Employment in European manufacturing

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Executive Summary

Employment in manufacturing declined in the European Union from 26.1 million in 1985 to 23.2 million in 1998. The greatest decline took place during the first half of the nineties, a period marked by severe cyclical downturn and currency turmoils. In 1998, employment was slightly higher than in 1995. In Europe, the share of manufacturing in total employment was 15%, if only direct employment is measured. However, many jobs in other branches of industry (construction or energy, for example) also depend on manufacturing output, as do business related services, a sector with increasing employment.

In the USA, the share of manufacturing in employment, as well as the absolute number of persons employed in manufacturing (17 million) was lower than in Europe. Employment in manufacturing was rather stable over the entire period. It increased in Japan until 1991, and thereafter fell by 12% (to about 10 million). Production growth was initially highest in Japan, but is now fastest in US manufacturing. Europe was in second place during both periods. Production and employment figures for Europe, Japan and the USA are not fully comparable due to differences in adjustments for prices, outsourcing etc. Nevertheless, the trends reported seem to be robust.

Productivity comparisons between the USA and Europe differ significantly before and after 1991. Europe increased productivity faster up to the nineties, successfully catching up (partially) with the absolutely higher rate of productivity in the USA. Since then, manufacturing productivity has risen faster in the USA. There are several explanations for this development: first of all, output grew significantly faster in the USA than in Europe during the nineties (3.6% vs. 1.4% in real value added); secondly, since the US economy is approaching full employment, growth is becoming less labour intensive; and thirdly, Europe is attempting to combat unemployment by increasing part time work to make labour more flexible. An earlier and more intensive use of new technologies in the USA (specifically information and communication technology) may also have contributed to the productivity growth in the USA in the nineties, too.

Employment trends differ among European countries. Over the long run, Greece, the United Kingdom, Finland and Germany lost 15% and more of their employment in manufacturing, while Ireland, Denmark, Netherlands and Spain enjoyed higher employment in 1998 than in 1985. Since 1995, nine countries have managed to stabilise or increase employment, some of them despite a severe crisis during the first half of the nineties and massive restructuring. In general, countries with higher growth have exhibited better performance in employment. However, three countries (Austria, Belgium and Portugal) reduced their lags in productivity relative to the leading countries or to the average, thereby achieving above average growth with declining employment. Three countries managed to increase employment despite of low growth in the nineties by lowering the employment intensity of growth (part time work, etc.); growth in these countries remained below average.

Industries and sectors with higher output growth in general perform better in employment. Over the long run, only four industrial sectors and 24 of 95 industries in Europe grew fast enough to increase employment between 1985 and 1998. If we group industries according to the main factor inputs used (WIFO typology), only Europe's marketing driven industries were able to achieve stable employment over the long run. Capital intensive industries lost 820,000 jobs (-2.2 p.a.), labour intensive industries lost 715,000 employees (-1% p.a.). Technology driven industries maintained their share in employment, but could not stabilise the absolute number of jobs. However, differences across European countries were considerable: Ireland increased employment in the technology driven industries by 6.5% p.a., Finland by 2.9% and Sweden by 1.2%.

Splitting employment growth into structural and locational components illustrates that the production structure is not responsible for differences in employment trends between Europe and the USA. The technology driven sector, which is growing at an above average rate in the triad, does not have a significantly lower employment share in Europe. But it does have a higher share in value added in the USA, reflecting the United States' higher degree of productivity in this sector.

During the nineties, the employment intensity of growth in Europe and the USA moved in opposite directions. While up to 1991, employment per point of output growth increased faster in the USA, the employment intensity of growth has since then been higher in Europe. The hypothetical rate of output growth needed in a typical industry to stabilise employment in manufacturing was 6.7% in Europe, 5.7% in Japan and 3.8% in the USA, for the period 1985 to 1997(8). The latest figures indicate that in the nineties, the USA also required output growth of 6%, while Europe pushed the growth rate needed

to stabilise employment temporarily down to 2%. One important result of this paper is that growth and employment are related across countries, across industries and over time. For given moderate growth rates, economic policy faces an unfavourable trade-off. One option is an increase in productivity, which fosters competitiveness and increases the potential for higher wages and welfare. In Europe, high productivity growth is needed to reduce the lag relative to US productivity. However, this path depresses employment in manufacturing. The alternative option is to lower the employment intensity of growth. This helps in combating unemployment over the short run, but limits the potential to catch up in productivity and wages. The impact of this unfavourable trade off can only be moderated if economic growth accelerates.

The main determinants of long term growth are innovation, the quality of human capital, and general conditions which promote the implementation of new technologies, knowledge spillovers, organisational innovation and the information and communication technologies. Some European countries seem successful in the application of these strategies in research and development, as is reflected by the increasing market shares of technology driven industries in Sweden and Finland, rising employment in Denmark and Netherlands, and increasing shares of core industries[1] in Germany, France and the United Kingdom. Europe is catching up in information technology, and is taking the lead in such areas as cellular phones, with all their future potential (for example, Internet access). Innovation determines employment directly in the technology driven sector, indirectly in other manufacturing sectors, as well as in services, and are decisive for growth, employment and the competitiveness of Europe.

1. Issues addressed and the scope of analysis

Employment in manufacturing supplies about 15% of the jobs in the European Union. Furthermore, manufacturing is the basis for an even larger share of jobs in other sectors of the economy, specifically in business related service industries, as well as in energy and construction. This paper presents stylised facts on the employment trends in individual countries and industries. Specifically, the paper focuses on the relation between employment and growth. The paper is structured as follows:

[1] Aiginger, K., Böheim, M., Gugler, K., Peneder, M., Pfaffermayr, M.), Specialisation and Deconcentration in European Manufacturing, Background Paper for the Competitiveness Report 1999. Study commissioned by the European Commission, Brussels, 1999.

first, we describe employment trends in manufacturing in Europe, Japan and the USA, according to European countries and industries; then we investigate the influence of structural and factor inputs; and finally we analyse the employment intensity of growth in Europe, the USA and Japan. The impact of innovation on employment is outside the scope of this paper, but reference is made to specific important examples, at the end of the paper.

The paper does not reflect in-depth research, but rather is based primarily on existing information provided in the Reports on Competitiveness of European Industry, the Employment Report and in publications on the knowledge and information society. No data base was specifically compiled for this paper. The picture we draw is not entirely complete, as some data are missing, in particular that on the interface between the manufacturing and service sectors.

