Union Network International

Investment and Employment in the Telecommunications Sector

April 2007

Rambøll Management
Nørregade 7A
DK-1165 Copenhagen K
Denmark

Phone: +45 3397 8200
www.ramboll-management.dk

Table of contents

Executive Summary

This final report is submitted by Rambøll Management to Union Network International and reports our own study on investments and employment in the telecommunications sector.

The overall objective of the study is to analyse the relationship between regulation and investment and to analyse the challenges for the employment in the telecommunications sector.

The conclusions are:

Failure to stimulate investments

The analysis regarding investment shows that regulation in the EU and US on investments has spurred competition but we found that the claims of a positive causality between regulation and investment are very difficult to verify. On the contrary, there is some evidence that the EU Commission has focused too narrowly on competition and disregarded a crucial side-effect, the sub-optimisation of (necessary) investment. Especially in certain parts of Europe, the level of investment is very low; France and Germany are the most striking examples, compared to Japan, UK and US.

- It is very difficult to maintain asymmetric regulation and at the same time try to fuel the investments in the next generation networks. Empirical evidence shows that the level of investment is lower in the EU compared to other regions, and a number of experts point to the asymmetric regulation and the diminished fixed-line revenues as the main reason.

- At the same time, there are also clear indications that the government-led strategy, followed especially in South Korea, designed to optimise investment, has placed the country at the forefront of the broadband penetration race.

Employment is declining in the telecoms sector

Employment in the telecommunications sector has been declining since the dot.com crash. The US and EU15 have experienced a decrease in the employment of more than 300,000 jobs since 1999.

The development of next generation networks means that the operators require employees in specific occupational categories. Looking into the future, the results indicate that skilled technicians will be in strong demand, however:

- The Danish case illustrates that within the next five years, 19% of the skilled technicians will retire, thus presenting HR departments with a serious recruitment challenge. This will test telecommunications operators, who will have to maintain the service level and, at the same time, develop the existing networks.

- The need for future training is massive but it appears that operators have less focus on investment in human capital and training. This

development only exacerbates the challenges mentioned above; the need for investment is not only in regard to infrastructure but also in human capital.

When analysing what kinds of jobs have been disappearing since 1999, it appears that this can be attributed to the fixed-line industry, whereas the mobile industry continues to grow.

Some interesting results are obtainable after a further division of the telecoms sector into specific occupations:

- Office and administrative support occupations in the US have decreased by 28% from 1999 to 2005.

- One out of four employees in the installation, maintenance, and repair occupations has lost his/her job in the US.

In the areas where jobs are created, it is primarily within the following functions: computer and mathematical science occupations as well as sales and related jobs. It is important to distinguish between fixed-line and mobile employment, because it is primarily in the mobile telecommunications that jobs are created.

1. Background and Methodology

The telecoms sector has been a major driver of globalisation and the liberalisation of the telecoms sectors has been an important factor in this development. Simultaneously, there has been a wave of privatisation of state owned telecommunications operators. The short-term result has been increased competition and lower prices. While independent regulatory regimes have been established to control and promote this situation, they have yet to demonstrate genuine impact. Evidence suggests that not enough attention has been paid to the long-term effects from asymmetric ex ante regulation, which has been the solution to stimulating competition.

New challenges lie ahead for the telecommunications sector, not least technological changes outpacing regulatory decisions. This means that the next generation convergence of ICT sector will require new investments by the telecommunications operators[1]. This development raises several important questions:

- *What is the relationship between regulation and investment?*
- *Are the current regulatory regimes on track to encourage the necessary investments in the telecommunications sector?*

Employees have had a front-row seat in a turbulent decade for the sector. First, they encountered a major technological revolution in the change from analogue to digital communications, while now they face a new transformation in the form of the next generation networks. This leaves another set of questions to be answered:

- *Who lost their jobs in the telecommunications sector after the dot.com crash?*
- *What kinds of jobs are being created today in the telecoms sector?*
- *What will happen next to employment in the telecoms sector?*

This report will seek to answer these questions and provide a clearer picture of the telecommunications sector, in regard to investment and employment.

1.1 Methodology and data sources

The following contains a brief presentation of the overall approach to the analysis and the methods used in the report.

The study focuses on two major issues respectively – on investment and employment in the telecoms sector.

The analysis of the investment level is based on three types of data:

- Econometric models estimating the correlation between investment and regulation in the telecoms sector. This econometric analysis consists of a joint panel model analysis of investment per capita applied

[1] In the following we use the term "next generation network" when we refer to *a single IP-based network platform capable of supporting all traffics with lower costs, providing a range of services such as VoIP, broadband and multimedia services leading to innovation and new income possibilities for operators*

for 31 OECD countries for the period 1997-2003 and a regression analysis of investment per capita and investments in terms of gfcf.

- Relevant written sources (research reports, statistics, etc.)

- Qualitative interviews conducted with leading researchers in the field of investment in the telecoms sector. The aim of these interviews was to facilitate an in-depth analysis of the impact of telecoms regulation in all regions of the world.

The analysis of the employment level in the telecoms sector is based on the following types of data:

- Case study and register-based analysis. The case study was enabled by the use of unique databases containing unique employment information on every individual person in the Danish labour force, broken down by sector, occupation, education, age and gender. The comprehensive data enables a comparative analysis with detailed information about the changes in education mix and occupation of the labour force in the US and Denmark. The case study makes it possible to estimate how the regulation impacts a small and large open economy and in different regulatory environments.

- Qualitative interviews conducted with leading researchers in the field of employment in the telecoms sector. The aim of these interviews was to facilitate an in-depth analysis of the impact of telecoms regulation on employment structures in all regions of the world.

- Relevant statistical data and written sources (OECD and ITU-database).

The following panel of leading researchers in the field has been interviewed and attached to the study:

- Eli Noam, United States, Professor of Finance and Economics, Columbia University
- Peter Ross, Australia, Doctor of Philosophy and Bachelor of International Business (Honours), Griffith University
- Jeff Keefe, United States, Associate Professor of Labour Studies and Employment Relations, Cornell University
- Owen Darbishire, UK, Professor, Industrial and Labour Relations expert, Oxford University
- Lutz-Michael Büchner, Germany, Prof. Dr., Institut für Bildung und Hochschulkooperation (IBH)
- Jette Steen Knudsen, Denmark, Director, Copenhagen Centre (independent thinktank), PhD Political Science, Expert on liberalisation and the impact of reforms on employment.

1.2 Further reading

In addition to presentation of conclusions and this background chapter, this report contains two other chapters.

Chapter Two which analyses the relation between regulation and investments and elucidates briefly the global regulatory trends in the telecommunications sector.

Chapter Three which outlines the employment development in the telecoms sector and takes a closer look at the requirement for different skills.

Finally, this report contains *references* and an *appendix* which outlines the statistical coding that has been conducted in the analysis in Chapter Three.

2. How to promote telecommunications investments

Over the past decade, investments in the telecoms sector have experienced a turbulent period with the telecommunications sector deeply involved in the hype around the dot-com peak in 2000. During this period, telecoms operators focused on investing in 3G licenses, especially the European operators were involved in expensive auctioning processes. Today the new investment area is the next generation network.

Looking broadly at global telecoms investments, different patterns can be seen throughout the world. In the following we will take a closer look at the importance of regulation in relation to telecoms investments.

This leads to the following key questions:

- *What is the relationship between regulation and investments?*
- *Are the current regulatory regimes on track in order to spur the necessary investments in the telecommunications sector?*

2.1 Regulation in developed and developing countries

A number of factors influence the proclivity to invest. First of all, investments are naturally highly dependent on the general economic conditions, i.e. GDP and the economic cycles of growth and recession. For instance, a significant decline in economic activity would spread across the economy, which may involve simultaneous declines in coincident measures of overall economic activity such as employment, investment, and corporate profits.

In relation to regulation, it is important to mention that employment structure in especially some of the European countries has made it difficult for the incumbents to keep up with the pace of regulatory reforms. The labour market regulation and historic employment of civil servants, has been – and still is – a serious obstacle for the incumbents to adjust their business economically and this collides with the regulatory reform pace. On the other hand, the technological development and urge to fuel the ICT sector through competition and demand for regulation just adds to the complexity of adjustment and regulation of the telecommunications sector.

Furthermore, a range of more specific factors also have significant effects on the level of investments in the telecoms sector. The choice of regulative models and the specific regulatory measures are of special importance, for instance universal service obligations, local loop unbundling, and access prices.

The asymmetric regulation that has been imposed on incumbents to strengthen competition means that the current profits on fixed-line networks have been diminished in the call for unbundling local loops.
Unbundling at low prices encourages competitors, but it does not encourage investments in infrastructure. If prices are set high, competition is reduced because it becomes harder for the competitors, but it encourages the incumbents to invest in infrastructure. In that respect the European regulation has been too strict:

"European regulatory regimes are more committed to unbundling at low prices, but it's a trade off because it lowers investment in infrastructure."

On the other hand, the incumbents' universal service obligations have been complicated by liberalisation of telecommunications markets. This is because new entrants naturally focus on the most profitable markets, i.e. international and business calls which erode margins as competition develops. Providing universal service then becomes an unfair burden for the incumbents[2]. All in all, the level of expected returns from the incumbents is closely linked to regulation, competition, access and universal service[3].

The developing countries

Looking at different regions around the globe and the level of investment a number of factors must be included when comparing regulatory regimes and investments. In that respect there is a difference between developed and developing countries, and potential problems in developing countries when incumbents are undermined through opening of the last-mile.

The developed countries are highly dependent on mobile infrastructure, but currently the mobile is not able to support internet access. So even though there is some evidence that developing countries can skip stages in fixed line technology – there are other downsides to this. Eventually this can lead to a further digital divide between the developed and the developing countries.

Telecommunications regulation in the developing countries is to secure sufficient but not excessive competition. This is because the "rules" are a bit different; a capital-intensive industry competition among a few players may provide better results in relation to coverage, penetration and the quality of service than competition among many operators.

It is important to stress that in developing countries duplicate infrastructure and lower margins can affect the ability of the operators to extend coverage and serve the segments with lower incomes – especially in rural areas. Opening the market to many competitors may create incentives that reduce coverage, focus intense competition on high-end customers and raise the initial costs for marginal customers to access network services[4].

The telecommunications sector in Africa has experienced enormous growth during the recent years. More Africans have become telecoms users in the few years of this century than during the past 100 years. This development is also reflected in the regulatory policies. In contrast to the developed countries, regulation in Africa has focused more on how to get connected than how to remove competitive barriers in the telecoms market. This government-supported regulatory priority has led to a high share of mobile users (about 76% of the total telephone subscribers are mobile users[5]), since the costs of setting up a mobile network are relatively low compared to the costs of a fixed network or broadband infrastructure. The high share of mobile

---

[2] OECD, 2006a: *Rethinking Universal Service for A Next Generation Environment.* OECD. http://www.oecd.org/dataoecd/59/48/36503873.pdf

[3] McKinsey, 2004: Beardsley, S.; Enriquez, L. & Garcia, J.C., 2004: *A new route for telecom deregulation*. In The McKinsey Quarterly, nr 3, 2004. http://www.bus.iastate.edu/prem/mis535/Readings/telecom-deregulation-mckinsey.pdf

[4] McKinsey, 2006: *Wireless Unbound – the surprising economic value and untapped potential for the mobile phone*. McKinsey & Company. http://www.gsmworld.com/documents/digitaldivide/wirelsunbnd_a4_092806.pdf

[5] ITU-statistics. http://www.itu.int/ITU-D/ict/statistics/ict/index.html

users also explains the low incentives for the major operators to make long term investments in broadband.

As is the case with Africa, the use of mobile telephony has increased dramatically during the last decade in the Latin American countries. Mobile penetration has by far surpassed the fixed teledensity. The average annual growth of mobile telephony users during 2000-2005 was 20.3% in the region, while growth in the case of traditional telephony was only 0.4%.[6] A major explanation for this development is the regulation which, as in African regions, has encouraged a high mobile teledensity.

The developing countries started out with an inadequate investment in telecom infrastructure in a typically inefficient state system. However, because of the extension of a mobile infrastructure there is not the same need for investment in fixed-line technology, when it comes to access and penetration. But in the long term the mobile technology is not sufficient to secure the necessary technological development of next generation networks, and investments in fixed-line infrastructure cannot be neglected.

The low penetration indicators in the developing countries and the presence of more mobile than fixed-line networks in the developing countries thus have consequences with regard to the pace and manner that next generation networks (NGN) assume in these regions of the world. Due to the lack of fixed-line networks, the current potential of upgrading to NGN is low in the lesser developed countries in Asia, Africa and Latin America, since the convergence of networks requires a "meta-infrastructure" which supports all subordinated networks (fixed, mobile and data). Seen in this context, the low penetration rate of fixed networks and broadband is a serious obstacle for the developing countries to follow the NGN-development in the rest of the world.[7]

2.1.1 Comparison of regulatory trends

The liberalisation of the telecommunications markets has accelerated around the globe throughout the past decade. The main aim has been to promote competition across communications markets through privatisation and regulation processes thus leading to lower prices, higher quality, and innovative new services in the former monopolistic and state-controlled sector. One of the most interesting experiences with regulatory processes is the increasing diversity of regulatory structures worldwide. The development in the telecom sector has shown that a regulatory process must be adjusted to meet the specific requirements of a particular country or region.[8]

As the next sections will show, there have been many different global trends and diverse approaches to the liberalisation of telecommunications.

