

Productivity in the EU, 1979–99



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INTRODUCTION

The purpose of this note is to present measures of relative productivity performance in order to yield an overview of the **current productivity position** of the EU as a whole relative to that in the United States. It shows estimates of GDP per capita, labour productivity, capital per hour worked and underlying total factor productivity, with the **primary focus** on relative levels and trends in aggregate economy-wide productivity. Its **aim** is to gauge to what extent the EU lags the US in terms of the amount of output produced for given inputs and to examine movements in the EU's relative position over time. Estimates for individual EU Member States are also presented.

In addition, it is useful to consider performance in sectors which are important contributors to aggregate activity. Although the data required to replicate the analysis for the aggregate economy are not readily available, it is possible to examine output per hour worked for two broad sectors: **manufacturing** and **'market services'** (transport, communications, distribution & repairs, hotels and catering, financial intermediation and business services).

These estimates should be seen as a broad overview of the relative productivity position of EU Member States. There are a number of problems with the data and estimation methods, described in a data Appendix, which will have some impact on the reliability of the estimates. In terms of **labour productivity**, there remains considerable uncertainty regarding cross country comparisons of annual average hours worked. This largely affects the smaller EU nations so that the labour productivity estimates for the total EU presented in this note are consistent with estimates by other researchers, e.g., with OECD estimates.

There is more uncertainty attached to the measurement of **physical capital**. The capital stocks estimates are based on total non-residential investment – a more refined estimate based on disaggregating by asset type, and hence taking account of capital quality, is likely to yield somewhat different conclusions. Despite these warnings, the estimates presented below are as reliable as is feasible given the existing data limitations.

One further important point of clarification is necessary before proceeding to the estimates. The numbers presented below in general refer to the total EU, derived by summing output or inputs across EU Member States. Thus total EU productivity estimates are equivalent to a **weighted average** across Member States with larger countries having a greater impact than smaller ones.

I. Productivity Measures for the Aggregate Economy

The most widely cited measure of a country's relative performance is GDP per capita. This measure has the most direct bearing on average standards of living. From an economist's point of view, however, productivity is more readily defined as output per unit of productive inputs. Hence economists' use of alternative measures such as labour productivity or total factor productivity (TFP). Two measures of labour productivity are presented in this note:

- (i) **GDP per person engaged**, which includes self-employed as well as employees; and
- (ii) **GDP per hour worked**, which adjust for differences across countries in the length of the standard working week and additionally takes account of time lost due to holidays, sickness etc. and the extent of part-time working.

Cross country differences in labour productivity performance in turn have two main components. The first is **capital-deepening** (increases in the quantity of physical capital per unit of labour input) and the second is **total factor productivity** or TFP (that is, the residual growth in output after allowing for increases in capital). This section begins with an examination of labour productivity and then considers capital deepening and TFP.

I.1. Labour Productivity

To put labour productivity comparisons in perspective it is useful to first consider relative levels of **GDP per capita**, shown in the first column of **Table 1**. This shows average standards of living in the United States at the end of the 20th century considerably above those in the total EU with a significant lead over almost all individual Member States. GDP per capita in the UK in 1999 was just above the EU total and not significantly different from other large EU countries such as France, Germany and Italy.

Comparisons of relative levels of **labour productivity** show a somewhat different picture. Labour productivity measured on a per worker basis (2nd column of Table 1) and in particular on a per hour basis (3rd column of Table 1) show a reduced United States lead over the total EU with the UK below both the total EU and many of the individual Member States (though as will be seen later, catching up).

Differences between the three measures reported in **Table 1** reflect variations across countries in rates of labour force participation, unemployment and annual average hours per person engaged. It is well known that labour force participation rates in the US are higher than in European countries and unemployment lower. Together, these explain the reduced US lead in GDP per person engaged. Thus the employment to population rate in the total EU in 1999 was only 87 per cent of that in the US, with the UK closer to the US at 94 per cent. Also, in general, annual average hours worked are higher in the US than in Europe with persons engaged in the EU working on average for more than 10 per cent less time than US employees. Again the UK position is between that in the US and the total EU.

