The Role of ICT in Catching Up of New Europe[1]

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13.1. Introduction

The recent accession to the European Union of the eight Central and Eastern European (CEE) countries marked the end of their transition from a centrally planned to a market economy. This historical event begs the question of the role that information and communication technology (ICT) plays in the catching-up process of CEE countries with the EU-15 and the U.S. and the potential it may have for accelerating growth in the future. Given that the most straightforward transition growth reserves (i.e. those resulting from largely completed privatization, advanced stage of the institution building, macroeconomic stability, elimination of most loss-making state-owned enterprises, etc.) in CEE countries (although less so in Bulgaria and Romania) have already been exhausted, the pace of further catching-up (convergence) with the EU-15 and the US will now partly rely on the productive use of ICT.

Hence, the purpose of this paper is to analyze the potential of ICT in CEE countries for faster growth towards the EU-15 income level. The paper investigates this question from both macro and industry perspectives. First, it argues that, between 1995 and 2003, ICT did, indeed, contribute to accelerated productivity growth in all five new EU member states (a case of technological leapfrogging) and thus contributed to their faster convergence with the EU-15. However, in two of the EU candidate countries: Romania and Bulgaria – the income gap widened, mainly due to the lower quality of economic and institutional environment. Second, the paper shows that ICT use had an important role in stimulating productivity growth at industry level in CEE countries. Third, it argues that ICT offers significant potential for faster productivity growth in services and non-ICT using industries. If they were able to achieve the same rate of productivity growth as the ICT-using industries, then they would make a significant

[1] An earlier version of this paper entitled "The Potential of ICT for the Development and Economic Restructuring of the New EU Member States and Candidate Countries" was published in the European Commission IPTS's Technical Report series, February 2005, available at www.jrc.es. This paper should not be reported as representing the views of the International Monetary Fund.

contribution to faster growth in CEE countries. Realizing this potential, however, will crucially depend on far-reaching structural reforms, business re-organization and investment in human capital.

The paper proceeds as follows. In Section II, the paper analyzes the role of each of the three channels through which ICT contributed to the process of catching up with the EU-15. It then relates it to the quality of economic and institutional environment as the determinant of the diffusion and productive use of ICT. In Section III, an industry perspective is adopted to show the divergence in labour productivity growth rates between ICT-using and non-ICT using industries in CEE countries, the EU-15 and the US. Section IV discusses the potential contribution of a more intensive use of ICT in the non-ICT using sector for the aggregate productivity growth in CEE economies. Section IV presents conclusions and policy recommendations.

13.2. The contribution of ICT to convergence and its determinants

Based on the growth accounting methodology, Piątkowski (2004) and Van Ark and Piątkowski (2006) estimate the contribution of ICT investment to growth in GDP and labour productivity in CEE countries, EU-15 and the US during late 1990s and early 2000s. Table 1 shows that the contribution of ICT capital to labour productivity growth in CEE countries, with the exception of Romania, Bulgaria and – to a lesser extent – Slovakia, in absolute terms was higher than in the EU-15 (column 3), despite lower levels of GDP per capita in the former. Thus, in the case of the four leading CEE countries, ICT capital contributed to convergence with the EU-15 (although not with the US). Yet, in the case of Romania and Bulgaria, low ICT investment led to the widening of the income gap with the EU-15 and the US.

Such a divergence in the impact of ICT begs a question as to what explains the differences in the intensity of ICT investment and its contribution to productivity growth within CEE countries relative to the EU-15 and the U.S. Piątkowski (2002, 2004) and Van Ark and Piątkowski (2006) argue that this divergence seems to be primarily driven by differences in the overall quality of the economic and institutional environment, labour and product market flexibility, development of infrastructure, spending on innovation, quality of human capital, development of financial markets and macroeconomic stability. Fig. 1 shows that in all of these dimensions, which are combined in the *New Economy Indi-*

cator, Romania and Bulgaria lag behind the other five CEE countries and the EU-15.[2]

Table 1. ICT capital contribution to labor productivity growth (GDP per person employed) in CEE countries, EU-15 and the U.S., 1995-2003, in %-points

