UNIVERSITY OF WUPPERTAL
BERGISCHE UNIVERSITÄT WUPPERTAL

EUROPÄISCHE WIRTSCHAFT
UND
INTERNATIONALE MAKROÖKONOMIK

Paul J.J. Welfens
Jarosław K. Ponder

Digital EU Eastern Enlargement

Diskussionsbeitrag 109
Discussion Paper 109

Europäische Wirtschaft und Internationale Wirtschaftsbeziehungen
European Economy und International Economic Relations

Paul J.J. Welfens
Jaroslaw K. Ponder

Digital EU Eastern Enlargement

October 2003

Herausgeber/Editor: Prof. Dr. Paul J.J. Welfens, Jean Monnet Chair in European Economic Integration

EUROPÄISCHES INSTITUT FÜR INTERNATIONALE WIRTSCHAFTSBEZIEHUNGEN (EIIW)/EUROPEAN INSTITUTE FOR INTERNATIONAL ECONOMIC RELATIONS
Bergische Universität Wuppertal, Gaußstr. 20, D-42119 Wuppertal, Germany
Tel.: (0)202 – 439 31 71
Fax: (0)202 – 439 31 77
E-mail: welfens@uni-wuppertal.de
www.euroeiiw.de

JEL classification: D40, F00, L10, L50, O00, O52
Key words: EU, Accession Countries, Economic Development, Technological Change, Growth, International Economics

Summary: EU eastern enlargement raises many challenges and brings new opportunities in terms of trade, capital flows and exchange of digital information/data. Relatively poor accession countries enter the Community during a period in which information and communication technology (ICT) play a particular role for OECD countries' growth and structural change. This is an important aspect which distinguishes the southern EU enlargement from eastern EU enlargement. In the 1990s, the US and several EU-15 countries recorded relatively high growth rates where ICT had a strong impact on the acceleration of productivity growth and output dynamics. We first look at the main characteristics of ICT and raise the question to which extent accession countries are well positioned to catch up with some EU-15 countries in selected fields of ICT, in particular in telecommunications. A series of descriptive statistics of EU-15 and accession countries shows that eastern European countries have a long way to go in some fields of digital catching-up. Some eastern European accession countries show better than average performance in terms of mobile telecommunication density, internet density or internet host density than is found in Portugal or Greece. However, the lack of competition and problems with privatization impair digital modernization – and economic catching-up – and digital European integration. The European Commission should look critically into the unsolved policy problems in accession countries.

Zusammenfassung: Die EU-Osterweiterung bringt Herausforderungen und neue Möglichkeiten für den Handel, den Kapitalverkehr und den Austausch digitaler Informationen/Daten. Relativ arme Beitrittskandidaten treten der Gemeinschaft während eines Zeitraums bei, in dem Informations- und Kommunikationstechnologien (I&K-Technologien) für das Wachstum sowie den Strukturwandel der OECD-Länder eine besondere Rolle spielen. Dies ist ein wichtiger Aspekt, der die Süd- von der Osterweiterung unterscheidet. In den 90er Jahren, haben die Vereinigte Staaten und mehrere EU-15 Länder relativ hohe Wachstumsraten erreicht, wobei I&K-Technologien einen starken Einfluss auf die Beschleunigung des Produktivitätswachstums und der Produktionserhöhung hatten. Zunächst betrachten wir die Hauptcharakteristika der I&K-Technologien und stellen die Frage, in welchem Umfang die EU Beitrittskandidaten gut positioniert sind für einen Aufholprozess zu den EU-15 Ländern in ausgewählten Bereichen der I&K-Technologien, insbesondere im Telekommunikationssektor. Deskriptive Statistiken der EU-15 und EU-Beitrittsländern zeigen, dass osteuropäische Länder noch einen langen Weg in Hinsicht auf den digitalen Aufholprozess haben. Manche osteuropäischen Beitrittsländer weisen allerdings bessere durchschnittliche Parameter in den Bereichen mobile Telekommunikation bzw. Internet- oder Internethostdichte auf als Portugal oder Griechenland. Mangel an Wettbewerb und Probleme bei der Privatisierung erschweren die digitale Modernisierung – und den wirtschaftlichen Aufholprozess – und die digitale Europäische Integration. Die Europäische Kommission sollte kritisch die ungelösten Regulierungsprobleme in den Beitrittsisländern untersuchen.

Prof. Dr. Paul J.J. Welfens, Jean Monnet chair in European Economic Integration and European Institute for International Economic Relations at the University of Wuppertal (EIIW), Gauss-Str. 20, D 42119 Wuppertal, Welfens@uni-wuppertal.de, www.euroeiiw.de

Jaroslaw K. Ponder, EIIW at the University of Wuppertal, Ponder@wiwi.uni-wuppertal.de

EIIW Paper No. 109

October 2003

DIGITAL EU EASTERN ENLARGEMENT

Contents

List of Figures

List of Tables

1. Introduction

With EU eastern enlargement, there will be considerable changes; the Community will become larger (EU-25 GDP being close to 11 bill. Euro, which is equal to that of the US) while economic growth is expected to increase in the context of economic catching-up in eastern Europe and an enlarged EU single market. Eastern European accession countries represent between 1/3 and 2/3 of the average EU per capita in purchasing power parity. Catching up and sustained growth is a natural interest of people in the accession countries, but it is also in the interest of EU-15, since both economic convergence and catching up will create dynamic new markets in eastern Europe and reduce the potential need for the Community to stimulate economic development through high EU structural funds over many decades. Relatively poor accession countries enter the Community during a period in which information and communication technology (ICT) play a particular role for OECD countries' growth and structural change. This is an important aspect which distinguishes the southern EU enlargement from eastern EU enlargement.

Part of higher growth in accession countries will be associated with trade creation and high inflows of foreign direct investment (FDI). The latter will largely come from EU-15 countries and implies that western Europe's multinationals will become even larger than at present; except for a few dozen joint ventures in Hungary, socialist eastern Europe had been practically inaccessible for western multinational companies. Modern information and communication technology (ICT) facilitates the organization of multinational companies: Computer networks and other elements of information technology plus the fast transmission of information and data through a digital telecommunications network allow firms to combine market power/economies of scale with efficiency-enhancing decentralized organization of production abroad.

FDI inflows together with domestic investment will raise capital intensity and help increase labor productivity, whose rise in turn will contribute to output growth in eastern Europe's postsocialist EU accession countries. Taking a look at the US and Germany, the analysis of labor productivity growth has shown that firms with relatively high investment were able to raise labor productivity strongly, particularly if there was a high share of ICT investment (HALTIWANGER/JARMIN/SCHANK, 2002). In eastern Europe, many sectors are not as capital intensive and technology intensive as production in advanced OECD countries; however, there is no doubt that the strong ICT technology dynamics of the 1990s (e.g., visible in the lead of telecommunications as the patent field with the highest growth rate recorded by the European Patent Agency) offer particular modernization opportunities for EU accession countries. As telecommunication density in socialist eastern Europe was rather low and international economic relations underdeveloped, the combination of systemic transformation, opening up and regional integration creates many fields in which ICT investment (even basic telephony) can contribute to productivity growth and more product differentiation. Greater product differentiation, which is often associated with innovation, will particularly stimulate trade and could also contribute to higher output growth.

Optimal information about market developments and processing of information within the enlarged single market will be a major challenge for all firms in the EU. In this context, modernization of telecommunications and the expansion of information and communication technology will be particularly crucial. Taking into account the growth-enhancing effects of ICT in western Europe, North America and Asia (SIEBERT, 2002; BARFIELD/HEIDUK/WELFENS, 2002), one may expect that economic catching-up in eastern Europe could indeed be accelerated through a rapid modernization of the

telecommunications sector, provided that this is associated with sustained competition. The EU-15 began opening telecommunications markets in 1998, with Portugal, Spain, Luxemburg and Greece obtaining some extra time; EU accession countries have obtained a specific transition periods for fully liberalizing network operation and voice telephony. Transition countries might realize some specific extra benefits from digital modernization as well as from an expansion of the telecommunications sector (WELFENS, 1997): A higher penetration rate will:

- increase market transparency and price transparency in particular, which in turn will stimulate arbitrage and international trade, resulting in a rise of consumer surplus and efficiency gains;
- allow firms to more efficiently organize production, outsourcing and distribution;
- stimulate multinational companies activities – in eastern Euorpe in general and in accession countries in particular – which consider advanced and reliable telecommunications services a requirement for investment:
- facilitate structural change towards more knowledge-intensive and technology-intensive products which use information as a specific factor input relatively intensively; digital telecommunications networks – fixed networks or mobile networks – provide the required data highways for such industries.

Since socialist countries in eastern Europe had very low penetration rates in fixed line telephony in the late 1980s, namely 10-20% compared to leading EU countries with about 50%, there is considerable scope for catching up with western Europe. Mobile telecommunications offers a crucial alternative to fixed networks in transforming countries, with state-owned telecommunications operators often facing low productivity, tight budgets and limited access to capital markets. At the same time, one may wonder whether certain benefits of telecommunications modernization accruing among advanced OECD countries in the 1990s are rather difficult to harvest for transition countries: e.g., the digitization of telecommunications networks in western OECD countries has enormously stimulated and accelerated internet traffic, which has become not only a consumer service but is also valuable for many companies eager to cut costs or provide new digital services worldwide (e.g., Dell, Cisco, IBM, Siemens), and this in turn requires the increased use of computers, advance software and skilled human capital. As regards computer density and availability of skilled human capital, EU-15 countries clearly are ahead of eastern European accession countries with Hungary being an exception.

Modernization and expansion of telecommunications networks plus provision of new services is not easy in technical terms, but special market conditions in telecommunications can create impediments. Specific characteristics of telecommunications markets cannot be ignored when looking into the dynamics of telecommunications. Opening-up of the fixed-line telephone market is not sufficient to generate sustained competition. In fixed line telephony there are high sunk costs which make competition in telecommunications quite difficult. EU regulation requires that national regulators make sure the former national monopoly operator offers unbundled access to customers and that interconnection be possible at non-discriminatory cost-oriented terms. The EU has summarized all main rules in the form of framework directives (EU, 2002).

The internet is a relatively new communication platform which is rather unregulated worldwide. It provides new opportunities for economic transactions and helps save transaction costs while also establishing better market transparency. The most significant use of the internet is the creation of procurement portals by industry (hence the Old

Economy!); e.g. several car producers have jointly established COVISINT as a joint platform for holding supplier auctions, other automotive firms have decided to set up an individual digital supplier site. The computer sector itself is using ICT intensively. Digital ordering and built-to-order-systems based on internet communication were successfully pioneered by DELL. While PC production is a growing global business, a leading company, IBM, has decided to focus more on digital services in the future, which means combining specific computer know how with innovative service arrangements associated with IT outsourcing of banks or airline companies. The worldwide expansion of the internet has created new international options for trade in digital services.

The internet is relevant for business-to-business (B2B) transactions as well as for business-to-customer (B2C) transactions. As regards trade in services, there are some special problems with respect to bringing digital services in line with the WTO framework. There are also problems with respect to security and digital copyrights (the Napster case has illustrated the relevance of digital intellectual property rights). While the novel internet raised some new policy issues, there is no doubt that internet usage and internet hosting – the supply of information through the internet/secure computers – are important aspects of digital networking relevant for productivity, innovation and growth. Eastern Europe's position was relatively weak in the late 1990s, but there are broad opportunities for catching-up in the internet business.

The following analysis first takes a look at ICT dynamics in western OECD countries (section 2). Section 3 describes telecommunications and internet dynamics in Eastern Europe, while the final section 4 draws some policy conclusions. At the bottom line, we find there is a digital divide within the new Europe, but there are opportunities for catching up in accession countries. As EU membership will impose full liberalization of telecommunications – network operation and voice telephony – in accession countries, there are strong impulses for more intensive competition and a more intensive use of both digital networks and information plus data. Some accession countries in eastern Europe might well overtake some of the western European countries within a decade in selected fields of telecommunications.

2. ICT: Telecommunications, Computers and Productivity in OECD Countries

2.1. ICT Dynamics, Investment and Productivity

ICT has stimulated economic growth in the US and some European OECD countries enormously in the 1990s. According to EITO definitions (it is important to notice that OECD uses a slightly different definition), ICT consists of three different elements, i.e. information technologies, telecommunication equipment and telecommunication services. Generally ICT is expressed through the following market segments:

- ICT equipment (including computer hardware, end user communications equipment, office equipment, and datacom and network equipment);
- software products;
- IT services;
- carrier services

Broad and growing international trade in ICT equipment implies a competitive market. As regards software products, there is less competition, in particular in the office market where Microsoft dominates. IT services represents an internationally competitive market with a few dozen big firms. Telecommunications carrier services are to some extent rather competitive, namely in the field of mobile telephony where most OECD countries have 2-4 suppliers. Fixed line telephony shows a relatively weak competitiveness as newcomers stand for 10-30% market share in most EU countries; the former monopoly operator, which is often also a leading actor in the mobile telephony market, typically has a dominant market position partly related to natural monopoly problems in both fixed line telephony and relatively high sunk costs. The opening up of voice telephony and network operation within continental EU countries in 1998 stimulated competition in carriers markets, not in the least through impulses for internationalization of telecommunications network operations; various former monopoly operators of EU countries have become active newcomers in EU partner countries and elsewhere. Moreover, cable TV networks have also entered the market for telephony and internet services in most EU-15 countries. This enormous technological progress in ICT lets one expect that mobile telephony – as well as mobile internet services, possibly soon on the basis of WLAN and UMTS – will play a growing role for communication in the future.

It is important to distinguish between levels of production in ICT, which has witnessed enormous productivity growth in the 1990s. The ever-growing power of chips and computers is obvious from an engineering point of view; and competition translates this into falling prices of computers, where the relative fall of computer prices stimulates the demand for PCs in firms (and in private households). This fact is not disputed among economists; however, there is no consensus that the use of ICT has brought about any special growth effect beyond cyclical effects associated with a temporary increase in the investment output ratio. A special effect of the use of ICT would indeed occur:

- if the supply elasticity of ICT capital were much higher than that of machinery and equipment (without ICT); here only time series analyses can help to better understand the issue.
- if there were major productivity spillover effects into other sectors; here one also has to carefully study the empirics of productivity spillovers; however, the fact that

certain digital services are characterized by network effects – thereby increasing demand endogenously – could create a special case for spillover effects, i.e. new information (relevant for productivity) or technology is diffusing faster than in normal markets.

- if marginal costs of providing digital services were declining or were close to zero, which would create a very elastic supply-side. This is indeed the case with the Internet, which allows global distribution of new information – including novel technologies – and digital products easily.

As regards the impact of ICT on both productivity growth and output growth, there are several findings. ICT production has strongly increased labor productivity growth in Korea, Finland, Ireland, Sweden, Japan and the US (OECD, 2003). None of the eastern European accession countries have characteristics similar to one of the relatively poor countries mentioned, namely Korea, Finland and Ireland. However, one should not rule out that Hungary or Poland could become major producers of ICT if government policies strongly favor FDI over an extended period in this sector; with EU accession, such sectoral targeting might, however, become rather difficult as EU subsidy control might be strictly applied.

Value added in telecommunications has gradually increased in OECD countries, namely from about 2% in the 1980s to slightly more than 3% in the 1990s. As prices for telecommunications services began to decline – in particular after the liberalization of EU markets in 1998 (the UK had already opened up its market in 1984) –, there has obviously been a strong increase in quantity. Such a growth of telecommunications volume can indeed be expected in the context of a fall of relative telecommunications prices. Part of the fall of telecommunications prices reflect the use of ICT in network operation; here the strong fall of relative computer prices in the 1990s has brought with it cost reductions as has digitization, which allows a more efficient and flexible use of transmission channels. Finally, digitization has intensified competition as former market segmentations – e.g. telecommunications, radio, TV, cable TV – have been blurred. More competition should bring about a fall in prices as market power erodes and as process innovations are stimulated. Moreover, there is a wave of product innovations which are particularly visible in the field of mobile telephony.

The use of modern telecommunications brings faster diffusion of both information and innovations. Indeed, taking a look at a modified aggregate production function which included capital, labor, patents (technology, including imported licenses) and the number of telephone calls – as a proxy for the use of telecommunications – WELFENS/JUNGMITTAG (1996, 2002) have shown that telecommunications is a significant input variable in Germany. Moreover, international telecommunications was found to be a significant variable in a modified gravity model (WELFENS/JUNGMITTAG, 2002a). FRÉUND/WEINHOLD (2003) have shown that the number of internet hosts is a significant variable in a modified gravity equation for trade. This suggests that the modernization and expansion of telecommunications in EU-15 and also in EU-25 will stimulate trade and growth in Europe. As the relative price of computer equipment falls over time, the incentive for the business community to invest increasingly into ever more powerful computers and digital networks will continue to grow, thereby possibly stimulating innovation as well as economic growth in OECD countries.

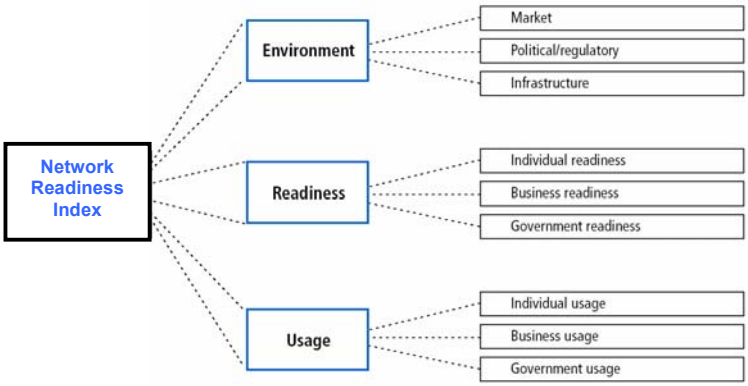
ICT investment is not only important for modernization of the manufacturing industry; ICT capital accumulation also has raised labor productivity growth in the services sector in several countries in the late 1990s, in particular in Mexico, the US, Australia, UK, Island, Sweden, Norway, Austria, Korea, Canada, Switzerland, Belgium, Denmark, and the

Netherlands. In contrast, Germany and Italy had very low increases in labor productivity in ICT intensive services. Moreover, their contribution reduced in the second half of the 1990s compared to the early 1990s (OECD, 2003). The case of Mexico, where labor productivity growth increased by almost 1.5 percentage points – translating roughly into 1 percentage point of additional output growth in the service sector (if the service sector stands for 50% of overall value-added, the overall growth bonus is 0.5 percent) – in the late 1990s, shows that not only advanced industrialized countries can benefit from the use of ICT in the services sector. This indeed suggests that labor productivity growth could be increased considerably by ICT investment in the services sector in EU accession countries. Productivity growth in many sectors will not, however, increase simply through high ICT investment; firm-internal reorganization and retraining also seem to be important (OK et al., 2003). It thus seems that modernization of telecommunications networks must go along with accelerated structural change at the firm level if high productivity growth is to be achieved.

Taking a look at the Network Readiness Indicator (NRI) developed by the World Economic Forum, we can clearly identify the leading western OECD countries with respect to telecommunications infrastructure and some other ingredients relevant for digital services. We can also see that several EU accession countries have ranked higher than Greece, which is one of the poorest EU-15 countries. Based on the way network readiness indicators are used – summarizing political environment in the digital field, infrastructure readiness and use of infrastructure by households, firms and government –, it is not actually clear, however, what is being measured. The infrastructure subindex measures an implicit digital production potential, while the use indicators reflect a kind of digital degree of capacity utilization. Adding the environment indicator makes the synthetic overall indicator rather opaque in the sense that the political framework might be set adequately for infrastructure investment – as well as sustained competition –, but this is only a necessary condition for digital expansion. For example, macroeconomic policy variables such as monetary policy or fiscal policy might be contractive, resulting in impaired overall output growth; moreover, the share of skilled labor might be low and the education system poor, bringing about an underdevelopment in human capital, which from a productivity perspective is complementary to telecommunications infrastructure.

