



Productivity, ICT and Innovation in Old and New Europe

Bart van Ark
University of Groningen
and The Conference Board

and

Marcin Piatkowski
TIGER, Warsaw

March 2004

A priori no reason to assume convergence of divergence

➔ *Convergence:*

“The new economy in New Europe and the old economy in Old Europe”

➔ *Divergence:*

“The old economy in New Europe and the new economy in Old Europe”



Convergence (the ‘East Asia model’)

- ➔ Advantages of backwardness (Gerschenkron)
- ➔ CEE countries may benefit from rapid diffusion of new technology (ICT) through FDI --> potential to leapfrog?
- ➔ Old EU countries may not succeed to reform labour and product markets to exploit their potential for faster growth



Divergence (the ‘Latin America model’)

- ➔ CEE countries will develop comparative advantage in low- and medium tech industries:
 - ⊙ even under rapid growth, industries are characterized by low productivity levels
 - ⊙ [no equalization of factor prices], no spillovers from FDI and no full diffusion of technologies
- ➔ EU will ultimately overcome rigidities and realize catch up potential on U.S



Set up

- ➔ Role of labour market in convergence & divergence process (TCB 2004)
- ➔ Contribution of ICT capital and productivity to convergence process (Piatkowski 2003b; Timmer, Ypma and van Ark 2003)
- ➔ Role of ICT by industry level (ICT production vs. ICT-use) (van Ark et al. 2002)
- ➔ Link to the institutional and innovation environment (Piatkowski 2002)
- ➔ Conclusions: two phases of convergence?



Productivity convergence between EU-15 and CEE-10 is largely driven by labour cuts in the latter group

Table 1: Growth of Real GDP, GDP per Capita, Labour Productivity and Working Hours, 1995-2002

	Real GDP	GDP per head of population	GDP per person employed	Employ- ment
EU-15	2.3	2.1	1.0	1.3
CEE-10	2.9	3.1	3.9	-1.0
EU-25	2.4	2.2	1.4	1.0
United States	3.2	2.1	2.0	1.2

