a diversification of modes of service delivery present convincing explanations. The article is of particular relevance for the analysis of modern economies, since it links the emergence of a 'service economy' and its characteristic features with the emergence of what other people call the 'information economy'.

In most countries, telecommunication services have long been provided by national monopolies. Progress in IT and the convergence of information and communication technologies made this market form obsolete, and in sometimes long and difficult processes, market liberalisation has been introduced. One of the major concerns in the deregulation process was the guarantee of a *universal service*, i. e., the supply of a basic set of telecommunication services to everyone (regardless the geographical location) to affordable prices. Despite sometimes heated debates about the issue, following deregulation, universal service did not seem to be a problem in most cases because prices fell and the new competitors were eager to serve everybody. A new situation emerged, however, with respect to international traffic flows in telecommunications. Here new problems come about due to the division of telecommunication markets among a few international players. This problem becomes evident in the reforms of international settlement systems, i. e., the mechanisms which divide telecommunica-

tion revenues between providers in different countries. *Francesco Castelli, José Luis Gómez Barroso and Claudio Leporelli* discuss the adequacy of solutions discussed in international regulatory bodies and conclude that additional measures might be necessary to ensure adequate access and participation of the poorer countries in international telecommunication systems.

E-commerce challenges traditional tax policies in various ways. Obvious snares exist in the case of 'virtual firms' conducting 'virtual', i. e., digitalised, transactions, and international trade that is often difficult to trace and to force into existing tax schemes. Another concern of tax policy makers is the transfer of economic activity into low tax countries, which is facilitated by the use of e-commerce platforms. As a consequence, in the long run, tax authorities see a remarkable proportion of their revenues fade away. The paper by *Stefan Bach, Markus Hubbert and Walter Müller* examines the options for and impacts of e-commerce taxation from the perspective of revenue generation, impacts on competition and fair distribution of revenues. Although governments might be tempted to subsidise the development of e-commerce and to attract e-commerce actors by giving specific tax incentives or by simply leaving it tax-free, the authors argue that such policies might distort competition between traditional and electronic forms of commerce.

This Special Issue on Information Technology can present only selected examples from a wide range of topics that emerge with the evolution of an internationally oriented information society. Some topics, like the recent discussion on the New Economy and the role that IT could potentially play in making it take off, have not been dealt with, and will have to be left to future surveys of IT impacts. However, the wide range of topics and authors who contributed to this volume already hints at the intrinsically international nature of patterns of IT supply and adoption, and of the debate on its economic effects.

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