Tab. 1 : NRI-Network Readiness Indicator

Country	Score	NRI Rank	Country	Score	NRI Rank
Finland	*5.92*	*1*	*Greece*	*3.77*	*42*
United States	5.79	2	China	3.70	43
Singapore	5.74	3	Botswana	3.68	44
Sweden	*5.58*	*4*	Argentina	3.67	45
Iceland	5.51	5	**Lithuania**	**3.65**	**46**
Canada	5.44	6	Mexico	3.63	47
United Kingdom	*5.35*	*7*	Croatia	3.62	48
Denmark	5.33	8	Costa Rica	3.57	49
Taiwan	5.31	9	Turkey	3.57	50
Germany	*5.29*	*10*	Jordan	3.51	51
Netherlands	*5.26*	*11*	Morocco	3.50	52
Israel	5.22	12	Namibia	3.47	53
Switzerland	5.18	13	Sri Lanka	3.45	54
Korea	5.10	14	Uruguay	3.45	55
Australia	5.04	15	Mauritius	3.44	56
Austria	*5.01*	*16*	Dominican Republic	3.40	57
Norway	5.00	17	Trinidad and Tobago	3.36	58
Hong Kong SAR	4.99	18	Colombia	3.33	59
France	*4.97*	*19*	Jamaica	3.31	60
Japan	4.95	20	Panama	3.30	61
Ireland	*4.89*	*21*	Philippines	3.25	62
Belgium	*4.83*	*22*	El Salvador	3.17	63
New Zealand	4.70	23	Indonesia	3.16	64
Estonia	**4.69**	**24**	Egypt	3.13	65
Spain	*4.67*	*25*	Venezuela	3.11	66
Italy	*4.60*	*26*	Peru	3.10	67
Luxembourg	*4.55*	*27*	Bulgaria	3.03	68
Czech Republic	**4.43**	**28**	Russian Federation	2.99	69
Brazil	4.40	29	Ukraine	2.98	70
Hungary	**4.30**	**30**	Vietnam	2.96	71
Portugal	*4.28*	*31*	Romania	2.66	72
Malaysia	4.28	32	Guatemala	2.63	73
Slovenia	**4.23**	**33**	Nigeria	2.62	74
Tunisia	4.16	34	Ecuador	2.60	75
Chile	4.14	35	Paraguay	2.54	76
South Africa	3.94	36	Bangladesh	2.53	77
India	3.89	37	Bolivia	2.47	78
Latvia	**3.87**	**38**	Nicaragua	2.44	79
Poland	**3.85**	**39**	Zimbabwe	2.42	80
Slovak Republic	**3.85**	**40**	Honduras	2.37	81
Thailand	3.80	41	Haiti	2.07	82



Source: Dutta, S., Lanvin, B., Paua, F., eds. (2003), Global Information Technology Report 2002-2003 - Readiness for the Networked World, World Economic Forum, p. 11.

From this perspective one may anticipate that at least some of the EU accession countries have a relatively high digital potential. It will depend on other ingredients, namely foreign direct investment inflows, human capital formation and investment in research and development for the full benefits of this potential to be exploited. As regards exploitation of economies of scale in ICT production, EU eastern enlargement and sustained growth in eastern Europe will create new opportunities for ICT firms. At the same time, EU eastern enlargement will create new options for trade and FDI, including digital services. However, much will depend on rapid digital expansion and modernization in EU accession countries.

A simple regression diagram (see Fig. 1) between fixed line telephone density and GDP per capita – on purchasing power parity basis – shows that Bulgaria is above the regression line while Romania, Poland, the Slovak Republic, the Czech Republic and Slovenia are below; this could indicate a large potential for catching up (there is, of course, the caveat that not only per capita income but also other variables determine telephone density). As regards the correlation between mobile telecommunication density and per capita income (Fig. 2), Estonia, the Czech Republic and Slovenia are above the regression line, making them relative leaders in a cross-country perspective. One must, however, take into account that low fixed line telephone density in eastern and southeastern Europe creates a particularly strong demand for mobile telephony, which in some regions is a substitute for fixed line telephony. The assumption widely used in the literature that mobile telephony and fixed line telephony are complementary is unrealistic in some parts of eastern and southeastern Europe. With respect to internet user density, only Estonia is above the regression line and above relative average. This also holds true with respect to internet host intensity.

Among EU accession countries, Estonia thus stands out as a country which is leading in the digital field. For this small economy, this could bring about a comparative advantage in information intensive goods and services. In contrast, the largest accession country, Poland, is below average and thus needs to catch up in various fields, including both fixed line telephone density and mobile density. Without strong improvements in fixed and mobile network expansion and increasing intensity of competition – read: falling user prices –, Poland will be unable to close the apparent digital gap. The network density gap translates into an internet gap. In other words, improving network density would have double benefits, namely in terms of telecommunications and the internet. This is crucial for both the business community and households as well as for the modernization of government services.

Fig. 1: Relationships between GDP and ICT-Subindicators in Europe, 2000

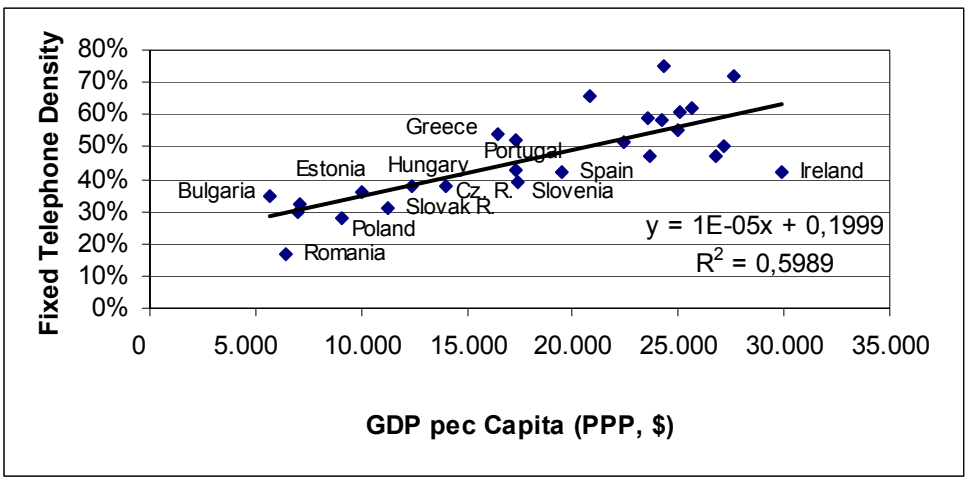
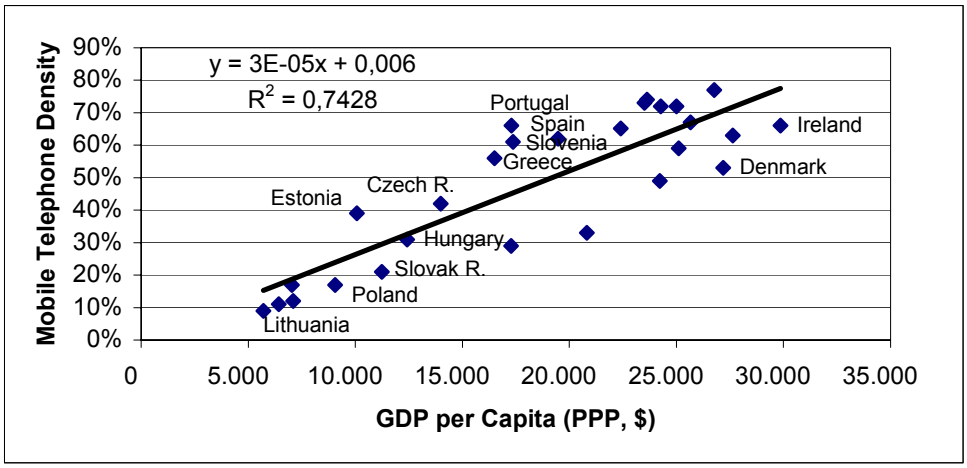
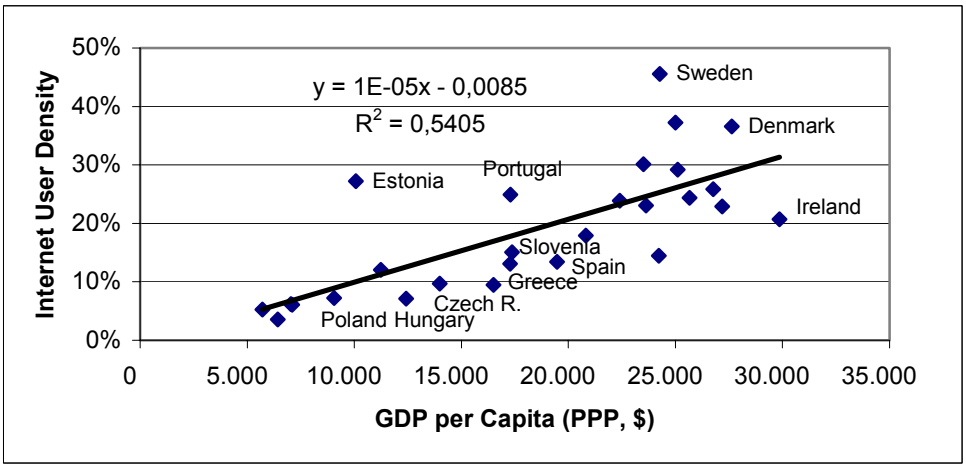
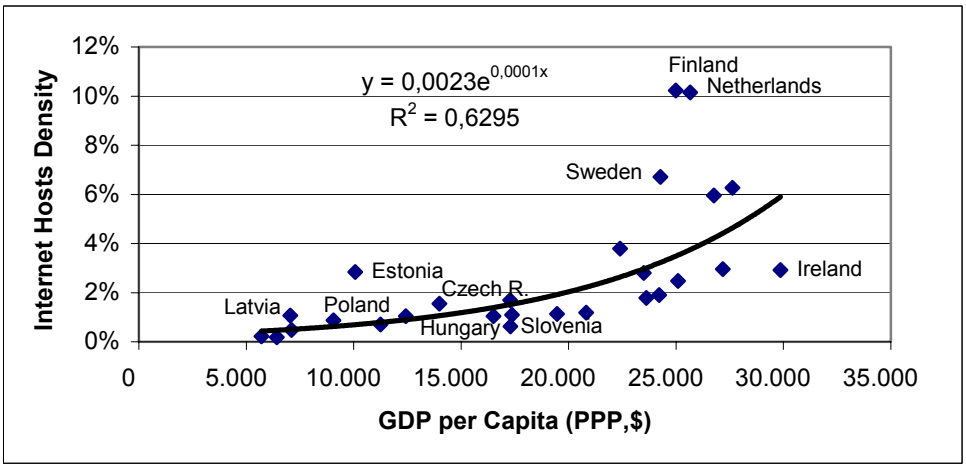


Fig. 1 : Continued







Note: The depicted relationship is calculated from data for the year 2000 from 26 European countries, i.e. EU-14 (EU-15 minus Luxemburg), EU accession countries, Turkey and Bulgaria.

Source: ITU (2002), own calculations.

Slovenia has the same per capita – in PPP terms – as the second poorest EU-15 country, Greece (Portugal is slightly poorer, see Tab. 2). However, Slovenia has higher indicators than Greece in the field of mobile telephone density, internet user density and internet host density. Only in traditional fixed line density is Greece better than Slovenia. The Czech Republic also does better in all fields than Greece, except for fixed line density. Generally, accession countries still suffer from the legacy of a low fixed line density

during their socialist era. Given the fact that there are considerable market entry barriers in fixed line telephony and that the dominant national operator has rarely been restructured in each accession country – this implies inefficiencies, poor service and relatively high prices –, this record is not surprising.

Modernization efforts in transition countries have also been impaired by budget deficit problems and transition recession in postsocialist countries in eastern Europe. Privatization has also been slow in the field of fixed line telephony. Taking into account that a high computer density is crucial for exploiting opportunities in digital modernization and productivity growth (partly associated also with network effects), one finds that the Czech Republic, Slovenia and Estonia are three accession countries which come close to the indicators in poor EU-15 countries. Computer density is quite important in the context of the internet economy, and Estonia, the Czech Republic and Hungary are well positioned in terms of the host density which represents the supply side of the internet system. Within the overall group of accession countries, there is considerable digital heterogeneity, but this is also the case among EU-15 countries, with the Scandinavian countries and the Netherlands as clear digital leaders.

Tab. 2 : Information and Communications Technologies per 100 Inhabitants in EU Accession Countries (EU AC) and European Union, 2002

	GDP per capita, PPP ($)	Fixed Telephone	Mobile Telephone	Internet User	Internet Hosts	PCs
EU AC countries						
Cyprus	13.300	69,3%	59%	30%	0,64%	24,4%
Czech R.	15.300	34,8%	84%	30%	2,48%	14,6%
Estonia	10.900	35,0%	63%	41%	4,68%	21,0%
Hungary	13.300	35,4%	68%	16%	2,57%	10,8%
Latria	8.300	30,6%	40%	14%	1,53%	17,1%
Lithuania	8.400	26,8%	47%	20%	1,77%	7,0%
Malta	17.000	52,7%	72%	29%	1,93%	22,9%
Poland	9.500	34,7%	35%	23%	1,89%	8,5%
Slovak R.	12.200	27,2%	54%	16%	1,65%	18,4%
Slovenia	18.000	42,4%	85%	42%	1,92%	30,0%
EU AC average	12620	38,9%	60,7%	26,1%	2,10%	17,5%
EU 15 countries : poor						
Greece	19.000	52,9%	83,8%	18%	1,45%	8,1%
Portugal	18.000	41,9%	81,9%	35%	1,58%	11,7%
Spain	20.700	45,9%	82,2%	19,3	1,45%	56,1%
EU-3 average	*19233*	*46,9%*	*82,6%*	*24,1%*	*1,49%*	*25,3%*
EU 15 countries : rich						
Austria	27.700	46,8%	82,8%	40%	4,50%	33,5%
Belgium	29.000	49,6%	78,6%	32%	3,25%	24,1%
Denmark	29.000	69,6%	83,3%	46%	15,56%	57,7%
Finland	26.200	54,7%	84,5%	50%	23,43%	44,2%
France	25.700	56,9%	64,7%	31%	2,32%	34,7%
Germany	26.600	65,0%	71,7%	42%	3,14%	43,5%
Ireland	28.500	48,4%	75,5%	27%	3,47%	39,0%
Italy	25.000	48,6%	92,6%	30%	1,19%	19,5%
Luxemburg	44.000	78,0%	101,3%	37%	3,14%	51,7%
Netherlands	26.900	62,1%	72,2%	53%	19,37%	42,8%
Sweden	25.400	72,0%	88,5%	57%	9,49%	56,1%
UK	25.300	58,7%	84,5%	40%	4,85%	36,6%
EU-15 average	26466	44,1%	60,3%	30,5%	6,02%	29,5%

Sources : ITU (2003), IBM (2003), EUROSTAT (2003) own calculations.

The following table shows Pearson's correlation coefficients. At first glance, positive and significant correlations between variables are visible in most cases. Only internet hosts show a lack of significance in relationship to the other variables, except with respect to internet users. Apparently, other influences are crucial for the host density. The percentage of firms engaged in trade, the share of multinational subsidiaries among all firms and the level of education of the population should be variables positively affecting internet host density. As regards the link between per capita income (or national output if population is constant) and digital indicators, there is a causality problem which, of course, is not clarified by any rank correlation coefficient. A better telecommunications infrastructure and increasing use of both the telecommunications network and the internet (and supply-side activities through the internet) can be expected to contribute to national output Y, reflecting an implicit production function Y(K,L,Z,T), where K is capital, L labor, Z level of technology and T the use of the telecommunications network; indeed, such a production function has been stated and tested by WELFENS/JUNGMITTAG (2002) with significant results for Germany. The demand for telecommunication services typically has positive income elasticity – often assumed to exceed unity – so that a positive correlation between digital indicators and per capita income is not surprising.

Tab. 3 : Correlation Coefficients, (2002)

		GDP per capita, PPP ($)	Fixed Telephone	Mobile Telephone	Internet User	Internet Hosts	PCs
GDP per capita, PPP ($)	Pearson Correlation	**1**	,759**	,752**	,542**	,358	,723**
	Significance (2-side)		,000	,000	,005	,079	,000
	N	25	25	25	25	25	25
Fixed Telephone	Pearson Correlation	,759**	**1**	,564**	,628**	,380	,726**
	Significance (2-side)	,000		,003	,001	,061	,000
	N	25	25	25	25	25	25
Mobile Telephone	Pearson Correlation	,752**	,564**	**1**	,506**	,237	,518**
	Significance (2-side)	,000	,003		,010	,254	,008
	N	25	25	25	25	25	25
Internet User	Pearson Correlation	,542**	,628**	,506**	**1**	,688**	,631**
	Significance (2-side)	,005	,001	,010		,000	,001
	N	25	25	25	25	25	25
Internet Hosts	Pearson Correlation	,358	,380	,237	,688**	**1**	,527**
	Significance (2-side)	,079	,061	,254	,000		,007
	N	25	25	25	25	25	25
PCs	Pearson Correlation	,723**	,726**	,518**	,631**	,527**	**1**
	Significance (2-side)	,000	,000	,008	,001	,007	
	N	25	25	25	25	25	25

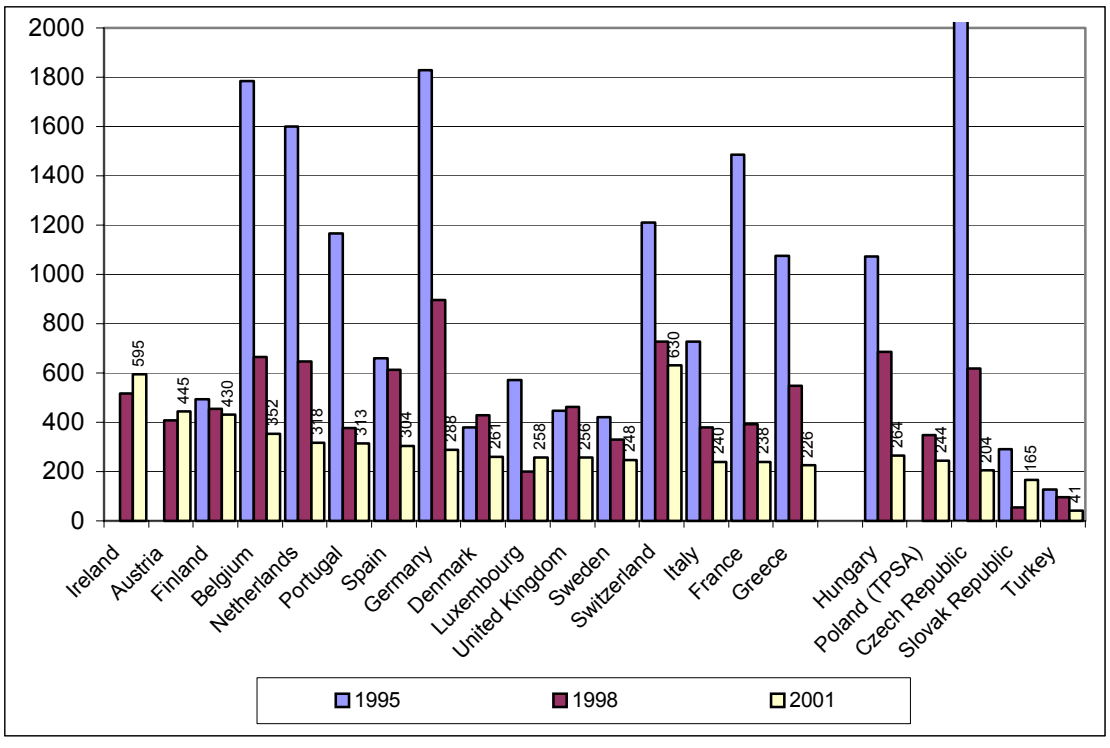
Note : ** The correlation is significant on the level of 0,01 (2-side).