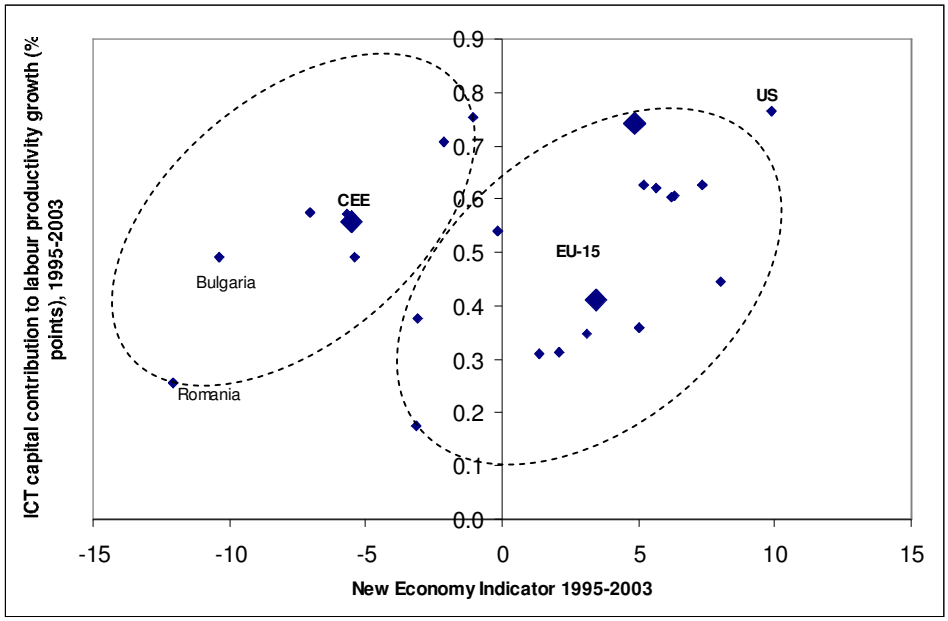
	GDP per person employed (annual growth, %)	%-point contribution of:			ICT capital share in LP growth
		Non-ICT capital intensity	ICT capital intensity	Total factor productivity growth	
CEE countries	**3.16**	**0.88**	**0.52**	**1.76**	**16%**
Bulgaria	2.28	0.35	0.46	1.48	20%
Czech Rep.	2.55	1.19	0.64	0.73	25%
Hungary	2.82	0.31	0.60	1.91	21%
Poland	4.73	1.94	0.57	2.22	12%
Romania	2.58	0.76	0.35	1.47	14%
Slovakia	3.77	0.82	0.48	2.47	13%
Slovenia*	3.36	0.78	0.52	2.06	15%
Russia	**3.47**	**-1.07**	**0.08**	**4.46**	**2%**
EU-15	**0.99**	**0.23**	**0.49**	**0.27**	**50%**
U.S.	**2.20**	**0.31**	**0.82**	**1.07**	**37%**

Note: * Slovenia 1995-2001 only. CEE represents an unweighted average.
Source: Van Ark and Piątkowski (2006) based on Total Economy Database, Groningen Growth and Development Centre and The Conference Board; www.ggdc.net/dseries/totecon.shtml

As regards the role of the ICT producing sector in the convergence process, table 2 shows that in Hungary and Slovakia the contribution of ICT production to labour productivity growth was higher than in the EU-15, thereby contributing to an accelerated convergence. This was, however, not the case for the Czech Republic and Poland, which reported lower contributions to growth. As argued by Piątkowski and Van Ark (2005), the divergence in the size of ICT production among CEE countries was mainly driven by the differences in the value of FDI. This in turn depended on trade openness, basic rule of law, development of infrastructure, macroeconomic stability and privatization policies.

[2] The *New Economy Indicator* combines ten variables. The sample mean of values of all variables is subtracted from each number and then the result is divided by sample standard deviation. This implies a mean of zero and a standard deviation of one across countries in the sample. Hence, all results are comparable and can be aggregated. Higher score implies higher quality of economic environment. For a complete methodology of the *New Economy Indicator*, please refer to Piątkowski (2002) and Van Ark and Piątkowski (2004).

Figure 1. Relationship between the ICT capital contribution to labour productivity growth and the value of the "New Economy Indicator", 1995-2003 average



Source: Van Ark and Piątkowski (2006). Higher value of the 'New Economy Indicator' implies higher quality of economic environment.