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

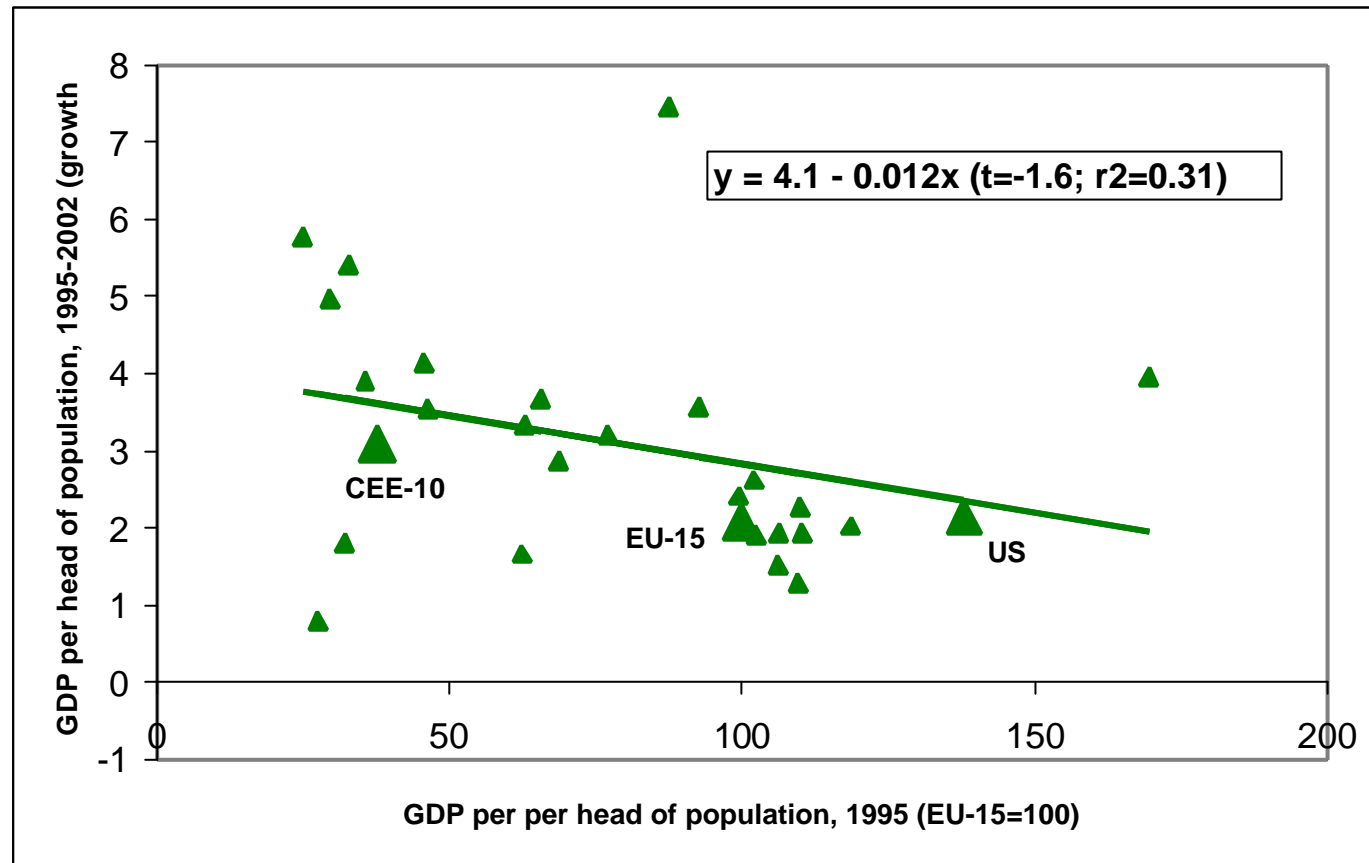
Despite substantial narrowing, productivity gap between CEE-10 and EU-15 is still very large

Table 2: Relative Levels of GDP per capita and GDP per person Employed, 1995 and 2002

	GDP per head of population (EU-15=100)		GDP per person employed (EU-15=100)	
	1995	2002	1995	2002
EU-15	100.0	100.0	100.0	100.0
CEE-10	37.8	40.6	37.4	45.6
EU-25	90.2	91.2	90.1	92.5
United States	138.0	138.7	118.3	126.6