Source : ITU (2002), own calculations.

As regards the revenue per subscriber in mobile telephony, it is clear that intensifying competition (read: additional firms entering the market over time) and technological progress as well as the logistical expansion path on the user side – with near-saturation, the marginal revenue of new users will fall – should drive down the revenue indicator in advanced OECD countries; new mobile services and a rise of per capita income could, however, raise mobile revenue per subscriber in the long term. Indeed, that indicator fell over time in almost all West European countries in the period from 1995 to 2001, except for Austria where the revenue per subscriber in 2001 was higher than in 1998. Austria and Finland had slightly more than 400 Euro per subscriber, Portugal and Greece slightly more than 300 and 200 Euro per subscriber, respectively. It is noteworthy that the fall of mobile revenues per subscribers could also be observed in accession countries. Hungary, as a country leading in mobile telephony among accession countries, had a per capita revenue which was roughly in line with those for Greece and Portugal.

Telecommunications revenue as a percentage of GDP is between 2 and 4 % of GDP in EU-15 countries. Greece and Portugal, with 4 to 5% of GDP, are outliers insofar as these countries are characterized by relatively weak competition in fixed line telephony and mobile telephony, thereby resulting in rather high prices. Since the demand for telecommunication services is rather inelastic with respect to firms, it is not surprising that countries with weak competition stand for relatively high telecommunication expenditures. Along the same line of argument, it is natural that EU accession countries, with their weak competition (except for international telecommunications), show a relatively large ratio of overall telecommunications revenue to GDP. Since fixed line telephony was underdeveloped in postsocialist countries in the 1990s and 2001/02, it is also not surprising to see that the share of mobile telecommunications revenue in overall telecommunications revenue was relatively high in accession countries in 2001 (see Tab. 4).

Fig. 2 : Cellular Mobile Telecommunication Revenue per Cellular Mobile Subscriber



Source : OECD (2003)

Tab. 4 : Telecommunications Revenue in Europe in 2001

	Telecom-munications Revenue as % of GDP	Fixed and Mobile Telecommunication Revenue		Mobile Telecommunication Revenue		
		Per Access Path	Per Capita	Per Mobile Subscriber	Per Capita	Percent of Total Revenue
Austria	2,7	471	621	445	370	59,6
Belgium	2,9	524	654	352	264	40,3
Denmark	2,6	541	787	261	193	24,5
Finland	3,5	553	815	430	346	42,4
France	2,2	380	494	238	149	30,1
Germany	3,1	526	693	288	197	28,4
Greece	4,6	353	470	226	170	36,1
Ireland	2,4	535	645	595	430	50,5
Italy	2,5	341	470	240	209	44,5
Luxembourg	2,0	478	844	258	254	30,0
Mexico	2,5	418	150	195	43	28,5
Netherlands	3,1	497	726	318	258	35,6
Portugal	5,0	440	540	313	248	45,9
Switzerland	3,2	739	1090	630	461	42,2
Spain	3,8	444	540	304	222	41,2
Sweden	3,4	520	811	248	199	24,6
United Kingdom	3,9	684	930	256	198	21,3
Czech Republic	4,5	231	249	204	137	55,3
Hungary	7,0	393	355	264	129	36,3
Poland	3,9	243	170	244	68	39,8
Slovak Republic	5,1	247	175	165	66	37,6
Turkey	4,0	158	86	41	11	12,9

Source : OECD (2003)

2.2. Basic Regulatory Aspects of Telecommunications

With the liberalization of 1998, the European Commission had given an important impulse for more competition in fixed line telecommunications. The opening up of network operation and voice telephony stimulated a wave of new market entries in fixed line telephony. At the same time, National Regulatory Agencies (NRA) in EU countries started an asymmetric regulation, imposing various rules on the dominant network operator (the former national monopoly operator), typically including interconnection rules and price caps as a means to stimulate static and dynamic efficiency; prices are thus expected to be largely determined by long-run incremental costs.

Prices in long distance and international telecommunications have fallen sharply among the continental EU-14 countries in the first five years of liberalization; this also holds for the UK, where liberalization in telecommunications had already begun in 1984. The incumbent telecommunications network operators have diversified into new activities, including GSM mobile services (not in Greece), internet services and other value-added services, including DSL, a broadband internet connection using existing twisted copper access lines. Local access is less contested than long distance and international telecommunications markets; however, regulators have imposed unbundling guideline allowing newcomers to rent access from the incumbent operator. Newcomers in the fixed

line market have rolled out their own network to some extent, but are also relying on leased lines.

The EU has developed various framework regulations. As of July 25, 2003, the EU introduced a new EC regulator framework for electronic networks and services. There are several changes compared to the previous framework, which mainly emphasized non-discrimination and avoidance of abuse of market power:

- NRAs may only impose ex-ante control on individual operators after having conducted a market review.
- Defining significant market power (SMP) is explicitly linked to the concept of dominance as used in the competition law.
- Appeals against decisions of NRAs can be both on merits and process (so far on process only).
- The existing licence framework has been replaced by a general authorisation regime with general conditions of entitlement and specific conditions.
- NRAs must cooperate with the Commission and other NRAs in the European Regulators' Group in order to establish common regulatory practices.
- The Commission's Recommendation of market definition and guidelines on market analysis as well as the assessment of SMP must be fully considered by NRAs.
- NRAs have to notify both the Commission and other NRAs about the result of market analyses (the Commission has veto power with respect to some fields of decision).
- The Commission expects access markets to become competitive through effective unbundling requirements from NRAs.

There are some unclear fields of regulatory intervention. While the Commission has expressed concern about anti-competitive behaviour in the field of mobile telephony, in particular as regards roaming fees, so far NRAs have been reluctant to focus on mobile telecommunications. Internet providers in several countries have had problems obtaining a wholesale flat rate from the dominant fixed network operator, which in turn made offerings for flat rate tariffs in narrowband internet services difficult. For example, AOL gave up its narrow band flat rate tariff in Germany once the dominant operator had dropped a flat rate tariff for its internet subsidiary (However, both AOL and T-Online – the subsidiary of Deutsche Telekom – offer DSL flat rate tariffs which, however, created the problem for AOL that it must obtain adequate access for its subscribers through Deutsche Telekom, which controlled 95% of the German DSL market in 2003). With respect to the competition laws, it is also a doubtful price strategy that T Mobile (mobile subsidiary of Deutsche Telekom) has offered various service bundles to its mobile users, including a bulk amount of free minutes for making calls to the fixed network in 2003. As Deutsche Telekom has significant market power in the fixed line telephony market, its subsidiary T Mobile's bundling offer effectively reinforces the dominant market position of Deutsche Telekom, which has majority ownership of government. However, there are similar strategies in other EU-15 countries; in some countries – including the Netherlands, Belgium and the UK – the market share of cable TV in telephony is considerable (e.g. some 10% in the case of the UK), thereby characterizing the access market with more intensive competition than in Germany.

Since regulations in telecommunications are so crucial for the pricing of telecommunications and internet services, weak or inconsistent regulations – leading to

weak competition or even encouraging a gain of market power by the former monopoly operator (resulting in high prices of digital services) – can impair dissemination of information, which is vital input in almost all sectors of the economy in OECD countries. By the same token, weak regulation can slow down the diffusion of innovations and thus undermine overall competitiveness and growth. This basic insight not only applies to EU-15, but to accession countries as well.

Accession countries have established politically-independent regulatory authorities as required by both EU membership and the acquis communautaire. However, the regulatory approaches in most accession countries are rather opaque. There was only partial market opening up in accession countries.

3. Eastern European Digital Modernization

Estonia, Hungary, Lithuania, Latvia, Poland, Slovak Republic, Slovenia, and the Czech Republic belong to the group of post-communist countries of Central and Eastern Europe (CEEC-8) which since the beginning of the 1990s has been undergoing a process of fundamental political and economic transformation. Their aim – in line with the Copenhagen criteria for EU membership – was to achieve a functioning market economy as well as the capacity to cope with competitive pressure and market forces within the European Union[1]. For about a decade, the economic policy of these countries has been dominated by the solving of transformation problems in the fields of social, economic or labour market policy, being a natural consequence of the process of transition from the old centrally-planned economy to a new decentralized system (KOLODKO, 2002). The main policy fields mentioned show that the telecommunications sector has not been a priority for major reforms. Certainly, competition policy was part of systemic transformation and in this context regulatory policy of infrastructure sectors was discussed, but there was no special emphasis on the telecommunication sector.

For many years the economic potential of both the telecommunication sector and ICT was not properly interpreted. Short-term budgetary revenue aspects of telecommunication services – offered by a national monopoly operator – were often considered more important than long-term aspects of digital modernization, the telecommunications sector and the associated spillover effects. In the socialist period, CEECs telecommunication could be characterized as backward, poorly performing[2] and being a source of a tremendous "digital divide" in basic communication infrastructure at the European level.[3]

---

[1] In addition, the stability of institutions guaranteeing democracy, the rule of law, human rights and respect for and protection of minorities should be guaranteed.

[2] Within CEEC-8 in 1989, telephone penetration rates were even below 2% in rural areas and below 8% in cities, main lines digitalization rates 6%, number of main lines not connected to automatic exchanges up to 10%, telephone faults up to 60 per 100 users per year. (ITU, 2002)

[3] The underdeveloped telecommunications infrastructure has achieved a political dimension in April 1997, when access to telecommunications had been considered a basic human right. In 1997, the UN issued a statement on Universal Access to Basic Communication and Information Services.

The situation has changed since 1989/90, although there is still a large modernization gap, with accession countries far away from EU standards[4].

Considering the social and economic advantages associated with well performing telecommunication systems in developed countries, CEEC-8 certainly find in the run-up to EU membership that modernization opportunities were neglected in the early 1990s when policymakers showed limited interest in upgrading and restructuring the telecommunications sector.[5] The boost to economic development in some poor EU-15 countries in the 1990s – including Ireland and Finland – made clear that the modernization of telecommunications and the stimulation of broader ICT sectors can have positive long-term effects on productivity growth and output dynamics. This clearly points to a potential for digital catching-up in eastern Europe.

Below we take a look at recent developments in the information and communication technologies markets in EU accession countries. Special attention is devoted to the problem of digital modernization, being considered the most important prerequisite for the process of technological and economic convergence. Former market separations for fixed and mobile voice transmission, TV broadcasting and radio are blurred by digitization, resulting in the emergence of more competitive, larger markets. This convergence has major implications in economic and regulatory perspectives. The fact that the UK has already set up an integrated regulatory agency in 2003 testifies to the new regulatory landscape in the digital sector – broadly defined – in Europe. For central and eastern European countries, the problem of digital modernization is especially important because of the following aspects:

- **Integration process**: assuming that the economic significance of information and communications technologies in EU countries increases exponentially, the underdeveloped ICT environment in CEECs can lead to a sustained digital divide within the Community. From a medium-term perspective, such a divide would become an obstacle in the process of European integration; in a single EU-25 market, countries having a relatively poor telecommunication and internet infrastructure will face high communication costs – and transaction costs, in particular for international trade – which are similar to a tariff on trade. Moreover, FDI inflows would be rather low as multinationals need a modern telecommunications network to optimally organize production abroad; as roughly 1/3 of international trade is intra-company trade (within multinational firms), countries attracting only small FDI inflows on a per capita basis will also suffer from non-realized trading opportunities.

- **Process of economic catching-up**: ICT brings new opportunities to accelerate the process of catching-up. Governments as well as the business community in accession countries should understand the opportunities of ICT and come up with adequate ICT investments as well as incentives to attract ICT producers. Certainly ICT products will be imported to a large extent in accession countries; however,

[4] To avoid any misunderstanding, it should be mentioned that here the term EU standards does not refer to the technological aspects of modernisation, as is normally common. Here it refers to the preferences according to ICT consumption. It is important to know that these slightly differentiate themselves in central and eastern Europe from EU developments.

[5] It has to be taken in consideration that the systemic transformation process embodies a very high level of complexity and sometimes gives policy makers no free space for promoting the most convenient and optimal strategy for modernization of old structured economies.

taking a look at Ireland – a major producer of ICT in the 1980s and the 1990s in the OECD area – it is obvious that small poor countries under certain circumstances can attract high technology multinationals in the IT sector. Given the fact that wages in eastern Europe are much lower than in EU-15 and that there is a broad base of skilled labor in several accession countries, it could be possible to attract major IT producers. Hungary successfully attracted IBM as a producer and exporter of hard disks in the 1990s. Yet in the course of dynamic product cycle trade, IBM closed its Hungarian factory in 2002 and relocated production. Poland and Eastonia have begun to actively encourage foreign ICT producers.

3.1. Digital Modernization

"Digital modernization" is basically understood here as the process through which historically grown electronic sectors and institutions in the field of computation, communication and data storage switch to digitally-oriented technologies and procedures; in particular switching from analogue transmission of voice and pictures to digital transmission is crucial. Digitization allows a wide array of innovative recombination of digitally stored information and knowledge as well as using both in computer controlled production or service provision. Digital modernization reflects a broad dynamic increase in knowledge and allows for the development and management of novel complex systems. Broader modernization waves have typically been accompanied by a scientific revolution.[6]

Narrowly defined, digitization can be understood as the process of conversion of a system from the analog to digital. The process of digitalization specifically concerns technological aspects and makes it possible to generate, process and transmit any type of information (voice, data, video) in a binary system of zeros and ones. This technological revolution has broad implications especially in tree dimensions (e.g. quality, speed and capacity).

With respect to ICT, digitization has to be defined broadly. On the one hand it concerns the process of digitization of existing communication networks, access infrastructure, products and services; on the other hand, it stands for an element of a changing market structure since digitization implicitly merges formerly separated markets such as voice telephony, cable TV and mobile telephony. Hence it goes along with an implicit opening up of markets and a merging of markets. Digital modernization is thus pro-competitive. Digitization also raises doubts whether telecommunications is a natural monopoly; taking into account the survival of several mobile operators in several EU countries, the mobile telephony business certainly is not a natural monopoly (the standard assumption of traditional telephony). The issue of natural monopoly is more complex when it comes to fixed line telephony where high sunk costs imply that markets are only weakly contests; actual and potential competition are rather weak unless one could duplicate – at similar costs – nation-wide networks on the basis of mobile communication technology. The more users consider mobile telephony a substitute to fixed line telephony, the more obsolete the natural monopoly argument in telephony. Whether mobile telephony and fixed line telephony are complementary or substitutive is an empirical question. For certain younger strata of the population, mobile telephony might well be a substitute for fixed line telephony. However, this certainly does not hold true for the majority of telephone users.

[6] This definition has been formulated on the basis of the definition of modernization presented by C.E. Black in "Dynamics of Modernization" (1996).

Digitization allows for a much more flexible and efficient management of spectrum than previous technologies; as spectrum is a scarce input in communication digitization, this amounts to factor-augmenting technological progress. From a technical point of view, digitization makes systems rather open. Any new network operator interested in linking up with the public network will find the existence of digital transmission much easier than reliance on the old analogue system. Digitization opens up a wide range of business opportunities especially for areas with a high rate of return. Digitization of communication systems influences the cost functions of firms. It reduces the marginal costs of communication services and thereby brings efficiency gains at the firm level, but this also uses transaction costs, which in turn implies trade creation.

Digital modernization should also be seen as a dynamic competitive process. As such, modernization is a key element for major suppliers; all competitors are stimulated to upgrade existing technologies. Many companies enrich their business activities, and in addition to the core business, firms intensify research and development. Thus companies contribute more actively to the national innovation system, thus enhancing the competitiveness of the whole economy

Digital modernization boosts the creation of new markets. Digital modernization thus creates perspectives for new business opportunities in many companies. This observation refers to both the ICT-sector, expanding through an increasing demand for use of advanced information and communication technologies, and to firms in the old economy. It also refers to the products and services which can be digitalized and traded electronically. Without digitization, the creation of new communications systems and platforms like fast internet, high definition television, advanced satellite TV and satellite and mobile telephony would not be possible. Digitization reinforces the role of information as a production factor; growing dependence on information in production processes partly reflects the dynamics of a new economy and of a new economic sector, the information sector (PORATA, 1974, 1976; DZIUBA, 2002).

Digital modernization will stimulate the process of convergence. Digitization eliminates existing borders between various kinds of information – voice, video, data. The dynamics of markets and technologies will lead to a multi-layer process of convergence in networks as well as in services. Digitization will also stimulate interactivity in many fields, and this is relevant for the business sector and private household and governments as well.

Digital modernization stimulates internationalization of the economy. Generally speaking, the process of digitization is effectively melting various information and communications platforms or makes them easier to interoperate. Through digital modernization, EU accession countries will get broad access to a borderless cyberspace which is relevant in nearly all sectors. However, as regards carrier services there are EU rules which have to be implemented in member countries. The fact that digitization creates new and larger international markets plays a crucial role especially for the small economies where the home market is rather small and where economic growth can be stimulated strongly thorough international cooperation or trade-promoting activities.

As communication is a reciprocal act and since some network externalities in some ICT fields are international, EU-15 countries will gain from the digital modernization of EU accession countries. Increasing use of ICT will stimulate trade within the enlarged Community. Digital modernization will finally stimulate diversification in ICT production and in digital services, whereby countries will try to exploit digital comparative advantages. Countries which are richly endowed with information and information capital – plus complementary human capital – will specialize in information intensive goods in

production and exports. This is a natural development in a dynamic international division of labor.

Digitization enhances democratic procedures and can stimulate efficiency gains in the public sector. The effects of digitization are twofold: (i) Digitization of information systems of the public sector can raise efficiency. New digital services can be introduced, many traditional services automated, and all services will become more reliable. As accession countries have to modernize public administration, this creates many opportunities for welfare gains and productivity increases; (ii) the speed of information flows within public administration and democratic institutions will be enhanced, and thus the efficiency and transparency of governing bodies increased. As digital modernization reduces the marginal costs of public services, there could be cost cutting effects and thus a welcome impulse for the provision of public services in a situation in which budgetary consolidation ranks high among EU accession countries; at least this is relevant for those countries seeking quick access to the Euro zone so that the Stability and Growth Pact (with limitations for the debt-GDP ratio and the deficit-GDP ratio) becomes relevant. More transparency might also help to reduce corruption significantly. For these reasons, the credibility of public institutions in accession countries could increase. This along with efficiency gains in public administration will help to reduce the existing institutional divide between EU-15 and the new member countries.

Essentially digitization will help to meet the Copenhagen criteria in several ways. EU accession countries could find it easier to withstand the competitive pressure in the EU single market and become stable democracies. Sustained political stability in turn will occur alongside higher investment, growth, employment and tax revenues.

3.2. Digital Modernization of Access Infrastructure

For decades, the communication infrastructure in central and eastern European countries has been underdeveloped with respect to a comparison with western European countries with similar per capita income. In the socialist system, the Communist party considered communication systems politically sensitive and put a clear priority on communication among firms; individual telecommunications was neglected to a large degree, leading to low telecom density. The political change in 1989/90 has altered the political paradigms. Diversified preferences of both households and the business sector became accepted, the monopoly telecommunication was restructured, and in some countries partial privatization began. Modernization measures in the national public switched telephone network (PSTN) are especially worth noting, especially in terms of digital modernization. Western experiences have shown that digitization crucially upgrades the quality of the core communication infrastructure; it opens up new areas for digital communications. Integrated services, digital networks (ISDN) and xDSL (generic digital subscriber line) have been introduced as interim technologies to bolster existing network performance within acceptable cost parameters.[7]

Poor and analogue fixed infrastructure has forced all EU accession countries to intensify investment in the telecommunications sector where two aspects were emphasized:

[7] ISDN is increasingly being deployed in POTS networks, which have found their market niches in the high-speed Internet access and SOHO (small office-home office) markets. xDSL provides a temporary fix by using the existing copper drop plant to support broadband applications; it gives the telcos the ability to compete with the CableTV operators' coaxial drop bandwidth advantage.