Despite the differences in the measures employed, the US labour productivity lead over the total EU remains large. **Levels of GDP per person engaged in the total EU reached only 75 per cent of US levels by the end of the 1990s.** On this basis only Luxembourg had a productivity advantage over the US although Belgium was close. On a per hour worked basis, however, a number of individual EU Member States enjoy labour productivity levels at or near US levels.

The EU (excluding Luxembourg) can be divided roughly into three groups on the basis of the results on GDP per hour worked. The first group consists of countries with levels of GDP per hour similar to those in the US and includes Belgium, France, Italy and the Netherlands. The middle group consists of countries where the US lead is significant but not too large (say a US lead of between 10 per cent and 30 per cent). This group consists of Austria, Denmark, Finland, Germany, Ireland, Sweden and the UK. Germany is at the top end of this group – if attention were confined to the former West Germany then it would be in the top group. The UK is firmly in this middle group. The third group consists of countries where the US advantage is large (greater than 40 per cent) and comprises, Spain, Greece and Portugal.

Table 1. Comparative Levels of GDP per Capita and Labour Productivity, 1999

	GDP per Capita	GDP per person engaged	GDP per Hour Worked
United States	151	132	115
EU total	100	100	100
Austria	109	95	90
Belgium	110	125	128
Denmark	119	100	99
Finland	101	101	99
France	101	108	113
Germany	106	99	102
Greece	67	79	74
Ireland	98	99	94
Italy	103	114	113
Luxembourg	185	194	199
Netherlands	115	99	119
Portugal	73	66	63
Spain	81	91	81
Sweden	102	94	95
United Kingdom	101	95	92
EU14 (excluding UK)	100	101	102

Note in these calculations the total EU is the sum across Member States, not the average across the 15 countries. For data sources and methods see Appendix.

Table 2 shows growth in output per person engaged and employment over selected time periods. On average throughout the 1980s and 1990s, the EU continued on its path of post-war convergence to US labour productivity levels. Within the EU, growth rates tended to be higher in countries which were furthest behind the US at the beginning of the 1980s, but this is not invariably the case as illustrated by the relatively weak growth performance of Greece. Since the mid 1990s, US growth has generally been higher than achieved in most European countries, and the EU countries which matched the US performance in this period tend to be the smaller Member States. The larger countries show a deceleration of labour productivity growth in the late 1990s. Labour productivity growth rates in the UK have been just above the total EU since 1979, and has continued to narrow the productivity gap with the EU through to the 1990s.

Table 2. Growth in labour productivity and employment, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
Output per person engaged				
United States	1.16	1.47	1.12	2.00
EU total	1.80	1.52	1.73	1.21
Austria	1.93	2.03	2.32	1.58
Belgium	2.40	1.60	1.67	1.49
Denmark	1.23	1.58	1.99	0.95
Finland	2.80	2.91	3.02	2.75
France	2.10	1.15	1.13	1.19
Germany	1.32	1.93	2.27	1.41
Greece	0.73	1.23	0.36	2.55
Ireland	3.53	2.91	2.46	3.58
Italy	1.92	1.24	1.71	0.54
Luxembourg	2.80	2.65	1.84	3.87
Netherlands	-0.37	0.59	0.35	0.96
Portugal	3.17	1.79	2.01	1.46
Spain	2.59	1.27	1.55	0.85
Sweden	1.51	2.53	2.64	2.36
United Kingdom	1.99	1.61	1.80	1.31
Employment				
United States	1.78	1.48	1.13	2.01
EU total	0.36	0.50	0.04	1.18
Austria	0.27	0.45	0.41	0.52
Belgium	-0.22	0.38	0.02	0.92
Denmark	0.28	0.21	-0.56	1.36
Finland	0.83	-1.11	-3.31	2.19
France	0.10	0.43	0.03	1.03
Germany	0.41	0.39	0.41	0.37
Greece	1.03	0.60	0.68	0.47
Ireland	-0.48	3.70	2.68	5.21
Italy	0.46	0.15	-0.33	0.86
Luxembourg	1.43	2.41	2.94	1.63
Netherlands	2.30	2.24	2.00	2.59
Portugal	-0.04	0.87	0.15	1.95
Spain	0.13	1.21	0.18	2.76
Sweden	0.76	-0.81	-1.66	0.46
United Kingdom	0.12	0.31	-0.41	1.38