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

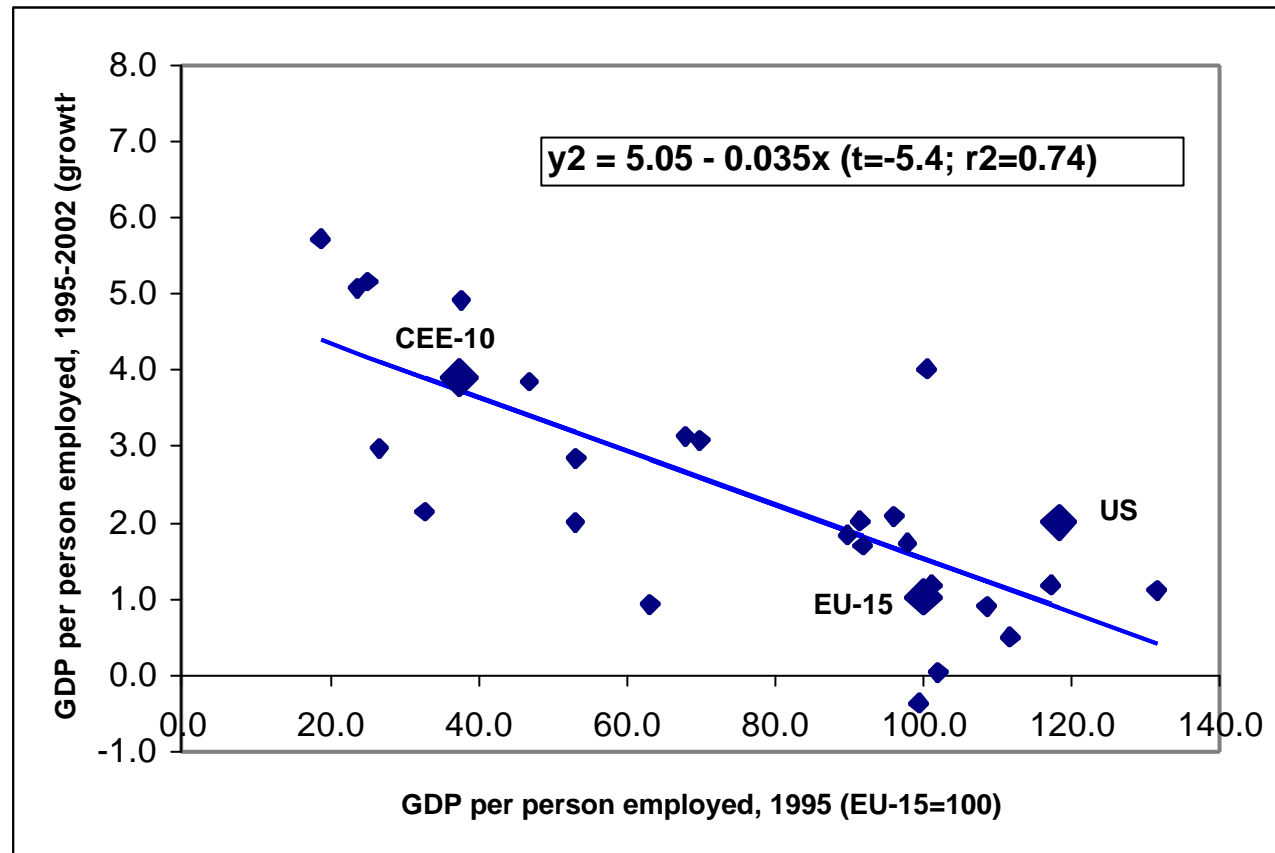
Per capita income convergence has been weak during second half of 1990s



Note: Relative levels are converted at 1999 EKS PPPs (OECD)

