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INFORMATION TECHNOLOGY AND PRODUCTIVITY – SOME LESSONS FOR EUROPE

Introduction

Investment on the information technology (IT) sector boosted labour markets productivity. The US economy is a notable example. Sizeable flows of investment on IT enabled the US economy to record high rates of productivity growth and boost up to very high rates during the second part in the 1990s. With the advancement of IT, US companies could broaden their opportunities for international business. Also, multinational enterprises recorded higher productivity rates and this could be linked to a distinct pattern in their use of IT within the organisation structure. Yet, the occurrence of ample investment on the IT sector in the USA was unmatched in Europe.

Technological advances have contributed to the shaping of the world we live. Simply recall that 50% of the world's economic growth and all new jobs are IT driven. Yet, millions of people in Africa have never made a telephone call. This reality in certain regions in the world must be addressed because without the ability to communicate and participate in the global society most developing countries could remain poor.

To operate efficiently in the new economic system, it is imperative to possess knowledge and means that affect business activities around the globe. Because the sector of IT is relevant both in advanced and less developed countries, this pa-

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per addressed the challenges and opportunities the sector represents for the future generations. We explore viewpoints on different issues relating to IT and strive to forward thinking on the development of a coherent approach to understanding this issue related to economic growth and competitiveness in Central Europe. The rest of this paper is organised as follows. Next two sections survey the literature and put forward important issues and lessons for the European economies. The last section concludes.

A Survey of the Literature

In the current era of globalisation, rapid technological changes and significant shift in wealth creation, international managers must remain at the forefront of IT to be able to achieve global competitiveness. From Europe to Asia, nations recognise the importance of IT innovations, economic growth and international competitiveness. The competitors are making ever-increasing investments in basic and applied IT strategies of government-industry collaboration to stimulate technology-based growth, trade and investment. An important focus of some nations is to target the acquisition of US IT uses in important industries to supplement their own efforts to foster innovation, rapid commercialisation and value-added production. Nations seek to increase both their international and US market share. The role of IT is critical to corporations. This is still critical as US firms collaborate with foreign firms as a way of addressing new opportunities while sharing technical strengths and financial resources. However, very few nations have open access to IT as in the US, where companies may find that their efforts alone are not fully effective when it comes to monitoring foreign IT. To address this need, the importance of continually re-evaluating the global market implications of foreign IT applies to the whole spectrum of US industry and research activities.

The sweep of digital technologies and the transformation of realities to a knowledge-based economy have created a robust demand for workers highly skilled in the development and use of IT. IT is the most important enabling technology in the world today in order to enhance our ability to manage information and to improve the quality of life and standard of living. IT is altering the way we live and work; it is changing the economy at a fundamental level. IT's share of the US economy nearly doubled between 1977 and 1998, growing from 4.2% to

8.2%. IT contributed more than one-third of real US economic growth between 1995 and 1997.

In 1994, three million people used the Internet. Year-end 1998 figures indicated more than 147 million people worldwide were accessing the Internet at least once a week from home or business. The number of Internet users grew to approximately 320 million by 2000 and it is predicted to be over 800 million by these days. Traffic on the Internet is doubling every 100 days. This rapid growth in traffic is generating demand for both hardware and software, as well as for skilled IT workers to implement and manage these systems. IT industries accounted for 35% of US real economic growth between 1995 and 1998; US business-to-business commerce over the Internet grew from $48 billion to $1.3 trillion between 1998 and 2003, with an additional $1.8 to $3.2 billion in global e-commerce. These numbers show the world's overwhelming response to technology. When computers and people are networked, their power multiplies. Not only can people share all that information inside their machines, but also they can reach out and instantly access the power of other machines and people and in essence bringing the world closer to them.

Starting with the end of World War II, productivity growth was strong throughout in the developed world, but stronger in Europe than in the US. The second phase started when this 'golden age of growth' shuddered to a halt with the 1973 oil shock. A second phase coincided with the widespread introduction of computers into the work place. Europe's productivity continued to catch up with US productivity levels right up to the mid-1990s. Some European countries even overtook the United States in the output-per-hour race. The third phase began in the mid-1990s with the so-called 'new economy' revival of rapid growth in the US driven by productivity growth rates that rivalled those of the 1945-1973 golden era. European economies remained in the second phase and no productivity acceleration has been recorded in the late 1990s.