- the telecommunications network and service accessibility had to be extended relatively fast, and the quality standards had to be simultaneously improved;
- subscriber lines and trunk networks had to be modernized; such modernization is considered a prerequisite for the provision of new digital communication services (e.g. broadband data transmission).

Taking the penetration rates of fixed telephony in 1991 as the point of reference and an EU average penetration rate in 2002 of 54 per 100 inhabitants (IBM, 2003), for an interim desirable optimum in accession countries, the required capital for digital modernization and the extension of a fixed telephone network for each EU accession country can roughly be estimated; see the table below. To achieve the average EU level of fixed telephone penetration, EU accession countries should together install 30.5 million telephone lines and bear the additional costs for the digital modernization of existing networks. Supposing that the costs of new telephone connections (digitally compatible) amount on average to $1000[8], the mere extension of fixed telephony networks would require investment exceeding $30 billion in the CEE region.

In addition, the costs of modernization of old fixed line infrastructure have to be considered. According to WELFENS and GRAACK (1997), the incremental costs of upgrading existing networks to standards allowing basic digital communication, e.g. Integrated Services Digital Network (ISDN), range from 20% to 30% of total investment. Thus for all EU accession countries the capital needed for upgrading existing networks would range from between $1.9 to $2.9 billion. Such upgrading investment could be financed through retained earnings and bank loans. Increasing investment in order to achieve higher penetration rates in fixed line telephony will require raising new equity capital in stock markets; tight governmental budget deficits make augmenting the capital base of the dominant operator by injecting new government funds very difficult.

By the end of 2002, telephone penetration had not achieved the EU level and probably even by 2005, one should not expect the gap in fixed line telephony to be closed. Given the enormous technological progress in mobile telephony and falling prices of the respective equipment, mobile telephony is relatively important in overall telephony within accession countries; in addition, there is cable TV in urban areas and other options which seem to have become a substitute for fixed line investment.

Through the end of 2001, about 15,8 mil1ion new fixed telecommunications connections had been installed in all East European accession countries, which should be equivalent – on the basis of the assumption made – to an overall investment of about $16 billion. The average penetration density of fixed telephone access has risen from a level of 22.5 to 40.1 telephones per 100 inhabitants. The highest growth rate in accession lines has been achieved in three EU accession countries, i.e. the Czech Republic[9], Hungary, and Poland. Their net growth in fixed telephone accessibility ranged from 20% to 26% over a decade. This development implies that there is true digital bridging in the newly enlarging Community, not in the least since those accession countries were among the countries with relatively low density figures within overall socialist countries in the 1980s.

---

[8] The average costs of new fixed telephone lines vary in the literature depending on density, geography, and broadband, e.g $250 and $1000 by NAVAS-SABATER et al. (2002), $1000 and €2500 by WELFENS and GRAACK (1997), and $1800 and $2500 by RAGHBENDRA and MAJUMDAR (1999).

[9] It should be mentioned that data concerning the Czech and Slovak Republics for 1991 represent their respective geographical regions of the former Czechoslovakia.

At the beginning of the 1990s, the penetration rate belonged to the lowest among CEECs and was under 20% (also in the Slovak Republic).

In Summary, one can observe that the costs of digital modernization investment in telecommunications (roll out of infrastructure and upgrade of existing networks allowing for digital communication) amounted to nearly $19 billion for all ten EU accession countries, equivalent to about 2.6% of accumulated gross fixed capital formation (GFCF) in the decade from 1991 to 2001.

Tab. 5 : Rough Estimated Costs of Digital Modernization in Ten EU Accession Countries

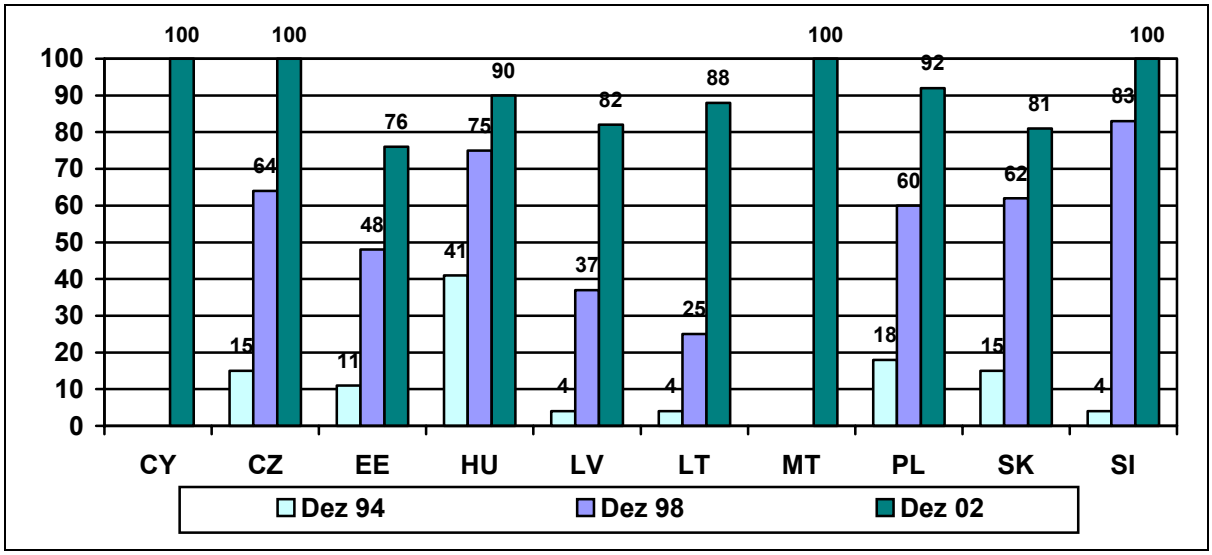
	Fixed Telephone Penetration			**Number of fixed connections**	**Number of new fixed connections**	**Costs of roll out of fixed infrastructure 1991-2001**	**Costs of digital modernization of existing networks Incremental costs: 20% - 30%**
	1991	**2001**	**Net Change**	**1991**	**1991-2001**	**USD million**	**USD million**
Cyprus	44,59%	63,40%	18,81%	337.546	142.392	142,4	67,5 – 101,3
Czech R.	16,57%	37,50%	20,93%	1.702.236	2.150.139	2.150,1	340,4 – 510,7
Estonia	21,19%	37,70%	16,51%	290.091	226.022	226,0	58,0 – 87,0
Hungary	10,89%	36,80%	25,91%	1.091.396	2.596.700	2.596,7	218,3 – 327,4
Latvia	24,39%	32,10%	7,71%	578.531	182.881	182,9	115,7 – 173,6
Lithuania	22,00%	33,70%	11,70%	812.900	432.315	432,3	162,6 – 243,9
Malta	38,60%	53,40%	14,80%	150.540	57.720	57,7	30,1 – 45,2
Poland	9,32%	31,60%	22,28%	3.602.180	8.611.220	8.611,2	720,4 – 1.080,7
Slovak R.	14,39%	32,40%	18,01%	777.319	972.864	972,9	155,4 – 233,2
Slovenia	22,91%	42,40%	19,49%	455.451	387.461	387,5	91,0 – 136,6
Together	**22,5%**	**40,1%**	**17,6%**	**9.798.190**	**15.759.714**	**15.759,7**	**1.959,6 - 2.939,5**

Note: The figures should be taken as a rough estimate only

Source: ITU (2002), own calculations.

The process of digitization of fixed telecommunication infrastructure has not been finished in eastern Europe. Only four EU accession countries have already achieved full digitalization of fixed networks in 2003. All others are still modernizing their infrastructure. Medium-term achievements are rather satisfactory and in most cases have brought a digitization degree of about 80% (see graph below). Most EU accession countries have assumed that the process of digitization will be finished by the year 2004, the year of EU accession.

Fig. 3 : Digitalisation Rate of Fixed Networks in CEECs (%)



Source: IBM (2003) and ITU (2002)

Taking a look at the aggregated telecommunications investment,[10] one finds that in a period of 10 years (1991-2000), $28.2 billion has been invested in ten EU accession countries[11]. Although this figure for investment in fixed line telephony is close to what is necessary to achieve a modern fixed network infrastructure, it should be taken into account that within the same period other communication platforms have emerged and expanded, e.g. mobile telecommunication or cable TV (see graph below). Comparing this with telecommunications investment in developed economies – the amount invested in Germany, France, Italy and the UK during the same decade, for example, was $117.7 bill., $59.1 billion, $67.1 billion and $84.6 billion, respectively –, one can easily see how large the infrastructure gap between western and eastern Europe in this period has been. Nevertheless, one should take into account the specific character of CEECs, i.e. investment capital is very scarce and in several countries there were low rates of return on capital.

Despite more than ten years of modernization of the telecommunication sector, eastern European telecommunications companies are still relatively inefficient and achieve weak ratings with respect to productivity in international comparisons. The aggregate telecommunications revenue per employee is below the EU average ($237,834) and for some countries (e.g., Poland or Slovak Republic), the difference is twice as large, $100,513 and $64,274 respectively (OECD, 2003).[12] Moreover, considering the basic financial indicators of the incumbent operator in 2002 – having a dominant role in the fixed telecommunications market –, one can observe that the profit rate in eastern European countries before interest and taxes relative to total capital employed (ROCE) minus the

[10] Telecommunication investment refers to the expenditure associated with acquiring ownership of telecommunication equipment infrastructure including supporting land and buildings and intellectual and non-tangible property such as computer software. These include expenditures on initial installations and on additions to existing installations.

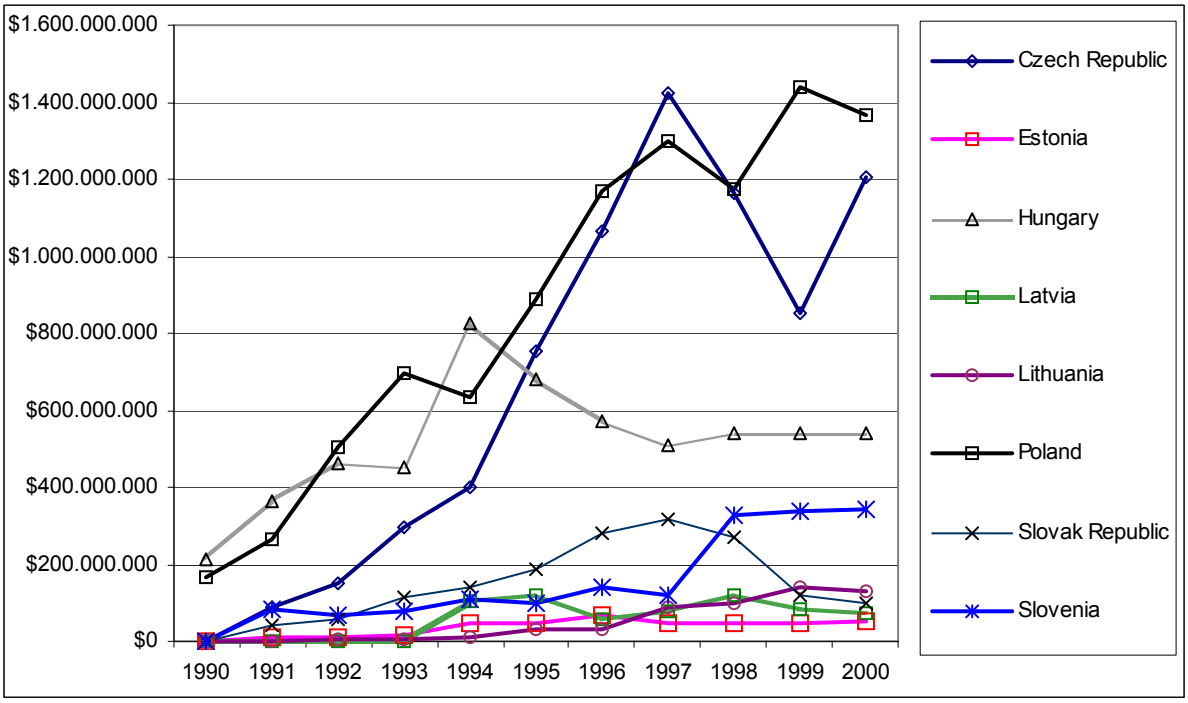
[11] Cyprus and Malta have not been considered.

[12] On the other hand, it should be observed that CEECs have experienced rapid growth in productivity in communication sector over the last several years, e.g. the revenue of each employee in both the Czech Republic and Hungary has increased by 20% (in Poland, 10%) in the decade up to 2001 (OECD, 2003).

inflation rate in most EU accession countries did not exceed 10% (only Hungary's ROCE achieved a level of 17% with inflation at 5%); this has broad implications in terms of foreign investment.

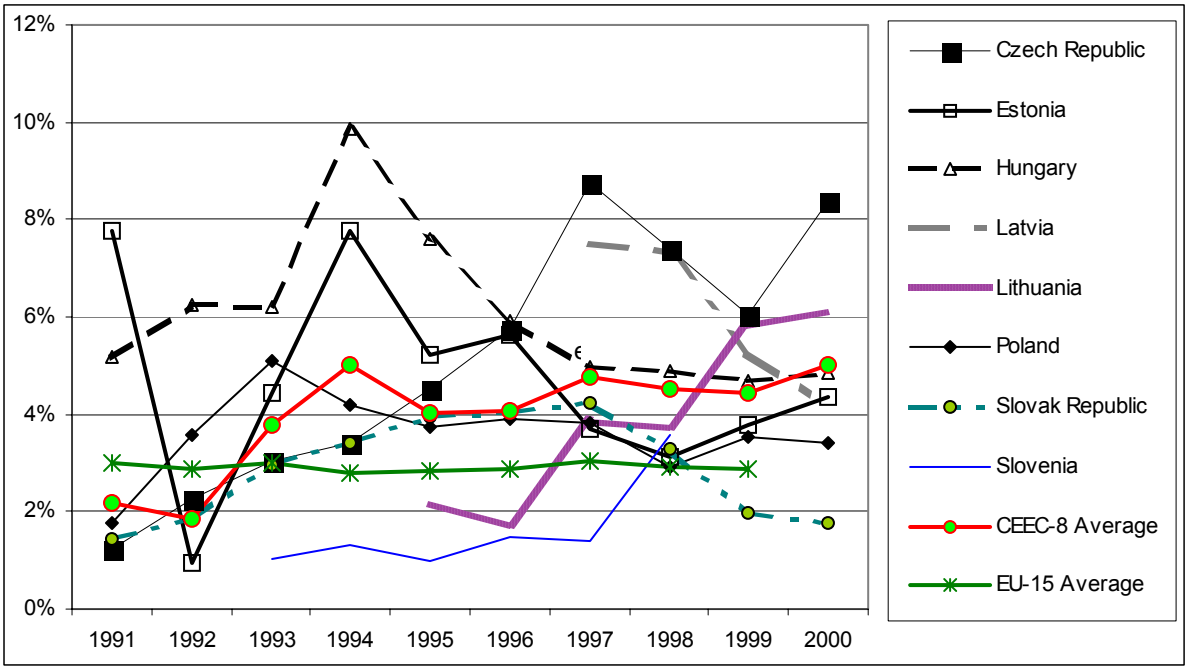
Since 1993, the average annual share of telecommunications investment in gross fixed capital formation of CEEC-8 (EU accession countries excluding Cyprus and Malta) has exceeded the EU-15 average, which can be taken as an indicator of real catching up in infrastructure. A similar situation can be found in Spain, Portugal and Greece, whose key indicators were also behind that of the EU average. However, all countries benefit from extra revenue in telecommunications generated by tourists. Among accession countries, these effects are certainly much lower, except for in Hungary, the Czech Republic and Estonia. It is clear that both population figures and the size of the economy are crucial for the absolute level of investment in telecommunications; by this token, Poland should clearly the lead, followed by Hungary. However, after 1995 position No. 2 was taken by the Czech Republic. Slovenia's investment increased strongly after 1997.

Fig. 4 : Annual Telecommunications Investment in EU Accession Countries



Source: ITU (2002)

Fig. 5 : Share of Telecommunication Investment on Gross Fixed Capital Formation



Source: ITU (2002)

If one considers telecommunications investment relative to overall gross fixed capital formation, we can see in the above figure that the CEEC-8 group has a higher share than EU-15 after the transformation recession of 1991 to 1993. In the early 1990s, Hungary and Estonia were clear leaders among transition countries; in the late 1990s, several countries recorded relatively high investment shares in telecommunications, namely the Czech Republic, Lithuania, Latvia and Hungary. Few countries have emphasized investment financing from revenues originating from the national operator directly (including privatization revenues); Hungary is a case for the latter to some extent, but the main source of investment financing was bank lending and new equity as well as profits. Poland has tried to use revenues from selling licenses in fixed line telephony to finance increased investment in fixed line telephony. In 2003, a new bill was passed creating the possibility that license revenues be used for investment in telecommunications infrastructure. In 2003, some $350 million had been paid by the three fixed telecom operators[13] for their respective licenses (allowing entrance into the market of long distance telecommunications services). From an economic policy perspective, this approach gives government a new instrument encouraging the development of the telecommunication infrastructure. One may assume that such an approach could be especially important for countries in which the communication infrastructure still needs to be upgraded on a large scale.

As regards the required capital for digital modernization programs, the question of sequencing in the process of transformation of the telecommunication market from a monopoly to a competitive system is significant. It could be argued that the opportunity for keeping a legal monopoly for some time allows the respective monopoly operator to exploit part of the consumer surplus and obtain a higher profit. These profits could be used for an acceleration of digital modernization and an extension of the core communication

[13] Telefonia Dialog, Netia and Elektrim.

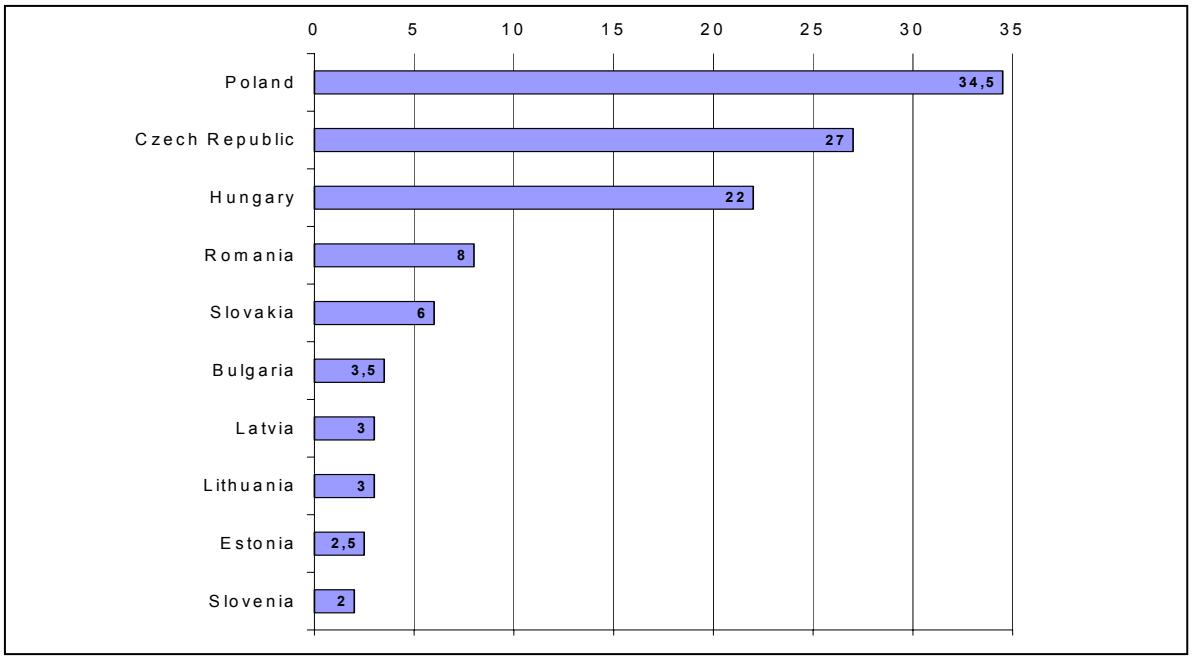
infrastructure. Such a perspective is, however, doubtful since it must additionally assume that maintaining the monopoly position is associated with effective restructuring of the dominant operator. If introducing competition goes along with product innovations and hence higher profits for some new services – while the monopoly rent is gradually melting away – under competition, overall profits in the telecommunications sector need not to be lower than in the monopoly case. As switching to competition brings a higher output and a higher innovation rate in the telecommunications market than the monopoly case, few arguments can be stated in favor of transitorily maintaining a telecommunications monopoly and state ownership. "Corporatization", or transforming a government-owned company into a company listed on the stock market (with minority private ownership in the beginning), is a minimum requirement for major efficiency gains. Firms listed in the stock market will have to publish a wide range of financial and performance data, and this transparency is already a welcome ingredient for medium-term restructuring and privatization. Full privatization will normally improve corporate governance and stimulate static and dynamic efficiency gains; however, the rating of a private company is often weaker than the rating for government bonds, leading to a rising costs of capital accompanied by privatization. For the dominant operator, the provision of universal services – for which government fixes a price often much above its costs – could help to generate safe medium-term profits; this aspect is quite important when it comes to full privatization.