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

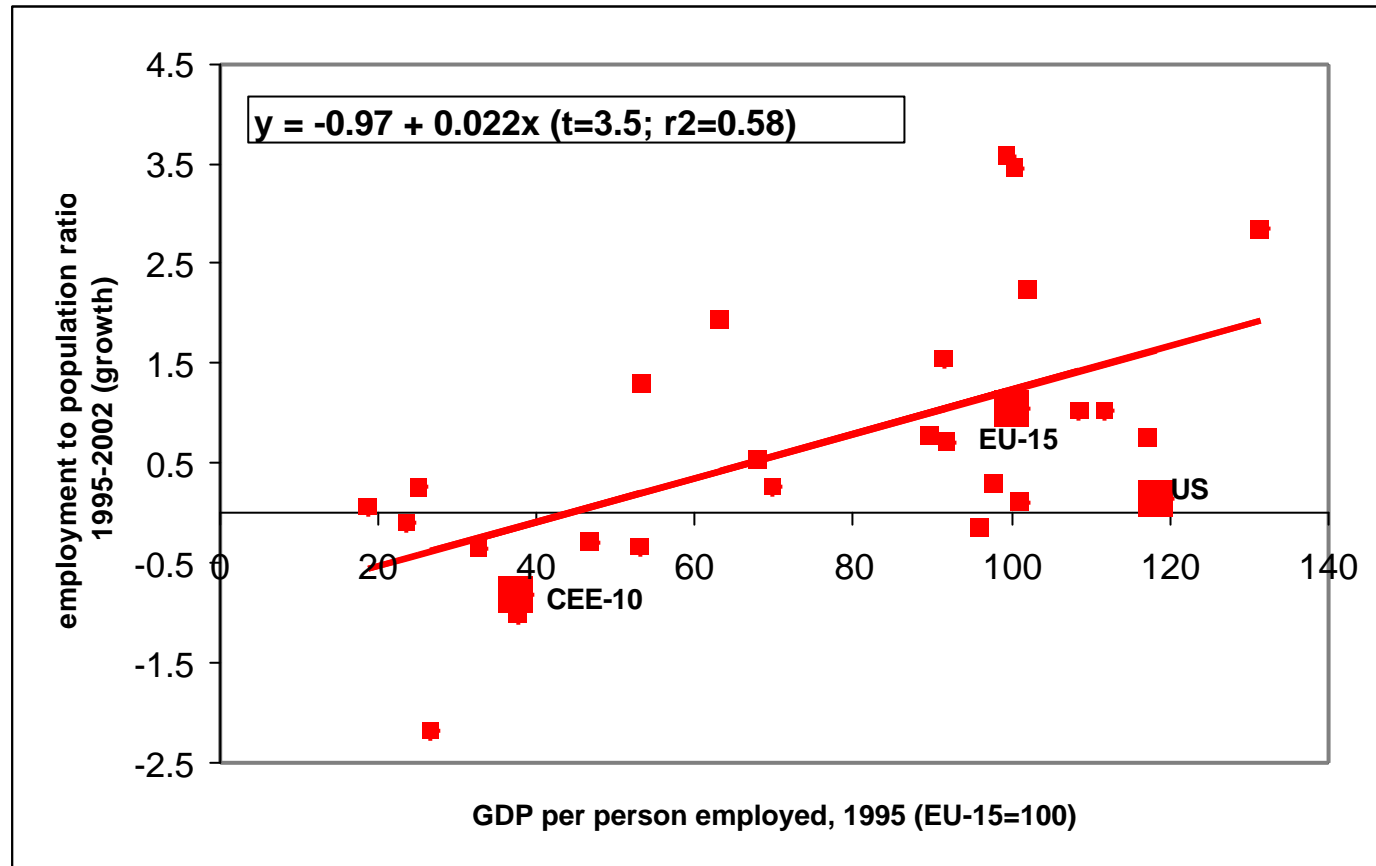
Productivity convergence has been stronger than per capita income convergence ...



Note: Relative levels are converted at 1999 EKS PPPs (OECD)

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

... due to strong positive relationship between productivity and employment/population ratio



Note: Relative levels are converted at 1999 EKS PPPs (OECD)

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

Trends in labour market indicators may continue to drive productivity convergence

Table 3: Employment-Population Ratios, Labour Force Participation Rates and Total Hours to Potential Hours (a), 1995 and 2002

	Employment to Population Ratio (%)		Labour Force to Population 15-64 yrs		Total Hours to Potential Hours (%) (a)	
	1995	2002	1995	2002	1995	2002
EU-15	0.404	0.435	0.678	0.704	0.349	0.367
CEE-10	0.370	0.350	0.687	0.654	0.462	0.422
	divergence		divergence		convergence	
EU-25	0.405	0.428	0.680	0.693	0.374	0.379
United States	0.472	0.476	0.777	0.759	0.480	0.477

(a) potential hours are based on working age population times 2,800 working hours per year

Source: Groningen Growth and Development Centre (www.ggdc.net) and OECD Labour Force Statistics, various issues.