2. Employment trends in total manufacturing

2.1 Decline in overall employment

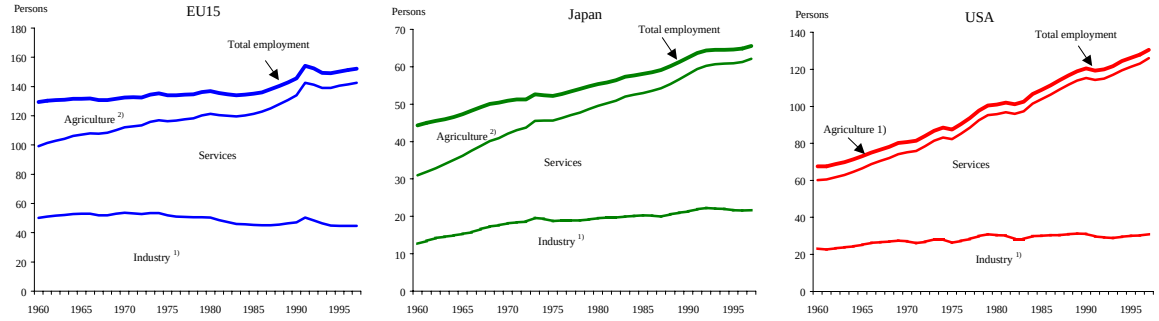
Employment in manufacturing in Europe declined from 26.0 million in 1985 to 23.2 million in 1998[2]. This decline of 11.2% in total and 0.9% annually occurred primarily between 1990 and 1995; employment has been stable since 1995 and was also stable between 1985 and 1990. Comparing employment with growth in value added shows that periods of high growth are accompanied by stable employment and periods of slower growth result in a decline in employment. In 1993 – a year with adverse business conditions and currency turmoil – (nominal) value added declined by 4.6% and employment fell by 6%.

Employment in manufacturing measures only the direct impact of industry demand on employment. Indirectly, manufacturing supports employment in other sectors, specifically the service sector. Employment in the service sector increased in the EU from 76 million in 1985 to 98 million in 1997;

[2] We use the SBS data base for manufacturing (NACE 15 – 36). Some of the data are incomplete and have been estimated by WIFO (for the techniques see Aiginger et al. Specialisation and Deconcentration in European Manufacturing, Background Paper for the Competitiveness Report 1999. Study commissioned by the European Commission, Brussels, 1999). The estimation techniques imply that in some cases the sum of the industries (3 digit NACE) or of the sectors and of total manufacturing exhibit slight differences. In this case, the sum of the 3 digit industries is taken as the total.

the increase amounts to 29% for the period taken as a whole, or 2.1% per annum. Total employment was 135 million in 1985 and 152 million in 1997. [3]

Fig 2.1: Employment in broad sectors – EU, Japan, USA 1960 to 1997



Source: OECD, Labour Force Statistic.

2.2 Differences between member states

Employment trends vary across countries. The manufacturing sector lost one quarter of its employment in Greece between 1985 and 1998, the UK one fifth, Finland and Germany 15% and 16% respectively. Ireland increased its employment by one third. Three other countries today have a higher level of employment in manufacturing than in 1985: Denmark, Netherlands and Spain.

Since 1995, nine countries have managed to increase employment in manufacturing. The increases were primarily in countries in which employment also increased over the long term (Denmark, Ireland, Netherlands and Spain), although countries which underwent severe restructuring (such as Finland and Sweden) also achieved rising employment in manufacturing, as well as Italy, Portugal and France. Despite the relatively favourable business climate during the second half of the nineties, employment has continued to decline in Germany, Greece, the UK, Belgium and Austria.

Employment and growth are related across countries. Greece, Finland, and the UK experienced – for the total period 1985 to 1998 – weak production growth as well as declining employment. Ireland, Netherlands and Denmark exhibited high growth in value added combined with rising employment. Outliers were Austria and Belgium, with a much higher level of output growth relative to its employment performance (catching up in the process of productivity), as well as Portugal, where the

[3] Source: OECD, Labour Force Statistic.

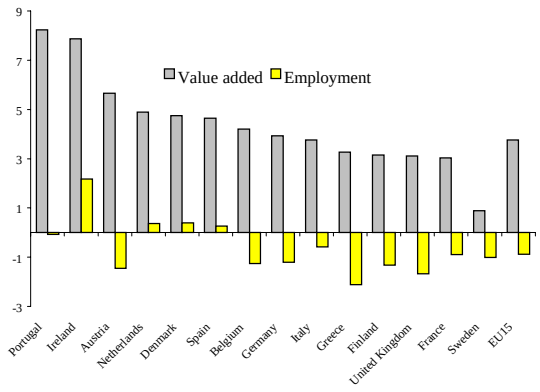
highest industry growth could not prevent a (slight) decrease in employment. In the short run, Denmark, France and Netherlands combined moderate growth with a positive employment trend. The results show that a stable relationship between growth and employment exists as a basic trend. However, the process of catching up (versus the highest productivity case of Austria and the average productivity case of Portugal) can weaken this trend. On the other hand, increasing part time work, increasing labour market flexibility, reducing the number of hours worked per week, and an active labour market policy permits the combination of low growth with stable employment, albeit at some costs.

Table 2.1: Employment growth in manufacturing across countries

Country	1985/90	1990/95	1995/98	1985/98
Belgium	0.1	-2.5	-1.4	-1.3
Denmark	-1.0	1.5	0.8	0.4
Germany	1.4	-3.3	-1.9	-1.2
Greece	-0.3	-4.1	-1.8	-2.1
Spain	1.3	-3.1	4.5	0.3
France	-1.5	-1.1	0.5	-0.9
Ireland	0.6	3.1	3.2	2.2
Italy	-0.5	-1.6	1.2	-0.6
Netherlands	1.7	-1.2	0.8	0.4
Austria	-1.3	-2.3	-0.4	-1.5
Portugal	-0.1	-1.4	2.1	-0.1
Finland	-1.9	-2.0	0.6	-1.3
Sweden	0.1	-3.7	1.9	-1.0
United Kingdom	-0.1	-3.6	-1.1	-1.7
EU15	0.2	-2.6	0.1	-0.9
Japan [1)]	0.5	-1.6	-1.6	-0.7
USA [1)]	0.1	-0.2	0.0	0.0

Source: WIFO calculations using SBS.

Fig 2.2: Growth of value added and change in employment 1985 to 1998



Source: WIFO calculations using SBS.