The second panel of [Table 2](#) shows that in the 1980s and first half of the 1990s, employment growth was considerably higher in the US than in the EU as a whole as well as the majority of the EU Member States. In the late 1990s employment growth picked up in the EU but output per person engaged declined relative to earlier periods. [Table 3](#) shows the decomposition of output growth into employment and productivity components implied by the numbers in [Table 2](#). In all three periods shown, US output growth involved large contributions from both employment and productivity whereas in the EU employment growth only made a significant contribution in the latter half of the 1990s.

Table 3. Decomposition of output growth into employment and labour productivity components

	(per cent share)					
	1979-89		1989-95		1995-99	
	Emp	Lprod	Emp	Lprod	Emp	Lprod
United States	60.5	39.5	50.2	49.8	50.1	49.9
EU total	16.5	83.5	2.2	97.9	49.4	50.6
United Kingdom	5.6	94.4	-29.3	129.3	51.2	48.7

Notes: *Emp* = number of persons engaged, *Lprod* = GDP per person engaged.

Although employment growth in the US in the early 1990s was not high relative to previous periods, it was relatively strong in the years immediately preceding the acceleration of US growth in the late 1990s, averaging about 2 per cent per annum in the years 1993 to 1995. At the same time labour productivity growth was relatively low, averaging only about 0.5 per cent per annum over the same years. This acceleration in US labour productivity growth in the second half of the 1990s has been associated with rapid diffusion of Information and Communications Technology (ICT) in that country, although there has been considerable debate concerning the precise impact of ICT on productivity.

As mentioned above, at this time labour productivity growth in the total EU, and in particular in the largest Member States, showed a deceleration from that achieved in the early part of the decade. But like the US previously, employment in the EU in general, and in the UK in particular, show a sustained increase in the late 1990s. Since it is well known that ICT diffusion rates in the EU lag those in the US, this raises the possibility that Europe may also experience both an increase in labour productivity growth and sustained employment increases in the future. Only time will tell if this is the case.

Finally [Table 4](#) shows growth rates in the second labour productivity measure, **output per hour** worked. This shows similar trends to those in [Table 2](#) but in this case, the higher growth rates in the EU compared to the US are proportionally greater over longer time periods. This in turn is due to greater reductions in annual average hours worked in Europe in general. (The rate of decline in hours worked, however, is less in the UK than in other European countries.) As [Table 1](#) showed, however, even after a sustained period of catch-up which was only reversed in the late 1990s, EU levels of output per hour are roughly 87 per cent those of the US.

Table 4. Growth in output per hour, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
United States	1.37	1.43	1.15	1.87
EU total	2.42	1.86	2.20	1.36
Austria	2.38	2.84	3.61	1.69
Belgium	3.08	2.05	2.35	1.60
Denmark	1.61	1.82	2.33	1.06
Finland	3.63	2.92	2.97	2.84
France	2.94	1.32	1.42	1.16
Germany	1.91	2.62	3.14	1.84
Greece	1.53	1.61	0.90	2.67
Ireland	4.41	3.31	3.05	3.70
Italy	2.22	1.47	2.08	0.56
Luxembourg	3.48	3.10	2.52	3.99
Netherlands	1.26	1.21	1.01	1.52
Portugal	3.76	2.09	1.91	2.37
Spain	3.63	1.31	1.62	0.84
Sweden	1.28	1.79	1.63	2.04
United Kingdom	2.35	1.91	2.28	1.37

1.2. Capital Intensity and Total Factor Productivity

Labour productivity is only a partial measure of relative performance since it will be influenced by rates of capital deepening. Relative levels of non-residential capital stocks were calculated using the perpetual inventory method converted to common currencies using 1996 purchasing power parities for investment. These measures can be combined with growth accounting methods to give estimates of underlying residual productivity, known as **Total Factor Productivity** (TFP). This adjusts labour productivity by subtracting capital intensity weighted by its share of value added (one minus labour's share). **Table 5** shows relative levels of capital per hour worked and TFP for 1999. In 1999 capital per hour in the total EU was only marginally below that in the US and hence can explain little of the EU labour productivity gap with the US.

