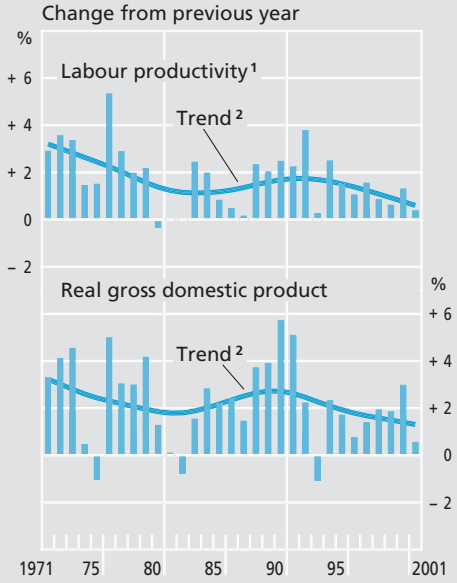
Productivity developments in Germany

The extent to which an economy grows and prospers is largely determined by changes in productivity. In Germany the rate of productivity increased much more slowly in the 1990s than in earlier decades. At the same time, however, the rise in output per hour worked was, at an average of 2.0%, discernibly faster than the rise in output per person employed, which was 1.4% per annum. Even so, Germany is less successful than, say, the United States in incorporating the factor labour into the production process, with the result that a hard core of structural unemployment has been formed. By contrast, the degree to which capital, as a factor of production, and total factor productivity have contributed to growth is not much different from that in other industrial countries. The rate of labour productivity is partly determined by changes in real labour costs. If these rise too quickly, labour tends to be replaced by capital, and the "employment threshold", ie the growth rate at which employment begins to increase, also rises. An international comparison shows that in 2001 output per person employed was significantly lower in Germany – as in other west European countries – than in the United States. However, there were only relatively small differences in the output per hour worked by each employed person. Even so, the analysis suggests that there is a need for action on the part of economic policymakers.

Labour productivity and growth* - longer-term trends



* From 1992 Germany as now territorially defined. — **1** Real gross domestic product per person employed. — **2** Values smoothed by means of an HP (100) filter.

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Aspects of output developments in Germany

Weak productivity trend

The outlook for productivity in Germany was favourable at the beginning of the 1990s. German reunification and the opening-up of central and eastern Europe appeared to provide new opportunities for greater specialisation in larger markets and consequently a more rapid increase in productivity. There were additional grounds for optimism in the middle of the decade. These were embodied in the term "new economy": new improved technologies – especially in the fields of information and communications – were seen as a means of accelerating the increase in productivity and thereby enhancing the output potential of the German economy. Yet these expectations were not fulfilled. The realisation that, even by international standards, the growth in production and productivity was only slight ultimately led to the belief that in terms of growth Germany was at the bottom of the euro-area league. Changes in productivity will be outlined below, and possible determinants will be analysed in an attempt to explain cause and effect.

Long-term trends

The rates of increase in macroeconomic output and in productivity per person employed show a similar trend over the long term (see the adjacent chart). During the past three decades there has been a general tendency for both rates to decline, albeit with sharp fluctuations. The downturn in the productivity trend was interrupted in the second half of the 1980s and again as a result of the boom following reunification.

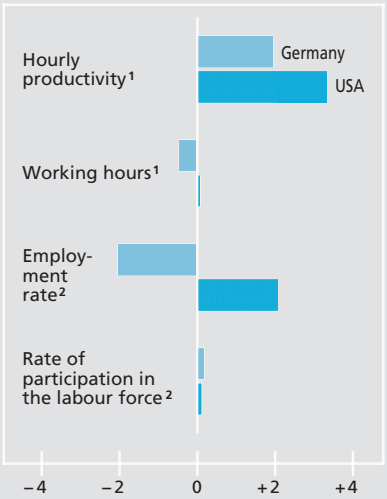
Per capita GDP and its components

The degree of progress in productivity can be illustrated by a comparison between Germany and the United States in the period from 1992 to 2001 (see the chart on page 49).[1] By definition, real gross domestic product (GDP) per head of the population – apart from demographic influences – can be divided into hourly productivity, working hours per person employed, employed persons in relation to the members of the workforce (employment rate) and members of the workforce in relation to the population of working age (rate of participation in the labour force). It becomes clear during the whole of the period observed that major factors contributing to the increase in material living standards