Table 2. Contribution to labour productivity growth of ICT-producing industries, 1995-2003

	EU-15	**US**	**Czech Rep.**	**Hungary**	**Poland**	**Slovakia**
Total Economy	1.21	2.39	2.17	2.54	4.97	3.95
ICT-Producing Industries	0.48	0.87	0.42	0.78	0.39	0.66
ICT Manufacturing	0.25	0.62	0.13	0.38	0.15	0.07
ICT Services	0.21	0.24	0.33	0.43	0.24	0.61

Note: Real estate has been excluded from both GDP and total persons engaged for all countries; Productivity growth defined as GDP per person employed.
Source: updated results from Van Ark and Piątkowski (2004) based on the Groningen Growth and Development Centre, 60 Industry database, www.ggdc.net

There is no data on the contribution of the ICT producing sector to labour productivity growth in other CEE countries.[3] However, Gaspar (2004), on the basis of data from Eurostat, provides estimates of the share of the ICT sector in GDP in Slovenia, Bulgaria and Romania in 2003.

It turns out that the size of the ICT sector in Slovenia and Bulgaria is comparable to that of Hungary, Slovakia, and the Czech Republic and significantly larger than in Poland. The size of the Romania's ICT sector is roughly equal to that of the latter country. Alas, lack of data on productivity growth rates in the ICT sector does not allow for measuring its contribution to productivity growth in these countries and thus its role in convergence.

To sum up, it turns out that in five CEE countries – the Czech Republic, Hungary, Poland, Slovakia and Slovenia – the total ICT contribution, from both ICT use and production, to labour growth was higher or comparable to that of the EU-15. Bulgaria and Romania though lagged behind. This results suggest that the five leading CEE countries, which have virtually completed the transition process, took advantage of ICT to accelerate their catching-up with the EU-15. Unfortunately, this was not the case of Bulgaria and Romania where due to a slower pace of reforms ICT played a much smaller role in growth. In these countries, ICT contributed to the increase in the income divide with the EU.

13.3. ICT use and convergence from an industry perspective

Given the small size of the ICT producing sector, which in all CEE countries does not represent more than 8 percent of GDP (Van Ark and Piątkowski, 2006), the sustained convergence towards the EU-15 income levels will naturally have to rely on the productivity growth in the non-ICT producing sectors, particularly in services. The accelerated labour productivity growth will be driven by a rise in capital intensity and technical change. ICT can have a large role in both.

Van Ark and Piątkowski (2004) provide estimates of labour productivity growth rates in ICT-producing, ICT using and non-ICT using industries in four CEE countries (the Czech Republic, Hungary, Poland and Slovakia) for the period 1993-2001. Table 3 provides updated results for 1995-2003, which show that productivity growth rates in ICT-using manufacturing in four CEE countries are in most cases more than double the productivity growth rates in the non-ICT

[3] Although Perminov and Egorova (2005) provide estimates of the contribution of the ICT production to labour productivity growth in Russia between 1995 and 2001.

using manufacturing.[4] This suggests that ICT use has been an important source of productivity growth and convergence.[5]

Productivity growth rates in the ICT-using manufacturing in CEE countries are also substantially higher than in the EU-15 and the US.

Table 3. Labour productivity growth of ICT-producing, ICT-using and non-ICT-using industries, 1995-2003

	EU-15	**US**	**Czech Rep.**	**Hungary**	**Poland**	**Slovakia**
Total Economy	1.21	2.39	2.2	2.5	5.0	4.0
ICT Producing Industries	7.91	10.78	4.9	11.0	8.8	10.5
ICT Producing Manufacturing	17.56	24.36	10.5	16.1	13.5	6.0
ICT Producing Services	4.58	4.32	4.5	9.1	6.7	11.7
ICT Using Industries	1.36	4.25	5.9	3.6	3.6	2.0
ICT Using Manufacturing	1.59	1.85	5.4	11.1	12.2	5.5
ICT Using Services	1.30	4.81	6.1	1.4	0.9	-0.1
Non-ICT Industries	0.51	0.38	0.2	1.1	5.0	4.1
Non-ICT Manufacturing	1.65	2.19	3.5	0.9	5.3	3.0
Non-ICT Services	-0.06	0.28	-1.9	1.0	2.6	4.9
Non-ICT Other	1.73	0.36	0.7	1.8	5.8	4.9

Note: Real estate has been excluded from both GDP and total persons engaged for all countries. Productivity growth defined as GDP per person employed. National deflators were used for the CEE countries, while hedonic deflators for the EU-15 and the US.
Source: updated results from Van Ark and Piątkowski (2004) based on the Groningen Growth and Development Centre, 60-Industry Database. www.ggdc.net

This provides evidence for the success of the restructuring process of ICT-using manufacturing industries in CEE countries driven by basic fundamental reforms allowing for inflows of FDI, increase in management skills, labour shedding, and replacement of old equipment with new capital embedding modern technologies, particularily ICT.