Recently, we see an increase in productivity growth in the IT-producing sectors of about 1.6% a year in Europe. The analysis of twenty studies reported in Stiroh (2002) finds an average IT-output elasticity of 5%, suggesting that a 1% increase of the IT stock increases productivity by 5%. Therefore, this would suggest that there are some special features of IT compared with other forms of capital. Other studies have found different average impacts of IT on firm productivity. Stiroh (2004) reports estimates ranging from an upper end of over 25% to negative 5%. Some of these differences are due to methodological differences.

However, it is more likely that a large amount of this variation is due to genuine differences in the impact of IT across firms and this is reflected in the different results from different datasets.

An important reason why the returns to IT differ across firms is that different firms have different management and organisation of the firm into which the IT is placed. For example, Bresnahan et al. (2002) examined the impact of IT on productivity in over 300 large US companies. A 1% increase in the IT stock was associated with an increase in productivity of 3.6%; this increased to 5.8% if a firm became more decentralised.

In sum, productivity grew at a rate of 1% a year for 20 years; starting in 1995, the productivity has grown at 3% per year. Note that between 1990 and 2000, the average annual growth rate of real investment in computer capital was about 33%. The growth in the sector of IT has had beneficial effects on the production (some 25% of the increase in production is because of IT). The impact could be substantial if the use of computers facilitates a broad collection of complementary innovations within firms and the benefits of computers becomes apparent when new technologies are combined with organisational aspects. There is evidence that the benefits from computer use persist long after firms have undertaken the investment.

Table 1

Sources of US Productivity Growth, 1959–2003

	1959–1973	1973–1995	1995–2003
Average labour productivity	2.85	1.49	3.06
IT Capital deepening	0.21	0.40	0.92
Non-IT capital deepening	1.19	0.49	0.83
Contribution of labour quality	0.33	0.26	0.17
IT Total Factor Productivity	0.09	0.24	0.53
Non-IT Total Factor Productivity	1.03	0.10	0.61

Note: IT capital includes computer hardware, software and telecommunication equipment.

Source: Jorgenson, Ho and Stiroh (2004), Table 1, p. 3.

The use of computers increases total factor productivity (TFP) in the manufacturing and service sectors also by the way of changes in the organisation of production. According to Brynjolfsson and Hitt (2003): computer use accounts

for a substantial share of TFP and output growth and computer investment has its maximal impact on productivity after about 7 years. Moreover, between 1987 and 1994, about 0.25% to 0.50% of TFP growth at the firm level was generated by the use of computer capital, which grew by about 25% per year.

However, why this has not influenced Europe and Japan? According to experts – for example, Brynjolfsson and Hitt (2003), Jorgenson, Ho and Stiroh (2004) – the beneficial effects of Internet and computers happen when their penetration into the markets reaches 50%. A critical degree of penetration enables to reduce production costs all across the economy. This critical value has been reached in the USA in 1999. Others say that if we focus on TFP growth, computer investment accelerated early in the 1990s. If the firm-level results are translated to the overall economy with a time lag of about 7 years, the gains in TFP growth from the 1995–1999 flows of computer investment growth, which exceeded 40% per year, should peak around 2006.

The Role of IT Outside of the US

One of the hottest debates of recent is that of outsourcing or offshoring. Outsourcing has become one of the key restructuring tools for companies seeking to boost their growth and business performance. Michael Mol (2007) developed a view that takes into account both opportunities and benefits from outsourcing. He includes the social cost of outsourcing that has previously been ignored and he shows that firm performance is an inverse U-shaped function of the extent of outsourcing. There can both too little and too much outsourcing. Still, the transfer of manufacturing and service jobs over the past few years, is clearly an area of debate at all levels.

While the USA could have lost millions of jobs and the associated economics, maintain critics of this phenomenon, India and China's economies are booming with IT leading the way. The advantages for outsourcing may include cost savings and highly skilled staff at lower (Adekola and Sergi, 2007). The disadvantages for outsourcing include possible culture issues, may affect the corporate image and cost-savings may not materialise (Adekola and Sergi, 2007).

Often the common factor of the countries either sending or receiving work is a large population that speaks and understands English. In India, the new giant of the outsourcing industry, more than one billion citizens speak 26 different native

languages, including its one unifying language – English (Adekola and Sergi, 2007).