1 The OECD data used here refer to the corporate sector and may therefore diverge from data on the economy as a whole in this text.

played a greater role in the United States than in Germany. Not only did productivity rise more rapidly in the United States; a larger percentage of the workforce was also actually employed. Furthermore, the average number of hours worked in the United States remained more or less constant whereas in Germany the number of hours worked per person employed fell substantially. The differences in employment ratios are particularly striking. In the 1990s the United States recorded a rise of 2 percentage points to about 95% in this ratio – calculated on the basis of standardised data – whereas the ratio in Germany declined by 2 percentage points to 92½%.

Change in the components of real GDP per inhabitant of Germany and of the United States



1 Average percentage rate of change between 1992 and 2001. — **2** Change in the rate between 1992 and 2001 in percentage points.

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Problems of definition and measurement

Productivity difficult to measure

Measuring increases in productivity is fraught with a number of terminological, conceptual and empirical difficulties.[2] Generally speaking, productivity in the sense of a measure of efficiency for a given factor of production is defined as the output-input ratio. It is therefore an indicator of how much a unit of that factor of production contributes to the production process.[3]

Output value versus value added

Regarding the numerator of the ratio, care must be taken to ascertain whether the rate of productivity refers to the volume of output that includes inputs or to the gross value added by an enterprise, economic sector or economy. There is a risk of double-counting if the output figure is used. If one economic sector manufactures only semi-finished products (eg leather) and another only finished products (eg shoes), adding the total inputs and outputs of both sectors would give a misleading result with respect to the total output of the economic sectors concerned because the flow of intermediate products (leather in the example cited) would be counted twice, ie as the output in the first sector and as the input in the second sector.[4] It is therefore cus-

2 An overview of these aspects can be found in P Schreyer and D Pilat, *Measuring Productivity,* OECD Economic Studies 33, p 127-170 and OECD (ed) (2001), OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity Growth, Paris. http://www.oecd.org/subject/growth/prod-manual.pdf.

3 One important aspect which is not addressed here owing to a lack of space is the productivity of natural resources. For example, the Council of Experts calculates an energy intensity for economic output as a whole. See Council of Experts for the Assessment of Overall Economic Trends (2001), Annual Report 2001-02: *Für Stetigkeit – gegen Aktionismus,* Stuttgart, p 452.

4 For more on this example see Schreyer and Pilat, loc. cit., p 130ff.

tomary to determine rates of productivity on the basis of the values added, ie after deducting the inputs.[5]

Value added in the public sector

If measures of productivity are to be interpreted meaningfully, inputs have to be independent from output. However, this requirement is not always fully met. The treatment of the public sector in the national accounts is a classic example of this. Here the value added is measured in terms of the inputs, ie on the basis of employee remuneration and assuming an estimated increase in productivity. It is therefore often advisable not to include this large sector when calculating aggregated measurements.[6]

Influence of price adjustment

It is also appropriate for a longer-term comparison to determine productivity on the basis of price-adjusted data. In this case the result is also influenced by the method of price adjustment used, and all the problems of deflating have a direct effect on the measurements. The main difficulties lie in taking adequate account of the changes in product quality. For example, price reductions on goods in the information and communications technology sector have been statistically much greater in the United States during the past few years than in Europe. This divergence can be explained to some extent by differences in the method of price adjustment.[7]