There is considerably greater variability across countries in capital per hour worked than in labour productivity. For some countries, in particular the smaller Member States, relative capital intensities have a large impact on relative labour productivity levels. The larger EU nations, except the UK, had levels of capital per hour in 1999 greater than or close to US levels. So for these countries the TFP gap with the US is greater than for labour productivity. As a result, the labour productivity gap with the US for EU large countries is largely explained by TFP. The UK is, however, an exception with capital intensity levels close to the bottom end of the EU distribution; TFP levels are considerably closer to US levels than was the case for labour productivity. The net effect is that the variation amongst EU countries in TFP levels is relatively small.

Table 5. Relative levels of Capital per Hour and Total Factor Productivity, 1999

	Capital per hour worked	TFP
United States	107	112
EU total	100	100
Austria	107	87
Belgium	145	111
Denmark	98	99
Finland	120	93
France	124	104
Germany	102	101
Greece	67	86
Ireland	78	105
Italy	111	109
Luxembourg	193	153
Netherlands	115	113
Portugal	39	90
Spain	90	85
Sweden	95	97
United Kingdom	81	99
EU14 (excluding UK)	104	100

Table 6 shows growth in capital per hour worked for selected time periods. As with labour productivity, there has been a process of catch-up of capital intensity levels in the EU to US levels throughout the 1980s and early 1990s. At the end of the latter decade, however, the US has moved marginally ahead. Although as explained in the Appendix, the results will be sensitive to capital stock measurement, this is unlikely to alter the conclusion that post-war European convergence of capital intensity to US levels at least faltered by the end of the 1990s.

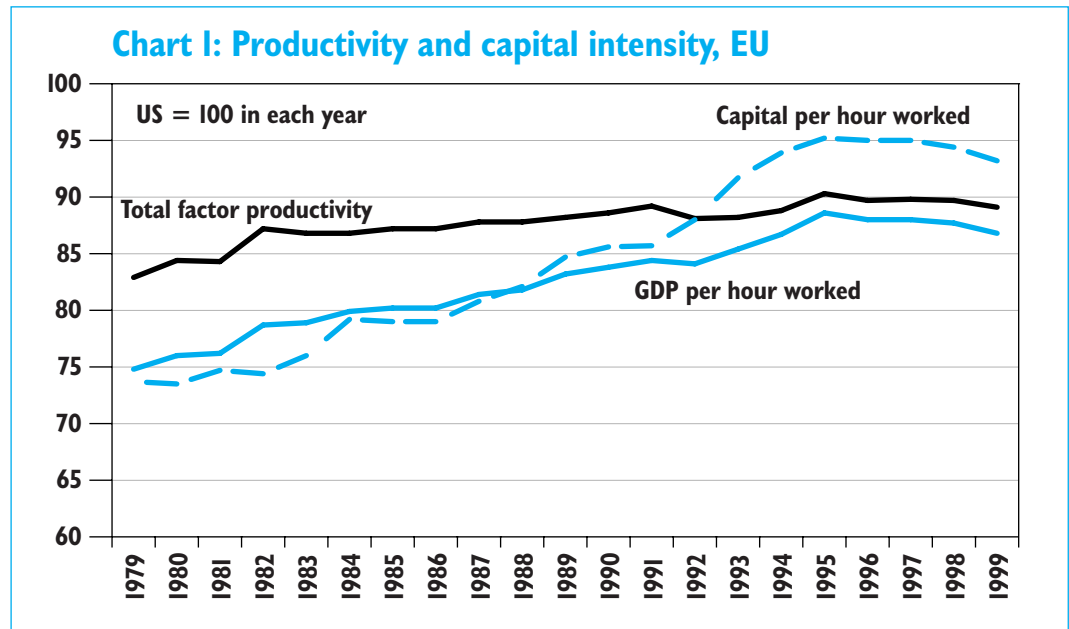
Table 6. Growth in capital per hour worked, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
United States	1.11	1.00	0.82	1.26
EU total	2.50	1.95	2.77	0.72
Austria	2.51	2.66	3.76	1.01
Belgium	2.21	2.49	3.23	1.38
Denmark	2.12	1.88	2.32	1.23
Finland	2.98	0.72	2.40	-1.80
France	3.82	1.85	2.90	0.28
Germany	1.83	2.26	3.14	0.94
Greece	1.58	2.16	1.58	3.03
Ireland	4.29	0.36	-0.19	1.20
Italy	2.30	1.45	2.11	0.47
Luxembourg	3.29	3.07	3.80	1.98
Netherlands	0.10	0.09	0.00	0.22
Portugal	2.98	2.79	2.89	2.63
Spain	3.93	2.31	3.77	0.12
Sweden	1.17	1.49	1.59	1.33
United Kingdom	2.49	2.57	3.35	1.39