Thanks to the high productivity growth rates, ICT-using manufacturing industries in CEE countries contributed between 0.33 and 0.74 percentage point to the aggregate labour productivity growth between 1993 and 2003, against close to zero for the EU-15 and the US (Table 4).

[4] For detailed data on labour productivity growth rates for each industry, please refer to www.ggdc.net

[5] Although it has to be remembered that these results do not prove the existence of causality between ICT and productivity growth. It may be that either ICT use contributes to faster productivity growth or that industries with high productivity growth rates happen to use ICT intensively. Given the evidence, the first proposition sounds more probable.

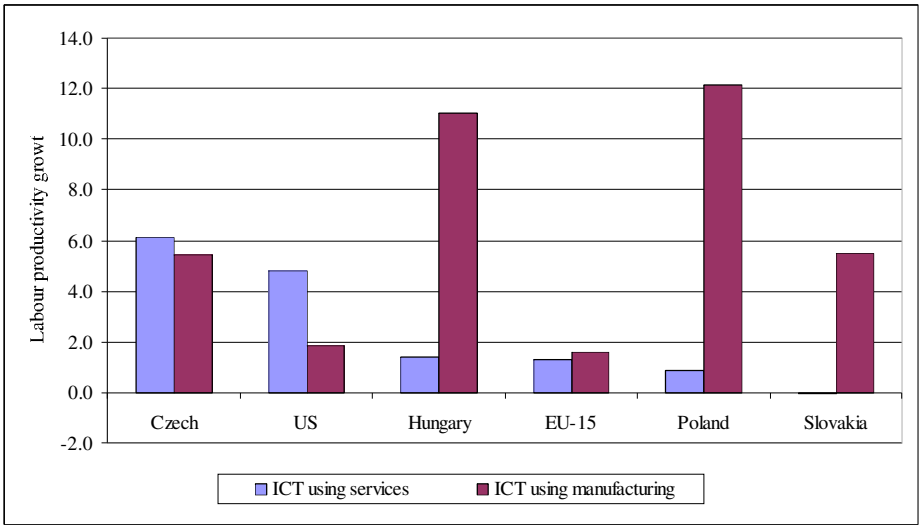
Table 4. Contributions to labour productivity growth of ICT-using and non-ICT-using industries, 1995-2003

	EU-15	**US**	**Czech Rep.**	**Hungary**	**Poland**	**Slovakia**
Total Economy	1.21	2.39	2.17	2.54	4.97	3.95
ICT Using Industries	0.39	1.34	1.59	0.98	1.16	0.55
ICT Using Manufacturing	0.11	0.09	0.38	0.65	0.74	0.33
ICT Using Services	0.29	1.25	1.22	0.30	0.23	-0.03
Non-ICT Industries	0.33	0.23	0.07	0.71	3.15	2.64
Non-ICT Manufacturing	0.22	0.23	0.63	0.13	0.74	0.52
Non-ICT Services	-0.02	0.11	-0.56	0.33	0.83	1.39
Non-ICT Other	0.21	0.03	0.10	0.26	0.98	0.85

Note: Real estate has been excluded from both GDP and total persons engaged for all countries. Productivity growth defined as GDP per person employed. National deflators were used for the CEE countries, while hedonic deflators for the EU-15 and the US.
Source: see table 3.

In ICT-using services, however, productivity growth rates in both CEE countries and in the EU-15 were much lower than in the US. They were also much lower than in manufacturing (figure 2).

Figure 2. Labour productivity growth rates in ICT-using services and ICT-using manufacturing in CEE, the EU-15 and the US, 1995-2003 average



Note: Countries ordered according to the size of labour productivity growth in ICT-using services.
Source: updated results from Van Ark and Piątkowski (2004) based on the Groningen Growth and Development Centre, 60-Industry Database, www.ggdc.net

The difference in the productivity growth in the ICT using services in favour of the U.S. provides grounds for a hypothesis of a "two-phase" convergence.[6] In the first phase, as argued by Van Ark and Piątkowski (2004), productivity growth is driven by the restructuring of ICT-using manufacturing based on a relatively simple replacement of old machinery with new equipment and growth in FDI-driven ICT production.