---

[6] Mariscal, J. 2006: *Mobile opportunities: Poverty and Telephony Access in Latin America and the Caribbean. Market Structure and Penetration in the Latin American Mobile sector.* Background paper. DIRSI. http://www.dirsi.net/english/files/background%20papers/070215--mariscal.pdf

[7] Cohen, T., 2007: *Next generation networks (NGN) Regulation Overview.* ITU, GSR 2007, Discussion Paper. http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/discussion_papers/Cohen_NGN_Overview_Final.pdf

[8] Pisciotta, A.A., 2001: Global Trends in Privatisation and Liberalisation. In Melody, W.H. (ed.): *Telecom reform – Principles, policies and regulatory practices.* Den private ingeniørfond. Technical University of Denmark. http://www.cict.dtu.dk/upload/centre/cict/publications/reports/telecomreform.pdf

One of the main differences between the regulatory frameworks in the US and EU-regions is that regulation has to be controlled and implemented by only one regulator in the US while it is controlled by many different national regulators in the EU. The fragmented structure of the regulatory environment in the EU as well as the difficulties of liberalising a sector traditionally characterised by a very monopolistic environment, obviously means setting different priorities for regulators in the EU than in the US, in terms of the overall legal conditions for the players in the telecoms markets.

Furthermore it is of significant importance that the liberalisation process has been initiated much earlier in the US than in the EU. Seen from an overall perspective, the regulatory framework in the US is enabling a more competitive market, even though the EU, in recent years, has been "catching up". While the EU in a large number of the Member States is still struggling with the inherited monopolistic market structure, the major regulation problem in the US is the lack of a competitive market in the local areas. It is also essential to note that US regulation is characterised by a larger degree of competition than the regulation in the EU (competition law- based model vs. regulation model).

Comparing US, Japan and EU, the EU was the last to liberalise. In this respect, the development in the telecommunications sector is different but the differences cannot be traced when looking at the overall rates for revenue growth. The correlation between a relatively early or late liberalisation and revenue growth is not obvious[9].

Comparison of regulatory response to the new technological challenges
As described above, the existing regulation has been a very important instrument to promote competition in the market – with various successes, the US being the frontrunner. Another important dimension of the regulation in the regions is how the framework is actually able to respond to the rapid development in the sector with ongoing new technologies such as cable, wireless and VoIP. The start-up of alternative platforms places increasing pressure on the major incumbents who are obliged to give access to new competitors and furthermore incumbents have the universal service obligation to follow. The problem is that increasing market competition and the entrance of new operators makes it difficult for the incumbent to maintain enough profitable revenue to sustain the incentive to make investments that are essential for the long-term development of the entire sector. In this respect, it is important to focus on the elements of the regulation that can prevent the decreasing incentive to invest in the sector. Seen in this perspective, it is interesting to observe that the EU apparently is at the cutting edge of the development compared to the US.

The EU has already taken action in order to deal with a market situation where the incumbent, due to increasing competition from other networks, is no longer market leader nor makes a profit that can mobilise further investment in the sector. A new EU directive aims to ease the degree of regulation in this situation and give way to general competition law. This regulatory approach gives room for the major operators to operate more flexibly in a constantly changing market. The US does not have the same regulatory approach to the increasing challenge that incumbents are facing. Even the FCC

[9] Braunstein, Y.M; Jussawalla M. & Morris, S.: *Comparative analysis of telecommunications globalization.* http://www.usfca.edu/fac-staff/morriss/PTC.html

admits that the existing regulation makes it is difficult to regulate the industry. The market is outpacing regulation.[10]

Despite the initiatives taken in the EU, it is very clear that there is still much work to be done as the development continues with a pace that the regulators can not follow.

2.2 Global investments

In order to get an understanding of the development of the telecommunications sector, we will briefly outline data for revenues and investments. As previously mentioned, theory states that decreasing revenues in fixed-line business leads to lower investment level especially for the incumbents, and therefore we examine the empirical evidence in order to trace regional differences. In the section following this, we present a thorough test of these theoretical statements.

To provide some future perspectives, we also outline the penetration of broadband to trace the pace of development. It should be noted that the broadband infrastructure is seen as the network where the upgrade to NGN is happening. Therefore the already visible affects of broadband penetration on investment and employment is an important starting point when focusing on how regulators should respond to the development of NGN.

Revenue from fixed telephone services has fallen dramatically in the OECD countries since 2000. The table below shows a clear decline in the revenue from fixed telephone services in the period from 2000 to 2005. UK is the only major exception from this general trend. Revenue in the UK fell until 2001 and then rose drastically from 26% to 65% and has since then been on a constant level. In other countries such as Germany, France, Spain and the Nordic countries, the revenue declined until 2001, but has since remained on a constant lower level.

The most obvious explanation to this is that the EU Member States agreed to liberalise their national telecom systems in 1998 and with the 2001 "Telecommunications Package", a general regulatory framework for the entire EU was implemented. The legislation was designed to recast the existing regulatory framework for telecommunications in order to make the electronic communications sector more competitive.

In the US, the revenue from fixed services is on a very high level compared to all other countries. Though it has been constantly decreasing in the period from 1997 to 2003 almost 70% of the total revenue in the telecoms sector comes from fixed phone services. The only country besides US with revenue higher than 50% is New Zealand. Except for UK, Germany and Belgium, the fixed telephone revenue in the European countries is at 30% and below with Finland being the lowest on the scale (only 14% of the total revenue comes from fixed telephone services).

In South Korea[11] there has been a steady but less dramatic decline in the revenue compared with the European region, falling from 43% in 1997 to 22% in 2003.

---

[10] McKinsey, 2006: *Wireless Unbound – the surprising economic value and untapped potential for the mobile phone*. McKinsey & Company. http://www.gsmworld.com/documents/digitaldivide/wirelsunbnd_a4_092806.pdf

[11] The report use the term *South Korea*, but when writing Korea this also refers to South Korea

Table 2.1 Revenue from fixed telephone services (% of total revenue from all telecom services)

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Germany	56%	53%	45%	38%	36%	36%	37%	37%	37%
France	64%	62%	57%	49%	44%	42%	36%	32%	30%
United Kingdom	48%	45%	40%	28%	26%	65%	64%	64%	N/A
Denmark	47%	45%	44%	40%	38%	37%	33%	31%	27%
Austria	78%	74%	54%	46%	42%	34%	33%	31%	25%
Belgium	63%	60%	N/A	50%	41%	38%	34%	32%	31%
Finland	31%	28%	26%	24%	24%	21%	20%	N/A	14%
Greece	69%	63%	56%	47%	47%	23%	29%	28%	26%
Ireland	74%	69%	53%	46%	31%	37%	45%	N/A	N/A
Italy	68%	66%	38%	65%	57%	N/A	43%	33%	N/A
Luxembourg	58%	N/A	N/A	N/A	N/A	N/A	37%	33%	29%
Netherlands	57%	47%	42%	35%	40%	N/A	N/A	N/A	N/A
Portugal	60%	56%	42%	30%	29%	28%	21%	19%	18%
Spain	58%	51%	49%	41%	37%	27%	24%	22%	N/A
Sweden	33%	37%	38%	33%	35%	33%	N/A	32%	29%
New Zealand	57%	66%	60%	73%	68%	65%	52%	N/A	N/A
Australia	50%	57%	53%	46%	39%	31%	37%	N/A	33%
Japan	49%	48%	45%	42%	38%	N/A	N/A	N/A	N/A
South Korea	43%	37%	45%	36%	31%	28%	22%	N/A	N/A
United States	86%	85%	82%	79%	75%	72%	69%	N/A	N/A

Source: ITU-database

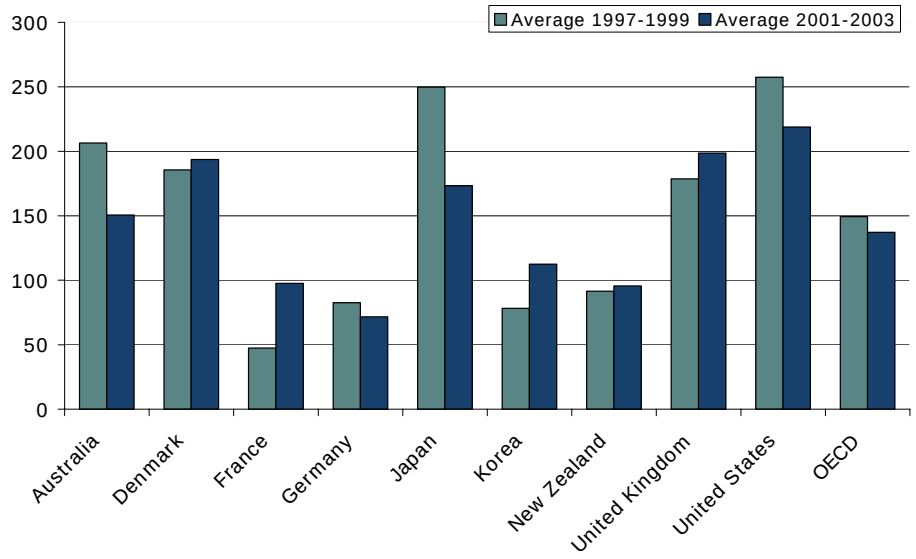
During the recent years investments in the telecoms sector have been decreasing. As shown below, there is a total decline in the investment level in all OECD countries. When comparing the average level of the two periods of 1997-1999 and 2001-2003, investments have fallen from almost USD 150 per capita in 1997-1999 to USD 137 per capita in 2001-2003.

When focusing on the EU-region, it is interesting to observe the rather big difference in the investment levels of Germany and France compared to Denmark and UK. Part of the explanation for the difference is the favourable economic conditions in UK and Denmark compared to France and Germany during the two periods.

Focusing on some of the individual countries in the OECD-area, it stands out that the US, Australia and Japan have all experienced major declines in the investment levels with Japan being the most dramatic (the investment fell from USD 250 to about USD 175 per capita in Japan). As an outstanding exception, the investment level in South Korea has increased from USD 78 to USD 113 per capita. Also UK, Denmark and New Zealand have experienced higher investments in 2001-2003 compared to 1997-1999.

In New Zealand the investment level has been on a low but constant level at USD 100 per capita, while the investments in Australia has fallen from USD 200 to USD 150 per capita.

Figure 2.1 Public telecommunications investments, USD per capita

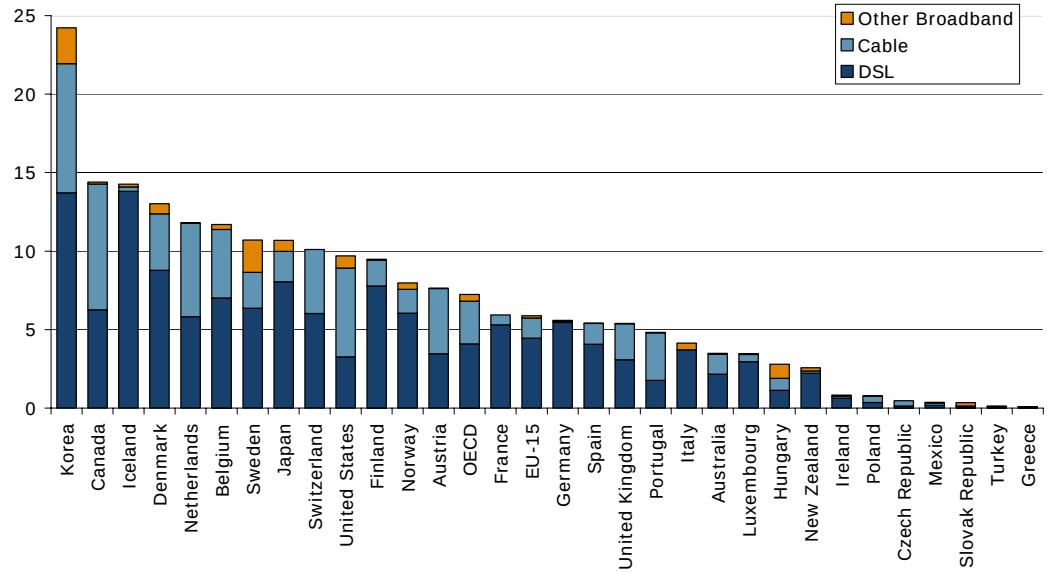


Source: OECD Communications Outlook 2005

Looking at the broadband penetration in the OECD-countries, it is notable that South Korea stands out with a relatively high broadband penetration (see figure below). Contrary to the rest of the OECD-countries, South Korea has a nationally led investment plan that ensures the essential investment in new networks. The high broadband penetration in Korea is clearly a result of this strategy whereas the low penetration rate in the rest of the OECD countries indicates the failure to stimulate investment in new networks primarily due to the increasing competition on the market. The economic crisis in 1997 was one of the main reasons for the Korean government to implement national policies to target broadband internet. The three phases of the government led KII programme in South Korea has, when it comes to broadband penetration outperformed the regulatory paths followed in other OECD countries, where the focus has been on investment and innovation in private telecommunications[12].

[12] Lee, C. & Chan-Olmsted, S., 2004: Competitive advantage of broadband internet: a comparative study between South Korea and the United States. Telecommunications Policy 28, 2004 p.649-677. Elsevier Ltd.

Figure 2.2 Broadband subscribers, 2003



Source: OECD Communications Outlook 2005

2.3 Regulation and investment

Focus of this section is to analyse the relation between regulation and investments. Dominant thinking points towards asymmetric regulation as a mean to generate investments in the telecommunications sector. In the following we take a closer look on what actually can – and cannot - be explained by regulation, in order to get a more balanced and nuanced picture of the effects of regulation.