Table 7 shows TFP growth rates since 1979. Although there was some convergence of total EU TFP levels to the US in the 1980s, the 1990s witnessed very little catch-up in the EU. **Chart 1** illustrates the trends in all three measures of performance – labour productivity, capital intensity and TFP – and shows that the total EU converged on the US in terms of output per hour worked and capital deepening but showed much less movement in underlying total factor productivity.

Table 7. Growth in Total Factor Productivity, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
United States	1.00	1.07	0.85	1.40
EU total	1.62	1.17	1.23	1.08
Austria	1.01	2.02	1.85	2.26
Belgium	2.36	1.14	1.18	1.08
Denmark	0.98	1.18	1.55	0.64
Finland	2.71	2.74	2.28	3.44
France	1.52	0.54	0.21	1.04
Germany	1.37	1.86	2.10	1.51
Greece	0.98	0.75	0.29	1.43
Ireland	2.98	3.07	3.07	3.07
Italy	1.48	0.95	1.34	0.37
Luxembourg	2.21	1.80	0.95	3.07
Netherlands	1.19	1.18	1.00	1.44
Portugal	2.77	1.05	0.86	1.32
Spain	2.38	0.49	0.29	0.79
Sweden	1.19	1.22	1.08	1.45
United Kingdom	1.55	1.14	1.28	0.93



2. Productivity Estimates by Sector

Concentration on relative performance at the economy wide level can hide interesting variations at more detailed sector levels. It is therefore useful to examine more closely the relative productivity position within broad sectors of the aggregate economy, not least because aggregate estimates are heavily influenced by the large non-market services sector which frequently employ inputs to measure outputs. By definition, this brings countries closer together than might actually be the case if outputs in these sectors were measured more accurately. Data constraints confine the analysis to only one measure of relative performance, value added per person engaged. This following section first considers manufacturing and then examines the position in market services.

2.1 Manufacturing

There is now sufficient data available in international publications to estimate relative labour productivity levels for all 15 EU Member States ([Table 8](#)) but the data are much more sparse before 1995. Growth rates for earlier periods are therefore shown only for a selection of EU countries. The first point to note about [Table 8](#) is that by 1995 **the US remained well ahead of all EU countries in manufacturing**. This US advantage widened in the years since 1995 against the total EU and all individual Member States bar Finland. Some of the smaller states did achieve growth rates close to those in the US but the experience of the larger countries, in particular the UK, was very poor.

The upsurge in US growth rates can be explained to some extent by the use of the much cited 'hedonic price index' for computers reinforced by the much larger size of the ICT producing sector in the US than in the EU. However, the use of the hedonic price index in the US is unlikely to explain entirely the US growth advantage in manufacturing. For example, the use of a hedonic price index for the UK would raise manufacturing productivity growth rates in the period 1995-99 by about 0.9 percentage points per annum. Even if the UK ICT producing sector was double its current size, this would not be sufficient to eliminate the US lead. Similar adjustments to incorporate hedonic price deflators are likely to be smaller for other Member States where ICT production represents a smaller share of manufacturing than in the UK.