Three major channels by which ICT impacts productivity growth

- ➔ CHANNEL 1: The effect of rapid technical progress in the ICT producing industry on total factor productivity growth
- ➔ CHANNEL 2: The effect of ICT investment on labour productivity growth through capital deepening or substitution
- ➔ CHANNEL 3: The effect of economy-wide use of ICT on total factor productivity growth through creating knowledge spillovers

Sources & Methods for ICT Growth Accounting

- ➔ EU-15 and U.S. (Timmer, Ypma and van Ark, 2003):
 - ⊙ national and OECD investment series in combination with constructed series using commodity-flow method
 - ⊙ harmonised U.S. hedonic deflators for ICT investment (based on method by Schreyer, 2000)
 - ⊙ geometric depreciation; ex-post estimates of internal rate of return on basis of national accounts

- ➔ CEE-8 (Piatkowski, 2003b)
 - ⊙ investment series for ICT based from WITSA; for total investment from World Bank (and complementary sources)
 - ⊙ otherwise procedures similar as for Timmer et al. (2003)
 - ⊙ ... but discount non-ICT capital stock in 1990 by 25% to reflect the true economic value in the market-based system

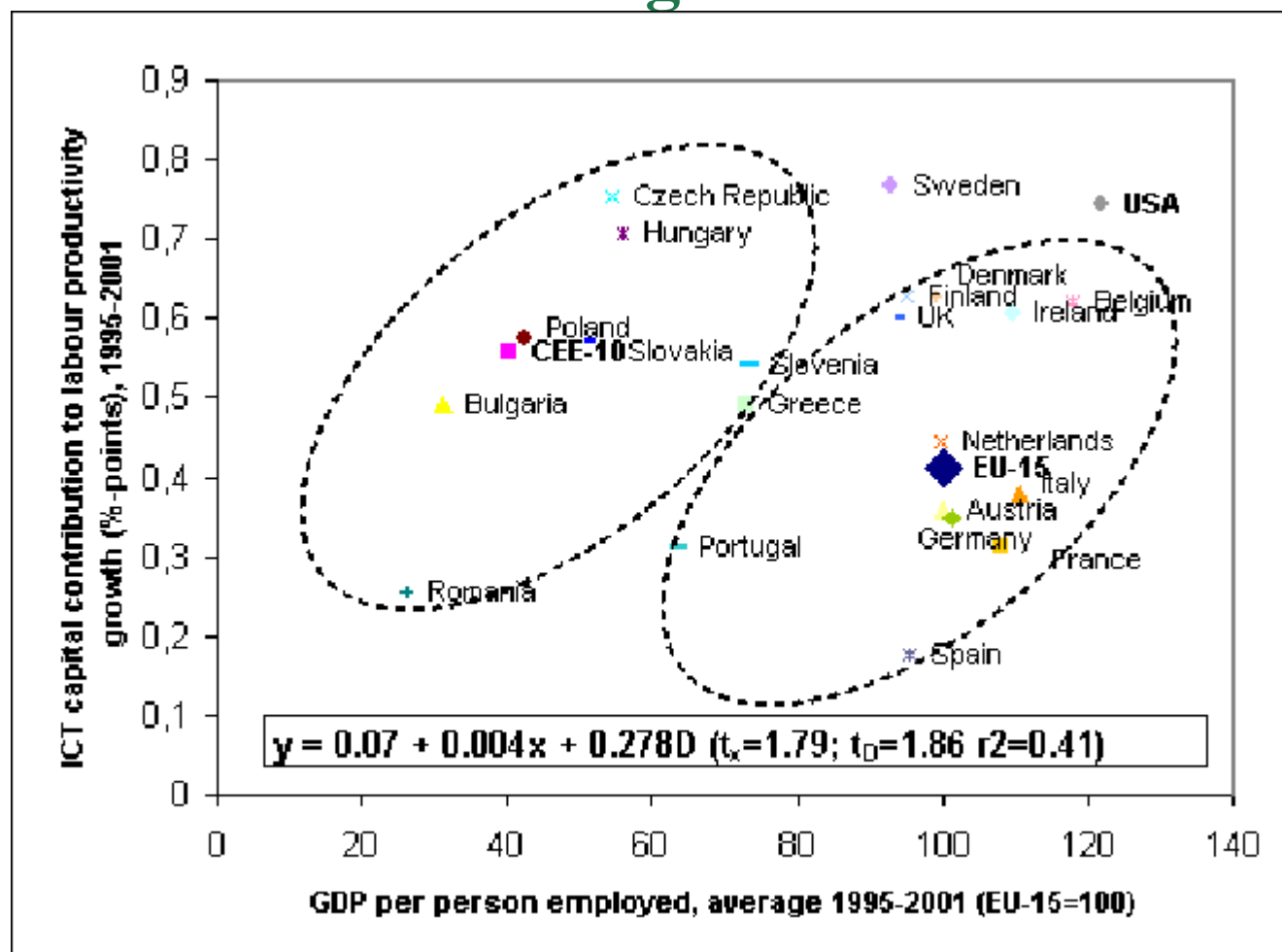
Absolute contributions of ICT capital are relatively high in CEE; relative contributions are much smaller; main differences to EU-15 are for TFP growth