The relation between regulation and investments has been subject to a number of studies. The conclusions from these studies vary from a positive causality between effective regulations and investment, which means that more competition leads to more investments. A number of other studies reveal that asymmetric regulation erodes the incumbent's revenue which leads to a sub-optimised investment behaviour, and the overall investment level is lower than under a symmetric regulation.

A study from ECTA (European Competitive Telecommunications Association) states that based on their own regulatory scoreboard, it is possible to trace a positive causality between effective regulation, competition and investments as proportion of gross fixed capital formation (gfcg). The study also shows a negative impact of gross domestic product per capita. It should be noted that other experts question the method and aggregating process in the construction of the ECTA scorecard[13].

A report from the European Commission states that economic theory suggests that under general conditions the aggregate network investments will increase with greater competition, but looking at the empirical evidence, the results are mixed. At industry and country levels, entry regulation has spurred countries, but a look at company level indicates no positive effect on

[13] Elixmann, D.; Schäfer, R.G. & Schöbel, A., 2007: *Internationaler Vergleich der Sektorperformance in der Telekommunikation und ihrer Bestimmungsgründe*. In Wik Biskussionsbeiträge nr. 289, februar 2007. Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste.

the investment level[14]. The overall results presented in the report show that a GDP increase stimulates an increase in investments, even though the regulation has only very weak explanatory power on the regulatory performance, the report concludes.

A quite different conclusion is drawn from a McKinsey study. A disproportional investment level is traced in EU-15 compared to an OECD benchmark, and the conclusion is that deregulation can be the solution, because the current regulatory EU-regime does not focus on securing investments and this is the major reason for a lower level of infrastructure investments per capita.

The same conclusion was also drawn in the United States in a study by Eisenach & Lenard in 2003. The conclusion is that deregulation of the unbundling network element (UNE), will lead to more investments in the telecommunications sector to the benefit of employment and the economy as a whole[15].

To sum up; a spectre of conclusions vary from studies that show increased investments caused by effective regulation– and studies show that the current regulatory set-up leads to a sub-optimising of investments.

2.4 The impact of regulation

In the following section we have tested different models to explore the link between regulation and investment.

The regulatory environment is measured by the OECD regulation index which assesses regulatory regimes in three categories: 1) the extent to which there is free entry into the market, 2) the extent to which the largest firms in the telecom sector are owned by the government and 3) the extent to which the market structure is based on market shares. A lower index number indicates an improved regulatory performance. The results from the econometric analysis conducted are presented in the following sections.

2.4.1 Panel model of the relationship between investment and regulation

Two panel models have been applied for the period 1997-2003. One model explains log investment per GFCF, while the second model explains log investment per capita. In both models the explanatory variables are log GDP per capita, index for regulatory environment and dummy variables for country and year.

The panel models have first been applied to all OECD countries and subsequently to subsets of the OECD countries given by the groups of EU15 Member States and non EU15 Member States.

---

[14] European Communities, 2006: An Assessment of Regulatory Framework for Electronic Communications – Growth and Investment in the EU e-Communications Sector. Final Report to the European Commission, DG information Society and Media. London Economics & PricewaterhouseCoopers.
http://ec.europa.eu/information_society/policy/ecomm/doc/info_centre/studies_ext_consult/assessmt_growth_invst/investment.pdf

[15] Eisenach, J.A. & Lenard, T.M., 2003: *Telecom deregulation and the economy: the impact of une-p on jobs, investments and growth*. In Progress on point 10.3.
http://www.pff.org/issues-pubs/pops/pop10.3unepimpact.pdf

1) All OECD Countries

Log investment per GFCF: Either regulatory environment or GDP are of any significance, while dummy variables for country and year are the main explanatory factors of investment, i.e. there is no explanatory value in the model.

Log investment per capita: Regulatory environment is insignificant, but GDP is significant together with the dummy variables for country and year.

2) EU15 Member States

Log investment per GFCF: Regulatory environment is significant; investments decreases with improved regulatory performance. Year and GDP are without importance, while country still is important. However, excluding year from the model implies that GDP becomes significant, while regulatory environment loses its explanatory power. The model for EU15 is therefore not satisfactorily determined.

Log investment per capita: Similar results as for log investments per GFCF.

3) Non EU Member States among the OECD Countries

Log investment per GFCF: Similar results as the model for all OECD countries; country and year are significant which illustrates the great variation among these countries, while GDP and regulation insignificant.

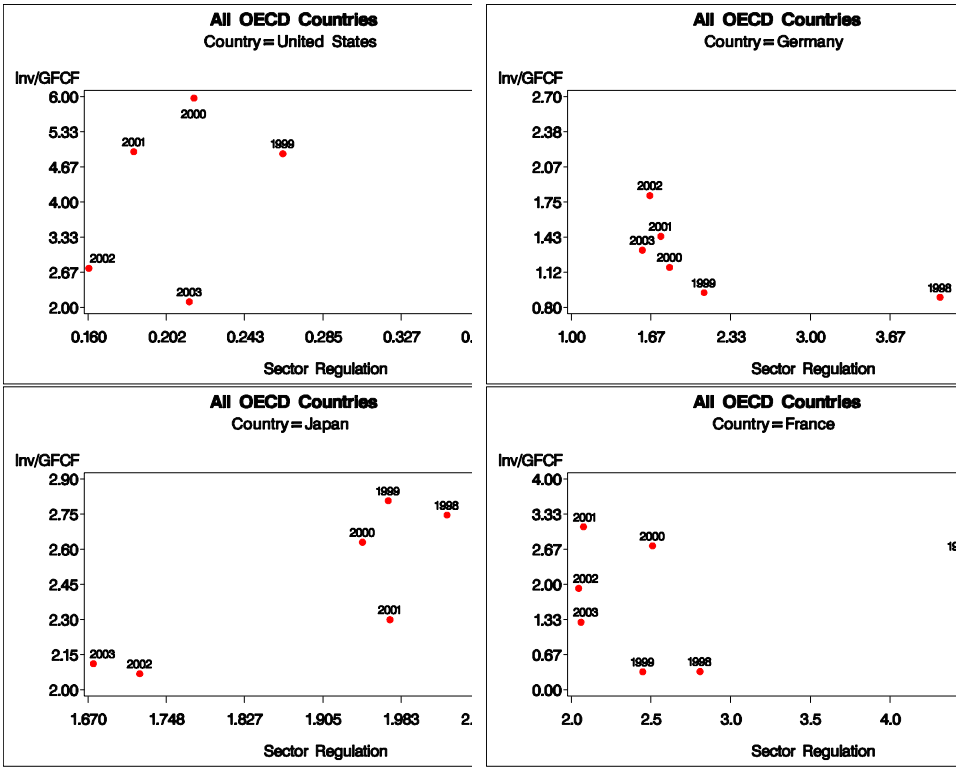
Log investment per capita: Regulatory environment is insignificant, but GDP significant together with the dummy variables for country and year.

4) Summary

The panel models for all or subgroups of the OECD countries for the period 1997-2003 show no evidence of a significant and uniform relationship between regulatory environment and investment. These results indicate that it seems to be difficult to restrain the relationship between investment and regulation both over time and countries.

Some of the underlying reasons for this result can be illuminated by plotting the relationship between investments and regulatory environment for some of the major OECD and EU countries for the period 1997-2003, c.f. figure below.

Figure 2.3 Relationship between investment and regulation for selected countries (1997-2003)



From these plots it is evident that for countries such as USA, Japan, Germany and France there is no clearly defined relationship between investments and regulation either among these countries or even within the individual countries across the period. Thus, both positive and negative relationships between investment and regulatory environment are evident within the same country over the period. Similar patterns are seen for the remaining part of the investigated OECD countries.

A common characteristic to all countries however seems to be that the relationship between investment and regulatory environment – regardless of whether it is positive or negative - changes around year 2000. For illustration, in USA investment increases with improved regulatory performance in the period 1997-2000, but from 2000 and onwards investment decreases with improved regulatory performance, c.f. figure below.

2.4.2 *Country specific regression models of the relationship between investment and regulation*

The results of the panel model showed that the relationship between investment and regulation is not clearly defined over the period 1997-2003.

In order to investigate, whether there might exist a more clearly defined relationship if contrary to looking at the entire period 1997-2003 the attention of the analysis is directed towards an individual year, regression models for individual years in the period have been estimated. The results are reported below.

Similar to the panel estimation, investments are measured both per GFCF and per capita, while countries are divided into all OECD countries, EU15 Member States and non EU15 Member States.

1) All OECD Countries

Log investment per GFCF: For all years in the period 1997-2003, the regressions show that GDP is highly significant and the main explanatory factor of investment, while regulation is insignificant at a 5 percent level in all years.

Log investment per capita: Similar to investment per GFCF expect that regulation is weakly significant at an 8 percent significance level in 2002, indicating that improved regulatory performance implies increased investments. But the relation is weak and the overall conclusion is that there is no relationship between investment and regulation in the period.

2) EU Member states

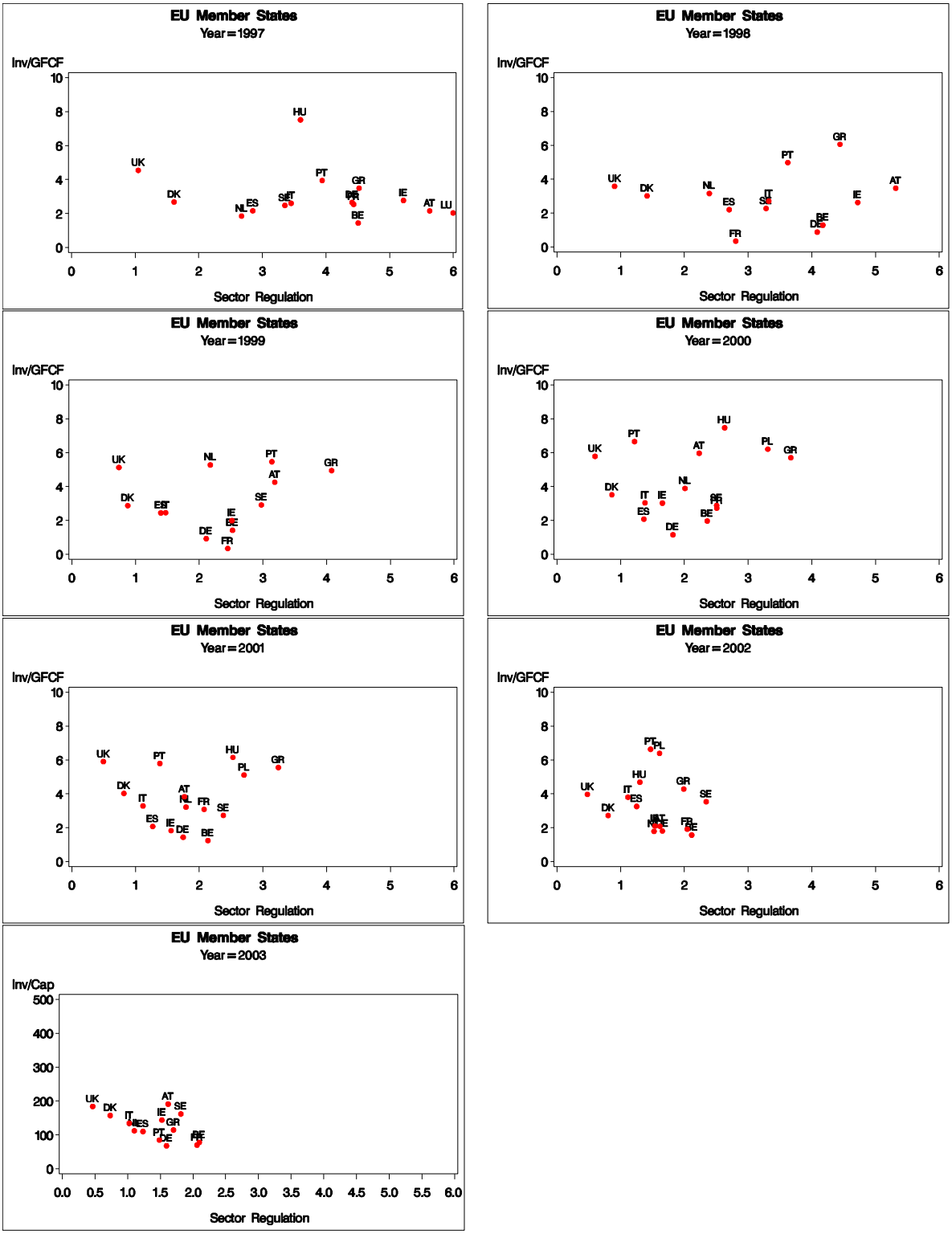
Log investment per GFCF: Contrary to the analysis of all OECD countries, GDP is only significant in 2002 and is otherwise without importance for investment when EU Member States are investigated separately.

In regard to regulation, there is no significant impact on investment in the first half of the period. The reason is an approx. flat relationship between investment and regulation in that period, c.f. scatter plots for the period 1997-2000 below.

However, in the second half of the period from 2001 and onwards, the figures show that there has been a significant improvement in the regulation performance. In the regressions, this is reflected by regulation becoming increasingly important as an explanatory factor, where improved regulatory performance give rise to increased investments. In 2002 and 2003 regulation is significant at 8 and 9 percent significance level.