Table 2.2: Growth of value added and employment in manufacturing

	Value added (nominal)				Employment			
Country	1985/98	Rank	1995/98	Rank	1985/98	Rank	1995/98	Rank
Belgium	4.2	7	0.4	13	-1.3	10	-1.4	12
Denmark	4.8	5	1.7	9	0.4	2	0.8	6
Germany	3.9	8	0.5	12	-1.2	9	-1.9	14
Greece	3.3	10	0.2	14	-2.1	14	-1.8	13
Spain	4.7	6	5.0	4	0.3	4	4.5	1
France	3.0	13	0.7	11	-0.9	7	0.5	9
Ireland	7.9	2	8.8	1	2.2	1	3.2	2
Italy	3.8	9	5.1	3	-0.6	6	1.2	5
Netherlands	4.9	4	1.4	10	0.4	3	0.8	7
Austria	5.7	3	4.4	6	-1.5	12	-0.4	10
Portugal	8.2	1	5.0	5	-0.1	5	2.1	3
Finland	3.1	11	2.5	8	-1.3	11	0.6	8
Sweden	0.9	14	2.7	7	-1.0	8	1.9	4
United Kingdom	3.1	12	8.2	2	-1.7	13	-1.1	11
EU15	3.8		2.9		-0.9		0.1	

Source: WIFO calculations using SBS.

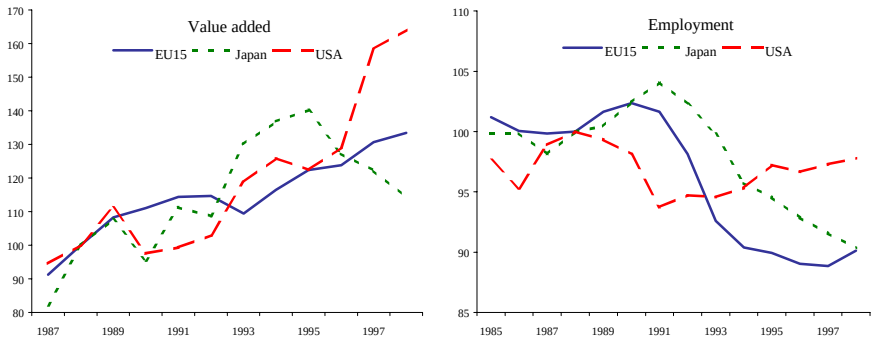
2.3 Comparing Europe with Japan and the USA

Employment in manufacturing declined in Japan and in the USA, but at different speeds and according to different time patterns. Employment in Japan decreased from 10.8 million in 1985 to 9.9 million in 1997. Employment increased between 1985 and 1990 and reached its climax in 1991. Following that peak, it fell by 12%. For the total period, these developments resulted in a decline of 8.3% or 0.7% per annum. Nominal value added over the entire period grew somewhat faster than in Europe (65.4% vs. 61.6%), but mainly during the first half of the nineties, while production suffered an absolute decline in Japan from 1995 onwards. Productivity rose sharply during the first half of the nineties, declining thereafter, levelling Japan's higher growth trend down to one percentage point (over the total period 1985 to 1998).

In the USA, employment in manufacturing was more or less stable, with 17.4 million employees in 1985 and 17.3 million in 1997. These figures exhibit less variation, although they are in absolute terms smaller than those for Europe, due to the larger service sector share (the higher share reflects not only the higher share of services in demand, but maybe also the intensive outsourcing in the USA). Employment in manufacturing increased slightly between 1985 and 1990, but decreased in 1991 by 4.5%; some of this decline was later regained. Production growth over the long run was since 1991 faster than in both Japan and in Europe. Up to 1991, productivity growth was slower than in Japan and in Europe; during the nineties, productivity growth in the USA was – parallel to the

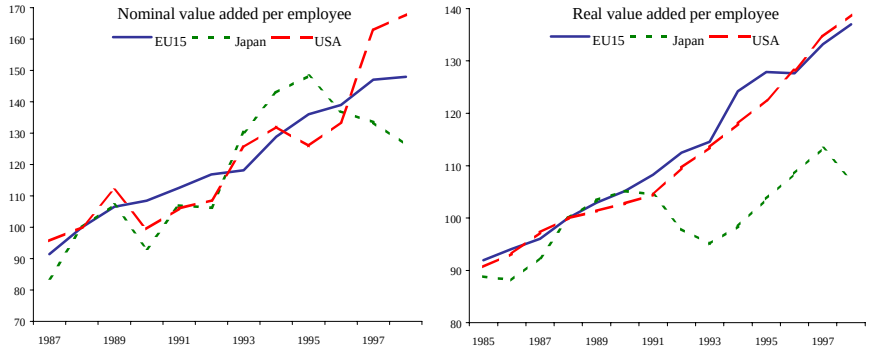
difference in growth – larger. This trend reversal – higher productivity growth in the USA as compared to Europe – correlates with the higher growth rate of output in the nineties, and also with the higher employment intensity of growth. Productivity increased in the USA, as its economy approached full employment in the nineties. At the same time, Europe increased its attempts to reduce unemployment by spreading employment among a larger number of employees. Together, these trends temporarily halted the European process of catching up in productivity.[4]

Fig 2.3: Growth of nominal value added and change of employment in manufacturing 1985 to 1998



Source: WIFO calculations using SBS.

Fig 2.4: Growth of productivity in manufacturing (value added per employee)



Source: WIFO calculations using SBS.

[4] This paper primarily uses data on nominal value added as an indicator of „output". For productivity calculation, data on real output would be preferred. These data are, however, not available at the disaggregated level and calculation methods for constructing price data appear to differ between the USA and Europe. For total manufacturing, we illustrate in Figures 2.5 and 2.6 that the utilisation of nominal or real values does not influence the essential results (short term fluctuations represent changes in the value of the currencies). This is due to the very low price increases for manufacturing goods over the last decade. In our econometric work, specific methods are used to minimise the influence of prices on the results.

2.4 Industry differences

Over the long run, only four industrial sectors[5] increased employment in the European Union: publishing and printing, and rubber and plastics increased employment by more than 1 percentage point p.a.; the other two sectors are very heterogeneous, and employment increased by less than one half a percentage point (furniture and manufacturing n.e.c., and fabricated metals). The strongest decline occurred in the three textile sectors, in tobacco, and in basic metals. In the USA, half the sectors increased employment, including wood products and food, while engineering industries, such as machinery and telecom equipment, maintained constant employment or achieved marginal increases.