The scarcity of the national financial resources has forced telecom enterprises in accession countries to use international capital inflows for investment financing and restructuring. Given pent-up demand at the end of the socialist period and a positive income elasticity of the demand for telecommunications (and sustained growth expected from the transition to a market economy), there are considerable investment opportunities in telecommunications. Given rather limited domestic savings in low-income economies of eastern Europe, there clearly is a welcome role of strategic investors as well as of international finance institutions (e.g. EBRD, EIB, World Bank). Telecommunications financing activities of major international institutions are typically a signal for private international investors to also invest in the respective country and sector. This, however, does not rule out that cyclical ups and downs of the EU-15 telecommunications sector affect the ability of telecommunications firms in eastern Europe to obtain financial resources for telecommunications projects. FDI outflows from EU-15 to accession countries typically fall in periods of recession among the EU-15 when profits are relatively small. It is obvious that the collapse of the stock market bubble in New York in 2001, when telecommunications stocks fell overproportionately, has negatively infected stock markets and the perception of analysts in western Europe. The new skepticism has also made the financing of telecommunications in eastern European accession countries relatively difficult, even if local market analysis suggests an enormous potential for medium-term expansion.

The financial engagement of international institutions in the process of digital modernization in EU accession countries should not be overlooked. The EBRD is of particular relevance. Between 1990 and 1999, EBRD was engaged in 50 telecommunications, informatics and media (TIM) projects (total project costs of €7.3 billion) in 20 transition economies with capital totaling €1.3 billion. The annual total of EBRD financing commitments to TIM projects has ranged from €100 million to €200 million. Although only 41 % of the projects in the "EBRD pipeline" that were intended for central Europe and the Baltic states were brought to fruition in 2001, one may assume that this source of investment financing could become less relevant in the medium-term in accession countries. This should hold true because EU membership will strengthen the role

of banks and capital markets in accession countries. At the same time, the role of the EBRD in the further process of digital modernization should not be underestimated. EBRD has a wide range of instruments to support project financing, such as becoming active in loan syndication, and providing guaranties for longer maturities or partial guarantees. This could be crucial in encouraging private financing of the ICT infrastructure in transformation economies. Moreover, funding in the framework of the existing EBRD Technical Cooperation Fund Program in CEECs and Baltic States should not be overlooked. Between 1990 and 1999, €2.1 billion has been granted. This type of financial help is quite valuable. Additionally, EU accession countries and the EBRD have signed a Memorandum of Understanding, which should promote the development of the telecommunications sector in central and eastern Europe and CIS.

Fig. 6: Cumulative FDI Inflows 1989-2001 ($ Billion)



Source: WIIW – WIFO (2002)

The function of other international finance institutions, such as the European Investment Bank (EIB) should also not be underestimated in the impact on the process of digital modernization (EBRD, 2000). Since 1990, EIB's financial engagement in the form of loans for infrastructure development projects reached €15.8 billion[14]. Seventeen percent of this amount, i.e. $2.7 billion, was given as loans for the digital modernization of communication infrastructure in CEEC-8, covering investment programs in fixed, mobile and data transmission networks.

Foreign direct investment has also played a very important role for digital modernization. However there is at least one caveat. Although the privatization revenues are also regarded as foreign direct investment, it does not directly contribute to the process of digital modernization to the extent that government, as the owner of the national monopoly operator, uses privatization proceess to cover general government expenditures; in other words, privatization revenues in the telecommunications sector have often been used outside the telecommunications sector. Nevertheless, there is a clear positive role of strategic foreign investors. Overall inward foreign direct investment in EU accession countries in the decade from 1989 to 2001 amounted to more than $100 billion. Although more than 60% of this amount was absorbed by three countries (i.e., Czech Republic, Hungary and Poland), it must be mentioned that in terms of FDI per capita (concerning average FDI per capita in the decade 1991-2000), other countries are the leaders in the accession countries: Slovenia, the Slovak Republic, Lithuania and Malta.

Because of data problems, it is very difficult to assess the meaning of FDI for the telecommunications sector. Basic figures are: 1) the share of transportation, storage and communications in FDI were 10.7% in Poland, 11.9% in Czech Republic to 13.9% in the Slovak Republic; 2) the share of FDI in postal services and communications in Slovenia amounted to 4.2 % of overall FDI inflows; 3) the FDI share of transport and communication in Lithuania, Estonia and Latvia amounted to 14.7%, 22.0% to 24.0% respectively (WIIW – WIFO, 2002).

In a long-term perspective, foreign investment in the manufacturing industry in eastern European accession countries has grown significantly. The ICT sector has become more and more important for foreign investors, whereby the telecommunications sector is particularly crucial. Producing telecommunications equipment also became important in some accession countries in the late 1990s. Assembling lines in the electronics industry can be built quickly if conditions for investors are attractive in eastern Europe.

With respect to digital modernization in EU accession countries, the role of the International Telecommunications Union's international settlement regime is noteworthy. Generally speaking, CEECs represent the beneficiaries of this international organization and the respective settlement rules. The price-oriented split of revenues in international telecommunications – between the outgoing country/operator and the incoming country/operator – has benefited countries with high prices of monopoly operators (or of operators which have politically set prices at a rather high level). Because the prices for international services in CEECs have been kept at a very high level, a strong asymmetry in traffic between developed and EU accession countries has emerged. Western telecommunications operators have been obliged to effectively give a generous contribution to CEECs' incumbent operators. We can easily highlight the asymmetry in international calls between USA and CEEC between 1990 and 1999. CEECs received

[14] This means that within period of 14 years (i.e., 1990-2003), EIB gave CEEC-8 loans for various investment programs in the amount of $15,8 billion, including ICT.

about $1.6 billion that decade (WALLSTEN, 1998); Poland, which is among the ten biggest net settlement surplus countries (7th position, 1998), received about $145 million net in 1998 from US telecom operators (KELLY and WOODALL, 1999**,** p. 3).

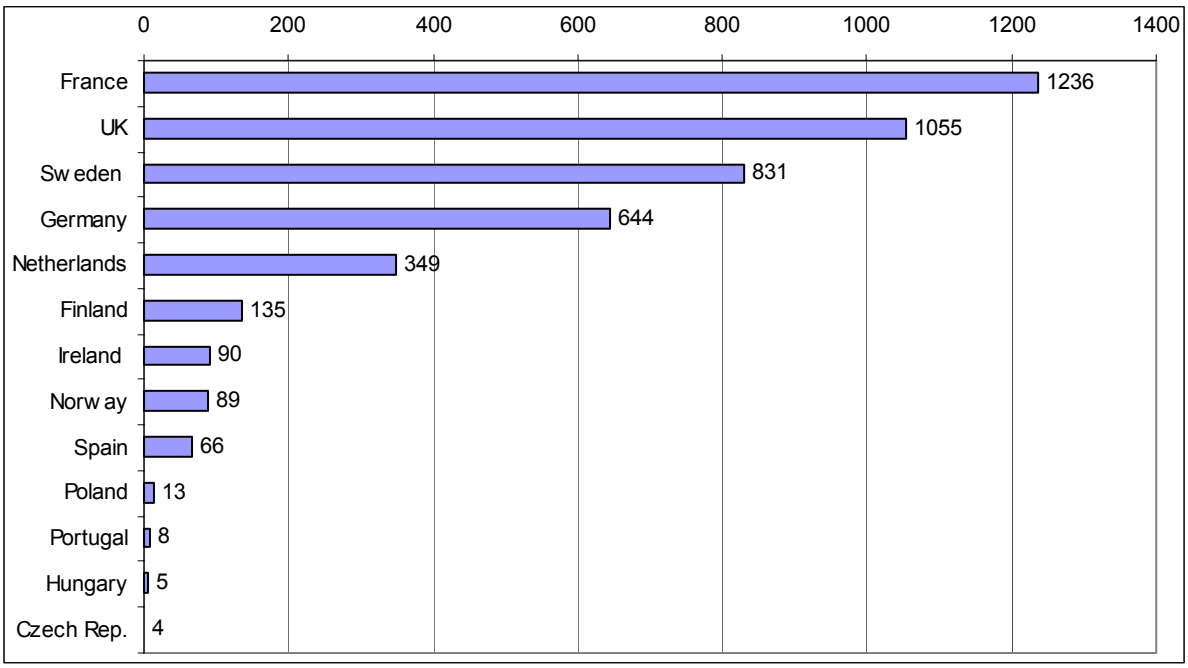
New financing instruments like private equity investment played a marginal role in the process of modernization in EU countries, with the exception of Germany, France, Sweden and UK. In general, private equity investment in European high-technology companies[15] decreased in Europe in 2001 and 2002, after a fast increase from €2.3 billion in 1997 to €11.5 billion in 2000.[16] In the year 2002, this reached a level of € 5.3 billion (PWC, 2003). Similar trends can also be observed in the four biggest EU accession countries, with private equity investment in high technology sectors reaching not more than 0.1 % of the total amount invested in Europe in the Czech Republic, Hungary and Slovakia and 0.2% in Poland[17]. These modern investment instruments are also unpopular in less developed EU countries, where the share of private equity amount invested in technology-intensive fields does not exceed 0.3% of European private equity investment in high technology. Comparing these shares with developed EU economies, private equity investment has played an important role as a financing instrument on the technology market. France (23.4%), United Kingdom (19.9%), Sweden (15.7 %) and Germany (12.2%) belong to the group of countries which most actively exploit the advantages of private equity investment. Taking a closer look at venture capital investment in Europe (being part of private equity investment), we see that Poland, Hungary and the Czech Republic rank low in international comparison.

[15] A wide range of sectors are understood under the term, technology: communications, computer-related, electronic-related, biotechnology, medical/health related and internet technology.

[16] EU-15 plus Norway, Swiss, the Czech Republic, Hungary, Poland and the Slovak Republic.

[17] Private equity technology investment in the Czech Republic, Hungary, Slovakia and Poland achieved the level of €4, €5, €1 and €13 million, respectively

Fig. 7 : Venture Capital Investment in High Technology in Europe, 2002 (USD Mill.)



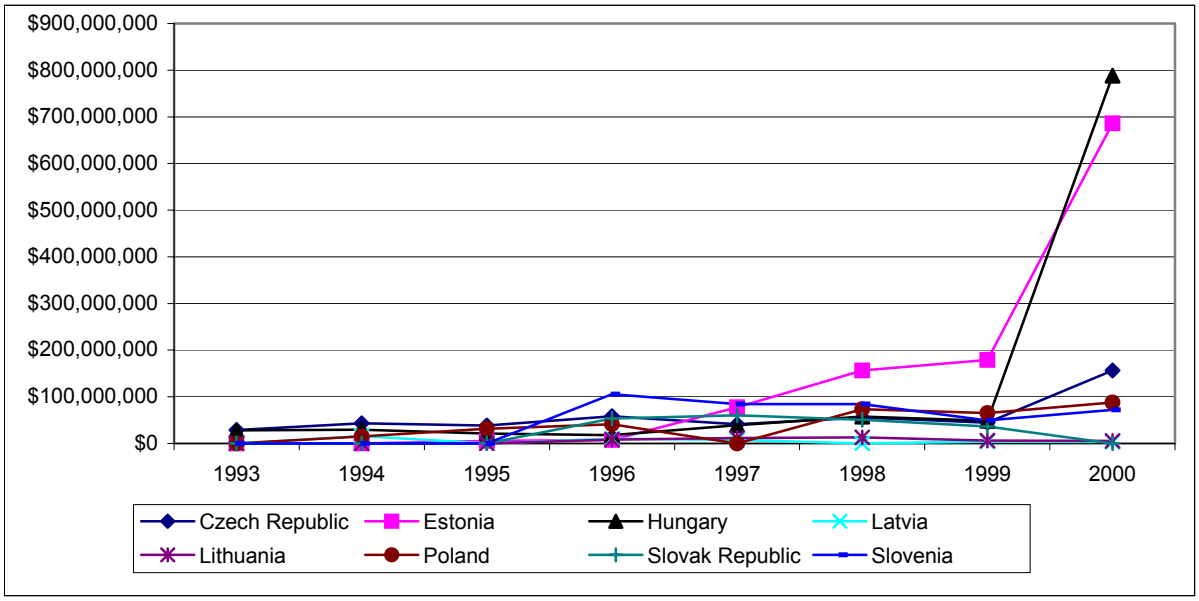
Source: PWC (2002)

The digital modernization of telecommunications also has implications for the trade balance. Upgrading and extending the communications network requires increased imports of technology-intensive equipment and software. Thus, it is interesting to shed light on trade patterns of telecommunications equipment[18]. Generally speaking, the digital modernization has significantly contributed to a rising trade balance deficit in accession countries. As one can see in the following figure, there was a gradual increase in the import of telecommunications equipment in the first half of the 1990s and an acceleration in the second part of the decade. The increase in exports of telecommunication equipment from central and eastern European countries is also noteworthy, although the amounts and annual growth rates do not exceed the figures on the import side except in Hungary and Estonia, which both had large MNC investment in the electronics industry. Positive growth in exports of transition countries indicates structural change and effects of economic opening up, which for some CEEC countries involves specialization in the production of certain ICT products. To the extent that ICT production is strongly associated with productivity growth, such a pattern of specialization will contribute to higher output growth, reinforcing economic catching up. From this perspective, two countries (i.e., Estonia and Hungary) indeed demand special attention. They recorded foreign direct investment by multinational companies in the ICT sector (e.g., IBM, Philips, Sony, Nokia,

[18] The data are aggregated from the following Standard International Trade Classification (SITC) subgroupings: (1) 764.1 Electrical apparatus for line telephony or line telegraphy (including such apparatus for carrier-current line systems). Telephone sets; teleprinters; telephonic or telegraphic switching apparatus; other apparatus for carrier-current line systems; other telephonic or telegraphic apparatus. (2) 764.3 Transmission apparatus for radio-telephony, radio-telegraphy, radio-broadcasting or television, whether or not incorporating reception apparatus or sound-recording or reproducing apparatus. Transmission apparatus; transmission apparatus incorporating reception apparatus. (3) 762.81 reception apparatus for radio-telephony or radio-telegraphy; and (4) Parts and accessories suitable for use solely or principally with the apparatus of sub-group 764.1. Expressed in US dollars.

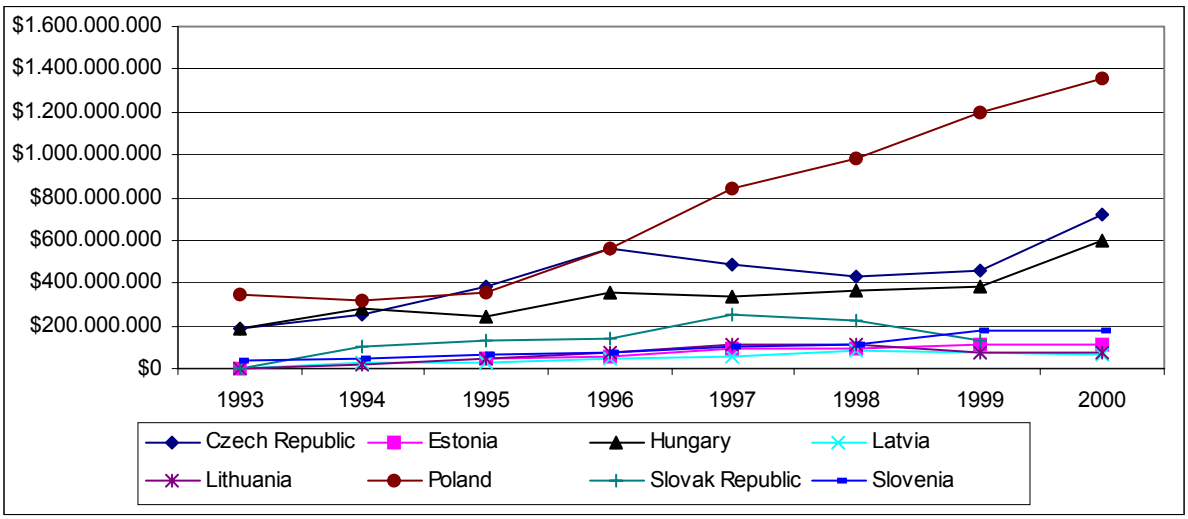
Samsung, Ericsson and Siemens) which used the new plants mainly for exporting to international – including EU-15 – markets.[19]

Fig. 8 : Export of Telecommunications Equipment in CEECs, 1993-2000 (USD)



Source: ITU (2002)

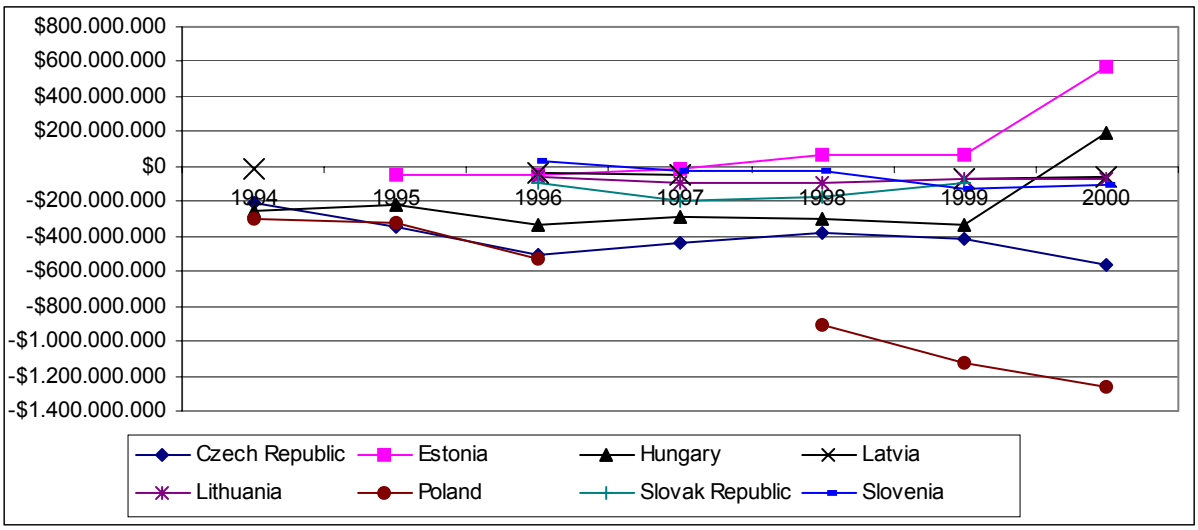
Fig. 9 : Import of Telecommunications Equipment in CEECs, 1993-2000 (USD)



Source: ITU (2002)

[19] The mentioned companies specialize in different areas of the ICT sector, including telephone exchanges and handsets, monitors, audio devices, monitors and TV sets (RADOSEVIC, 2002).