Thus, contrary to the overall pattern of all OECD countries, it seems that an increasing number of the EU Member States over the period have regulated more intensively in order to ease the entry barriers to the market for new participants. This development can mainly be explained by the increasing political focus on regulating the telecommunications market.

Figure 2.4 Relationship between investment and regulation for EU15 Member States (1997-2003)



Log investment per capita: Similar results as for log investment per GFCF expect that the relationship between investment and regulation is slightly stronger in 2002 and 2003, where regulation is significant at 5 and 8 percent significance level.

3) Non EU Member States

Log investment per GFCF: Expect for 1997, GDP is highly significant and the main explanatory factor of investments in the period.

Regulation on the contrary is without significance in all investigated years. Similar to the EU Member States, the lack of significance is due to an approx. flat relationship between investment and regulation. However, in contrast to the EU Member States, the relationship remains flat throughout the period showing no change in the relationship between investment and regulation, c.f. scatter plots for the period 1997-2000 below.

Log investment per capita: Similar results as for log investments, only difference is that GDP is highly significant throughout the period including 1997.

Figure 2.5 Relationship between investment and regulation for non EU15 Member States (1997-2003)

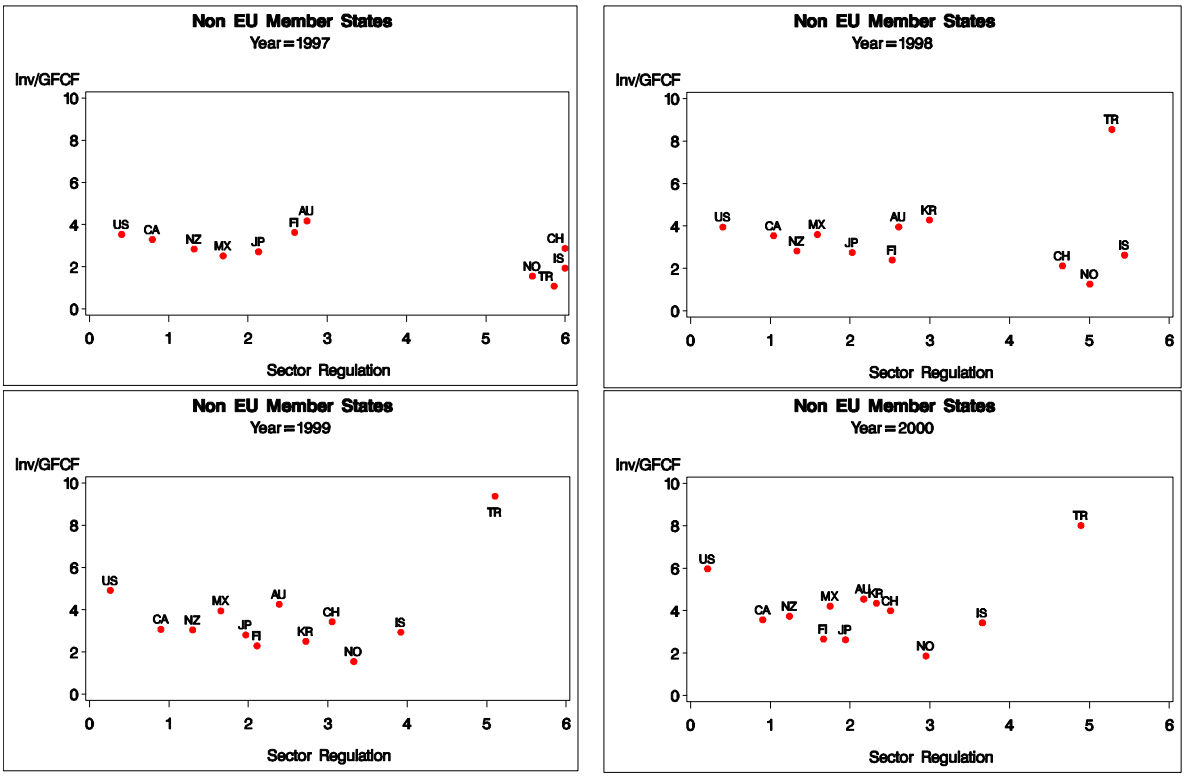
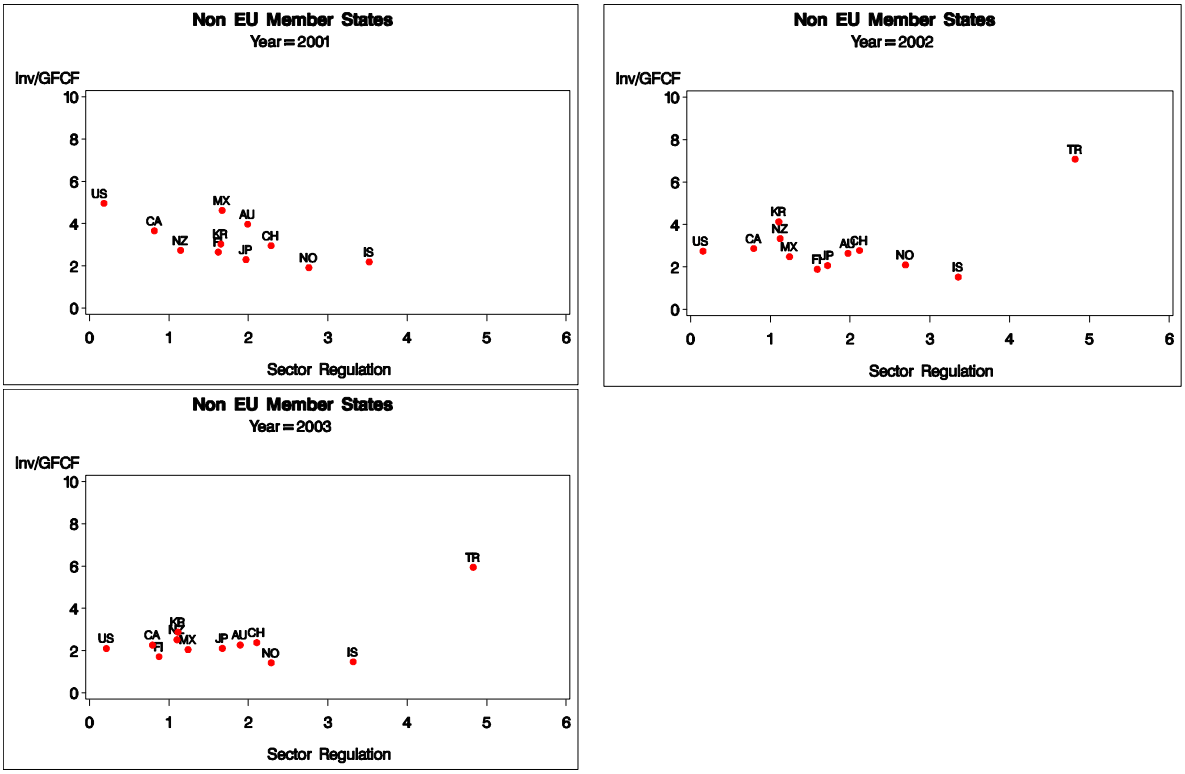


Figure 2.6 Relationship between investment and regulation for non EU15 Member States (1997-2003), continued



4) Summary

In regard to regulation, the figures show that there has been a significant improvement in the regulation performance of EU Member States over the period. These countries have regulated more intensive in order to ease the entry barriers to the market for new actors. This development can mainly be explained by the increasing political focus on regulating the telecommunications market.

The investment level for the major countries in EU is decreasing. In the UK, Germany and France there is a decline in the investment figures. The falling investment level is also the trend in the US, Australia and Japan. In New Zealand the level is rather constant. In South Korea there is an increase in the investments.

When looking at the relation between investment and the OECD regulatory reform index the most important thing to note is that there is no significant relation between the two variables, which means that regulation cannot explain the investment level neither in the EU or non-EU countries. This is obviously an interest finding since other studies have claimed that countries with effective regulation have higher levels of investment. Our analysis does not indicate any trends that support this argument. Regulation as a determining factor of telecommunications investment is insignificant as the scatter plots of the different countries are very random and unsystematic.

2.5 Conclusions: regulation and investments

To sum up, the econometric analysis cannot support the thesis that effective regulations leads to increased level of investments; this thesis cannot be verified either in terms of investments per capita or investments as proportion of gross fixed capital formation.

A positive relation can be established through a strong panel model but the interpretation is very difficult, and it cannot be recommended to conclude that regulation has resulted in lower investments.

In relation to European regulation and the results from the regulatory regime, the results supporting the European Commission are as follows: It is difficult, based on data from both OECD and ITU, to establish positive effect from the regulation that has been impeded by the EC; at best a weak but inconclusive effect can be traced, and in the end the gross domestic product has more explanatory power. At "worst" seen from the EC, the conclusion is that the regulatory regime has hindered necessary investments in the telecommunications.

One very possible explanation of the inconclusive results is that the analysed period is too short and the development during recent years still does not figure in the statistics. Regulation has been coming into effect the last couple of years, as the European Commission has concluded. The paradox is that after the regulation has been widely implemented, there is no clear causality between regulation and the level of investments. As the empirical evidence shows when comparing revenues in EU, it is very clear that revenues have been lowered, but the negative effect on investments has not come into force - yet.

- The empiric evidence shows that investments in Europe are lagging behind, while other countries are ahead, when it comes to the necessary broadband penetration. This calls for a regulatory review that takes these challenges into consideration. Furthermore the facts and results show a need for loosening the asymmetric regulation in order to enable the telecoms operators to invest in next generation networks without risking their investments. The regulatory focus therefore needs to change from cutting prices to develop the necessary environment for technological investments that will fuel next generation networks (NGN).

Throughout recent years there has been an increasing regulatory focus on how to respond to the convergence of the telecommunications technologies (mobile, cable and internet), next generation networks (NGN). While the reality of convergence is developing rapidly, the challenge for the policymakers is to promote the competition on the market and at the same time ensure that benefits of the consumers are consolidated. As a consequence of the further deployment of the NGN, the main question facing policymakers and regulators is whether to maintain the current regulatory framework where the different platforms are regulated differently.

Looking at NGN and comparing EU and US, a new EU directive aims to ease the degree of regulation in the situation and give way to general competition law. This regulatory approach gives room for the major operators to operate more flexible in a constantly changing market. The US does not have the same regulatory approach to the increasing challenge that incumbents are facing.

Despite the initiatives taken in the EU, it is very clear that there is still much work to be done as the development continues with a pace that the regulators can not follow.

- The major incumbents in the telecoms sector that have been regulated asymmetrically so far are very much interested in transforming their services to NGN, as this area is less regulated. However if the future regulatory framework does not accommodate the innovative business needs, there is a potential risk that the major players will lose interest in the market. This may undermine the development of NGN.[16]

[16] OECD, 2005b: *Working party on telecommunication and information services policies. Next generation network development in OECD countries*. OECD. https://www.oecd.org/dataoecd/58/11/34696726.pdf

3. Employment in a turbulent sector

The transition from analogue to digital technology and the development of mobile technology have been major drivers in the development of the information society. Liberalisation of the telecommunications sector and the following restructuring of national champions also caused turmoil in the sector and the employees in the telecoms sector have experienced these restructurings first-hand.

In this chapter we first analyse the consequences of these events and how employment development differs globally. Second, the next section goes a step further and explores how employment in specific occupations in the telecoms sector has developed during the 1990's and after the dot.com boom.

3.1 Global employment

The analysis of employment distinguishes between:

1. Developed countries where large, formerly public companies in fixed-line business have dominated the sector.
2. Developing countries that have leapfrogged the fixed-line telephony to mobile networks. The result of this leapfrogging is a different employment pattern and therefore these developing countries are analysed in a separate section.

Employment is closely related to the investments in the sector, but there are numerous other factors that have direct and indirect effect on employment. Even though investment is only one among many contributing factors, it is still relevant to include the conclusions from the previous chapter.

The overall employment trend in the developed countries is an increasing level of employment that peaked in the late 1990's when dot.com was booming, at the same time competition led to pressure to reduce employment. The investment level grew as well as the employment, but then an overinvestment occurred (a bubble burst). According to Eli Noam this development is a product of deregulation, which was formed on the basis of too high expectations of the liberalisation effect:

"The regulators thought that there would be huge opportunities of growth and profit, but they ended up "overselling" the liberalisation impact on sustainable competition."

Eli Noam

In both the EU and US, the incumbent carriers argued that the regulatory authorities had set the wholesales prices too low. In the US, a court decision made explicit that the wholesales prices were inappropriate. As mentioned earlier, as a result, investments decreased as well as especially fixed-line employment.

Looking at the different patterns for the EU, US, Australia, New Zealand, South Korea, and Japan, it is clear that a complex pattern can be traced.

Employment in the US increased almost 40% from 1993 to 2000. In the EU, the increase was more modest with 10% in the same period. New Zealand experienced an opposite trend with decreasing employment from 1993 to 1999, accounting for a 28% drop. This opposite trend can be explained

partly by early privatisation and take over by one of the American "Baby Bells". The New Zealand Post Office (NZPO) state monopoly was restructured and readied for sale in 1987, and then given a new lease on life as the re-branded, Telecom. The telecommunications market was the first in the world to totally deregulate in 1988. The effect on employment can be traced within only a few years after the liberalisation.