Table 4: ICT capital contribution to labour productivity growth (GDP per person employed) in CEE countries, EU-15 and the U.S., 1995-2001, in %-points

	Labour productivity growth	Contribution of:			Relative ICT capital share in LP growth
		Non-ICT capital intensity	ICT capital intensity	Total factor productivity growth	
CEE countries	3.5	1.0	0.6	2.0	0.2
Slovakia	4.8	1.4	0.6	2.8	0.1
Poland	4.4	1.8	0.6	2.1	0.1
Slovenia	3.8	0.7	0.5	2.5	0.1
Romania	3.5	1.4	0.3	1.8	0.1
Hungary	3.3	0.2	0.7	2.4	0.2
Czech Republic	2.8	1.4	0.8	0.6	0.3
Bulgaria	1.9	-0.1	0.5	1.6	0.3
European Union	1.1	0.4	0.4	0.3	0.4
United States	2.2	0.4	0.7	1.1	0.3

Source: updated results from Piatkowski (2003b) for CEE countries (with adjustment to non-residential capital and extension with investment series from World Development Indicators) and Timmer et al. (2003) for the EU countries and the US. CEE represents an unweighted average

The contribution of ICT capital in CEE-10 has been as high as in EU-15



Note: Relative levels are converted at 1999 EKS PPPs (OECD); D=1 for CEE-10 countries; D=0 for EU-15 countries

Source: The Conference Board (TCB), Groningen Growth and Development Centre (GGDC)

Industry composition in CEE is biased towards manufacturing, and remains behind in services

Table 5: Employment shares (persons employed) of ICT-producing, ICT-using and non-ICT industries

	EU		US		Czech Rep.		Hungary		Poland		Slovakia	
	1995	2001	1995	2001	1993	2001	1993	2001	1993	2001	1993	2001
Total Economy												
ICT Producing Industries	3.5	4.0	3.9	4.6	3.7	4.0	3.9	4.9	2.3	2.4	4.0	4.3
ICT Producing Manufacturing	1.1	1.1	1.3	1.2	1.2	1.5	1.4	2.2	0.8	0.7	1.4	1.6
ICT Producing Services	2.4	2.9	2.6	3.4	2.5	2.5	2.5	2.7	1.5	1.7	2.6	2.7
ICT Using Industries	27.2	27.3	31.0	30.1	26.1	29.2	22.9	25.0	22.2	23.5	21.6	23.6
ICT Using Manufacturing	6.7	6.0	5.3	4.4	10.4	10.0	7.6	8.4	7.3	6.2	9.6	8.0
ICT Using Services	20.6	21.3	25.7	25.7	15.7	19.2	15.3	16.5	14.9	17.4	12.1	15.6
Non-ICT Industries	69.2	68.7	65.1	65.2	70.2	66.8	73.2	70.1	75.5	74.1	74.4	72.2
Non-ICT Manufacturing	11.7	10.8	7.6	6.6	18.7	18.4	16.0	14.5	13.0	11.0	16.3	14.5
Non-ICT Services	43.9	45.7	48.5	49.4	29.6	33.4	38.5	39.8	25.5	27.5	34.8	38.4
Non-ICT Other	13.7	12.1	9.0	9.3	21.9	15.0	18.7	15.9	37.1	35.6	23.3	19.3