Table 2.3: Employment growth in sectors (ranked according to long term growth in the EU)

	EU15		Japan		USA	
Sector	1998/95	1998/85	1997/95	1997/85	1997/95	1997/85
Publishing, printing and reproduction	1.3	1.4	-0.9	0.3	0.1	1.0
Rubber and plastic products	1.0	1.2	-1.5	0.8	0.8	2.5
Furniture; manufacturing n. e. c.	1.9	0.4	-2.0	-1.8	-0.1	1.1
Fabricated metal products	1.2	0.4	-1.1	0.1	1.3	0.6
Motor vehicles, trailers and semi-trailers	2.1	-0.3	-1.0	-0.2	0.7	0.6
Wood, products of wood and cork	0.6	-0.3	-2.4	-1.8	1.1	1.8
Food products and beverages	-0.7	-0.4	1.3	1.0	-0.2	0.6
Radio, TV and communication equipment	-0.5	-0.7	-2.2	-1.2	2.0	0.2
Chemical and chemical products	-0.2	-0.8	-1.4	-0.2	-0.4	-0.2
Machinery and equipment n. e. c.	0.2	-0.9	-1.2	-0.5	1.5	0.3
Pulp, paper and paper products	-0.5	-0.9	-0.6	-0.3	-0.3	0.2
Electrical machinery and apparatus n. e. c.	0.4	-1.1	-2.0	0.2	0.3	-0.6
Other non-metallic mineral products	-0.8	-1.3	-2.9	-1.1	0.8	0.3
Medical, precision and optical instruments, watches	0.7	-1.7	-1.7	-2.3	1.0	-1.5
Coke, refined petroleum and nuclear fuel	-2.7	-1.8	-1.5	-1.8	-3.2	-2.2
Other transport equipment	0.7	-2.3	-1.8	-2.6	-0.2	-2.9
Office machinery and computers	-4.8	-2.5	-1.8	-0.5	1.9	-3.2
Wearing apparel; dressing and dyeing of fur	-2.5	-2.6	-5.0	-2.6	-7.4	-3.0
Textiles	-1.7	-2.9	-4.9	-3.7	-2.3	-0.1
Tanning and dressing of leather	-2.2	-3.0	-3.0	-2.9	-7.6	-5.3
Tobacco products	1.5	-3.1	-1.6	-6.2	-1.4	-3.9
Basic metals	-2.5	-4.1	-3.9	-2.6	-0.7	-0.9
Total manufacturing[1)]	**0.1**	**-0.9**	**-1.6**	**-0.7**	**0.0**	**0.0**

[1)] Sum of sectors.

Source: WIFO calculations using SBS.

[5] In accordance with the WIFO terminology, we address NACE 2 digit industries as sectors, and 3 digit industries as industries.

At the industry level, 24 of 95 industries increased employment in Europe between 1985 and 1998. Reproduction of recorded media, medical equipment and pharmaceuticals are the high tech industries in this sample. No single industry in Europe increased its employment by more than 3%, a rate achieved in plastic products, builders, carpentry, wooden containers and sports goods in the USA. European industries with the most rapidly declining employment were – outside the textile and the steel industries – watches and clocks, control equipment, tubes, ships and boats, musical instruments and agricultural machinery. In most of these industries, employment declined in the USA also, although at a slower rate.

Table 2.4: Ten industries with highest increase in employment (ranked according to growth in the EU 1985 to 1998)

Industry	EU15	Japan[1)]	USA[1)]
Reproduction of recorded media	2.6	5.6	1.9
Treatment and coating of metals	2.4	-0.5	1.4
Plastic products	2.4	1.1	3.1
Publishing	2.3	-0.3	0.7
Cutting, shaping, finishing of stone	1.7	0.0	1.4
Parts and accessories for motor vehicles	1.5	0.2	1.8
Medical equipment	1.3	-0.5	2.6
Pharmaceuticals	1.1	-0.2	2.5
Jewellery and related articles	1.0	1.5	-1.1
Structural metal products	0.8	1.0	0.9
Total manufacturing [2)]	**-0.9**	**-0.7**	**0.0**

[1)] Last year 1997. - [2)] Sum of sectors.
Source: WIFO calculations using SBS.

Table 2.5: Ten industries with highest decline in employment (ranked according to rate of decline in the EU 1985 to 1998)

Industry	EU15	Japan[1)]	USA[1)]
Dressing and dyeing of fur; articles of fur	-8.0	-10.5	-3.5
Watches and clocks	-6.1	-5.6	-4.2
Basic iron and steel, ferro-alloys (ECSC)	-6.1	-4.8	-3.3
Industrial process control equipment	-5.4	-1.7	-0.2
Tubes	-5.3	-2.8	0.4
Ships and boats	-4.3	-4.7	-1.8
Musical instruments	-4.2	-4.4	1.4
Agricultural and forestry machinery	-4.0	-3.3	0.7
Textile fibres	-3.8	-7.4	-1.9
Man-made fibres	-3.7	-2.7	-2.7
Total manufacturing[2)]	**-0.9**	**-0.7**	**0.0**

[1)] Last year 1997. - [2)] Sum of sectors.
Source: WIFO calculations using SBS.

The technology driven sector neither had a lower employment share than the USA, nor did it perform better than the other sectors in terms of employment.[6] Its employment share was stable in Europe at 18%, while in the USA it declined slightly from 22.0% to 19.0%. However, the share of technology driven industries in value added, as well as their growth and productivity, were higher in the US. In Europe, three countries enjoyed rising employment in this sector: in Ireland, Finland and Sweden the technology driven industries outperformed the industry average by far, with annual increases in employment of 6.5%, 2.9%, and 1.2% respectively. These three countries succeeded in attracting modern technology production, specifically telecommunications, while other countries increased their competitiveness through the use of modern technology, but did not stabilise employment in the technology driven sector. In most countries, the marketing driven sector exhibited a slightly better performance in employment, in part through increasing employment directly, but also by limiting decreases relative to total manufacturing.

3. The role of structure, intangible investments and skills

3.1 Intangible investments and human resources

We investigated the influence of industry structure on employment by applying two terminologies, namely one which classifies industries according to factor inputs, and one which classifies them according to the skills used. These typologies were developed by WIFO (Peneder, 1999[7]) and are described in Box 3.1.