The increase in employment in Korea and Japan occurred earlier than in the US and EU. Japan experienced a 41% increase from 1993 to 1995, and Korea gained 36% more employees in the sector from 1993 to 1999. Japan liberalised the telecommunications sector as early as 1985 and was indeed one of the first countries in the world to liberalise just as the US, UK and New Zealand. In 1996, the monopoly of NTT was broken in order to revitalise the telecommunications sector through increased competition. At the same time competition was introduced in the long-distance and international markets. This is not the case in South Korea. Even though South Korea since the beginning of the 1980s had experienced a fast developing telecoms sector, the market was first opened to full competition in 1997. The South Korean policy is characterised by a state-controlled sector aiming at meeting the objectives set in the Korean Information Infrastructure Plan (KII), the timing in South Korea has thus led to a quite different pattern than other OECD countries[17].

Around the events in 2000, employment decreased at almost the same speed as it rose the previous period. This pattern holds especially in the US, EU and Japan, but employment in Korea followed another pattern than the other countries and was peaking in 1999 and again in 2002. In the same period phase II and III of the government led KII broadband scheme were implemented[18].

[17] Lee, C. & Chan-Olmsted, S., 2004: *Competitive advantage of broadband internet: a comparative study between South Korea and the United States.* Telecommunications Policy 28, 2004 p.649-677. Elsevier Ltd.

[18] Lee, C. & Chan-Olmsted, S., 2004: Competitive advantage of broadband internet: a comparative study between South Korea and the United States. Telecommunications Policy 28, 2004 p.649-677. Elsevier Ltd.

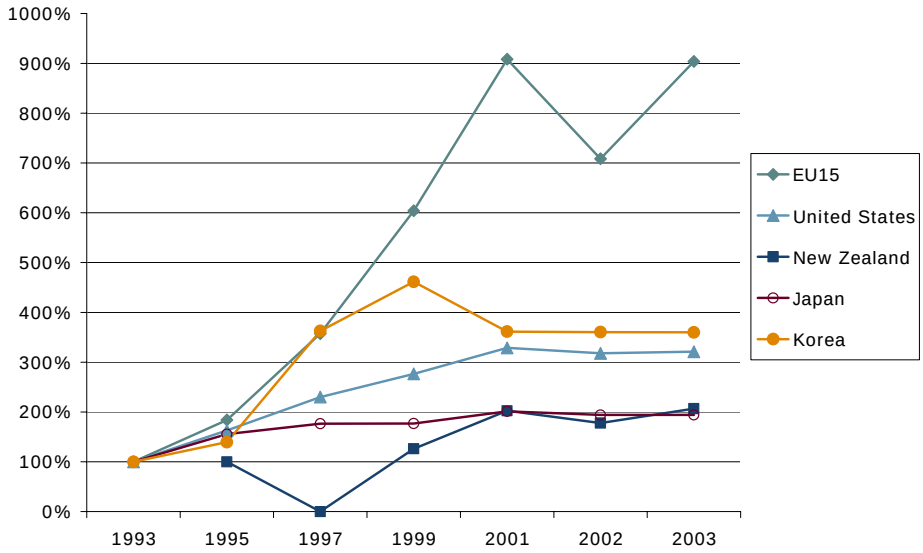
Table 3.1 Telecommunications employment in the OECD (1993-2003)

	1993	1995	1997	1999	2000	2001	2002	2003	CAGR 1993-2003
Australia	70 273	75 516	79 654	74 471	76 000	77 275	77 000	67 750	-0.4
Austria	18 144	17 273	17 820	22 986	23 975	24 431	20 000	18 190	0.0
Belgium	25 344	24 908	23 611	22 699	23 938	23 096	21 016	19 430	-2.6
Canada	101 493	106 631	99 504	101 402	103 692	104 879	105 096	110 834	0.9
Czech Republic	24 742	26 097	25 821	23 685	18 810	18 493	17 659	16 419	-4.0
Denmark	16 891	16 476	17 268	18 864	21 330	22 405	21 873	20 471	1.9
Finland	15 153	16 405	17 976	21 601	24 190	25 015	22 004	18 991	2.3
France	154 548	169 498	170 043	155 297	154 522	151 191	145 487	137 414	-1.2
Germany	234 000	217 900	215 624	221 000	241 000	241 000	231 000	226 000	-0.3
Greece	26 349	24 581	22 741	25 966	25 631	26 033	24 700	25 000	-0.5
Hungary	22 463	22 657	21 765	21 732	21 047	20 870	21 046	19 763	-1.3
Iceland	995	1 010	932	1 458	1 379	1 305	1 598	1 552	4.5
Ireland	12 818	12 025	11 705	15 000	20 000	17 000	14 900	14 656	1.3
Italy	93 172	91 802	93 782	100 026	95 809	90 880	86 469	83 436	-1.1
Japan	255 938	360 135	348 008	334 179	330 383	320 876	304 221	304 221	1.7
South Korea	63 929	66 921	73 323	87 025	73 978	68 779	81 202	75 168	1.6
Luxembourg	790	799	828	1 356	1 478	1 487	1 500	1 500	6.6
Mexico	49 819	50 413	69 138	86 769	93 346	94 641	90 268	89 517	6.0
Netherlands	34 359	32 288	31 229	47 500	47 500	52 171	47 953	39 197	1.3
New Zealand	9 778	10 354	9 536	7 047	7 802	7 459	8 100	8 100	-1.9
Norway	18 561	18 771	21 268	22 067	18 487	15 991	14 746	14 384	-2.5
Poland	71 500	73 267	73 100	77 187	69 013	65 498	55 901	50 533	-3.4
Portugal	22 499	21 006	20 807	19 648	18 481	18 652	18 140	15 433	-3.7
Slovak Republic	15 824	15 633	15 871	15 883	15 111	14 651	12 621	11 552	-3.1
Spain	74 389	69 543	73 000	69 273	71 521	70 669	66 743	67 026	-1.0
Sweden	26 059	32 825	34 035	29 289	30 340	28 256	20 529	18 825	-3.2
Switzerland	20 521	19 560	22 145	24 150	24 158	24 688	23 568	22 329	0.8
Turkey	93 897	74 837	73 177	72 463	72 412	69 545	63 888	61 219	-4.2
United Kingdom	185 505	153 166	168 740	206 500	230 300	231 500	255 000	242 000	2.7
United States	946 600	976 800	1 082 000	1 219 300	1 323 400	1 255 900	1 126 800	1 060 000	1.1
OECD	2 706 353	2 799 097	2 934 451	3 145 823	3 279 033	3 184 636	3 001 028	2 860 910	0.6
EU15	940 020	900 495	919 209	977 005	1 030 015	1 023 786	997 314	947 569	0.1

Note: Data for 2003 for Japan refers to 2002
Source: OECD Communications Outlook 2005

One common trend for development in the OECD area is the development of mobile technology. The figure below depicts employment in mobile communications from 1993 to 2003, and for EU the growth from 20,000 to 180,000 employees underlines the mobile sector's importance. The other countries also experienced a significant growth in employment. As earlier stated, the investment level for a number of countries in the EU has been lower than average. The regulatory focus has been on the access for new entrants, and as the figure below illustrates, this has had its impact on the employment in the mobile sector, where most of the new entrants are placed.

Figure 3.1 Employment in mobile communications, 1993-2003



Source: OECD Communications Outlook 2005

3.1.1 Developing countries

Employment in developing countries is, among other factors, influenced by lack of investment and different technology, i.e. mobile technology is much more prevalent than fixed-line technology. Lack of regulatory capacity was one of the obstacles for new entrants since investors were reluctant to enter a market without safety in terms of stable political institutions.

But times are changing. In Africa the business and operating environment in the telecommunication sector has shifted. The introduction of market liberalisation has helped shape an environment which fosters competition. And most importantly, regulatory bodies are being established to monitor the introduction of services and to resolve disputes.

It is difficult to compare developed and developing countries directly as developing countries primarily want to be ”connected”, and only to a lesser extent have the same focus as developed countries on “moving into the information age” and “high speed, low cost and low price”. A study of wireless markets in Asia shows that the economic impact of the mobile markets in China, India and Philippines is up to four times the value of the wireless operators alone. The value results from productivity gains and a general economic surplus[19].

Developing countries do have different market structures, use mobile technology and face a number of regulatory challenges; therefore a direct duplication of the regulatory set-up in the EU or US must be taken into consideration.

Most of the Latin American countries have experienced an increase in the telecommunications sector in the period from 1993-2000, though a few exceptions occur. From 2001 until 2005, the picture is rather mixed. However

[19] McKinsey, 2007: *The true value of mobile phones to developing markets.* In McKinsey Quarterly, February 2007.
http://www.mckinseyquarterly.com/article_abstract_visitor.aspx?ar=1917

in some countries, the number of employees in the sector increased again in the following years, while the decline has continued in a considerable number of countries.

After years with increasing employment numbers in Brazil, the country experienced a major decline in telecoms employment in the period from 2000 to 2003, decreasing from 104,960 employees to 69,475 employees. The employment is now on its way up again with 81,597 employees in the sector in 2005. The other major economy in the region Argentina has experienced the same pattern; the telecommunications employment in Argentina fell 40 pct. from 33,736 in 1993 to 20,113 in 2002. In 2004 it increased to 22,921.

Almost the same development has occurred in larger countries of the Latin America region such as Venezuela, Mexico and Bolivia and Argentina. After the decline they are all close to reaching the same employment level as in the 1990's.

Table 3.2 Telecommunications Employment in Latin America (1993-2005)

Staff (Total full-time telecommunications staff)	1993	1995	1997	1999	2000	2001	2002	2003	2004	2005
Argentina	33.736	29.690	23.089	19.461	20.533	20.221	20.113	21.880	22.921	..
Bahamas	2.305	2.415	2.216	1.249	1.109	1.115	1.141	1.137	..	..
Barbados	1.010	1.007	1.003	1.100	888	1.032	..	..	919	..
Belize	387	365	316	403	399	417	412	482	442	494
Bolivia	1.806	1.745	4.680	3.135	2.424	3.241	3.219	3.269	3.567	..
Brazil	93.574	92.509	87.282	96.428	104.960	93.494	..	69.475	76.120	81.597
Cayman Islands	240	250	255	264	269	..	..	..	..	..
Chile	11.309	12.679	15.526	20.261	21.277	19.855	19.391	..	..	..
Colombia	25.420	20.929	25.455	44.098	39.100	32.197	..	..	..	..
Costa Rica	3.927	4.526	4.409	4.517	4.807	4.137	4.876	4.965	5.840	5.422
Cuba	17.353	15.686	15.580	15.033	16.724	16.700	16.685	17.617	17.288	16.970
Ecuador	5.577	4.594	5.700	6.901	6.981	4.865	..	..	7.735	12.000
El Salvador	6.869	5.800	5.382	4.078	4.235	3.859	3.568	3.325	3.137	2.862
Guatemala	5.333	5.537	5.204	3.786	3.534	3.205	..	..	..	..
Guyana	635	726	723	670	658	645	650	650	625	..
Haiti	..	2.600	2.800	3.500	4.000	4.500	5.000	5.000	..	..
Honduras	4.400	4.730	4.758	4.444	..	..	5.167	4.760	5.892	..
Jamaica	4.166	4.212	3.911	3.189	3.207	2.599	2.387	3.000	..	..
Mexico	48.771	49.016	63.229	88.684	..	94.655	90.503	89.913	91.654	96.415
Nicaragua	3.154	3.204	3.110	2.318	2.239	2.135	2.087	2.013	..	..
Panama	3.666	3.632	3.689	5.380	5.500	5.623	5.764	6.173	6.543	6.562
Paraguay	6.842	6.600	6.187	5.883	..	11.733	..	..	..	..
Peru	12.051	8.456	5.836	5.735	6.330	5.429	..	10.527	11.007	11.692
Suriname	1.131	1.209	1.175	1.071	1.047	1.025	1.029	1.019	1.029	988
Trinidad and Tobago	2.775	2.735	2.761	2.778	3.041	3.128	..	..	..	..
Uruguay	7.062	6.323	5.777	5.805	5.504	5.667	..	..	..	..
Venezuela	21.595	20.523	13.325	14.769	20.665	18.643	14.769	17.185	17.394	..

Source: ITU-statistics

Looking at the biggest economy in Africa it should be noted that South Africa has experienced a remarkably constant decline in telecoms employment, with numbers falling dramatically from 61,255 in 1993 to 33,775 in 2005. In Africa the general employment trend in the telecom sector is rather mixed which makes it difficult to state an overall picture of the development in the region. However, most of the major countries have either experienced a stabile constant employment level or a slight increase over the time period from 1993 to 2005. In Kenya, Cameroon, Senegal, Uganda and Ethiopia, there has been a constant increase in the employment level since 1993. Egypt and Algeria have both experienced a few ups and downs in the period from 1993 to 2004, but in general the level is rather stabile. In Egypt there were 52,890 employees in 1993 and 54,218 in 2005 and in Algeria it went from 22,712 to 24,379 during this period.