Quite importantly, such a replacement does not require any major changes to enterprise organization or large investments in human skills. In the second phase, however, economy-wide productivity growth needs to be driven by ICT use in the service and "old economy", non-ICT-using sectors. This requires a more conducive business environment, the full opening of product markets to competition, more flexible labor markets, and re-organization of business processes around ICT rather than automation of the existing organizational structures, which yields only marginal benefits (OECD, 2004; Davenport, 1992; Brynjolfsson and Hitt, 2000). It also requires larger investment in human and ICT skills and improvement in management practices. As to the latter, Dorgan and Dowdy (2004) show, on the basis of an enterprise survey in the U.S., UK, Germany and France, that productivity growth stemming from IT investment can be substantial only when it is supported by high quality management practices. These seem to be indispensable to allow for the process innovation necessary to reap full benefits of ICT use.

Piątkowski and Van Ark (2005) argue that among the analyzed group of CEE countries, EU-15 and the U.S., only the latter has succeeded in creating a sufficiently conducive business environment to move to the "second phase" of the productive use of ICT as evidenced by much higher productivity growth rates in ICT-using services. OECD (2004), World Economic Forum (2005) and Timmer and Van Ark (2005) also point to the success of the Nordic countries and Australia in promoting the diffusion and productive use of ICT.

As for CEE economies, this means that to move to the "second phase" of convergence they will have to implement far-reaching structural reforms largely modelled on either the U.S., Australia or Nordic economies. This, however, will not be easy, given the social sensitivity to enhancing labour market flexibility (including the ease of hiring and firing) and opening industries to full competition (particularly in telecommunications, postal services and utilities). Furthermore, given the lack of fiscal space for substantially higher public spending in most CEE countries, it will be difficult to increase spending on R&D and innovation. Lastly, as argued by Piątkowski (2004), given that under the centrally planned economic system there were no incentives to innovate, due to the lack

[6] It is worth noting though, that the measurement of productivity growth in the service sector is plagued by a number of measurement problems. See, for instance, Triplett and Bosworth (2004).

of a history of innovation, enterprises in CEE countries will be less likely to experiment than those in developed economies. All in all, if the structural reforms are not implemented, the ICT-led convergence may slow as the restructuring process in ICT-using manufacturing nears completion and further investment in ICT yield only diminishing returns.

13.4. The potential of ICT use in non-ICT using industries

Since ICT-using services in the US reported higher productivity growth rates than in CEE countries, higher investment in ICT in the latter countries, coupled with organizational innovations in enterprises and appropriate human skills, could contribute to faster productivity growth and thus accelerated catching-up with both the EU-15 and the US.

But what would be the size of the potential contribution of a more intensive ICT use to faster productivity growth? Figure 3 shows that under the assumption that the aggregate productivity growth in the ICT using services in CEE countries caught up with the rate of productivity growth in the US, the additional contribution to the economy-wide productivity growth would be substantial.[7] In Poland, for instance, the additional 0.99 percentage point contribution to labour productivity growth would allow it to catch-up with the average EU-15 level of productivity six years earlier than in a baseline growth scenario, that is, in 2023 instead of 2029. Hungary and Slovakia would also catch-up faster.