Outsourcing, or what Bhagwati (1984) termed the 'long-distance' purchase of services abroad, is a trade phenomenon that can lead to further gains. Outsourcing can be either goods or services that are shipped or sent over the Internet or telephone from one country to next. Its effect is positive and brings about a benefit to all economies over time since the process could result in higher-value jobs replacing losing low-wage jobs (see also Mankiw, Forbes and Rosen, 2004). While its effects on jobs and wages are not different from traditional trade in goods, it has been a small phenomenon in the US labour market. Bhagwati, Panagariya and Srinivasan (2004) state that those who "profess that this phenomenon causes a shrink in IT jobs "seems especially far-fetched" (p. 111). Who "contend that all or most service jobs will be outsourced to India and China are both empirically and theoretically mistaken", Bhagwati, Panagariya and Srinivasan say (2004, p. 109).

Groshen, Hobijn and McConnell (2005) have observed employment changes that have been caused by bilateral trade flows and the significant job implications for the US. They substantiate that offshoring has been a limited phenomenon and has contributed little to the labour markets' poor performance in recent years. They calculated how many US workers at current wages, prices and productivity levels are needed to produce the goods and services that the US imports minus how many jobs are required to produce the goods and services that the US exports. They found that the jobs embodied in recent net trade for the entire private economy is small, at most 2.4% and sometimes less than zero. The maximum value of the jobs lost in the USA did not exceed 2.4% of its total employment in 2003, which is the maximum value for the entire period observed, i.e. from 1983 through year-end 2003. Moreover, they found that jobs lost to net trade flows grew at a slower pace after the recession, dropping from approximately 45,000 jobs per month in 1997–2001 to 30,000 jobs per month in 2001–2003. Data, therefore, would not support the claim that the transfer of US jobs to workers abroad is to blame for the jobless recovery (Groshen, Hobijn and McConnell, 2005).

If India has the best reputation as an outsourcing destination among top US companies. A potential challenger is the Philippines, which has a large pool of English speakers thanks to its American occupation in the 20th century. Despite the language handicap, Eastern European countries such as Poland, Hungary and the Czech Republic also have potential, particularly for outsourcing from We-

stern European countries like Germany and France. Another country to watch, however, is China, say Adekola and Sergi (2007). With a population of 1.3 billion and an exploding industrial base and educational system, the only downfall at this point is its amount of English speaking citizens. However, that is quickly changing (Adekola and Sergi, 2007).

IT and Its Effects on Labour Market

Another major competitive factor concerns the production of hardware versus the production and application of software. Developing and producing high-tech hardware is capital intensive, requiring expensive manufacturing plants and other facilities. This is a relatively high barrier to entry into the business and that tends to limit the number of competitors. In contrast, software development and applications can be carried out from a home basement, with a couple of computers and desks. This low barrier to entry has allowed many competitors to enter the market with a rapidly growing array of products and services for different industries and consumer markets.

The IT industry is advancing at a rapid pace, with the lifetime of product delivery to market periods shortening; demands for continued creativity and innovation growing daily. What we will offer next year has not been invented today. In this environment, it is critical to have competent employees who can do the job and keep the company in front of the rest of the competition.

The World Economic Forum (2006) has recently published its global competitiveness index, which contains 125 countries. The Growth Competitive Index (GCI) names nine factors that are critical to driving productivity and competitiveness – institutions, infrastructure, macroeconomic, health and primary education, higher education and training, market efficiency, technological readiness, business sophistication and innovation. In first place is Switzerland followed by Finland, Sweden, Denmark and Singapore; China and India ranked 13th and 43rd, respectively. The USA was first in 2005, however has dropped to 6th place in 2006, reporting the most dramatic drop by falling five places. Similar to our findings regarding e-readiness, we see that several Scandinavian countries are leading not only in technology but also in global competitiveness. Over 11,000 business leaders were polled in a record of 125 economies worldwide in 2006. To compete effectively in global markets and to hold their own in the domestic

market, US companies need to track and remain current with foreign IT developments.