Table 3.3 Telecommunications employment in Africa (1993-2005)

Staff (Total full-time telecommunications staff)	1993	1995	1997	1999	2000	2001	2002	2003	2004	2005
Benin	1.528	1.389	1.288	1.242	1.225	1.231	1.261	1.214	1.264	1.331
Burkina Faso	1.193	1.220	1.245	1.256	1.272	1.289	1.266	1.246	1.251	..
Burundi	604	607	617	581	555	530	548	548	549	..
Cameroon	2.000	1.936	1.820	2.213	2.213	2.213	2.225	2.821	3.130	3.223
Cape Verde	279	417	409	433	483	466	469	459	454	442
Cote d'Ivoire	3.779	3.596	3.567	3.720	3.897	3.837	3.702	3.408	2.850	..
Eritrea	521	624	628	463	453	476	641	638	832	977
Ethiopia	5.296	5.496	5.619	6.573	7.083	7.370	7.580	8.190	8.192	..
Gabon	745	800	773	1.062	1.062	1.152	1.934	2.101	2.165	..
Kenya	16.767	13.978	13.741	19.829	20.025	19.337	18.756	18.756	20.162	22.197
Lesotho	796	796	632	357	349	349	359	359	274	268
Mauritius	1.420	1.673	1.801	1.770	1.838	1.859	1.811	1.592	1.997	2.061
Mozambique	2.486	2.486	2.202	2.240	2.287	2.308	2.136	2.078	1.982	1.968
Sao Tome and Principe	181	146	134	122	108	97	95	93	89	..
Senegal	1.910	1.845	1.346	1.400	1.406	1.557	1.586	2.027	3.346	..
South Africa	61.255	57.501	56.893	55.480	50.421	45.870	41.590	38.492	35.416	33.775
Sudan	8.678	2.500	2.468	2.657	2.804	3.021	3.837	3.006	2.974	3.840
Togo	895	888	850	930	1.081	1.084	1.078	1.082	1.099	1.150
Uganda	1.246	1.324	1.399	1.672	2.375	2.400	2.632	5.028	5.193	5.511
Zambia	3.126	3.452	3.287	3.397	3.111	3.061	3.041	2.864	3.172	..
Zimbabwe	5.139	5.144	6.409	7.900	4.609	4.049	4.060	4.101	4.694	4.226
Algeria	22.712	18.423	18.817	17.809	17.900	17.900	19.037	21.776	24.379	..
Bahrain	2.070	2.139	2.049	2.118	2.089	2.038	1.879	1.617	1.923	..
Egypt	52.890	52.291	51.981	55.524	54.922	54.810	53.108	53.108	54.759	54.218
Morocco	12.632	14.626	14.208	14.068	14.511	16.200	13.089	12.910	12.963	..
Tunisia	6.314	5.800	6.221	6.567	7.011	7.400	7.703	8.592	8.844	9.373

Source: ITU-statistics

3.2 Request for other skills

The previous section has revealed how employment has developed in different parts of the world. Two trends were visible: after the crash in the late

1990's, employment has stalled, and it is primarily the mobile sector employment that has increased.

Employment in overall terms tells us little about what kinds of jobs are being created and who the winners and losers are in this massive process of restructuring. It is necessary to break down the overall employment data into more detail so that it can provide information on the skills that are required in the telecoms sector. Unfortunately this kind of data is very difficult to generate – in particular for developing countries.

This subsection is therefore devoted to a detailed study of the employment in the telecoms sector in the US and Denmark. Detailed data, allows for an analysis of occupation, education and age of the employees. The data and variable definitions are described in the appendix.

Even though these two studies present more detailed data, the available data is not directly comparable. Looking at skills, functions and educational level, it becomes a major challenge to find data that is reliable and possible to compare between different countries. The following analysis of the US and Denmark is hence based on two different sources that each have their strengths and weaknesses. This means that they each contains some analytical options that are unique to respectively the US and Denmark, but some comparison is possible in relation to occupations.

There are also some important similarities to be mentioned; the studies of the US and Denmark allow a comparison of two countries which have experienced similar development with regard to early liberalisation. But the two countries are rather different with regard to market, economic and regulatory structures, hence giving a unique possibility to compare developments and draw broader general conclusions that are relevant for both EU countries as a whole and the US as a frontrunner in many aspects when it comes to future challenges.

This section thus answers the following questions:

- *Who lost their jobs after the dot.com crash?*
- *What kinds of jobs are being created today in the telecoms sector?*
- *What will happen next to employment in the telecoms sector?*

3.2.1 Employment turbulence in the US

In the first half of the 1990's, employment in the American telecommunications industry ruled constantly just under 1 million, exhibiting a weak decreasing tendency from 1990 to 1993. By late 1995, employment had almost recovered to its 1990 level, fuelled largely by anticipation of changes in telecommunications' regulations[20].

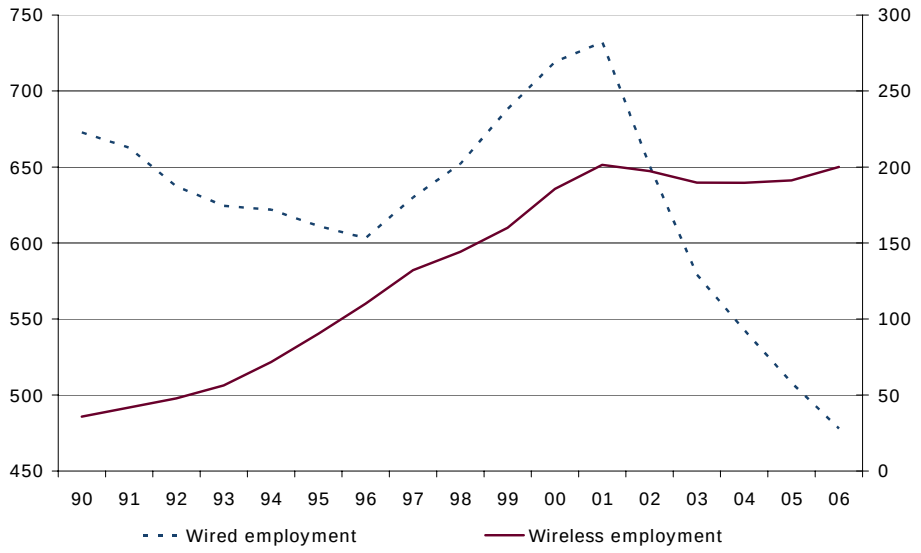
The decomposition of the telecommunications industry reveals that employment in wireless telecommunication increased by more that 20.6% per year from 1990 to 1996, while employment in wired telecommunications decreased by 2.1% per year in the same period, indicating a gradual shift from wired to wireless employment.

[20] Carbone, C.C., 2006: *Cutting the cord: telecommunications employment shifts toward wireless.* In Monthly Labor Review Online, July 2006 vol. 129, no 7. http://www.bls.gov/opub/mlr/2006/07/art3abs.htm

When introduced, the Telecommunications Act of 1996 kicked off an unprecedented growth in telecommunications employment, increasing 36% from March 1996 to March 2001. General economic expansion and rapid advances in technology, nurtured high expectations of future profits, stimulating the effects of the liberalisations.

Following the burst of the dot.com bubble, the telecommunications employment level decreased sharply after March 2001, and by early 2006 the number of employees fell below the 1996 level. The mass lay-off was almost exclusively delimited to the wired industry, leaving the wireless employment virtually constant. This constitutes an enhanced shift toward wireless technologies.

Figure 3.2 Wired and Wireless employment, 1990-2005. Thousands, yearly average



Source: Bureau of Labor Statistics (US)

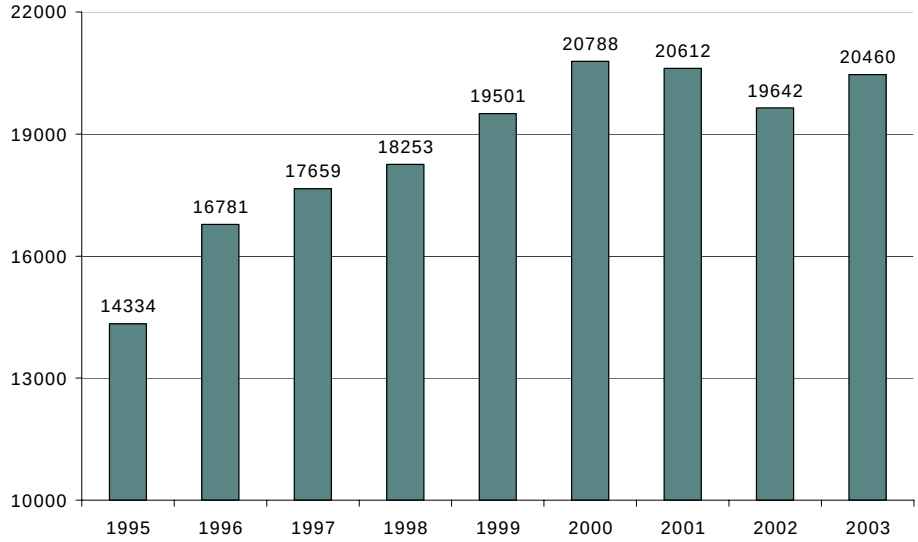
3.2.2 Constant job growth in Denmark

Using detailed data unique to Denmark, it is possible to analyse the effect technological change and liberalisation has had on the occupation, education and age distributions of the employees in the industry.

In the wake of the liberalisation, the employment level in the telecommunications sector grew upwards from 1995, rising 45%, before reaching almost 21,000 employees in 2000. With the end of the dot.com bubble, and the following recession, the employment fell by 6% over 2 years.

The number of employees in the Danish telecommunications sector increased a great deal more than the total Danish employment, which rose 6.6% from 1995 to 2002.

Figure 3.3 Employees in the Danish telecommunications industry, 1995 to 2003



Source: Statistics Denmark

This increase of the employment in the Danish telecommunications industry from 1995 to 2000 cannot fully be explained by an increase in the overall Danish employment. Table 5.1 illustrates the development in the total Danish employment.

Table 3.4 Employment in telecommunications industry, percent of Total Danish Employment and Total Danish employment index 1995=100.

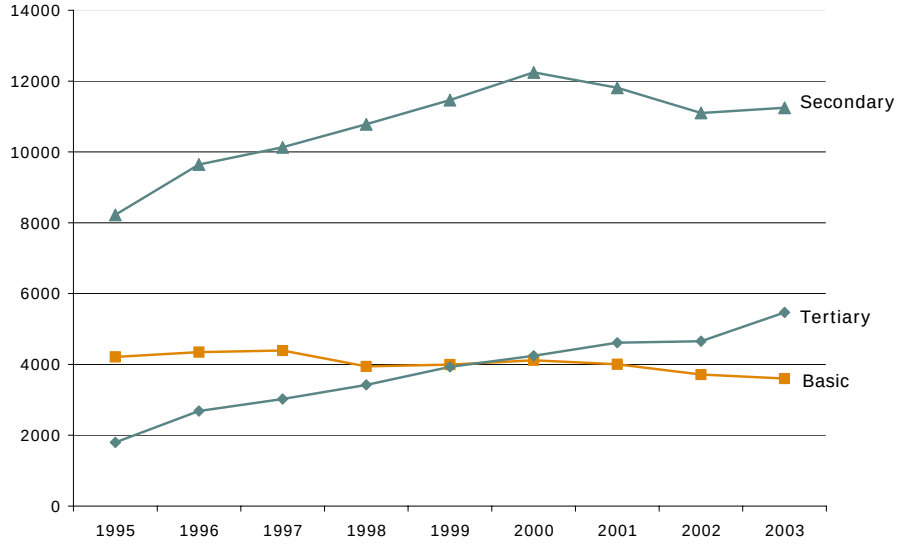
Employment	Year								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Employment in tele-industry, 1995=100	100	101	102	103	105	105	106	106	105
Empl. in tele-industry, percent of Total Empl.	0,5%	0,6%	0,7%	0,7%	0,7%	0,8%	0,7%	0,7%	0,7%

Source: Statistics Denmark

Figure 5.2 depicts the educational distribution of employees in the Danish telecommunications industry. Two tendencies can be read from the figure: First, the number of employees with a tertiary education is gradually increasing, both in absolute an relative terms. Second, the number of employees with a secondary education seems more volatile and more closely related to the market fluctuations, indicating that their positions are more scalable.

The number of employees in the Danish telecommunications industry with a basic education is somewhat constant over time. The corresponding number of employees with a tertiary education is gradually increasing. The number of employed with a secondary education seems to be more volatile, and more closely related to the market fluctuations. In contrast, the employment of the highest and lowest educated appears less sensitive to market conditions.

Figure 3.4 Employees in the Danish telecommunications sector by level of education, as percent of total employment sector.



Source: Statistics Denmark

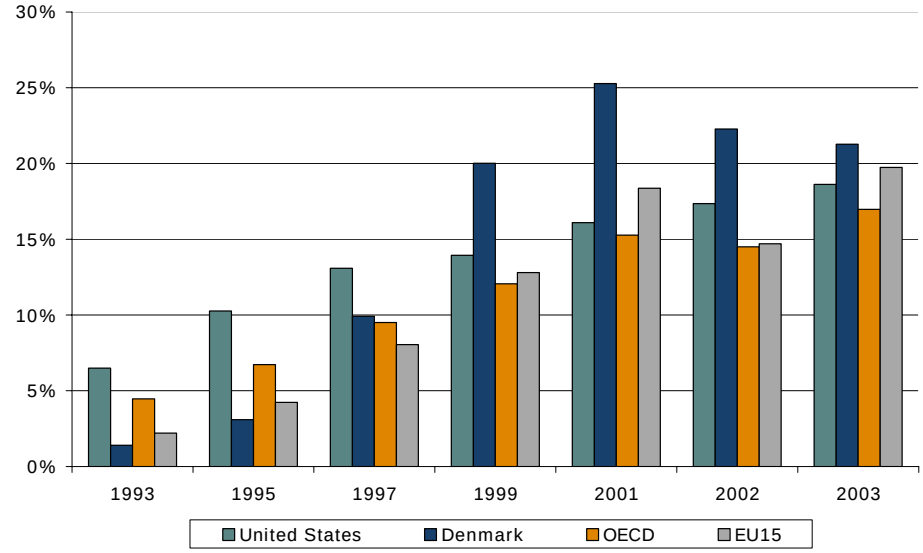
3.3 A comparison of telecoms occupations in US and Denmark

Telecommunications employment has been presented for both the US and Denmark on detailed levels for different occupations. This gives us the opportunity to trace trends in the telecoms labour market, even though it is necessary to bear in mind that it is not possible to compare two different data sources directly. In addition to the different data sources, a number of other factors make it difficult to compare Denmark and the US. On the other hand, when keeping these differences in mind, one has the opportunity to see how these differences produce various types of *employee compositions* in the telecoms sector and various types of *development of occupations* in US and Denmark. The sector boomed in the late 1990's, hence, in order to extract the following turbulence, the period being analysed is narrowed down from 1999 onwards.