Fig. 10 : Balance of Trade in Telecommunications Equipment in CEECs, 1993-2000 (USD)



Source: ITU (2002)

It is not really clear whether accession countries have dynamic comparative advantages in electronics or in the production of telecommunications equipment. Several MNCs have started to move plants to more lucrative locations (e.g., Bulgaria, Romania or China) after an initial phase of FDI in Hungary. This brought considerable unemployment in that industry in Hungary, with several thousand skilled workers being affected. With a real appreciation of currencies of accession countries, the relative wage advantage of other locations will rise over time.

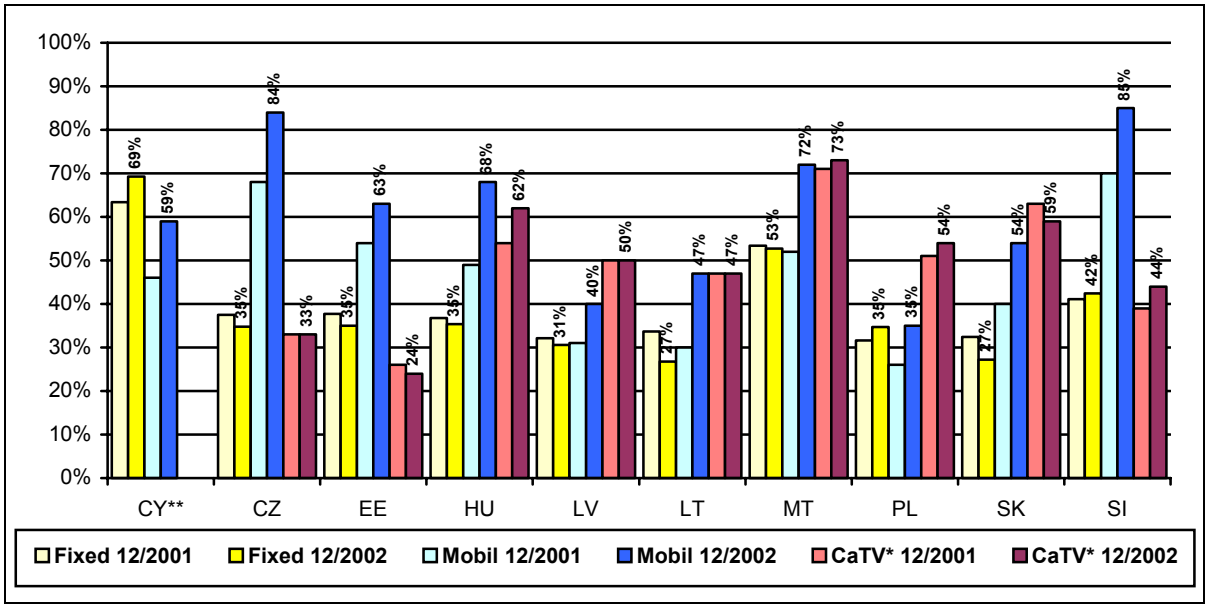
From this perspective, the question arises if creating links from old industrial structures of transformation economies to the dynamic networks of world economy can be interpreted in terms of shallow or deep integration (SZALAVETZ, 2002). It is well known that the incorporation of existing industrial organizations into the vertically-integrated production networks of MNCs can bring major short-term benefits, but it is doubtful that it brings a major contribution to the process of systemic transformation. Certainly from a middle-term perspective, there could be positive technology spillover effects and human capital upgrading, gradually leading to a sectoral specialization associated with a more intensive use of immaterial assets in production and more innovation activities.[20] This change can bring countries on a comprehensive path of deep integration with part of the international production network in the export sector being characterized by elements of the New Economy. Ireland has set a good example in industrial modernization based on FDI inflows into the IT sector.

Considering the developments in the extension of telecommunication infrastructure and digital modernisation of infrastructure, EU accession countries achieved high level, although there is still the need for improvement especially in rural areas. Statistics for the number of fixed lines per 100 inhabitants shed light on a very interesting – specific for central and eastern European countries – development. Due to liberalisation processes, vast investment programs by ex-monopolists as well as a rapid expansion of newcomers, the fixed telephone household penetration rate rose significantly over the last 12 years in

[20] The R&D centres of MNCs has been gradually creating in EU accession countries, i.e. IBM in in Prague, Nokia, Ericsson and Xerox in Budapest.

nearly all EU accession countries, up to a level of nearly 70 % of all households. Since 2001, however, this quota has sunk in all countries except Slovenia. Similar observations can also be made on the basis of fixed telephone penetration rates referring to the number of inhabitants, with the exception of Cyprus, Poland and Slovenia, where the rates have increased (see graph below).

Fig. 11 : Basic Communication Access Infrastructure in EU Accession Countries: Cable-TV, Fixed and Mobile Telephone Penetration Rates (Connections per 100 Inhabitants*)



Note: * CaTV penetration rate relates to the percentage of households passed by CaTV Operators; ** In Cyprus, there is no CaTV operator.

Source: PWC (2002) and IBM (2003)

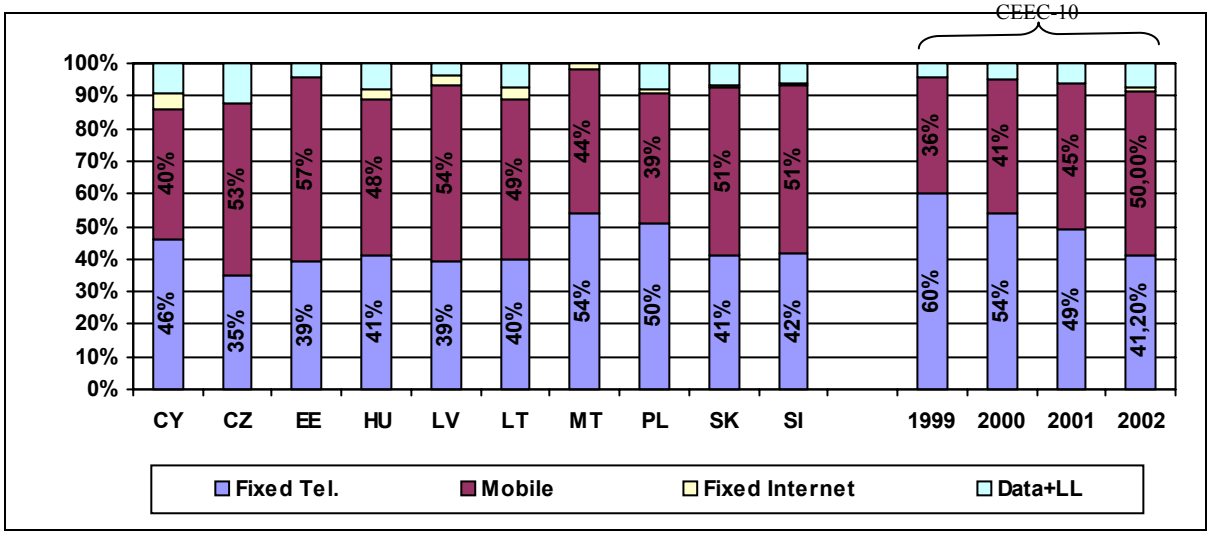
The observed decrease in the connections of fixed telecommunications can be interpreted twofold. On one hand, from the market efficiency gap perspective and on the other, from access gap (WORLD BANK, 2002). First, because of slow market liberalisation of telecommunications, optimal performance of the fixed telecommunications sector has not been achieved. In central and eastern European countries, for example, the prices for telecommunication services are still high, and the popularity of enhanced telecommunications access (e.g., ISDN or xDSL)[21] is very low. Existing gaps can be corrected through market mechanisms, assuming the existence of effective regulatory institutions. Second, the access gap in CEECs must be recognized. In this case, it refers to the limitations of the market (i.e. in spite of efficient and highly competitive markets, some services cannot be delivered because of a lack of profitability). The need for state intervention in the form of state assistance (e.g., public subsidies based on competitive principles) can help in eliminating this gap.

Emerging new markets, like cable TV (offering bundled telecommunications and internet services for households more and more frequently) or cellular telecommunications,

[21] XDSL means x Digital Subscriber Line. X behind DSL represents different types of DSL (e.g. A, H, M, RA, S, V).

gradually take over some group of customers and wean new ones. These communications platforms have been expanding since the beginning of the 90s and have gradually become substitutes for fixed telecommunications. The average investment needed for the creation of one connection for both cellular service and CaTV does not exceed $730, which in comparison with traditional fixed telecommunications is considerably different[22]. From this perspective, one might suspect that the emergence of new communications networks influences the performance of fixed networks, simultaneously boosting the development of competition within the sector. RAGHBENDRA and MAJUMDAR (1999) have proved a positive and significant impact of cellular technology diffusion on the competitiveness of telecommunication sector in OECD countries in the period from 1980 to 1995.

Fig. 12 : Telecommunications Market Segmentation in EU Accession Countries (left) and Regional Development* (right), 2000



Note: * - Cyprus, Malta has been excluded, LL – leasing of lines.

Source: PWC (2002), IBM (2003), own calculations.

The above-mentioned market structure change relates to market revenue developments. In 2002, revenue from mobile telecommunication exceeded revenues from traditional fixed telecommunications in seven of the ten countries. Moreover, mobile telecommunications is seen as very remunerative. One can expect that this tendency within fixed telecommunication can be changed in EU accession countries, if coupled with the development of broadband access that boosts the development of internet. Up to now, however, the development of ISDN or xDSL access technologies has proceeded quite sluggishly.

The development of broadband access technologies was introduced very late in EU accession countries. At the beginning, the main aim of the sector was to achieve an appropriate level of accessibility to basic telecommunication services. Based on WELFENS and GRAACK (1997), similar tendencies could be observed in EU countries with a poor telecommunications infrastructure at the beginning of 1990s (e.g., Spain, Portugal and Greece).

[22] For a comparison of investments in fixed telecommunications, see the beginning of chapter 3.

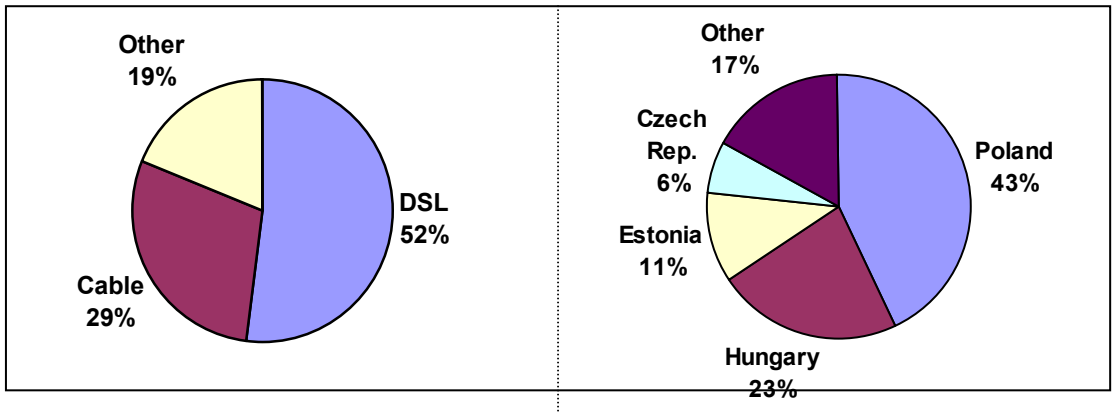
Tab. 6 : ISDN and xDSL Subscribers in EU Accession Countries

	1993 ISDN	1994 ISDN	1995 ISDN	1996 ISDN	1997 ISDN	1998 ISDN	1999 ISDN	2000 ISDN	2001 ISDN	2002 DSL
Cyprus	0	0	0	28	621	1.279	2.607	7.195	14.082	4200
Czech Republic	0	0	0	0	196	2.753	11.394	26.194	84.000	0
Estonia	0	35	114	279	887	2.307	5.481	9.463	11.095	22500
Hungary	0	0	90	1.756	3.472	5.650	25.545	103.662	..	28118
Latvia	0	0	0	0	0	918	2.815	5.785	5.011	5585
Lithuania	0	0	0	0	0	79	421	3.085	6.557	6129
Malta	0	0	0	0	0	0	0	441	864	7858
Poland	0	45	82	238	450	1.213	24.714	57.158	..	87630
Slovak Republic	0	0	0	0	0	771	4.353	11.911	..	0
Slovenia	0	0	981	1.794	6.445	13.918	30.785	54.748	76.291	7956
Greece	0	0	0	981	1.926	3.706	29.020	100.918	..	
Ireland	0	0	0	0	5.819	9.774	28.983	43.367	..	
Portugal	0	1.827	7.891	19.667	47.845	90.354	139.657	195.033	240.032	
Spain	138	2.234	10.828	35.406	85.641	182.240	364.421	646.105	..	

Source: ITU (2002) and IBM (2003)

Initial implementation of ISDN in EU accession countries (i.e., in Poland and Estonia) took place in 1994 and has not won much popularity up to now. These services have mostly been directed to the business customers. The developments on the xDSL market depict another situation. Although first attempts of a broad implementation of xDSL on the market took place at the turn of year 2000/2001, the market has grown exponentially after its implementation, achieving better density than that of ISDN. Last year, xDSL became the biggest impetus of growth in broadband access within EU accession countries, reaching approximately twice the number of subscribers in 2003 (820,000) as in 2001 (400,000). In 2003, the broadband market value is estimated at $467 million.

Fig. 13 : Broadband Connections in Central and Eastern Countries in 2003 (left*) and share of Broadband Connections in Central and Eastern Countries in 2002 (right)**



*Source: *Budd, J. (2003), DSL Boosts Broadband Services in the Czech Republic and Slovakia, IDC and **Budd, J. (2003), Central and Eastern Europe Broadband Access Services and Analysis, 2002-2007, IDC.*

The role of Cable TV operators in broadband diffusion within central and eastern European countries should not be overlooked. For four years, a rapid expansion of operators in this market of internet access has been observed. These technologies dominate especially in markets in which DSL rollout has not yet taken place (e.g., even Czech Telekom expects up to 30,000 connections in the Czech Republic by the end of 2003). The positive reception of DSL[23] has gradually changed business circumstances. Strong competitiveness between different broadband access modes can be expected. Especially the rapid rolling out of wireless technologies could play a significant role here. Additionally, the more and more frequent implementation of modern business strategies in the ICT sector – for example, bundling (e.g. the provision of internet, telephone and cable TV services as a package plan) makes the situation more complex and promotes the implementation of new developments in terms of market structure (i.e., market convergence by means of mergers, acquisitions and joint ventures); or legal aspects (i.e., introduction of new regulatory regimes concerning convergence developments) – play an important role here.

As mentioned above, new wireless technologies for broadband access play a significant role in CEECs. In terms of technological advancement and diffusion, the rates in EU accession countries are near, or sometimes even exceed, those of their EU counterparts. Roots of wireless communication in EU accession countries can be dated back to the beginning of the 1990s, when the first analogue radio-communication systems were implemented. High usage costs, the quality of law services quality as well as narrow possibilities for the implementation of value added services have been slowing down the broad implementation of mobile telecommunication. The initial introduction of second generation digitalized technologies allowed the market to expand.

[23] It should be mentioned that most telecom providers offered broadband access mostly to business customers until the end of 2001.

Tab. 7 : Mobile and Fixed Internet Access Speeds

Mobile Generation	Mobile Technology	Theoretical Data Speed	Actual Data Speed	Forecast Data Speed 2006
2G	GSM	14.4 Kbps	7-9 Kbps	..
	HSCSD	36 Kbps	20 Kbps	30 Kbps
	PHS and PDC	64 Kbps	10-20 Kbps	..
	CDMA	64 Kbps	10-20 Kbps	..
2.5G	GPRS	115 Kbps	25 Kbps	60 Kbps
2.75G	EDGE	384 Kbps	36 Kbps	80 Kbps
3G	UMTS	2 Mbps	40 Kbps	200 Kbps
4G	OFDM	20-54 Mbps	Not expected before 2008	..
Fixed Generation	**Transmission speed[1)]**			
	Downstream		**Upstream**	
Dial-up modem	Up to 56 Kbps		Up to 56 Kbps	
ISDN	56-128 Kbps		56-128 Kbps	
xDSL	1.5-9 Mbps		64-500 Kbps	
Cable modem	0.5-30 Mbps		0.1-1 Mbps	

Note: 1) Downstream refers to data transmission towards the user; upstream refers to transmission back to the service provider.

Source: Montagnier P., Muller E., Vickery, G. (2002), The Digital Divide: Diffusion and Use of ICTs, OECD: Paris.

The average density of mobile telecommunications within EU countries in 2002 was 75%, while only about 35% in central and eastern Europe. There is still huge potential for investment and development of infrastructure.

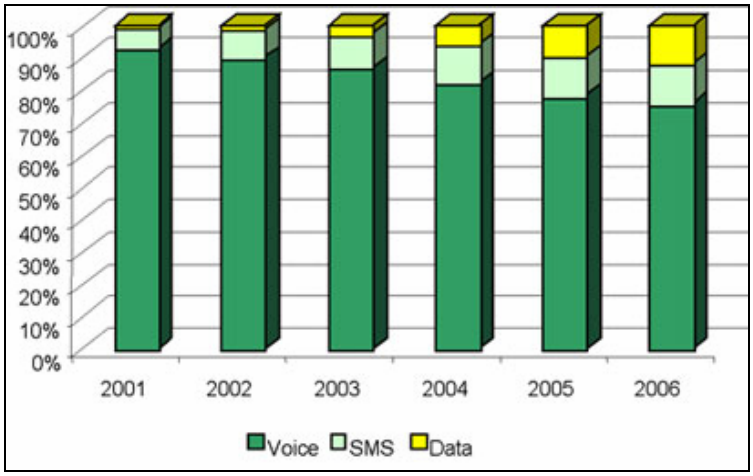
In central and eastern European countries, mobile operators also paid for the 3G/UMTS licenses, between $9 per capita in the Czech Republic, up to $45 per head in Slovenia and nearly $51 in Poland. This, however, is nothing in comparison to the $600 spent in western countries. Thus countries could concentrate merely on the geographic rolling out of the existing system and not on the extent of market scarcity in investment capital.

Looking at all accession countries together, the regional average penetration reached a level of 43% of the population in 2002. Regional subscription penetration varied widely, from just over 15% in some countries to nearly 80% in others. Special attention should be drawn to the leading markets existing in some EU members, reaching upwards of 90%.

In terms of penetration, the development of mobile telecommunication in the least developed markets is worth mentioning. They expand very quickly, and the regional penetration is expected to reach 73% in 2007. In 2002, regional spending on mobile services amounted to $9.2 billion. The significance of SMS services in revenues increased to 15% in 2002, up from 10%. In 2002, data and SMS accounted for 7% of all revenue in CEE. SMS services alone accounted for 6.7% of all revenue. New services, like MMS and other GPRS-based applications, have been launched across most of the region and are gradually picking up usage. UMTS should spread rather rapidly across the region in the near future, but its commercial success and significant usage levels are more long-term prospects.

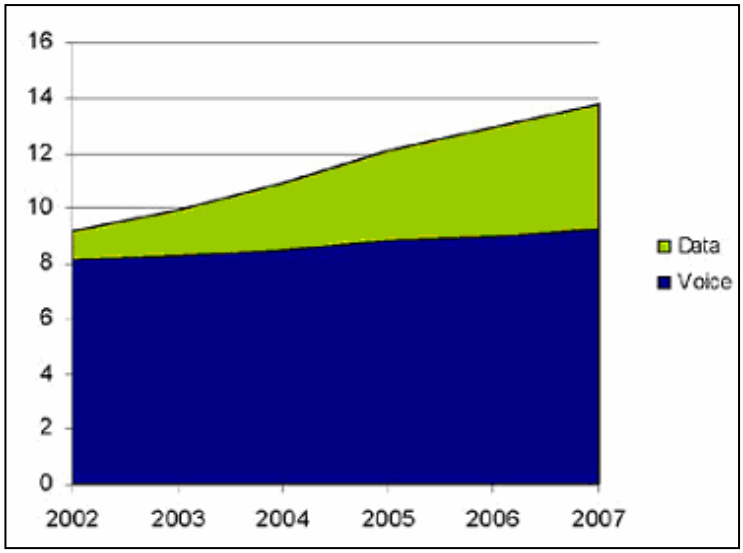
By 2006, voice services will generate 76% of all revenue. The rest will be evenly split between SMS and other data services.