Technology and Inequality

The skill premium in the USA kept approximately constant in the pre-1970 era. Successively, the economy has witnessed sharp increases in wage and income inequality. In the US, the college premium (the wage of college graduates relative to the wages of high school graduates) increased over 25% between 1975 and 1995 and overall, earnings inequalities soared: in 1971, a worker at the 90th percentile of the wage distribution earned 266% more than a worker at the 10th percentile. By 1995, this percentage had risen to 366.

Why did the demand for skills accelerate over the past decade? Why has new technology favoured more skilled workers throughout the 20th century, but not during the 19th century and what are the implications of technical change for the labour market? It is certain that technical change in the USA and the OECD over the past 60 years has been skill-biased. Some economists trust that what happened over the past few decades is a matter of 'technology skill complementarity'. The consensus among experts is that technical change is able to privilege more educated workers, to replace tasks previously performed by unskilled and to increase the demand for skills. However, how can we rationalise the large increase in the supply of skilled workers with the increase in the college premium? Simple microeconomics would suggest us that the relative demand for skills must have increased and this because of the changes in technology (for 'tech' it is intended not only the machines available to firms, but also the organisation of production, of labour markets, consumer tastes, etc.). That is, the acceleration in the skill bias began in the 1970s and 1980s has been steered by advances in IT or a sort of 'third industrial revolution'.

For the economist Daron Acemoglu (1998), it can be argued that the increased skill bias of technology throughout the 20th century and its acceleration during the past 30 years resulted from the changes in profit opportunities which were, in turn, a consequence of the steady increase in the supply of skilled workers over the past century and its surge starting in the early 1970s.

The acceleration of skill bias in the USA is that returns to schooling rose over the past three decades despite the unusually rapid increase in the supply of

educated workers. Because of the entry of the large and well-educated baby boom cohort starting in the late 1960s and the Vietnam era draft laws meant to increase government support for higher education, the educational attainment of the US labour force increased sharply starting in the early 1970s. Put it differently, in a world in which skilled workers are scarce, firms are more inclined to hire, train and employ them in relatively low-paid jobs. As there is an increasing supply of skilled workers, firms are more selective in recruiting people and design jobs specifically for them. This fact excludes low- and medium-skilled workers from well-paid jobs and explains the decline in the relative wages of low-skilled workers and the rise in inequalities.

But how is the skill bias of technology related to the supply of skilled workers? Technical changes privilege more profitable areas and two factors determine the profitability of new technologies. The price effect: in light of relative price changes, also the relative profitability of different types of technologies changes. Technologies used predominantly in the production of goods that are now more expensive will be demanded more. The invention and improvement of these technologies will be become more profitable. The market size effect: it is more profitable to introduce machines that will be used by a large number of workers because greater market sizes will enable greater sales and profits for the producers and inventors. That is, it is through this effect that an increase in the supply of skills induces technology to become even more skill biased. Therefore, when there are more skilled workers in the labour market, this effect will make the production of skill-complementary machines and technologies more profitable.

In the end, the market size effect can be so strong that the relative demand curve for skills can be upward sloping, this in contrast to the standard downward sloping relative demand curve for labour. Moreover, the skill premium and returns to education will be higher when there are more skilled workers in the economy. That is, as the market size increases, it becomes more profitable to create and introduce more such technologies.

Conclusion

Technology will be a part of our lives and will continue to grow. It is possible to suggest that computer advancement and organisational factors are important to understand economic developments; such factors are expected to take

a dramatic hold of the reins well into the future of the information age. The old way of doing business has been replaced by new methods that are sometimes complex, but potentially vigorous. IT is an important base for economic growth and development; a good organisation is equally important in getting the most out of IT investment.

Following the experience in the US, European managers need to continually watch and see what new companies, old companies and other countries are doing and what kind of technology they are using. They need to form partnerships with international firms as a means of identifying new opportunities. It is also the hope that the European legislation will continue to encourage technical growth and advancement through political tactics that are contingent with the businesses in mind.

TECHNOLOGIE INFORMATYCZNE I PRODUKTYWNOŚĆ – KILKA LEKCJI DLA EUROPY

Streszczenie

W artykule przedstawiono dowody na to, że inwestycje w technologie informatyczne wzmacniają produktywność rynków pracy w USA. Opierając się na inwestycjach w tym sektorze, odnotowano wysoką stopę wzrostu produktywności i duży wpływ na krajowy wzrost ekonomiczny.

Tłumaczenie Tomasz Bernat