Note: Real estate has been excluded

Source: OECD STAN Database; OECD Structural Statistics for Industry and Services; OECD Services Statistics on Value Added and Employment, and additional sources from national accounts of individual countries. For EU countries and OECD, see also van Ark et al. (2002).

Productivity advantages in (ICT-using) manufacturing has been important source of convergence

Table 6: Labour productivity growth of ICT-producing, ICT-using and non-ICT industries

	EU 1995-2001	US 1995-2001	Czech 1993-2001	Hungary 1993-2001	Poland 1993-2001	Slovakia 1993-2001
Total Economy	1.5	2.2	2.8	2.4	3.3	2.5
ICT Producing Industries	6.2	8.2	13.0	7.8	5.8	8.5
ICT Producing Manufacturing	18.7	22.3	15.4	7.5	8.1	7.1
ICT Producing Services	5.6	1.6	12.9	8.6	4.6	9.2
ICT Using Industries	1.6	4.6	4.4	1.0	4.8	1.8
ICT Using Manufacturing	2.1	1.6	9.2	7.1	12.0	7.1
ICT Using Services	1.6	5.2	2.3	-0.6	2.3	-1.1
Non-ICT Industries	0.7	-0.2	1.3	2.3	2.4	2.4
Non-ICT Manufacturing	1.3	-0.2	5.3	2.6	4.6	3.4
Non-ICT Services	0.2	0.0	-1.5	2.1	1.9	4.1
Non-ICT Other	1.9	0.2	2.3	2.6	1.3	-1.8
<i>Pro Memoria: Using national ICT deflators</i>						
Total Economy	1.3		2.8	2.9	3.5	2.3
ICT Producing Manufacturing	7.1		14.1	22.1	17.9	-7.4



Convergence?