Fig. 14 : The Emerging Role of Data Services; Mobile Service Revenue by Type in CEE, 2001-2006



Source: Ludwiczynski A. (2002).

Fig. 15 : Mobile Voice and Data(*) Spending in CEE, USD Billion, 2002-2007



(*) The "data" category includes data services and SMS

Source: Ludwiczynski A. (2003).

4. Policy Conclusions

From a policy perspective, it is crucial that competition in EU accession countries be realized. For small countries – such as the Baltic countries – this might require regional network integration. Finland has shown in EU-15 that even in a relatively small country, there can be strong competition. Internet competition in local access markets is also crucial. The unbundling requirement of the EU framework regulation is important, as it will force eastern EU accession countries to establish competition in the access market, which in turn should help to bring down prices for internet use. For the business community, broadband internet access will be quite important, leading to a greater need for the expansion of DSL, cable networks and mobile broadband technology in eastern EU accession countries.

As several network operators from EU-15 have invested in fixed link telecommunications or in mobile network providers, the prospects for EU accession countries to catch-up with EU-15 are rather favorable. Sustained high aggregate output growth will stimulate the demand for telecommunication services, and the presence of many multinational companies in accession countries – above all in Hungary, the Czech Republic and Poland – will add to sophisticated demand for digital value-added services. Mobile telephony is likely to be more important than fixed line telephony in the medium-term, since competition in mobile telecommunications is more intense than in fixed line telecommunications where the dominance of the former monopoly operator is quite obvious in all transition countries of eastern Europe. Within the accession countries, there is a clear digital divide between metropolitan areas and the countryside or peripheral regions. If this telecommunications gap should continue, there are rather grim prospects for poor regions to catch-up with national average in terms of per capita income. National governments and the European Union should therefore closely watch how large and sustained the digital regional gap in accession countries is. It might be useful for the European Commission to encourage the use of structural funds to invest in the expansion and modernization of telecommunications in economically-challenged areas.

Digital modernization of government and public administration will also be useful for improving productivity and growth in accession countries. However, a lack of skilled personnel could be a problem in both the public and private sectors. As one may indeed expect that increasing the use of ICT goes along with a higher demand for skilled labor, it would also be reasonable to expect a rising wage premium to the favor of skilled workers. It would be wise for governments in accession countries to increase government expenditures in the field of education and retraining while putting particular emphasis on learning with and about modern software as well as advanced communication opportunities.

As regards options to attract high FDI in the ICT producing sector, there are some natural opportunities for Estonia to benefit from ethnic links with Finland. Hungary offers relatively skilled labor and a long tradition of software development which might help to nurture the software sector in Hungary while simultaneously attracting producers of ICT equipment. Poland has the advantage of a relatively large domestic market, a relatively good skill base among workers and close proximity to Scandinavia and Germany. This could be seen as a considerable incentive among producers from these countries who seek to exploit the relatively low wages in Poland. This, however, does not mean that Poland should be expected to strongly specialize in technology intensive products. Taking a closer look at the production process, one will typically find that assembly-line production is dominant in the electronics field. Only in the long-run will opportunities for moving up the

technology ladder gradually present themselves, namely as R&D intensity increases over time. This in turn requires that long-term government spending on the promotion of R&D – relative to GDP – must increase. Here, the strict EU budget rules could bring about some problems for accession countries already having suffered in 2002 and 2003 from high budget deficits.

There is not doubt that digitization and modern telecommunications will stimulate trade and investment in the new EU-25. From this perspective, it will be quite important that regulators in EU accession countries adopt a regime consistent with the acquis communautaire that also stimulates economic development. One may anticipate that within a decade, some of the accession countries will come close to the indicators of EU average.

Appendix

Tab. 8 : Period Needed for Economic Catch-up: EU Accession Countries and Poor EU Members*

EU AC countries	GDP per capita, PPP ($)	Years needed to Catch-up to the EU average Hypothetic Average Economic Growth Rates				
	2002	1%	2%	3%	4%	5%
Slovenia	18.000	39	19	13	10	8
Malta	17.000	44	22	15	11	9
Czech Rep.	15.300	55	28	19	14	11
Cyprus	13.300	69	35	23	18	14
Hungary	13.300	69	35	23	18	14
Slovakia	12.200	78	39	26	20	16
Estonia	10.900	89	45	30	23	18
Poland	9.500	103	52	35	26	21
Latria	8.300	117	59	39	30	24
Lithuania	8.400	115	58	39	29	24
EU AC average	**12.620**	**74**	**37**	**25**	**19**	**15**
Spain	20.700	25	12	8	6	5
Greece	19.000	33	17	11	8	7
Portugal	18.000	39	19	13	10	8
EU-3 average	**19233**	**32**	**16**	**11**	**8**	**7**
EU-15 average	**26466**					

Note: For the simplification of analysis it has been assumed that average GDP of EU-15 is constant during process of catch-up. Demographic developments over time have not been taken into consideration.

Source: Own calculations based on data from the World Fact Book (2002).

Tab. 9 : Technology Cost Guidelines

Technology	Density / Application	Geography /Distance from telephone exchange	Cost range per line (in econ. Niche) incl. Accessories
Cellular Networks (GSM, UMTS)			$700
CATV	High and clustered		$600
Fiber to the home (FTTH)*	High (urban areas, sub-urban or peri-urban communities)	Max 10 km radius from exchange	$2000 (per residential connection)
Cable direct from urban switch	High and clustered (sub-urban or peri-urban communities)	Max 5 to 10 km radius from exchange	$250 - $1000
Rural exchange or concentrator with wire network	Low/Medium and clustered (small town or large village with good affordability)	As above, may serve clusters (e.g., 100 subscribers) located more than 10 km from nearest exchange	$1000 - $2000 including trunk system and building
Fixed cellular and wireless	Medium/high, not clustered	Medium area (<30 km radius per cell)	$500 - $1500 heavily dependent on users per cell
Multi-access radio	Low but clustered (e.g., more than 5 users per location)	Wide area (radius of several hundred km)	$1000 - $5000 varies widely with terrain and clustering
VHF/UHF signal links	Low, no clustering & no satellite alternative	Medium –long distance (>25 km)	$10000 +
Satellite VSAT (stand-alone)	Low, but most economic with some clustering (e.g., justifying 2-3 lines)	Very large area, long distances (>200 km)	$3000 - $8000 plus $0,05-0,10/min 'space segment'
Integrated VSAT/WLL	Low, but serving larger distant communities or clusters (typically 10 to 50 lines in vicinity)	Large area, but economic at shorter distances (e.g., 100 km)	$1500 - $3000 plus $0,05-0,10/min space segment'
Mobile satellite (MSAT and LEOs)	Low, with no clustering	Very large area & long distances	$1000 - $3000 plus $0,50/min space segment'

Note: * Data from Raghbendra and Majumdar (1999)

Source: Author's update from Navas-Sabater, J., et al (2002), p. 18.

References

AUDRETSCH, D.B., WELFENS, P.J.J., EDS. (2002), The New Economy and Economic Growth, Springer: Heidelberg

BARFIELD, E.B., HEIDUK, G., WELFENS, P.J.J. (2003), Internet, Economic Growth and Globalization, Springer: Heidelberg.

BUDD, J. (2003), Central and Eastern Europe Broadband Access Services and Analysis, 2002-2007, IDC.

BUDD, J. (2003a), DSL Boosts Broadband Services in the Czech Republic and Slovaki, IDC.

CASSEL, D., WELFENS, P.J.J., HG. (2003), Regionale Integrationsräume und Osterweiterung der Europäischen Union, Stuttgart: Lucius.

DUTTA, S., LANVIN, B., PAUA, F., EDS. (2003), Global Information Technology Report 2002-2003 -Readiness for the Networked World, World Economic Forum, p. 11.

DZIUBA, D. (2002), Sektor Informacyjny w Nowej Gospodarce, Uniwersytet Warszawski.

EBRD (2000), Telecommunications, Informatics and Media, European Bank for Reconstruction and Development, January 2000.

EITO (2002), European Information Technology Observatory 2003, Frankfurt.

EITO (2003), European Information Technology Observatory 2003, Frankfurt.

EU (2002), Overview of the EU regulatory framework for the electronic communications sector, http://www.europa.eu.int/information_society/topics/ecomm/all_about/todays_framework/index_en.htm

FREUND, C.L., WEINHOLD, D. (2003), The Internet and Evolving Patterns of International Trade, in : Barfield, E.B., Heiduk, G., Welfens, P.J.J. (2003), Internet, Economic Growth and Globalization, Springer: Heidelberg, p. 85-104.

HALTIWANGER, J., JARMIN, R., SCHANK, T. (2002), Productivity, Investment in ICT and Market Experimentation: Micro Evidence from Germany and the United States, paper presented at OECD Workshop on ICT and Business Performance, Paris.

IBM (2003), 3rd Report on Monitoring of EU Candidate Countries, Brussels-Luxemburg.

ITS (2003), Communications Regulation in the Age of Digitalisation and Convergence, paper prepared for ITS 14th European Regional Conference, Helsinki/Finland, August 23-24 2003.

ITU (2003), Basic Indicators, www.itu.org.

JUNGMITTAG, A., WELFENS, P.J.J. (1996) Telekommunikation, Innovation und die langfristige Produktionsfunktion: Theoretische Aspekte und eine Kointegrationsanalyse für die Bundesrepublik Deutschland, October 1996, EIIW Discussion Paper No 20.

KELLY, T., WOODALL, M. (1999), Telecom Traffic Indicators, Analysis, ITU.

KENNY, C., NAVAS –SABATER, J., C. QIANG, C. (2001), Information and Communicaitons Technologies and Poverity, World Bank.

KOLODKO, G., ED. (2001), Nowa Gospodarka i jej implikacje dla dlugookresowego wzrostu w krajach posocjalistycznych, Wydawnictwo Wyzszej Szkoly Przedsiebiorczosci i Zarzadzania im. Leona Kozminskiego.

KOLODKO, G.W. (2001), The `New Economy´ and Old Problems: Prospects for Fast Growth in Postsocialist Countries, TIGER, Paper presented to the international conference on: The New Economy and Ith Implications for Long-Term Growth in Post-Socialist Countries, WSPIT, March 30-31, 2001.

KOLODKO, G.W. (2002), Globalization and Catsching-up in Emerging market Economies, Discussion Paper No. 2002/51, United nations University and World Institute for Development Economic Research.

LEE, J. OM, K., RIM, M., SAWNG, Y. (2002), Realizing Digital Life in Korea: Core Technology and Promotion Policy, Discussion Paper in frame of Research on "IT R&D and Innovation Systems" project.

LUDWICZYNSKI, A. (2003), Central and Eastern European Mobile Communications Services Forecast, 2002-2007, IDC Central Europe.

LUDWICZYNSKI, A. (2003), Central and Eastern European Mobile Communications Services Forecast, 2001-2006, IDC Central Europe.

MONTAGNIER, P., MULLER E., VICKERY, G. (2002), The Digital Divide: Diffusion and Use of ICTs, OECD: Paris.

NACAS-SABATER, J., DYMOND, A., JUNTENEN, N. (2002), Telecommunications and Information Services for the Poor, World Bank Discussion paper No. 432.

OECD (2003), Communications Outlook 2003, OECD, Paris.

OK, W., ARNAL, E., TORRES, R. (2002), Knowledge, Work Organisation and Economic Growth, in : Audretsch, D.B., Welfens, P.J.J., Eds. (2002), The New Economy and Economic Growth, Springer: Heidelberg, p. 327-276.

PORATA, M.U. (1974), Defining the Information Sector in the U.S. Economy.

PORATA, M.U. (1976), The Information Economy.

PWC (2002), Money for Growth, The European Technology Investment Report 2002, Price Waterhouse Coopers: London.

RADOSEVIC, S. (2002), Electronics industry in CEE: the emerging production location in alignment of networks perspective, Working Paper No. 21, ESRC at University London Collage.

RAGHBENDRA, J., MAJUMDAR, S.K. (1999), A Matter of Connections: OECD Telecommunications Sector Productivity and the Role of Cellular Technology Diffusion, Information Economics and Policy 11 (1999) 243-269.

SZALAVETZ, A. (2001), Strukturalne i Regionalne Implikacje "Nowej Gospodarki" w Krajach Transformacji na Przykladzeie Wegier, in: Kolodko, G., ed. (2001), Nowa Gospodarka i jej implikacje dla dlugookresowego wzrostu w krajach posocjalistycznych, Wydawnictwo Wyzszej Szkoly Przedsiebiorczosci i Zarzadzania im. Leona Kozminskiego, p. 277-297.

WALLSTEN, S.J. (1998), Telecom Traffic and Investment in Developing Countries: The effects of International Settlement Rate Reduction, The World Bank.

WELFENS, P.J.J. (1997), Telecommunications in Systemic Transformation: Theoretical Issues and Policy options, in: Welfens, P.J.J., Yarrow, G. (1997),

Telecommunications and Energy Sector in Systemic Transformation, Springer: Heidelberg and New York, p. 85-138.

WELFENS, P.J.J., JUNGMITTAG, A. (2002), Internet, Telekomlibersalisierung und Wirtschaftswachstum, Springer: Heidelberg.

WELFENS, P.J.J., JUNGMITTAG, A. (2002a), Europäische Telekomliberalisierung und Außenhandel, Jahrbücher für Nationalökonomie und Statistik, Bd. 222/1, Lucius&Lucius, Stuttgart, p. 98-111.

WELFENS, P.J.J., JUNGMITTAG, A. (2003), Telecommunivations, Internet, Innovation and Growth in Europe, in : Barfield, E.B., Heiduk, G., Welfens, P.J.J. (2003), Internet, Economic Growth and Globalization, Springer: Heidelberg, S. 9-65.

WELFENS, P.J.J., YARROW, G., EDS. (1997), Telecommunications and Energy Sector in Systemic Transformation, Springer: Heidelberg and New York.

WELFFENS, P.J.J., GRAACK, C. (1997), Telecommunications in Western Europe: Liberalisation, Technological Dynamic and Regulatory Developments, in: Welfens, P.J.J., Yarrow, G. (1997), Telecommunications and Energy Sector in Systemic Transformation, Springer: Heidelberg and New York, p. 9-78.

WIIW – WIFO (2002), Foreign Direct Investment in Eastern Europe, Wiener Institut für internationale Wirtschaftsvergleiche, Vienna.

WORLD BANK (2002), The Network Revolution and Developing World, Final Report for World Bank and infoDev, Analysys Report Number 00-216, May 2nd , 2002.

EIIW Discussion Papers

ISSN 1430-5445:
Standing orders (usually 13 issues or more p.a.): academic rate 95 Euro p.a.; normal rate 250 Euro p.a.
Single orders: academic rate10 Euro per copy; normal rate 20 Euro per copy.

Die Zusammenfassungen der Beiträge finden Sie im Internet unter:
The abstracts of the publications can be found in the internet under:

http://www.euroeiiw.de

No. 1 **Welfens, P.J.J.:** Telecommunications in Systemic Transformation, January 1995.

No. 2 **Welfens, P.J.J.; Graack, C.:** Telecommunications in Western Europe: Liberalization, Technological Dynamics and Regulatory Developments, January 1995.

No. 3 **Welfens, P.J.J.:** Achieving Competition in Europe's Telecommunications Sector, February 1995.

No. 4 **Addison, J.T.:** The Dunlop Report: European Links and Other Odd Connections, May 1995.

No. 5 **Addison, J.T.; Blackburn, McKinley L.:** A Puzzling Aspect of the Effect of Advance Notice on Unemployment, May 1995.

No. 6 **Welfens, P.J.J.; Graack, C.:** Deregulierungspolitik und Wettbewerb in Netzindustrien: Bedeutung und Optionen für osteuropäische Transformationsländer, May 1995.

No. 7 **Addison, J.T. Chilton, J.B.:** Models of Union Behavior, June 1995.

No. 8 **Graack, C.:** EU-Telecom Markets and International Network Alliances: Developments, Strategies and Policy Implications, August 1995.

No. 9 **Welfens, P.J.J.:** Koordinationserfordernisse der EU-Infrastrukturpolitik, November 1995.

No. 10 **Hillebrand, R.:** Umweltpolitik in föderalen Systemen - eine kritische Analyse der EU-Umweltpolitik, December 1995.

No. 11 **Addison, J.T.; Schnabel, C.; Wagner J.:** On the Determinants of "Mandatory" Works Councils in Germany, December 1995.

No. 12 **Welfens, P.J.J.:** Towards Full Employment and Growth in the European Union, December 1995.

No. 13 **Welfens, P.J.J.:** Wirtschaftspolitische Kompetenzverteilung in der Europäischen Union, December 1995.

No. 14 **Welfens, P.J.J.:** Privatization, Efficiency and Equity, January 1996.

No. 15 **Hartwig, K.-H.; Welfens P.J.J.:** EU and Eastern Europe: Western European Integration and Eastern European Transformation, May 1996.

No. 16 **Welfens, P.J.J.:** Konsequenzen einer Osterweiterung für die EU und deren Reformbedarf, May 1996.

No. 17 **Graack, C.:** Structure of the Telecoms Sector and Degree of Internationalization in Europe and Russia, July 1996.

No. 18 **Bogai, D.:** Werkstatt der Deutschen Einheit? Wirtschaft und Arbeitsmarkt in der Region Berlin-Brandenburg, October 1996.

No. 19 **Graack, C.:** Internationale Aspekte der Telekommunikationswirtschaft: Liberalisierung, internationale Tarifmechanismen und Wohlfahrtseffekte, October 1996.

No. 20 **Jungmittag, A.; Welfens P.J.J.:** Telekommunikation, Innovation und die langfristige Produktionsfunktion: Theoretische Aspekte und eine Kointegrationsanalyse für die Bundesrepublik Deutschland, October 1996.

No. 21 **Welfens, P.J.J.; Guth M.:** EU-Strukturpolitik in Deutschland: Entwicklung, Effizienzüberlegungen und Reformoptionen, October 1996.

No. 22 **Welfens, P.J.J.; Graack C.:** Telekommunikationsmärkte in Europa: Marktzutrittshemmnisse und Privatisierungsprobleme aus Sicht der Neuen Politischen Ökonomie, October 1996.

No. 23 **Welfens, P.J.J.:** Die Position Deutschlands im veränderten Europa: Wirtschaftliche und reformpolitische Perspektiven, November 1996.

No. 24 **Hartmann, P.:** Foreign Exchange Vehicles Before and After EMU: From Dollar/Mark to Dollar/Euro?, November 1996.

No. 25 **Jungmittag, A.; Welfens P.J.J.:** The Political Economy of EMU and Stabilization Policy, May 1997.

No. 26 **Hölzler, H.:** Privatisierung und Einführung von Wettbewerb in Rußland, January 1996.

No. 27 **Welfens, P.J.J.:** Small and Medium-sized Companies in Economic Growth: Theory and Policy Implications in Germany, May 1997.

No. 28 **Bogai, D.:** Europäische Arbeitsmarktpolitik und nationale beschäftigungspolitische Initiativen, May 1997.

No. 29 **Welfens, P.J.J.:** Research & Development Policy and Employment, June 1997.

No. 30 **Sinclair, A.:** Liberalising the Electricity Supply Industry in Western and Eastern Europe: Lessons for Russia, July 1997.