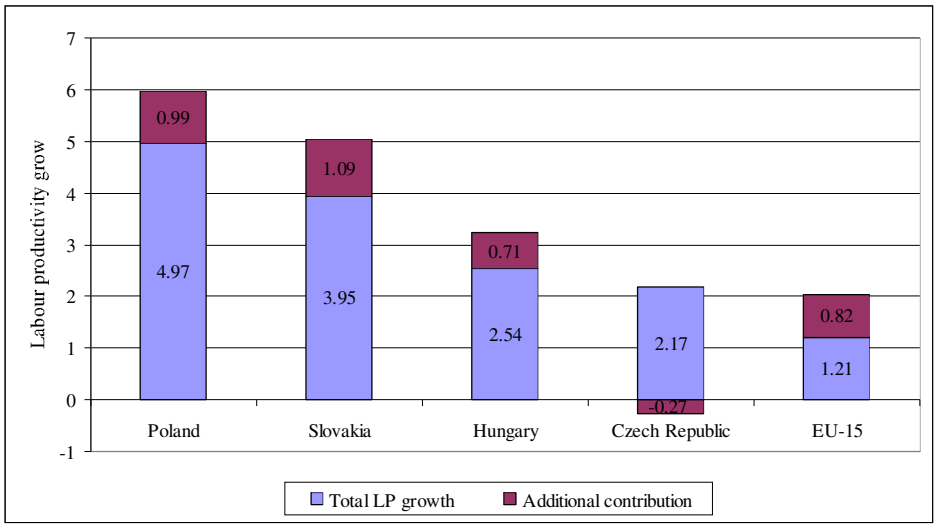
As argued by Piątkowski (2006, 2005), similarly large economic benefits to the whole economy would ensue if the "old economy", non-ICT-using manufacturing in CEE countries caught-up with the labour productivity growth rate in the modern, ICT using manufacturing industries. However, as asserted in the previous section, such a sizeable productivity increase could not be achieved without a large increase in ICT investment, supported by macroeconomic stability and fully developed market institutions, complimented with improvements in the business organization, process innovation, human skills, management practices and in the quality of the business climate.

The potential for ICT-driven productivity growth and convergence can also be assessed on the basis of experts' assessments. Rivlin and Litan (2001) provide estimates of ICT-related savings due to the use of the Internet in the U.S. between 2000 and 2005 in eight sub-sectors of the economy representing 70 percent of GDP. They find that the manufacturing, health and transport industry

[7] Although the high productivity growth in the US service sector seems to have been at least partly driven by factors unique to the US, including economies of scale, stock market boom, and the "Walmart effect". See, for instance, McKinsey (2001).

show the largest promise for ICT-related savings and related increase in productivity (Table 5). The benefits of ICT use in education and retail trade, however, proved to be too hard to quantify.

Figure 3. Additional contribution to aggregate labour productivity growth from faster productivity growth in ICT using services in CEE countries and EU-15, 1995-2003 average



Source: author's calculations based on the Groningen Growth and Development Centre, 60-Industry Database, www.ggdc.net

Table 5. Estimates of the potential savings due to the use of Internet in the US during 2000-05, by sub-sectors

Industry	Estimated savings until 2005 (in billion $)	As share of GDP in 2003
Education	Hard to estimate	-
Financial services	19	0,2%
Public administration	At least 12	0,1%
Health	41	0,4%
Manufacturing	50-100	0,5% - 1,0%
Retail trade	Hard to estimate	-
Transport	3-79	0%-0,7%
Total	125-251	1,2%-2,4%

Source: based on Litan and Rivlin (2001, p. 39).

Litan and Rivlin (2001) also underscore the potential for ICT-led productivity growth in the public sector. This potential seems to be particularly large for CEE countries, where the overall quality and efficiency of the public sector is low relative to the EU-15 and to the US in particular. An enhanced use of ICT in the public sector would contribute to an increase in its productivity, improve revenue collection, generate large savings in operating costs, and reduce corruption. These benefits could go a long way towards "saving the welfare state" in both CEE countries and in the EU-15 that is now being undermined by the erosion of the tax base due to the combined effect of globalization and spread of ICT networks.[8] More intensive use of ICT in the public sector would also boost productivity of the private sector through enhancing the quality of public services, improving access to information, reducing the red tape and increasing transparency.

13.5. Conclusions

Between 1995 and 2003, ICT contributed to an accelerated convergence of all five new EU member states from Central and Eastern Europe with the EU-15. Romania and Bulgaria, however, lagged behind as ICT contribution to growth was lower than in the EU-15. This was due to a lower quality economic and institutional environment than in other CEE countries. The divergence between the economic impact of ICT indicates a close link between diffusion of ICT and advancement of economic reforms.

Since the ICT-producing sector in CEE countries, with the possible exception of Hungary and Slovakia, is too small to be a main driver of growth and because the simple transition growth reserves have been already exhausted, sustained productivity growth and convergence with the EU-15 will now have to rely on the productive use of ICT in the non-ICT producing sector, particularly in services. This paper provides evidence that ICT use had an important role in stimulating productivity growth at industry level in CEE countries, as between 1995 and 2003 ICT-using industries reported higher productivity growth rates than non-ICT using ones.