Marketing driven industries have the best employment performance

The decline in manufacturing employment was most pronounced in the capital intensive industries, amounting to a total loss of 820,000 jobs (-2.2% p.a.) for the EU. The largest losses occurred in Austria (-4.1%) and Belgium (-3.7%). In all other types of industries, the decline was close to or somewhat below 1% per annum. Marketing driven industries was the only group able to maintain employment close to the level of 1985 (-0.2%). Among the EU member states, Ireland (+1.3%), Netherlands and Portugal (all +0.8%), as well as Spain (+0.5%) and Denmark (0.4%) realised

[6] Note however that its share in value added is higher, implying higher productivity (and maybe also higher outsourcing).

considerable employment gains in marketing driven industries. In the technology driven industries, employment declined despite average growth in production. The differences across countries were considerable, with Ireland increasing employment by 6.5% per annum. Finland (+2.9%) and Sweden (+1.2%) also enjoyed rising employment. In other countries, productivity increased faster than value added, resulting in decreasing employment in the technology driven industries.

Box 3.1: The WIFO taxonomies of manufacturing industry

In our investigation of the structural dimension of changes in manufacturing employment, we apply two taxonomies, which group individual industries according to typical combinations of factor inputs and various requirements for skilled labour. The first classification ("taxonomy I") differentiates between (i) exogenous competitive advantages based on *factor endowments*, such as physical capital and labour, and (ii) endogenously created advantages based on the purposeful *investment in intangible assets*, such as marketing and innovation. In contrast, the second classification ("taxonomy II") clusters industries according to their respective skill requirements, which are both intangible and largely location related.

Compared to earlier classifications, the new WIFO taxonomies are distinguished by their application of statistical cluster analysis, designed specifically for classifying observations according to their relative similarities with respect to a multidimensional array of variables. In the end, about 100 manufacturing industries were completely categorised under the headings given below. Like any broad classification, the new taxonomies must be interpreted with care, since industries listed in the same category can still be highly heterogeneous.

Taxonomy I (factor inputs)
Mainstream manufacturing (MM)

Labour intensive industries (LI)	Capital intensive industries (CI)
Marketing driven industries (MDI)	Technology driven industries (TDI)

Taxonomy II (human resources)
Industries with high shares of ...

.. low-skilled labour (LS)	.. medium-skilled, "blue-collar" labour (MBC)
.. medium-skilled, "white-collar" labour (MWC)	.. high-skilled labour (HS)

In the USA, the decline of employment in technology driven sectors was even more pronounced, despite above average growth in value added. Closer examination reveals that most of the job cuts were executed at the end of the 1980s and in the first half of the 1990s. However, following this process of restructuring and rationalisation, value added growth was much higher than in all other

[7] Peneder, M., Intangible Investment and Human Resources, The New WIFO Taxonomy, WIFO Working Paper No. 114, 1999.

types of industry – with its positive impact on employment just starting to take off. Over the entire period, the job decline in technology driven (-1.3% p.a.), capital intensive (-0.4%), and labour intensive industries (-0.2%) was nearly offset by increasing employment in marketing driven industries (+0.5%) and mainstream manufacturing (+0.8%). In Japan, the overall trends in employment appear to be much more even across industry types, characterised by the largest declines in capital intensive (-1.4%) and labour intensive industries (-1.3%), followed by technology driven industries (-1.0%) and mainstream manufacturing (-0.4%). In Japan, only marketing driven industries achieved a slight increase in manufacturing employment (+0.2%).

Table 3.1: Employment by factor inputs

	1998		1985		Annual average growth 1985/98
EU15		Shares		Shares	
Mainstream manufacturing	6,310,793	27.2	6,943,922	26.7	-0.7
Labour intensive industries	5,088,810	21.9	5,803,382	22.3	-1.0
Capital intensive industries	2,466,569	10.6	3,287,140	12.6	-2.2
Marketing driven industries	5,130,386	22.1	5,286,297	20.3	-0.2
Technology driven industries	4,193,546	18.1	4,712,737	18.1	-0.9
Japan					
Mainstream manufacturing	2,652,795	26.8	2,788,046	25.8	-0.4
Labour intensive industries	2,168,170	21.9	2,540,218	23.5	-1.3
Capital intensive industries	1,105,062	11.1	1,306,133	12.1	-1.4
Marketing driven industries	2,218,490	22.4	2,178,504	20.1	0.2
Technology driven industries	1,772,343	17.9	1,999,829	18.5	-1.0
USA					
Mainstream manufacturing	4,825,827	27.8	4,408,716	25.3	0.8
Labour intensive industries	3,804,203	21.9	3,904,402	22.4	-0.2
Capital intensive industries	1,570,090	9.1	1,656,117	9.5	-0.4
Marketing driven industries	3,852,057	22.2	3,607,804	20.7	0.5
Technology driven industries	3,290,750	19.0	3,828,774	22.0	-1.3

Source: WIFO calculations using SBS.

Table 3.2: Employment by skills

	1998	Shares	1985	Shares	Annual average growth 1985/98
EU15					
Low skills	7,835,475	33.8	9,516,811	36.6	-1.5
Medium/blue collar workers	5,863,956	25.3	6,036,929	23.2	-0.2
Medium/white collar workers	6,105,512	26.3	6,732,737	25.9	-0.7
High skills	3,385,161	14.6	3,747,001	14.4	-0.8
Japan					
Low skills	3,470,756	35.0	3,879,645	35.9	-0.9
Medium/blue collar workers	2,250,384	22.7	2,445,039	22.6	-0.7
Medium/white collar workers	2,934,549	29.6	3,150,442	29.1	-0.6
High skills	1,261,171	12.7	1,337,604	12.4	-0.5
USA					
Low skills	5,203,925	30.0	5,278,056	30.3	-0.1
Medium/blue collar workers	4,112,620	23.7	3,753,350	21.6	0.8
Medium/white collar workers	5,276,146	30.4	5,375,992	30.9	-0.2
High skills	2,750,236	15.9	2,998,415	17.2	-0.7

Source: WIFO calculations using SBS.

Europe looses more low paid jobs

Within the EU15, the decline in manufacturing employment was most pronounced in the low-skilled industries, where between 1985 and 1998 about 1.7 million jobs were erased. This amounted to an average decline of 1.5% per annum. The countries most affected by the decline in low-skilled industries were Finland and Sweden (both -3.3% p.a.), Austria and Greece (both -2.5%), Germany (-2.1%) and the United Kingdom (-2.0%).

In total, the industries relying most intensively on medium-skilled blue-collar performed best of all the four classes of industries. Besides Ireland (+2.8% p.a.), which excelled in all categories except the low-skilled ones, considerable gains in employment were also recorded for the Netherlands (+1.5% p.a.), Denmark (+1.4% p.a.) and Spain (+1.1% p.a.). In most countries, medium-skilled white-collar, as well as high-skilled industries, exhibited intermediate performances with regard to employment. Variations between countries were rather modest, except for the particular case of Ireland. There, the two most skill dependent types of industry contributed most to the general increase of manufacturing employment (medium-skilled white-collar: +4.3% p.a.; high-skill: +5.6% p.a.).