No. 31 **Graack, C.:** Infrastructure Investments and Regulation in Telecommunications, July 1997.

No. 32 **Welfens, P.J.J.; Schwarz A.:** Die Rolle des Staates in der Sozialen Marktwirtschaft bei Globalisierung der Wirtschaftsbeziehungen, August 1997.

No. 33 **Welfens, P.J.J.; Wiegert R.:** Transformation Policies, Regulation of Telecommunications and Foreign Direct Investment in Transforming Economies, July 1997.

No. 34 **Welfens, P.J.J.:** Internationalization of Telecoms, Deregulation, Foreign Investment and Pricing: Analysis and Conclusions for Transforming Economies, July 1997.

No. 35 **Schwarz, A.:** Subventionspolitik in den mittel- und osteuropäischen Transformationsländern: Gegenwärtige Strukturen, Probleme und Transparenzdefizite, September 1997.

No. 36 **Welfens, P.J.J.; Hillebrand R.:** Globalisierung der Wirtschaft: Wirtschaftspolitische Konsequenzen des internationalen Standortwettbewerbs, September 1997.

No. 37 **Stiller, H.:** Material Intensity of Transportation and Implications for Sustainable Mobility in Europe, September 1997.

No. 38 **Gerstberger, T.; Graack C.:** Competition and Deregulation in the Japanese Telecommunications Network Industry, September 1997.

No. 39 **Welfens, P.J.J.:** Wirtschaftspolitische Flankierungserfordernisse des Euro-Starts, November 1997.

No. 40 **Aslund, A.:** The Political Economy of Systemic Transformation and Institution-Bulding, November 1997.

No. 41 **Guth, M.:** Regionale Beschäftigungspakte im Rahmen der EU-STrukturpolitik: Hintergrund und Einordnung, November 1997.

No. 42 **Jungmittag, A.; Welfens P.J.J.:** Politische Ökonomie der Europäischen Währungsunion und Stabilitätspolitik, January 1998.

No. 43 **Welfens, P.J.J.:** Labor Costs, Unemployment and Innovation, February 1998.

No. 44 **Addison, J.T.; Audretsch, D.B.; Gries, T.; Grupp H.; Welfens, P.J.J.:** Economic Globalization, Innovation and Growth, April 1998.

No. 45 **Welfens, P.J.J.:** Euro, Währungsunion und EU-Binnenmarkt, April 1998.

No. 46 **Addison, J.T., Schnabel, C.; Wagner J.:** Works Councils in Germany: Their Effects on Firm Performance, March 1998.

No. 47 **Addison, J.T.; Portugal, P.:** Short- and Long-Term Unemployment, March 1998.

No. 48 **Welfens, P.J.J.:** Trade and Optimum Import Tariffs: A Note in the Context of Foreign Direct Investment, June 1998.

No. 49 **Bohn, F.:** Monetary Union and the Interest-Exchange Trade-off, July 1998.

No. 50 **Welfens, P.J.J.:** Exchange Rate Policy for the Euro: Theory, Strategic Issues and Policy Options, July 1998.

No. 51 **Addison, J.T.; Portugal P.:** Job Search Methods and Outcomes, July 1998.

No. 52 **Jungmittag, A.; Welfens P.J.J.:** Telecommunication, Innovation and the Long-Term Production Function: Theoretical Analysis and a Cointegration Analysis for West Germany 1960-1990, August 1998.

No. 53 **Welfens, P.J.J.:** Eastern EU Enlargement: Problems, Conflicts and Policy Options, September 1998.

No. 54 **Welfens, P.J.J.:** Die russische Transformationskrise: Monetäre und reale Aspekte sowie Politikoptionen, November 1998.

No. 55 **Graack, C.; Welfens, P.J.J.:** Internationaler Technologiewettlauf, Arbeitsmarktdynamik und Unternehmensgründungsdynamik bei Standortkonkurrenz, September 1998.

No. 56 **Welfens, P.J.J.:** Liberalisierung der Energiewirtschaft in Deutschland und EU-Partnerländern, Januar 1999

No. 57 **Welfens, P.J.J.:** The RussianTransformation Crisis: Origins, Analysis and NewPolicy Requirements, January 1999

No. 58 **Komulainen , Tuomas:** Currency Crisis Theories – Some Explanations for the Russian Case, May 1999

No. 59 **Welfens, P.J.J.:** Internet Market Dynamics in Germany: From a small Market towards a Strategic Sector of the Economy, May 1999

No. 60 **Wiegert, R.:** Der russische Bankensektor im Prozeß der Systemtransformation, Juni 1999

No. 61 **Vogelsang, M.:** How to rescue Japan: Proposal of a staggered VAT reform. Draft, May 1999

No. 62 **Welfens, P.J.J.:** The Start of the Euro, International Relations and Inflation, April 1999

No. 63 **Sutela, P.:** Overcoming the Russian Transformation Crisis: Selected Issues and Policy Options, June 1999

No. 64 **Bohn, F.:** The Italian Case: A Parable for the Eastern Enlargement of the EMU, July 1999

No. 65 **Meyer, B.; Welfens, P.J.J.:** Innovation – Augmented Ecological Tax Reform: Theory, Model Simulation and New Policy Implications, September 1999

No. 66 **Gavrilenkov, E.:** Crisis in Russia: Selected Problems of the Macroeconomic Performance, September 1999

No. 67 **Steinsdorff, S. v.:** Wie demokratisch ist Rußland? Dezember 1999

No. 68 **Pelzel, R.:** Internationalisierung der Telekommunikation, eine Vergleichsanalyse für USA, Großbritannien und Deutschland, Dezember 1999

No. 69 **Serebryakov, G.:** Structural Change and Econometric Prospective, January 2000

No. 70 **Bohn, F.:** Political Instability, Inflation, and International Loans, February 2000

No. 71 **Welfens, P.J.J.:** The EU and Russia: Strategic Aspects of Transformation and Integration, April 2000

No. 72 **Jungmittag, A.:** Techno-Globalismus: Mythos oder Realität?, Juli 2000

No. 73 **von Westernhagen, N.:** The Role of FDI in the Transition Process of Selected CIS and Eastern European Countries, September 2000

No. 74 **Welfens, P.J.J.; Hollants, J.; Kauffmann, A.:** Mittelständische Unternehmen und das Internet: Perspektiven in Deutschland, Oktober 2000

No. 75 **Jungmittag, A.; Welfens, P.J.J.:** Auswirkungen einer Internet Flatrate auf Wachstum und Beschäftigung in Deutschland, März 2000

No. 76 **Addison, J.T.:** Is Community Social Policy Beneficial, Irrelevant, or Harmful to the Labor Market Performance of the European Union?, September 2000

No. 77 **Welfens, P.J.J.:** Modern Exchange Rate Theory and Schumpetrian Economic Analysis: New Approach and Application to the Euro, June 2000

No. 78 **Guth, M.:** From technology policy for regions to regional technology policy towards a new policy strategy in the EU, December 2000

No. 79 **Welfens, P.J.J.; Kauffmann, A.; Vogelsang, M.:** Evaluationsbericht: Das Internet strategisch richtig nutzen, Februar 2001

No. 80 **Welfens, P.J.J.:** Transatlantische Wachstumsunterschiede, Euro-Schwäche und Finanzpolitik, Mai 2001

No. 81 **Jungmittag, A.; Welfens,P.J.J.:** Effects of an Internet Flat Rate on Growth and Employment in Germany, February 2001

No. 82 **Welfens, P.J.J.:** Transatlantic Growth Differentials, ICT Dynamics, Fiscal Policy and the Fall of the Euro, July 2001

No. 83 **Wiegert, R.:** Financial Sector and Human Capital in a Long-Term Growth Perspective: The Case of Russia, July 2001

No. 84 **Addison J.T.:** Principles of Market-Oriented Labor Market Policies; July 2001

No. 85 **Jungmittag, A.; Welfens, P.J.J.:** Europäische Telekomliberalisierung und Außenhandel: Theorie, Gravitationsansatz und Implikationen, Juni 2001

No. 86 **Ponder, J.K.:** Telekommunikationssektor in Polen: Entwicklungen, Investitions-perspektiven und Regulierung, Oktober 2001

No. 87 **Jungmittag, A.; Welfens P.J.J.:** Liberalization of EU Telecommunications and Trade: Theory, Gravity Equation Analysis and Policy Implications, October 2001

No. 88 **Bohn, F.:** Powerful Groups and Corruption, December 2000

No. 89 **Welfens, P.J.J.:** Aggregation in a Two-Sector Growth Model: A Modified Solow Approach with Cobb-Douglas Production Functions, September 2001

No. 90 **Welfens, P.J.J.:** Stabilization and Growth: A New Model, October 2001

No. 91 **Addison, J.T.:** Principles of Market-Oriented Labor Market Policies, March 2002

No. 92 **Jungmittag, A.:** Innovationsdynamik in der EU: Konvergenz oder Divergenz?, Eine Zeitreihen-Querschnittsanalyse, Februar 2002

No. 93 **Welfens, P.J.J.; Wiegert, R.:** Reform des Bankensektors und Stabilität in Rußland, November 2001

No. 94 **Welfens, P.J.J.:** Mittelfristige Herausforderungen für Euroland: Stabilität, EU-Osterweiterung, Wachstum; November 2001

No. 95 **Welfens, P.J.J.:** Constitutional Issues and the Quality of Political Competition: Analysis and Implications for a Future EU Constitution, April 2002

No. 96 **Jungmittag, A:** Innovation Dynamics in the EU: Convergence or Divergence?, A Cross-Country Panel Data Analysis, June 2002

No. 97 **Welfens, P.J.J.:** I&K-Technologie, Produktivität und Wachstum: Transatlantische Ananlyseperspektiven und wirtschaftspolitische Optionen, Juli 2002

No. 98 **Jungmittag, A.; Welfens, P.J.J.:** Telecommunication, Internet, Innovation and Growth in Europe and the US, August 2002

No. 99 **Welfens, P.J.J.:** Finanzpolitik zwischen Wachstumsschwäche und Maastrichter Vertrag / Stabilitätspakt: Ausgabenschwerpunkte neu setzen und kluge Steuerreform, September 2002

No. 100 **Gavrilenkov, E**: Macroeconomic Situation in Russia - Growth, Investment and Capital Flows, October 2002

No. 101 **Agata, K.**: Internet, Economic Growth and Globalization, November 2002

No. 102 **Blind, K.; Jungmittag, A.**: Ausländische Direktinvestitionen, Importe und Innovationen im Dienstleistungsgewerbe, February 2003

No. 103 **Welfens, P.J.J.; Kirn, T.:** Mittelstandsentwicklung, BASEL-II-Kreditmarktprobleme und Kapitalmarktperspektiven, Juli 2003

No. 104 **Standke, K.-H.**: The Impact of International Organisations on National Science and Technology Policy and on Good Governance, March 2003

No. 105 **Welfens, P.J.J.:** Exchange Rate Dynamics and Structural Adjustment in Europe, May 2003

No. 106 **Welfens, P.J.J.; Jungmittag, A.; Kauffmann, A.; Schumann, Ch.:** EU Eastern Enlargement and Structural Change: Specialization Patterns in Accession Countries and Economic Dynamics in the Single Market, May 2003

No. 107 **Welfens, P.J.J.:** Überwindung der Wirtschaftskrise in der Eurozone: Stabilitäts-, Wachstums- und Strukturpolitik, Juni 2003

No. 108 **Welfens, P.J.J.:** Risk Pricing, Investment and Prudential Supervision: A Critical Evaluation of Basel II Rules, September 2003

No. 109 **Welfens, P.J.J.; Ponder, J.K.:** Digital EU Eastern Enlargement, October 2003

EIIW Economic Policy Analysis

No. 1 **Welfens, P.J.J.:** Globalisierung der Wirtschaft und Krise des Sozialstaats: Ist die Wirtschaftswissenschaft am Ende?, April 1997

No. 2 **Welfens, P.J.J.:** Nach der D-Mark kommt die E-Mark: Auf dem Weg zur EU-Währungsunion, Juli 1997

No. 3 **Welfens, P.J.J.:** Beschäftigungsförderliche Steuerreform in Deutschland zum Euro-Start: Für eine wachstumsorientierte Doppelsteuerreform, Oktober 1998

Fordern Sie den EIIW Newsletter an: www.euroeiiw.de

Please subscribe to EIIW Newsletter: www.euroeiiw.de

Weitere Beiträge von Interesse:
Titels of related interest:

MC MORROW, K.; RÖGER, W. (2003), The Economic and Financial Market Consequences of Global Aging, Heidelberg and New York: Springer.

WIEGERT, R. (2003), Transformation, Wachstum und Wettbewerb in Rußland, Heidelberg und New York: Springer.

PETZOLD, L. (2003), Infrastrukturreform in Transformationsländern, Lohmar: EUL-Verlag.

LANE, T., ODING, N., WELFENS, P.J.J. (2003), Real and Financial Economic Dynamics in Russia and Eastern Europe, Heidelberg and New York: Springer.

BARFIELD, C.E., HEIDUK, G., WELFENS, P.J.J. (2003), Internet, Economic Growth and Globalization, Perspectives on the New Economy in Europe, Japan and the USA, Heidelberg and New York: Springer.

GRIES, T., JUNGMITTAG, A., WELFENS, P.J.J. (2003), Neue Wachstums- und Innovationspolitik in Deutschland und Europa, Heidelberg und New York: Springer.

ADDISON, J.T., WELFENS, P.J.J. (2003), Labor Markets and Social Security, Heidelberg and New York: Springer.

WELFENS, P.J.J., WIEGERT, R. (2002), Transformationskrise und neue Wirtschaftsreformen in Russland, Heidelberg und New York: Springer.

WESTERNHAGEN, N. VON (2002), Systemic Transformation, Trade and Economic Growth, Heidelberg and New York: Springer.

AUDRETSCH, D.B., WELFENS, P.J.J. (2002), The New Economy and Economic Growth in Europe and the US, Heidelberg and New York: Springer.

WELFENS, P.J.J. (2002), Interneteconomics.net, Heidelberg and New York: Springer.

BUNTE, H.-J., WELFENS, P.J.J. (2002), Wettbewerbsdynamik und Marktabgrenzungen auf Telekommunikationsmärkten, Heidelberg und New York: Springer.

JUNGMITTAG, A., WELFENS, P.J.J. (2002) Internet, Telekomliberalisierung und Wirtschaftswachstum, Heidelberg und New York: Springer.

SCHWARZ, A. (2001), Subventionen in Mittel- und Osteuropa, Lohmar: EUL-Verlag.

PELZEL, R.F. (2001), Deregulierte Telekommunikationsmärkte, Heidelberg und New York: Springer.

WELFENS, P.J.J. (2001), Stabilizing and Integrating the Balkans, Heidelberg and New York: Springer.

WELFENS, P.J.J. (2001), Internationalization of the Economy and Environmental Policy Options, Heidelberg and New York: Springer.

WELFENS, P.J.J. (2001), European Monetary Union and Exchange Rate Dynamics, Heidelberg and New York: Springer.

GAVRILENKOV, E., WELFENS, P.J.J. (2000), Restructuring , Stabilizing and Modernizing the New Russia, Heidelberg and New York: Springer.

TILLY, R., WELFENS, P.J.J. (2000), Economic Globalization, International Organizations and Crisis Management, Heidelberg and New York: Springer.

JUNGMITTAG, A., REGER, G., REISS, T. (Eds., 2000), Changing Innovation in the Pharmaceutical Industry. Globalization and New Ways of Drug Development, Heidelberg and New York: Springer.

GRAACK, C., WELFENS, P.J.J. (1999), Technologieorientierte Unternehmensgründungen und Mittelstandspolitik in Europa, Heidelberg und New York: Springer.

GRAACK, C., GRINBERG, R., WELFENS, P.J.J., YARROW, G. (Eds., 1999), Towards Competition in Network Industries – Telecommunications, Energy and Transportation in Europe and Russia, Heidelberg and New York: Springer.

ADDISON, J.T., AUDRETSCH, D.B., GRIES, T., GRUPP, H., WELFENS, P.J.J. (1999), Globalization, Economic Growth and Innovation Dynamics, Heidelberg and New York: Springer.

WELFENS, P.J.J. (1999), EU Eastern Enlargement and the Russian Transformation Crisis, Heidelberg and New York: Springer.

WELFENS, P.J.J. (1999), Globalization of the Economy, Unemployment and Innovation, Heidelberg and New York: Springer.

TILLY, R., WELFENS, P.J.J. (1999), Economic Globalization, International Organizations and Crisis Management, Heidelberg and New York: Springer.

WELFENS, P.J.J. et al. (eds., 1998), Competition in Network Industries: Telecommunications, Energy and Transportation in Europe and Russia, Heidelberg and New York: Springer.

PALKINAS, P.; EICHHORN, B., WELFENS, P.J.J. (eds., 1998), Europäische Währungsunion: Argumente und Fakten zur Euro-Debatte, Frankfurt/Main.

GLOEDE, K., STROHE, H.B. WAGNER, D., WELFENS, P.J.J. (eds., 1998), Systemtransformation in Deutschland und Rußland: Erfahrungen, ökonomische Perspektiven und politische Optionen, Heidelberg und New York: Springer.

AUDETSCH, D.B., ADDISON, J.T. GRUPP, H., WELFENS, P.J.J. (1998), Technological Competition, Employment and Innovation Policy in OECD Countries, Heidelberg and New York: Springer.

ADDISON, J.T., WELFENS, P.J.J. (eds., 1998), European Labor Markets and Social Security, Heidelberg and New York: Springer.

GRAACK, C. (1997), Telekommunikationswirtschaft in der Europäischen Union: Innovationsdynamik, Regulierungspolitik und Internationalisierungsprozesse, Heidelberg: Physica (award-winning book).

WELFENS, P.J.J., WOLF, H. (ed., 1997), Banking, International Capital Flows and Growth in Europe, Heidelberg and New York: Springer.

BÖRSCH-SUPAN, A., VON HAGEN, J., WELFENS, P.J.J. (eds., 1996,1997), Springers Handbuch der Volkswirtschaftslehre, Band 1 und 2, Heidelberg und New York: Springer.

WELFENS, P.J.J., YARROW, G. (eds., 1996), Telecommunications and Energy in Systemic Transformation, Heidelberg and New York: Springer.

GRAACK, C., WELFENS, P.J.J. (1996), Telekommunikationswirtschaft: Deregulierung, Privatisierung und Internationalisierung, Heidelberg und New York: Springer: (award-winning book).

WELFENS, P.J.J. (ed., 1996), European Monetary Integration, 3rd edition, Heidelberg and New York: Springer.

WELFENS, P.J.J. (ed., 1996), Economic Aspects of German Unification, 2. rev. and enlarged edition, Heidelberg and New York: Springer.

TILLY, R., WELFENS, P.J.J. (eds., 1995), European Economic Integration as a Challenge to Industry and Government, Heidelberg and New York: Springer.

WELFENS, P.J.J. (1995), Grundlagen der Wirtschaftspolitik, Heidelberg und New York: Springer.

JASINSKI, P., WELFENS, P.J.J. (1994), Privatization and Foreign Direct Investment in Transforming Economies, Aldershot: Dartmouth/Gower.

WELFENS, P.J.J. (1992), Market-oriented Systemic Transformation in Eastern Europe. Problems, Theoretical Issues and Policy Options, Heidelberg and New York: Springer.

KLEIN, M., WELFENS, P.J.J. (eds., 1992), Multinationals in the New Europe and Global Trade, Heidelberg and New York: Springer.

WELFENS, P.J.J. (1990), Internationalisierung von Wirtschaft und Wirtschafspolitik, Heidelberg und New York: Springer.

BALCEROWICZ, L., WELFENS, P.J.J. (1988), Innovationsdynamik im Systemvergleich. Theorie und Praxis unternehmerischer, gesamtwirtschaftlicher und politischer Neuerung, Heidelberg: Physica.