If services and non-ICT using manufacturing industries were able to increase the intensity of ICT investment and thus achieve the same rate of productivity growth as the ICT-using industries, it would provide a considerable boost to the convergence process. Realizing this potential, however, would require further structural reforms aimed at deregulating product markets, more flexible labour

[8] See Tanzi (2001) for the discussion of the implications of globalization and ICT for revenue collection in developed countries.

markets, business re-organization based on improved management practices, higher spending on innovation and, finally, larger investment in human capital and ICT skills.

The public sector could also contribute to the realization of this potential by stimulating a conducive business environment and promoting ICT use publishing rankings of productivity level and growth rates, thus raising awareness of the existing productivity gaps. The public sector should also accelerate the development of public e-services and impose a mandatory use of e-procurement by the whole public sector. Finally, EU funding on ICT-related programmes should be based on a detailed cost-benefit analysis to ensure the highest returns on investment.

References:

1. Brynjolfsson E. and L. M. Hitt (2000), *Beyond Computation: Information Technology, Organizational Transformation and Business Practices*, "Journal of Economic Perspectives", Vol. 14, No. 4, Fall, pp. 23-48.
2. Davenport T.H. (1992), *Process Innovation: Reengineering Work Through Information Technology*, Harvard Business School Press, Boston (MA).
3. Dorgan S. J. and J. J. Dowdy (2004), *When IT lifts productivity*, "McKinsey Quarterly", No. 4.
4. Gáspár P. (2004), *Factors and Impacts in the Information Society: A Prospective Analysis in New Member States and Associated Candidate Countries in the EU – Synthesis Report*, IPTS, Sevilla.
5. Litan R. and A. Rivlin (2001), *The Economic Payoff from the Internet Revolution*, Brookings Institution Press, Washington (DC).
6. McKinsey (2001), *U.S. Productivity Growth, 1995-2000: Understanding the Importance of Information and Technology Relative to Other Factors*, McKinsey Global Institute, Washington (DC).
7. OECD (2004), *The Economic Impact of ICT*, OECD, Paris.
8. OECD (2003), *ICT and Economic Growth: Evidence from OECD Countries, Industries and Firms*, OECD, Paris.
9. Perminov S. and E. Egorova (2005), *ICT Impact on Labor Productivity and Employment in Russia*, "TIGER Working Paper Series", No. 73, Warsaw, February.
10. Piątkowski M. (2006), *Can Information and Communication Technologies Make a Difference in the Development of Transition Economies?*, "Information Technologies and International Development", Vol 3, Number 1, Fall, pp. 37-51.
11. Piątkowski M. and B. van Ark (2005), *ICT and Productivity Growth in Transition Economies: Two-Phase Convergence and Structural Reforms*, "TIGER Working Paper Series", No. 72, January, Warsaw.
12. Piątkowski M. (2005), *Information Society in Poland. A Prospective Analysis*, Leon Kozminski Academy Publishing House, Warsaw.

13. Piątkowski M. (2004), *The Impact of ICT on Growth in Transition Economies*, "TIGER Working Paper Series", No. 59, July, Warsaw.
14. Piątkowski M. (2002), *The 'New Economy' and Economic Growth in Transition Economies. The Relevance of Institutional Infrastructure*, "WIDER Discussion Paper" No. 62, United Nations University World Institute for Development Economics Research (UNU/WIDER), July.
15. Timmer M.P. and B. van Ark (2005), *Does Information and Communication Technology Drive Productivity Growth Differentials?*, "Oxford Economic Papers" no. 57, pp. 693-716.
16. Tanzi W. (2002), *The Rise of the New Economy and Its Implication for Fiscal Policy*, "WSPiZ & TIGER Distinguished Lectures Series" No. 2, Warsaw.
17. Triplett J.E. and B. Bosworth (2004), *Productivity in the U.S. Services Sector. New Sources of Economic Growth*, Brookings Institution Press, Washington (DC).
18. Van Ark B. and M. Piątkowski (2006), *Productivity, Innovation and ICT in Old and New Europe* In: G. Cette, M. Fouquin and H.W. Sinn (eds), *Divergences in Productivity between Europe and the United States*, Edward Elgar, London (forthcoming).
19. Van Ark B. and M. Piątkowski (2004), *Productivity, Innovation and ICT in Old and New Europe*, "Research Memorandum" GD-69, Groningen Growth and Development Center, March.
20. World Bank (2005), Doing Business. Removing Obstacles to Growth, Washington (DC).
21. World Economic Forum (2005), *Global Information Technology Report (2004-2005).*