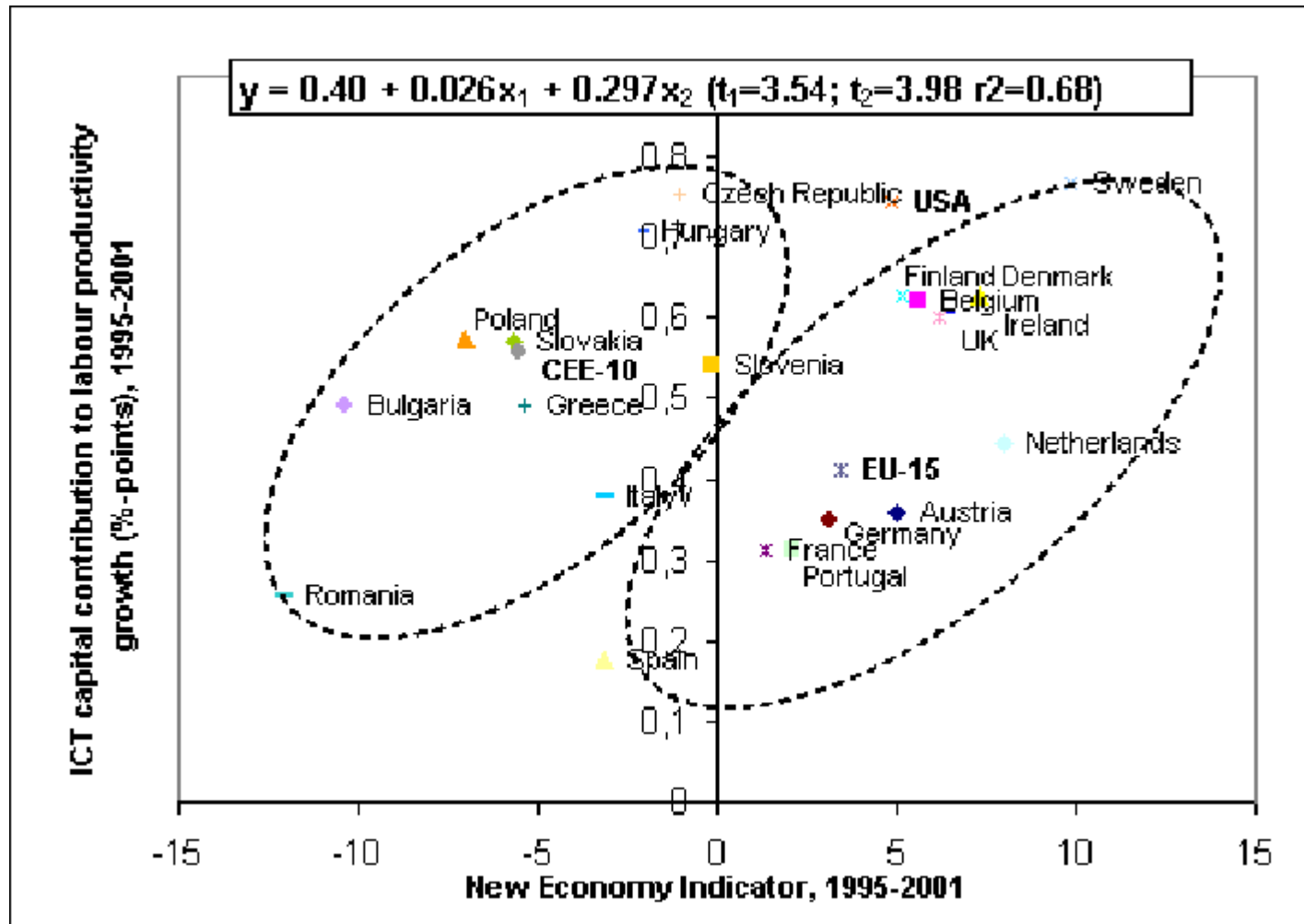
- ➔ Combination of labour cuts and TFP have driven restructuring and convergence process during 1990s
- ➔ Faster productivity growth in ICT manufacturing has facilitated this process
- ➔ But first phase of convergence will diminish in importance as restructuring process gets to completion
- ➔ The second phase of convergence requires faster growth in services ...
- ➔ ... which requires ICT to be complemented with other inputs (human resources, organizational innovations, etc.) as well as a more conducive environment

“New Economy Indicator” reflects degree of Competition, Innovation and Macroeconomic Stability

Table 7: Variables and data sources for the New Economy Indicator

Factor	Variable	Source
1. Quality of regulations and contract enforcement	Sum of World Bank Regulatory Quality and Rule of Law Indicator*	Kaufmann et al. (2003)
2. Infrastructure	Sum of total number of telephone lines (main and cellular) and PCs per 1000 persons	WDI 2003
3. Trade openness	Share of trade in GDP	WDI 2003
4. Development of financial markets	Domestic credit to private sector (% of GDP)	WDI 2003
5. R&D spending	Annual R&D spending (% of GDP)	Eurostat 2003
6. Quality of human capital	Public spending on education (% of GDP)	Eurostat 2003
7. Labour market flexibility	Unemployment rate	WDI 2003
8. Product market flexibility	Product market regulation indicator (Nicoletti et al. 2000)**	EBRD 2003
9. Openness to foreign investment	FDI (% of GDP)	WDI 2003
10. Macroeconomic stability	Inflation (CPI)	WDI 2003

Due to restructuring ICT capital played bigger role in CEE countries than “predicted” by New Economy Indicator



Note: Relative levels are converted at 1999 EKS PPPs (OECD);

Note: x1 refers to the New Economy Indicator, x2 refers to a dummy for CEE countries.