The most striking feature revealed by the US-data was the rather positive development of employment in those industries, which are characterised by large shares of medium-skilled blue-collar workers. In the USA, these industries were even able to increase employment by an annual average of 0.8%, in comparison to a modest decline of 0.2% p.a. in the European Union. Corresponding to the large losses of employment in technology driven industries in the USA (reported above), high-skilled industries

similarly showed the steepest decline in employment, amounting to -0.7% p.a. In the USA, both low-skilled industries and medium-skilled white-collar industries experienced rather stable development. In contrast, data for Japan show little variation in the dynamics of employment between any types of industry. However, ranging from -0.9% in low-skill industries to -0.5% in high-skill industries, the decline appeared to be somewhat more pronounced, the less skill intensive industries were.

3.2 Structural vs. locational components of employment growth

We distinguish between changes in employment attributable to factors which are specific to individual countries (the locational component) and to factors characteristic of industries (the structural component). While this division should not interpreted as an explanation of growth differences, it does help us to establish stylised facts and provides a first indication of how important the structural composition of the manufacturing sector is. For methods, caveats and definitions see Box 3.2.

Box 3.2: Shift and share analyses

The aim is to decompose changes in employment into the two hypothetical components of general, location dependent factors, which are specific to the development of the individual country or economic area on the one hand, and the impact of the particular structural composition of production on the other. Thus, the total change in employment is first broken down into *locational*, and *structural* components. These components are often referred to as 'sources' of changes in employment. However, this reference is largely misleading, since the underlying assumptions for such an interpretation (e.g. the orthogonality of the two dimensions) are not secured. Shift-share analysis thus only hypothetically decomposes the differences in observable changes in employment into two economically interpretable effects.

The following analysis applies the so called *differences method*.[8] This method is based on the calculation of relative differences in employment growth between individual economies and their aggregate. In short, the method produces three numbers. The first, is the *Total Net Shift* (TNS), i.e. the difference between the total growth in employment of a particular country and the EU15 (or the EU15 plus Japan and the USA, respectively) during the period 1985 to 1998 (1997). This is decomposed into two further effects: The *Net Differential Shift* (NDS) captures the *locational component* and is calculated as the difference between the actual and hypothetical

levels of employment in 1998, under the assumption that all the industries in the country under consideration grew by the same rate as the corresponding industries in the EU15. It thus isolates any impact of the differences in the sectoral composition of production between countries. The corresponding *structural component* is captured in a separate number, called the *Net Proportional Shift* (NPS)[9]. The numbers are linked by the relationship: *Total Net Shift* (*TNS) = Net Differential Shift (NDS) + Net Proportional Shift (NPS).*

Differences between countries in the development of manufacturing employment were mostly due to general locational effects, whereas structural effects played a much smaller role. On average, the absolute value of the Total Net Shift of employment between 1985 and 1998 amounted to 8.05% of an EU country's[10] manufacturing employment in the base year. The Net Differential Shift, which captures the locational effect, was almost identical and amounted to 7.74% on average. In contrast, the mean of the absolute values for the Net Proportionality Shift, which signals the hypothetical scope of the structural effect between 1985 and 1998, was only 1.82%.

However, the comparison of mean absolute values is biased by a very uneven distribution of the *locational component*, which is characterised by extraordinarily high gains by manufacturing employment in a few countries such as Ireland (+40.9% of manufacturing employment in 1985), the Netherlands (+15.0%), Spain and Portugal (both +13.3%) and Denmark (+13.0%). In contrast, within the European Union, only a few countries were characterised by a substantial positive structural component. Among these were Denmark (+3.1% of manufacturing employment in 1985), Ireland (+2.3%), and the United Kingdom (+2.0%). In contrast, the industrial structures of Greece (-5.3%), Belgium and Italy (both -2.4%) had the most negative impact on employment, relative to the total of the European Union. In all the other EU countries, the structural component accounted only for a minor part of the Total Net Shift in employment.

Compared to Japan and the USA, the European Union experienced the largest decline in employment, due to the negative effects of both the structural and locational components. If changes in employment

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[8] Alternatively, we have also used the so called *index method*, which is based on the calculation of ratios, instead of differences in employment growth. The results produce the same overall picture, but are somewhat more complex in their interpretation. We therefore decided to present only the differences method.

[9] Formally, the *Net Proportional Shift* is defined by the difference between two hypothetical numbers: The assumed total employment of a particular country, first of all, in the case that all industries grew at the same rate as the corresponding industries in the EU15; and secondly, in the case that all industries grew at the same rate as the total for the manufacturing industries in the European Union.

[10] Ireland was considered an outlying case and not included in the calculation of mean absolute values.

had been the same as in the totals for the three areas, approximately 1,200,000 jobs could have been saved within the manufacturing sector. Decomposing this Total Net Shift, about 830,000 jobs were lost due to differences in general locational factors. Hypothetically, differences in industrial structure contributed to about 360,000 additional job losses (i.e. 1.4% of total employment in 1985). In Japan, a positive structural effect almost outweighed a negative locational component of similar size. In the USA, both effects were positive, although the locational effect was again much more important than the structural effect.

4. The employment intensity of growth

4.1 Comparing the EU15, the USA and Japan

Employment in manufacturing is in part a result of production growth, and in part a result of the employment intensity of growth. We described the relationship between growth in output, employment and productivity in our analysis which revealed that productivity increased faster in Europe than in the USA, albeit not during the last period. Higher productivity growth is the other side of the picture of lower employment intensity of growth.

Box 4.1: Panel results for employment intensity of growth (Okun's law)

Okun's law summarises the relationship between employment growth and output growth as a stylised fact. In particular, it provides a rough estimate of the amount of output growth required for stabilising employment growth. Since there is a marked long run trend in labour productivity across all manufacturing industries, compensation is possible only when average output growth is higher than productivity growth. We use 3 digit data for the triad and estimate this relationship in a three way panel covering the period 1985-1998(97) with fixed time and industry effects. Unfortunately, real output figures are not available at this detailed level; the only output indicator at hand is nominal value added. To control for differences in macroeconomic performance, especially exchange rate movements, country specific time dummies were included in the specification. This accounts for most of these effects, although differences in industry specific price movements across the triad could be neither observed nor accounted for.