Alternative measures of employment

Levels of productivity for labour as a factor of production can be calculated using alternative measures of employment, namely output per person employed and output per hour worked. Differences may arise in the way these measures change owing, for example, to reductions in working hours or an increase in the spread of part-time working. Depending on the aim of the analysis, efforts can also be made to take account of quality changes in the factor labour. For example, studies undertaken on the United States indicate that the volume of labour is increasingly reflecting activities for which a higher qualification is necessary.[8] If measures of labour productivity are to be used to analyse the labour market, it has to be borne in mind that so-called marginal productivity is the important measure. However, this coincides with the average level of productivity only under fairly specific assumptions.[9]

Performance of the capital stock

In the case of capital as a factor of production there is the difficulty that – analogous to the volume of labour – it is actually the "services" derived from the capital stock which should be measured.[10] As these cannot be directly monitored, however, it is often assumed for

5 The problem also exists at the macroeconomic level because large volumes of inputs are often imported in open economies.
6 The real estate sector is likewise often excluded from the calculations as the total value of housing added in this sector is established and estimates are necessary for the value added in the case of owner-occupied dwellings.
7 See Deutsche Bundesbank, Appendix: Problems of international comparisons of growth – a supplementary analysis, *Monthly Report,* May 2001, p 39 f and Deutsche Bundesbank, Changes in the official consumer price statistics and their implications for the "measurement bias" in the inflation rate, *Monthly Report,* August 2002, p 38-39.
8 See, for example, K W Stiroh (2001), *What Drives Productivity Growth?,* Federal Reserve Bank of New York, Economic Policy Review, March 2001, p 37-59.
9 For example, the Council of Experts for the Assessment of Overall Economic Trends calculates a labour productivity threshold as a guideline for wage policy. See Council of Experts (1999), Annual Report 1998-99: *Vor weit reichenden Entscheidungen,* Stuttgart, p 22*-24*.
10 See N Oulton (2001), *Measuring Capital Services in the United Kingdom,* Bank of England, Quarterly Bulletin 41, p 295-309.

simplicity's sake that the services are proportional to the level of capital held. Another problem in measuring the factor capital is that capital goods are installed at different times. If the productivity calculation is to be used to estimate the output potential, it may be necessary to take account of the heterogeneity of capital goods as far as their (relative) efficiency in different "vintages" is concerned.[11]

Productivity and prosperity

If measures of productivity are to be interpreted as measurements of prosperity, it would also be necessary to take into account that part of the output must be used to maintain the capital stock.[12] It may therefore be advisable to base calculations on net value added or net productivity. However, in this case, too, the ability to interpret *(partial)* factor-related levels of productivity, ie productivity levels calculated for individual factors of production, is limited. The reason is that total output always depends on the volumes used, the factor combination and the quality of all factors and not just on the particular factor being observed at any one time.

Productivity changes since beginning of 1990s

A comparison of the annual average rates of change in selected productivity measurements for Germany between 1992 and 2001 (see the adjacent table) illustrates the significance of conceptual differences. As expected, the productivity values rose faster than the corresponding ratios based on price-adjusted data. The growth in labour productivity is also largely dependent on the definitions of the employment variables chosen. For example, output per hour, at 2.0% per annum, rose discernibly faster than real GDP per person employed (1.4% per annum). By contrast, the productivity of capital shows a negative trend over the period under review. The salient point here is that production in Germany has become more capital intensive, ie jobs have been accompanied by an ever increasing use of capital.

Labour and capital productivity in the 1990s

%

Measures of productivity	Annual average change between 1992 and 2001
Productivity of labour	
Real GDP	
per person employed	+ 1.4
per hour worked by person employed	+ 2.0
Nominal GDP	
per person employed	+ 3.1
per hour worked by person employed	+ 3.8
Real gross value added 1	
per person employed	+ 2.2
per hour worked by person employed	+ 2.7
Productivity of capital	
GDP per unit of capital stock (at constant prices)	– 1.1

Source: Federal Statistical Office. — **1** Excluding public-sector but including other private-sector services between 1992 and 1999.

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11 See K McMorrow and W Roeger (2001), *Potential Output: measurement methods, "new" economy influences and scenarios for 2001-2010: a comparison of the EU 15 and the US,* European Commission, Directorate-General for Economic and Financial Affairs, Economic Paper No 150, Brussels.