Table 8. Relative Labour Productivity Performance in Manufacturing, 1995-99

	(value added per worker engaged, EU= 100)	
	1995	1999
United States	143	159
EU total	100	100
Austria	103	113
Belgium	130	143
Denmark	93	86
Finland	104	121
France	106	109
Germany	99	98
Greece	51	54
Ireland	133	140
Italy	104	100
Luxembourg	118	132
Netherlands	117	117
Portugal	56	60
Spain	97	90
Sweden	101	111
United Kingdom	100	95
EU14 (excluding UK)	100	99

Table 9. Growth in Output per Worker, Manufacturing, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
United States	2.56	3.64	3.18	4.33
EU total				1.67
Austria		3.79	3.64	4.01
Belgium				4.00
Denmark	1.75	1.02	2.10	-0.61
Finland	4.66	5.41	5.58	5.16
France	2.82	2.73	2.70	2.77
Germany	1.24	2.80	3.59	1.62
Greece				2.46
Ireland				2.80
Italy		1.84	2.60	0.69
Luxembourg				4.28
Netherlands				1.86
Portugal				3.26
Spain				0.19
Sweden		5.19	5.80	4.28
United Kingdom	4.31	2.02	2.90	0.71

2.2 Market Services

In contrast to manufacturing, [Table 10](#) shows output per worker in the EU closer to US levels in market services by the mid 1990s. But as in manufacturing, the US has speeded ahead of the EU in the late 1990s – in fact [the difference between growth rates in the total EU and the US is greater for market services than for manufacturing](#). Also, the US acceleration in labour productivity growth post-1995 over the first half of the 1990s is considerably higher in market services than in manufacturing. These sectors include some of the most intensive users of ICT technology.

It is not possible to estimate if there was an acceleration also in the EU post 1995. But the results for the countries for which data are available (mostly the larger Member States) suggest this change did not occur in Europe. The UK appears to be the exception in this respect, showing an increase in market service labour productivity growth post 1995, although at rates considerably lower than those enjoyed in the US. This change in the UK's fortunes within the EU occurred mainly in transport and communications (following deregulation of much of this sector) and in business services.

Table 10. Relative Labour Productivity Performance in Market Services,* 1995-99

	(value added per worker engaged, EU= 100)	
	1995	1999
United States	107	123
EU total	100	100
Austria	106	104
Belgium	132	130
Denmark	92	95
Finland	88	94
France	105	104
Germany	97	98
Greece	94	99
Ireland	81	84
Italy	130	123
Luxembourg	182	177
Netherlands	91	79
Portugal	61	69
Spain	116	111
Sweden	85	94
United Kingdom	81	85
EU14 (excluding UK)	105	104

* Comprising transport, communications, distribution, repairing, hotels & catering, financial intermediation and business services.

Table I I. Growth in Output per Worker, Market Services, selected periods

	(per cent per annum)			
	1979-89	1989-99	1989-95	1995-99
United States	0.95	2.63	1.30	4.63
EU total				1.01
Austria		1.16	1.59	0.50
Belgium				0.68
Denmark	1.12	1.98	2.10	1.79
Finland	2.69	2.31	2.01	2.76
France	1.95	0.00	-0.48	0.72
Germany	1.95	1.63	1.78	1.41
Greece				2.53
Ireland				2.07
Italy		0.99	1.70	-0.06
Luxembourg				0.37
Netherlands				-2.64
Portugal				4.27
Spain				-0.13
Sweden				3.64
United Kingdom	2.72	1.87	1.39	2.60

3. Summary

In summary at the end of the twentieth century productivity levels in the total EU, whether measured by labour productivity or total factor productivity, remain much lower than those in the US. Improvements in the EU relative position in the 1980s faltered in the 1990s with the US moving ahead in the latter half of that decade. Catch-up by the EU to US labour productivity levels in the two decades since 1979 has primarily occurred through capital deepening. The EU shortfall in underlying TFP has narrowed by less and remained virtually unchanged since 1989, with the EU failing to achieve acceleration in TFP growth post 1995 similar to that experienced in the US.