Okun's law at the industry level;, fixed effects estimation results

		Specification I		Specification II	
		ß	t	ß	t
Growth in value added - base = EU15		0.39	21.17$^{**)}$	0.37	11.91$^{**)}$
Difference to base:	USA	0.07	2.79$^{**)}$	0.17	4.14$^{**)}$
	Japan	0.07	2.95$^{**)}$	0.12	2.87$^{**)}$
Difference to 1991-97(98):	Base			0.03	0.77
	USA			-0.14	-2.83$^{**)}$
	Japan			-0.08	-1.41

Number of observations	3610	3610
R^2	0.62	0.66
Root MSE	2.92	2.92
Ramsey Reset Test (t-test) [a)]	1.46	5.60 [**)]
Structural break (USA, Japan; 91-97)	-	6.50 (2, 3467) [**)]
Fixed industry effects(F-Test) [b)]	3.52 (98, 3468) [**)]	3.35 (98, 3467) [**)]
Fixed time effects (F-Test) [b)]	24.46 (12,3468) [**)]	24.96 (12,3467) [**)]
Difference of fixed time effects USA (F-Test) [b)]	43.09 (12,3468) [**)]	43.66 (11,3467) [**)]
Difference of fixed time effects Japan (F-Test) [b]	29.12 (12,3468) [**)]	27.89 (11,3467) [**)]

Note: Time dummies are included for each member of the triad to account for differences in exchange rate movements. Four dummies for particularly high or low productivity shocks are not reported. Estimates are corrected for heteroscedasticity. Observations with standardised residuals greater than 3 in absolute value were classified as outliers and eliminated
a) t-test of the squared predicted value as an additional regression. b) degrees of freedom in parenthesis. **)significant at 5%.

In this chapter, we use econometric panel techniques to quantify the relationship, to reveal differences between Europe, the USA and Japan, and to investigate whether the results for the first part of the period analysed differ from those for 1991 onwards. Box 4.1 describes the technique as well as the comprehensive results.

4.2 Trends over the full period

On average, an increase in nominal value added of 1 percentage point increases employment by 0.39 percentage points in a typical European industry[11]. For the entire estimation period, growth was less labour intensive in Europe than in the USA and Japan. For the USA as well as for Japan, employment increased by 0.46% per point of growth; the difference is statistically significant.

There are also differences in the estimated intercepts (which are not presented, because they are included in the time effects), which mainly capture a mixture of the variations in productivity, prices and macroeconomic performance. To illustrate the combined effect, we calculated the amount of manufacturing output growth which would have been necessary to stabilise employment; we named this figure the „employment stabilising rate of growth“ (ESGROWTH, Table 4.1).

Table 4.1: Average employment stabilising rate of nominal value added growth (ESGROWTH) derived from regressions in % based on logarithmic differences

	Specification I	Specification II

[11] Given the ceteris paribus condition, i.e. for given fixed industry and time effects. Despite these limitations, the estimation results compare well to previous work using data on real value added, despite a shorter time period and a much smaller number of industries (Peneder, et al., The competitiveness of European industry, 1998 Report, European Commission, 1998).

	1985-1998	1985-1990	1991-1998
EU15	6.7	5.6	1.7
Japan	5.7	4.1	2.9
USA	3.8	0.8	6.0

Source: WIFO calculations using SBS.

4.3 Division into subperiods

In the EU15, industries needed to grow by 6.7% on average p.a. over the period 1985 to 1998 in order to stabilise employment in manufacturing. This indicates, inter alia, a marked increase in productivity and the ongoing catching up process of European industries. For Japan, the corresponding value amounts to 5.7%. For the USA, the figure is much lower (3.8%), indicating that manufacturing in the USA has been more successful in preserving jobs than it has in the EU, despite comparable growth rates in demand.

Specification II indicates that this relationship did not remain stable over the entire period. A visual inspection of the aggregate time series (Figure 2.5 and 2.6) suggests that in the triad, the pattern of labour productivity growth changed during the nineties. Testing for a structural break in the estimated equation for the period 1991 to 1998 indeed confirms this hypothesis. Although the average rate of growth (ESGROWTH) necessary to stabilise employment (as derived from the estimated model) is rather sensitive with respect to the econometric specification, the overall tendency is robust enough to draw some tentative conclusions. Over the period 1986-1990, manufacturing industries in the EU and Japan achieved relatively stable growth in labour productivity, whereas in the US, productivity growth was slow. During the 1990s, the situation reversed: Productivity growth gained momentum in the USA, while in the EU and Japan, the catching up process came to a temporary halt (in Japan, the main reason was the recession in the late nineties). The estimated ESGROWTH (average employment stabilising rate of value added growth) is now 6.0% for the USA, but only 1.7% for the EU and 2.9% for Japan. These are rough estimates and should not be taken literally, since they vary considerably across industries and are partly not statistically significant (see Box 4.1). The standard deviation ranges between 5.5 and 20.8 percentage points. What we can learn from these findings is that (i) the average employment stabilising rate of growth is not constant over time and inter alia depends on

overall macroeconomic performance. (ii) ESGROWTH increased sharply in the USA in the nineties, and declined in Europe (the first tendency is statistically significant, the second not).

5. Innovation as a determinant of long term employment

The paper demonstrates the impact of growth and innovation on employment. Growth in the USA was higher and employment in manufacturing was stable. Within Europe, Ireland, Netherlands and Denmark enjoyed above average growth and rising employment. Finland, Sweden and Ireland could increase employment in technology driven industries and improved the competitiveness of their technology driven industries. The technology driven sectors grew faster than average in most countries, but the direct employment effect was not always positive because the productivity increase was specifically large in these sectors. Indirectly, the technology driven industries fostered competitiveness and provided the basis for services founded on new technologies.

A full evaluation of the role of new technologies in employment is beyond the scope of this paper (European Commission 1999, or OECD 1999)[12]; our goal is not to monitor the competitive position of Europe within the triad (see the Competitiveness Reports 1998, 1999). We will use some examples from the telecom sector to illustrate the positive net effect of new technologies on jobs, which may directly or indirectly (via increasing competitiveness) create employment. In addition, we will illustrate how the competitive edge is quickly changing different parts of the telecom sector.

Liberalisation directly and indirectly created jobs in telecom

The liberalisation of telecommunications in Europe had a significant impact on employment in this sector. One of the most important implications of liberalisation was the creation of new employment opportunities at alternative network operators, new cellular operators and in Internet related services. This additional demand led to shortages of qualified labour, as well as to premium salaries in the telecommunications sectors.