As earlier mentioned, the ratio of fixed-line versus mobile share of market has an impact on employment and occupations, simply because two different techniques are involved. On the other hand, many operators share back-office functions, sales and marketing, and therefore, a complete separation of the two is less impossible and has no actual effect on the following analysis.

Comparing Denmark to the US and other OECD countries in the period after 2000, the downturn was less dramatic; the overall telecommunications employment experienced a little downturn in 2002 but was on track again 2003. The main reason for this is that the mobile sector employed more than the average for the EU and OCED, which is illustrated below.

Figure 3.5 Mobile employment as share of total employment (1993-2003)



Source: OECD Communications Outlook 2005

The occupational groups in the US and Denmark are not directly comparable. The table below illustrates the occupational categories that have been generated in the analysis. In the following analysis we focus on

- Office and administrative support
- Installation, maintenance and repair occupations
- Sales and related occupations
- High-level specialists.

Table 3.5 Occupational categories in US and Denmark

US occupations	*Denmark occupations*
Management Occupations	Management Occupations
Business and Financial Operations Occupations	High-Level Specialists
Computer and Mathematical Science Occupations	Computer Programming, operations and planning
Architecture and Engineering Occupations	Administration and Accounting
Sales and Related Occupations	Skilled Machine Operation, Construction Trades and Technicians
Office and Administrative Support Occupations	Healthcare and Teaching
Installation, Maintenance, and Repair Occupations	Sales and Customer Support
	Unskilled Machine Operation and Process-Oriented work

Office and administrative support

Occupation in office and administrative support has decreased by 28% from 1999 to 2005 in the US; more than 1 out of 4 employees lost their jobs in the period after the dot.com boom. Similarly 14% of the employees in back office functions have been replaced in Denmark. Increase in efficiency through new technology and offshore outsourcing is the most likely explanation to this decrease.

It is worth noticing that this occupation still amounts to around 30% of the total employment in the US, whereas in the Danish case, the back office occupation in 2003 only counts for 23% of the total employment. In the recent years, offshore outsourcing has increased through all sectors including telecoms, which means that a further decrease in both the US and Denmark is predictable.

Office and Administrative Support Occupations		1999	2003	2005
US	Share of total employment	31%	30%	29%
	Number of employees, 1999=100	100	79	72
Denmark	Share of total employment	30%	23%	-
	Number of employees, 1999=100	100	78	-

Source: Statistics Denmark, Bureau of Labor Statistics (US)

Installation, maintenance and repair occupations

Installation, maintenance and repair occupations in a US context are closely related to the Danish Skilled Machine Operation, Construction Trades and Technicians – and two very different trends can be traced:

In the US, employees have decreased by 26% from 356,080 in 1999 to 261,750 in 2005. In Denmark, employment for the almost similar occupations has increased by 7% from 5525 in 1999 to 5929 in 2003, which is a strikingly different development. Part of the explanation for this is that in the Danish case, the restructuring process took place earlier than 1999 and that a proportion of the skilled technicians were downsized in the period from 1992 to 1998.

Another interesting detail is that the share of total employment in the US and Denmark is very similar in 1999, but apparently the following development in the US has affected the installation, maintenance and repair occupation differently. Consequently the US has experienced a downgrade in quality of service, which has suffered from downsizing in this area. While some employees who were laid off by the incumbents could be employed by new entrants this has only happened to a limited extent. As Eli Noam explains on employment and service:

"Competition and demands for efficiency lowered employment. The negative side to this efficiency growth was some decline in quality of labour intensive telecoms services.

Eli Noam

Installation, Maintenance, and Repair Occupations		1999	2003	2005
US	Share of total employment	27%	26%	26%
	Number of employees, 1999=100	100	78	74
Denmark	Share of total employment	28%	29%	-
	Number of employees, 1999=100	100	107	-

Source: Statistics Denmark, Bureau of Labor Statistics (US)

The fixed-line operators are employing a considerable number of higher skilled technicians who mainly work in the business areas in which the technological improvements usually take place. In the cable industry, however, the technicians usually are occupied in the residential areas, which are less technologically developed. This means that the higher skilled technicians in the fixed line industry are more vulnerable to technological developments than in the wireless and cable industries, Jeff Keefe explains.

"*Due to the automation a lot of the higher skilled jobs have been eliminated - For instance the monitoring of network will be increasingly centralised.*"

Jeff Keefe

Sales and related occupations

The jobs created are chiefly concerning sales and related occupations. Comparing the US and Denmark, it is obvious that, in the Danish case, the occupation in sales has increased at a much higher speed and accounts for a much substantial share of the total employment in the sector. The number of employees rose by 39% from 1999 to 2003. Already in 1999, the total share of total employment was greater in Denmark compared to the US. As earlier illustrated, the fact that the boom in the mobile sector was substantially bigger in Denmark can be part of the explanation of this growth in sales and related occupation, given that wireless generally employs more sales and marketing personnel than the fixed-line industry does.

Looking at the educational level in Denmark for employees, the share with tertiary education rose from 19% in 1999 to 23% in 2003, which leaves a share of 77% of the employees within these occupations, having basic or secondary education. A striking feature of this occupational category is that employees very often are employed on short-terms contracts or precautional contracts.

Sales and Related Occupations		1999	2003	2005
US	Share of total employment	11%	15%	17%
	Number of employees, 1999=100	100	105	110
Denmark	Share of total employment	15%	20%	-
	Number of employees, 1999=100	100	139	-

Source: Statistics Denmark, Bureau of Labor Statistics (US)

High-level specialists

In the telecommunications sectors as well as other sectors in the developed world, high level specialists are gaining a bigger share of the labour market, and this trend is visible in both the US and Denmark. A closer look at the increase in this occupational category reveals that the increase in employ-

ment to a large extend concerns financial occupations, and only to a lesser extend comprises high level technicians.

The comparison for these occupations is unfortunately more complex, while the variety of occupational categories makes it more difficult to compare the two cases. The US operates with legal occupations, architecture & engineers, computer & mathematical science and business & financial operation, whereas Denmark operates with high level specialists and computer and programming occupations.

From 1999 to 2003, the US telecoms sector increased its uptake of high level specialists with 12%, only to fall 92% of the 1999 level in 2005. This can to some extent be interpreted as the result of falling investment level described in section 3.2. The Danish case reveals a similar but significantly higher uptake of high levels specialists of 27% from 1999 to 2003.
The share of total employment is higher in the US than in Denmark, and of course this occupational complexity can explain some of the difference, but due to the similarities in the other groups taken into consideration, it can be expected to see more high level occupations in the US in the future.

High Level Specialists		1999	2003	2005
US	Share of total employment	17%	21%	21%
	Number of employees, 1999=100	100	112	92
Denmark	Share of total employment	13%	16%	-
	Number of employees, 1999=100	100	127	-

Source: Statistics Denmark, Bureau of Labor Statistics (US)

3.4 Conclusions: employment and skills

In this concluding section we briefly summarise the results from the analysis above, and use these trends to take a look at what happens next to the employees in the telecommunications sector.

3.4.1 The situation today

Employees in the telecommunications sector have experienced ups and downs in the past decade. Employment increased from 1993 to 2000 especially in the US and EU. New Zealand experienced an opposite trend with decreasing employment from 1993 to 1999, accounting for a 28% drop. In the period following the dot.com crash, most of the OECD countries faced decreasing employment in the telecommunications sector. The mobile sector hindered a steep downfall but the mobile sector also altered the composition of skills required in the telecommunications sector.

- The EU and the US have clearly suffered from a lack of investments; exact US data reveals that employment has dropped even further and with the conclusion from the European Union in terms of low investment levels, it is clear that employment also in this region is under heavy pressure today – and has been in recent years. It is difficult to trace a direct link between regulatory regimes and employment as for regulation and investments, but the results indicates that employment has been effected by the lower level of investments.

On a general level, the conclusion is clear that the composition of telecommunications employment has changed at very high speed. The booming years are over and a set of winners and losers in the labour market have been singled out;

- Skilled technicians have been the ones who lost their jobs; in the US during the period from 1999 to 2005, one out of four employees lost their job which amounts to nearly 90,000 jobs. Occupations in back office functions were laid off at the same pace.

- The new employees in the sector have primarily been low skilled, placed in sales and customer service on short term contracts.

- The high level specialists have also seen a number of additional jobs created since 1999, but the US has experienced a downturn from 2003 to 2005, which despite a higher level than the Danish employment composition, can be seen as a warning that this group will also face challenges in the years to come.

3.5 What next?

In summary, it was employees with occupation in back-office functions, maintenance and installation in particular who lost their jobs after the dot.com bubble burst. Even though jobs are created in the telecoms sector, this is only true for sales and marketing and high level specialists. But what will happen next?

Predicting future trends is always risky, and this is also true for the question about what happens next to employment in the telecoms sector. To minimise uncertainties, we therefore focus on what we know will happen, and two colliding trends are certain: *the technological change and the demographic change.*

- The technological evolution that has enabled convergence between fixed-line, mobile and IT systems, meaning that different skills will be requested in the future, just as with the transition from analogue to digital technology
- The demographic change means that a large share of telecoms employees will retire within the next few years.

Another factor that must be added is how the regulatory capacity keeps up with the technological change related to next generation network; uncertainty about the regulatory set-up means that necessary investments are being postponed, which ultimately also leads to lower employment. Alternatively the investments will be placed in other regions, with higher certainty and higher outcomes from investments.

The role of regulation as regards employment figures is that it creates uncertainty, primarily in the fixed-line business. This uncertainty has a negative effect on investments, which again has a negative effect on employment.

Next generation networks
Starting with the technological factor and the transition to next generation networks, it is of course a difficult task to predict exactly how the convergence will take place. It is clear though that the technological development will lead to a further decrease of higher skilled technicians since there will no longer be the same demand on the functions they hold.

"*In the long run there will also be less low skilled technicians. The broadband fibre optic based networks will need a lot less employees - The demand for technicians will clearly decline"*
Jeff Keefe

So what are the challenges for the employees in the sector when changing to NGN? It will mainly affect the higher skilled workers since it is in the core networks that they are employed. These consequences are already visible in areas where the networks have been upgraded. In the residential areas, this is not the case as the networks are not upgraded yet, but as soon as that happens there will be significantly fewer technicians and employment will decrease because of the tremendous efficiencies of the NGN.

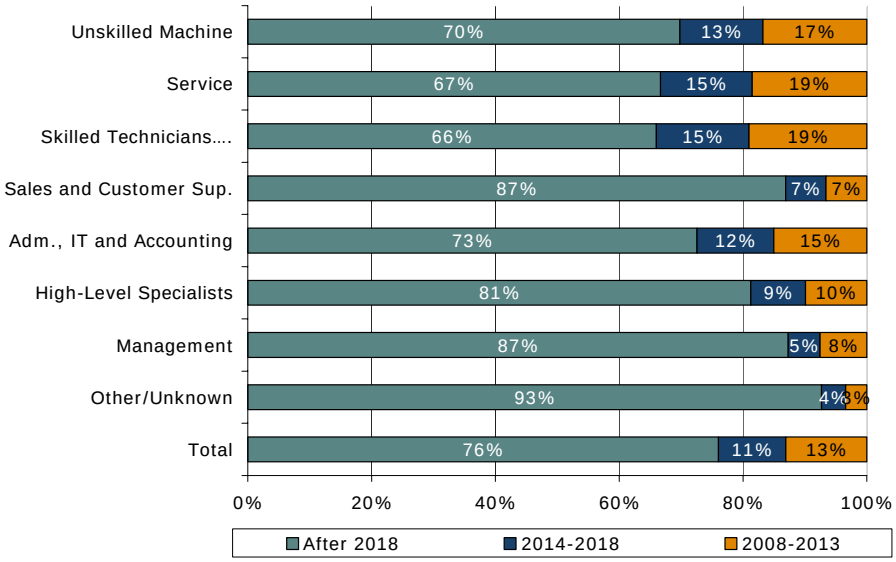
"*Investments are likely to increase, innovation will emerge, and employment will also increase. However it will eventually lead to new bubble burst (because of overcapacity of broadband providers). The market will not be stabile."*
Eli Noam

On the other hand, the NGN and the technological improvements in the telecom sector do not necessarily lead to a demand for higher skills in other occupations, instead this requires *different* skills. The analogue network requires people with real so-called troubleshooting skills, for instance conceptual and mechanical skills. But the new networks do not need technicians with the same level of mechanical skills. In other words, it is not true that NGN will require higher level skilled employees compared to earlier.