In manufacturing, productivity levels in the total EU and in the majority of Member States fall very far short of US levels but the US lead is less pronounced in market service activities. Nevertheless the US productivity acceleration is apparent in both manufacturing and market services, the latter encompassing the most important ICT using sectors. Together these observations on relative productivity, at both the aggregate and sector level, suggest a lack of 'dynamism' in productivity performance in the EU, relative to recent experience in the US.

APPENDIX: DATA SOURCES AND METHODS

Gross value added at current and constant prices, employment and labour compensation were taken from the OECD Statistical Compendium CD-ROM supplemented by *National accounts of OECD countries, Volume II, OECD Paris*, various issues. Note these series, and all other variables included the most recent years data for Germany (from 1991), refer to unified Germany which were then spliced to data for the former West Germany for earlier years. This is far from ideal, since productivity growth in the 1980s in the former East Germany was not on a par with the Western part of the country, but separating the two would lead to breaks in the series for the total EU.

Data on annual average hours worked were not available in a single source and therefore there is greater uncertainty on their comparability across countries. Estimates for the US, the UK, France and Germany were taken from O'Mahony and de Boer (2002)¹. For other countries, data were taken from unpublished estimates derived by researchers at OECD which in turn is based on results from European Labour Force Surveys.

Purchasing power parities for 1999 GDP were downloaded from the OECD web-site. Price ratios for manufacturing were based on unit value ratios for 1997. These were constructed by matching products across all EU countries on values and quantities from the Eurostat PRODCOM data base. Price ratios for market services for 1996 were estimated as consumer expenditure PPPs excluding medical equipment and services. These were taken from *Purchasing power parities and real expenditures, Results 1996*, (OECD Paris, 1999). Finally, gross fixed capital formation series back to 1970 were unpublished series produced by OECD. Since the construction of capital stocks requires long time series, the OECD data were backdated to the early 1960s using data from *National accounts of OECD countries, Volume II*, and the national sources cited in O'Mahony and de Boer (2002) for the US, the UK, France and Germany.

Measuring Capital Stocks

Capital stocks were estimated using the perpetual inventory method assuming geometric depreciation rates. With a constant depreciation rate, d , capital stocks in time t are estimated using the formula:

$$(1) \quad K_t = K_{t-1} (1-d) + I_t$$

where I_t is real investment. The depreciation rates employed were based on those currently used by the US Bureau of Economic Analysis. Experimentation with alternative depreciation rates suggested the resulting capital stocks were quite sensitive to the rates used, although cross country comparisons were less effected. More importantly, the available data refers to investment across all asset types. Given the much publicised rise in the share of ICT investment in the total, the use of a constant (across time) depreciation rate is not appropriate – depreciation rates for computing equipment and software currently used by BEA are about three times greater than general equipment rates. In order to take account of the changing asset composition, depreciation rates were allowed to vary across time, based on shares of investment by asset type for the UK employed in the more sophisticated capital stock estimation in O'Mahony and de Boer (2002). These rose from 0.091 in 1965 to 0.122 in 1999 with most of the increase occurring in the final decade. This declining depreciation rate was applied to all countries. This is a somewhat heroic assumption but data constraints preclude the calculation of country specific rates. In particular, the estimated average

¹ *Britain's relative productivity performance: updates and extension*, O'Mahony and de Boer, mimeo, NIESR, February 2002.

depreciation rate in the US has in fact been rising faster in the final few years since that country's ICT share in total investment is considerably greater than in Europe in general. Employing average US depreciation rates for that country alone would lower growth rates of capital intensity in the US by about 0.8 percentage points in the period 1995-99, leading to rates marginally below that achieved in the EU at that time.

The use of the PIM method requires estimates of initial period capital stocks. The initial period was set at 1965 – this was dictated by data constraints. By setting the start period sufficiently far back in time, the undepreciated proportion of this stock is small relative to the current stock by 1979. Initial period stocks were based on the sum of investment over the previous five years, based on the calculation that, assuming constant depreciation in earlier years, about half the stock is depreciated after about five years.