Nonetheless, the overall employment increase occurred parallel to the job losses sustained by the formerly monopolistic operators. In certain countries and periods, these cut backs were larger than the

[12] The competitiveness of European industry, 1999 Report, Working document of the services of the European Commission, and The knowledge-based economy: a set of facts and figures, OECD, 1999.

number of jobs created by new operators. Many operators have become overstaffed due to the digitisation of the industry. Digitisation – which is not related to the liberalisation of the industry – has led to the redundancy of many tasks involved in the operation of telecommunications networks. During the monopoly regime, operators often did not have incentives to increase the efficiency of their operations and were reluctant to shed employment. New competition unleashed by liberalisation created an environment which encouraged former monopolists to significantly restructure their operations, with the aim of increasing their efficiency and becoming more customer oriented.

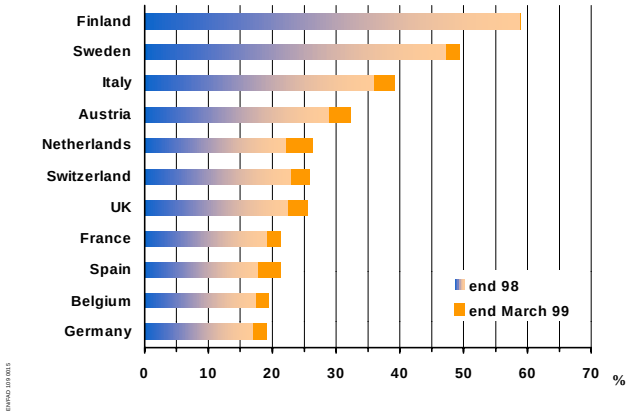
Internet use lags in Europe, while cellular phones surge

Liberalisation has had a fundamental impact on the European telecommunications sectors and has improved the international competitiveness of European operators, and their economies as well. A significant reduction in prices (see for example European Commission, 1999[13]) and greater choice have stimulated the acceptance of the Internet in Europe, although long term forecasts still assume that the USA will maintain a significant lead in Internet use (DOC, 1999[14]). Interestingly, the rapid development of cellular systems may change this structure significantly. The success of cellular telephones in Europe has led to far higher penetration rates in Europe than in the United states (see Figure 5.1). The next generation of cellular phones (based on UMTS/IMT-2000) will be ready for implementation in 2002, providing fast access to multimedia services and the Internet. Via their cellular terminals, a large number of users will enjoy access to the Internet and a wide range of advanced multimedia services. Internet literacy and availability will be boosted by these systems; consequently, the gap between the United States and Europe should diminish.

Fig 5.1: Wireless penetration in Europe

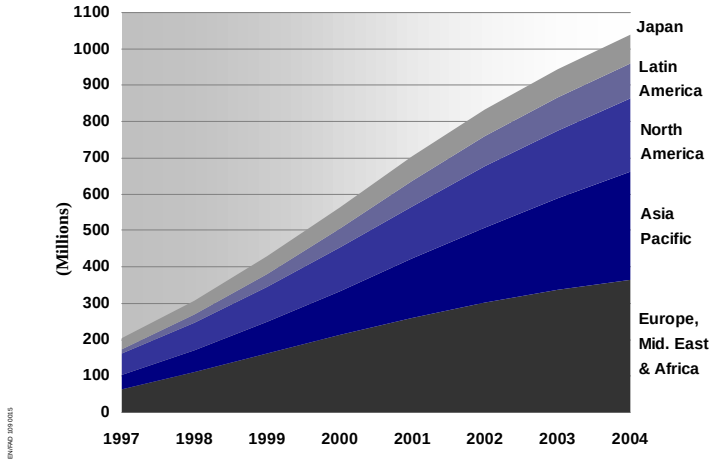
[13] European Commission, Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions, Fifth Report on the Implementation of the Telecommunications Regulatory Package, Brussels, 1999.

[14] U.S. Department of Commerce, The Emerging Digital Economy II, June 1999.



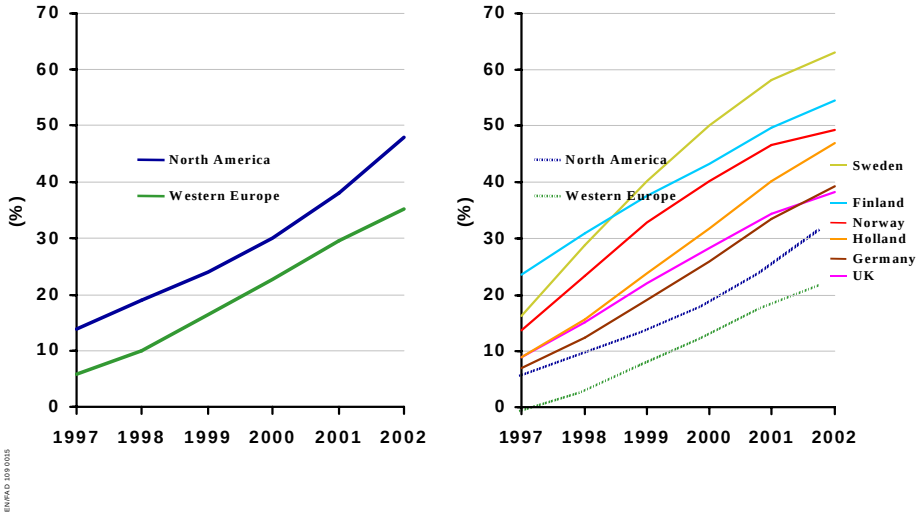
Source: Ericsson.

Fig 5.2: Worldwide mobile Subscribers by region



Source: Ericsson.

Fig 5.3: Web users by region (users as share of population)



Source: International Data Corporation, '98.

Employment needs economic growth and innovation

The overall comparison of the trends in production, productivity and employment, has illustrated the two sides of the problem. In the short run, Europe must choose between higher productivity growth

(which is needed to boost competitiveness, to reduce lags in productivity and to stimulate income growth) or higher employment intensity of growth (which is needed to decrease unemployment). Both short run strategies have important disadvantages. This conflict can only be resolved if Europe is able to increase economic growth. In this case, productivity would increase and a moderate rate of „employment intensity of growth“ would suffice to increase employment. Intensifying innovation and further upgrading of human capital are two core elements in the realisation of this strategy. Reducing Europe’s lag in the technology driven industries in general, and forging ahead in other sectors, such as in the cellular telephone industry, indicate that this path is feasible for Europe.