Another result from the developing next generation networks is a new set of strategy for the operators. In the last decade, the incumbents have divided their business in three pillars: fixed-line, mobile and cable/fibre divisions. The convergence of the three technologies means a convergence between the three business pillars and that again means that employment will head on to a turbulent period again.

Demographic changes
Looking at the age composition for the different occupational groups, it is possible to observe the future development. The figure below illustrates how many employees within each occupational group will retire in 5-10 years and how the operators base for recruiting diminishes unless training and retraining is given a higher priority.

Figure 3.6 Employees in the Danish telecommunications industry by occupation and age, percent of total employment



Source: Statistics Denmark

Knowledge-sharing requires a gradual recruitment and retirement of employees. If the bulk of the employees is due to retire within a period of time, it can cause serious trouble for a company and for an industry. In Denmark, the retirement age is 65. However, the popular pre-pension scheme allows retirement at 60. From Table 5.2 it is evident that the share of employees scheduled for retirement within the next 5-10 years varies greatly between occupations. *Skilled Machine Operation, Construction Trades* and *Technicians and Administration, IT and Accounting* will be greatly affected by retirement in the next decade.

The remarkable conclusions from these trends are that a number of cases from, for instance, Australia and New Zealand, show that the operators to a large extent have stopped training employees. Simultaneously, within the next five years approximately 20% of the technicians will retire. This will result in a serious challenge for those left to maintain and upgrade the existing networks. Additionally, the HR departments will face serious recruiting challenges. The challenge will probably be solved by outsourcing the tasks, which is already happening but the costs of maintenance and upgrading will therefore exceed the existing level, and the service can be expected to decrease in the future.

References

Braunstein, Y.M; Jussawalla M. & Morris, S.: *Comparative analysis of telecommunications globalization.*
http://www.usfca.edu/fac-staff/morriss/PTC.html

Cadman, R. & Dineen, C., 2006: *European Telecom's Lost Investment: An analysis of the ECTA Scorecard*. Strategy and Policy Consultants Network Ltd (SPC Network).
http://www.spcnetwork.co.uk/uploads/Investment_Elasticity_Paper_Updated.pdf

Carbone, C.C., 2006: *Cutting the cord: telecommunications employment shifts toward wireless.* In Monthly Labor Review Online, July 2006 vol. 129, no 7.
http://www.bls.gov/opub/mlr/2006/07/art3abs.htm

Cave, M. & Crandall, R.W. (ed.), 2001: *Telecommunications Liberalization on Two Sides of the Atlantic*. AEI – Booking Joint Center for Regulatory Studies.
http://www.aei-brookings.org/admin/authorpdfs/page.php?id=110

Cohen, T., 2007: *Next generation networks (NGN) Regulation Overview.* ITU, GSR 2007, Discussion Paper.
http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/discussion_papers/Cohen_NGN_Overview_Final.pdf

Conway, P. & Nicoletti, G., 2006: *Product market regulation in the non-manufacturing sectors of OECD countries: Measurement and Highlights.* Economics Department Working Papers No. 530. OECD.
http://www.olis.oecd.org/olis/2006doc.nsf/43bb6130e5e86e5fc12569fa005d004c/754494cce33a9049c12572440031e2a0/$FILE/JT03219400.PDF

Economides, N., 1998: *The Telecommunications Act of 1996 and its Impact*. Economics of network. Presented at the Annual Telecommunications Policy Conference, Tokyo, Japan, December 4, 1997.
http://www.stern.nyu.edu/networks/telco96.html

Eisenach, J.A. & Lenard, T.M., 2003: *Telecom deregulation and the economy: the impact of une-p on jobs, investments and growth*. In Progress on point 10.3.
http://www.pff.org/issues-pubs/pops/pop10.3unepimpact.pdf

Elixmann, D.; Schäfer, R.G. & Schöbel, A., 2007: *Internationaler Vergleich der Sektorperformance in der Telekommunikation und ihrer Bestimmungsgründe*. In Wik Biskussionsbeiträge nr. 289, februar 2007. Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste.

European Foundation for the Improvement of Living and working Conditions, 2005: *Trends and drivers of the change in the EU telecoms sector: Mapping report.* European Foundation for the Improvement of Living and Working Conditions.
http://www.eurofound.europa.eu/emcc/publications/2005/ef04148en.pdf

Green, J.R & Teece, D.J: *Four approaches to telecommunications deregulations and competition: The U.S, U.K, Australia and New Zealand - a review*

and comparative analysis of the regulatory setting in each of the four countries. Workingpaper.
http://groups.haas.berkeley.edu/imio/crtp/publications/workingpapers/wp49.PDF

Jerram, R.; Hodges, M.; Turner, L. & Kurz, R.: Liberalisation: Case Studies in Telecommunications *(Chapter 4).* In *Political Environment for Global Business - Course Guide.* London School of Economics and Political Science. Department of International Relations. 1997-98.
http://www.mega.nu/ampp/PEGB/chap04.htm#metatop

Jungmittag, A. & Welfens, P.J.J., 2006: *Telecommunications Dynamics, Output and Employment.* Discussion Paper Series, IZA DP No. 2379. IZA Forschungsinstitut zur Zukunft der Arbeit, Institute for the Study of Labour.

Koopmann, G.: *Competition politicise and telecommunications Regimes*
http://www.hwwa.de/Forschung/Handel_&_Entwicklung/docs/Archiv/CompetitionPolicies.pdf

Lee, C. & Chan-Olmsted, S., 2004: *Competitive advantage of broadband internet: a comparative study between South Korea and the United States.* Telecommunications Policy 28, 2004 p.649-677. Elsevier Ltd.

European Communities, 2006: *An Assessment of Regulatory Framework for Electronoc Communications – Growth and Investment in the EU e-Communications Sector. Final Report to the European Commission, DG information Society and Media*. London Economics & PricewaterhouseCoopers.
http://ec.europa.eu/information_society/policy/ecomm/doc/info_centre/studies_ext_consult/assessmt_growth_invst/investment.pdf

Mariscal, J. 2006: *Mobile opportunities: Poverty and Telephony Access in Latin America and the Caribbean. Market Structure and Penetration in the Latin American Mobile sector.* Background paper. DIRSI.
http://www.dirsi.net/english/files/background%20papers/070215--mariscal.pdf

McKinsey, 2004: Beardsley, S.; Enriquez, L. & Garcia, J.C., 2004: *A new route for telecom deregulation*. In The McKinsey Quarterly, nr 3, 2004.
http://www.bus.iastate.edu/prem/mis535/Readings/telecom-deregulation-mckinsey.pdf

McKinsey, 2006: *Wireless Unbound – the surprising economic value and untapped potential for the mobile phone*. McKinsey & Company.
http://www.gsmworld.com/documents/digitaldivide/wirelsunbnd_a4_092806.pdf

McKinsey, 2007: *The true value of mobile phones to developing markets.* In McKinsey Quarterly, February 2007.
http://www.mckinseyquarterly.com/article_abstract_visitor.aspx?ar=1917

Melody, W.H. (ed.), 2001: *Telecom Reform – Principles, policies and regulatory practices.* Den Private Ingeniørfond, Technical University of Denmark. Lyngby.
http://www.cict.dtu.dk/upload/centre/cict/publications/reports/telecomreform.pdf

Messere, F., 1996: *Analysis of the Telecommunication Act of 1996*.
http://www.oswego.edu/~messere/telcom1.html

OECD, 2005a: *Information and Communications Technologies*. *OECD Communications Outlook*. OECD.
http://new.SourceOECD.org/database/telecom

OECD, 2005b: *Working party on telecommunication and information services policies. Next generation network development in OECD countries*. OECD.
https://www.oecd.org/dataoecd/58/11/34696726.pdf

OECD, 2006a: *Rethinking Universal Service for A Next Generation Environment.* OECD.
http://www.oecd.org/dataoecd/59/48/36503873.pdf

OECD, 2006b: Next Generation Networks: Evolution and Policy Considerations. OECD Foresight Forum.
https://www.oecd.org/document/12/0,2340,en_2649_34223_37392780_1_1_1_1,00.html

Pisciotta, A.A., 2001: Global Trends in Privatisation and Liberalisation. In Melody, W.H. (ed.): *Telecom reform – Principles, policies and regulatory practices.* Den private ingeniørfond. Technical University of Denmark.
http://www.cict.dtu.dk/upload/centre/cict/publications/reports/telecomreform.pdf

Reding, V. 2006: *Connecting up the Global Village: European View on Telecommunications Policy.* Speech/06/772 at the Conference of the International Telecommunications Union (ITU).

The Telecommunications Act of 1996. Pub. L. No. 104-104, 47 U.S.C. 151 et, seq. (1996)
http://www.fcc.gov/Reports/tcom1996.pdf

Østergaard, P.H, 1998: *Konkurrencen skal styres.* In Tele Tema 1, februar 1998.
http://itst.dk/wimpdoc.asp?page=tema&objno=95028638

Statistics

OECD International Regulation Database, Indicators of Product Market Regulation Homepage at: http://www.oecd.org/eco/pmr

Bureau of Labour Statistics - Current Employment Statistics program, CES:
www.bls.gov/ces

Statistics Denmark (Integrated *Database for Labour Market Research* (IDA)):
www.dst.dk

ITU-statistics:
http://www.itu.int/ITU-D/ict/statistics/ict/index.html

ITU, The World Telecommunication/ICT Indicators 2006 Database, Link:
http://www.itu.int/ITU-D/ict/

Appendix

Definitions and Statistical Analysis

Denmark

The data used in the case-study on the Danish telecommunications industry is drawn from the Integrated *Database for Labor Market Research* (IDA). IDA contains employment data on every person living in Denmark, aged 20-70 in a given year.

Industry

Employees in the telecommunications industry are defined as persons employed in industry 640000 of the *Danish Industry coding system of 1993* (DB93).

Education

The educational levels are defined, from the *International Standard Classification of Education* from 1997 (ISCED). We have defined three levels of education: Basic, Secondary and Tertiary. They are defined from ISCED as:

Basic education:

- Level 0 - Pre-primary education
- Level 1 - Primary education or first stage of basic education
- Level 2 - Lower secondary or second stage of basic education

Secondary education

- Level 3 - (Upper) secondary education
- Level 4 - Post-secondary non-tertiary education

Tertiary education

- Level 5 - First stage of tertiary education
- Level 6 - Second stage of tertiary education

Occupations

Danish occupations are defined using the DISCO-88 classification system, witch is the official Danish version of the International Standard Classification of Occupations of 1988 (ISCO-88). The Occupations are defined as:

Danish Occupation	DISCO-88
Unskilled Machine Operation and Process-Oriented Work	8000-8999,9210-9330
Service	9120-9162
Skilled Machine operations, Construction Trades and Technicians	3000-3119,3123-3213,3420-3429,3440-3999,7000-7442
Sales and customer support	3410-3419,5200-5999,9110-9113
Computer Programming, operations and planning	3121-3122
Administration and accounting	4000-4999,3430-3439
High Level Specialists	2000-2310,2350-2999
Management	1000-1999

US

Employment

The analysis of employment data is based on data available through the Current Employment Statistics program (CES, bls.gov/ces). Each month the CES surveys about 160,000 businesses and government agencies, representing approximately 400,000 individual worksites, in order to provide detailed industry data on employment, hours, and earnings of workers on nonfarm payrolls. Figure 2.1 depicts the employment in wired - and wireless telecommunications, defined as the North American Industry Classification System (NAICS-2002, 4-didget) industries 5171 and 5172, respectively.

Occupations

The US occupational employment data used in the report is subtracted from the Occupational Employment Statistics (OES) survey. In November 2002, the OES survey changed from an annual survey of 400,000 establishments to a semiannual survey of 200,000 establishments. The OES survey now samples and contacts establishments in May and November of each year.

From 1999 to 2002 the number of employee's is reported directly from the annual OES survey estimates. In 2003 and 2004 the employment is calculated as an average of the May and September survey estimates. In 2005 the May survey estimate is reported.

OES Data are available from 1998 to 2005. It is not possible to include 1998 in our presentation because the Standard occupational Classification changes from 1998 to 1999. Hence we report employment estimates 1999-2005.

The industry classification used in the OES, changed in 2002. Before 2002, the industries were identified by the 1987 Standard industry classification (SIC). After 2001, the industries are identified by the 2002 North American Industry Classification System (NAICS). As a result the definition of the telecommunications industry changes in 2002. The table below illustrates the definition of the telecommunications industry before and after 2002:

1999-2001, SIC (3-digits)	**2002-2005, NAICS (4-digits)**
4810	517100
4820	517200
4840	517300
4890	517400
	517500
	517900

There is not full comparability between SIC and NAICS. Hence, the SIC data includes some sub industries, that are not included in the NAICS data. The sub industries are:

- Cable and other subscription programming.
- Ship to shore broadcasting carriers.
- Radio broadcasting operated by cab companies.
- Pay telephone concession operators.

US occupations are defined, using the Major Groups of the 2000 Standard Occupational Classification (SOC). The occupations are defined as listed in the table below:

US occupation	**SOC (Major) group**
Management Occupations	11
Business and Financial Operations Occupations	13
Computer and Mathematical Science Occupations	15
Architecture and Engineering Occupations	17
Sales and Related Occupations	41
Office and Administrative Support Occupations	43
Installation, Maintenance, and Repair Occupations	49