12 See Deutsche Bundesbank, Appendix: Discussing the growth and prosperity gap between the United States and the euro area, *Monthly Report,* May 2002, p 34 f.

Labour productivity
and gross domestic product
in the economic cycle

1 Cyclical components as a percentage of the original time series.

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Progress in productivity and its components

Cyclical fluctuations

The trend in the productivity of labour is often obscured by cyclical factors. Cyclical fluctuations in productivity per person employed are closely correlated to cyclical fluctuations in total economic output, and there is little time lag between them (see the chart above).[13] The productivity of labour therefore follows a pronounced pro-cyclical course. However, the interpretation of this finding is controversial. It can be taken as proof that changes in productivity are of great significance for cyclical developments. However, measurement problems and the customary "hoarding" of employees in periods of economic weakness point in the other direction. Even so, emphasis will be given in what follows to productivity trends over the medium and longer term rather than to cyclical aspects.

More information on this issue can be obtained by using Solow growth accounting. Here economic growth is attributed to the effects of changes in labour and capital as factors of production and to a residual component – which is often defined as total factor productivity and can be regarded as a measure for technical progress.[14] In order to carry out such a breakdown, however, the income shares that accrue to the factors of production must be known.[15] Another important point here is the definition of the factor labour. If it is broadly defined, it includes not only employees' income but also an imputed entrepreneurial remuneration. Accordingly, a smaller share of total income accrues to the factor capital.[16]

13 The cyclical component is calculated on the basis of productivity per person employed using a band-pass filter as demonstrated by M Baxter and R G King (1999), *Measuring Business Cycles: approximate band-pass filters for economic time series,* The Review of Economics and Statistics 81, p 575-593. All fluctuations that last for more than two years but less than eight years were regarded here as being cyclical.

14 For this procedure see also Deutsche Bundesbank (2001), Factor prices, employment and capital stock in Germany: results of a simulation study, *Monthly Report,* July 2001, p 49-61, especially p 54.

15 Assuming that there is unrestricted competition on the goods and factor markets and constant returns to scale, the income shares of the factors of production are equivalent to the partial threshold levels of productivity of the factors of production and add up to 1.

16 Another possible theoretical assumption is that the income shares attributable to the factor capital should also include payment for the use of human capital. In this case the capital stock would have to be defined differently, and the share of the factor capital increased accordingly. See G Mankiw, D H Romer and D N Weil (1992), *A contribution to the empirics of economic growth,* The Quarterly Journal of Economics 107, p 407-437.

Empirical contributions to growth

Quite apart from this problem of definition the Solow growth accounting for Germany between 1992 and 2001 shows a fairly stable pattern (see the adjacent table). For example, the (arithmetical) contribution which the factor labour makes to growth is negative because the number of hours worked has fallen. This finding illustrates once again that employing the factor labour more intensively in the production process represents a key challenge for Germany. Instead of this, the country is forming a hard core of structural unemployment, a development which is also typical of a few other continental European economies. By contrast, the factor labour in the United States and in various EU countries has been able to make a sizeable contribution to economic growth.[17] Radical reforms of job allocation, wage formation and the social security systems appear necessary so that the factor labour no longer impedes GDP growth but, instead, strengthens it. This is all the more urgent given the fact that the age structure of the German population is developing less favourably than in other industrial countries. That alone will check the momentum of growth.

Solow growth accounting for alternative shares of income attributed to capital as a factor of production *

Item	Contribution to growth in percentage points			Average annual percentage growth in GDP 1
	Factor capital	Factor labour	Total factor productivity	
10 % income share	0.3	– 0.5	1.7	1.5
20 % income share	0.5	– 0.4	1.4	1.5
30 % income share	0.9	– 0.4	1.0	1.5
40 % income share	1.0	– 0.3	0.8	1.5

Source: Federal Statistical Office and own calculations. — * Calculation on the basis of the change in real gross domestic product and of hours worked. — 1 Between 1992 and 2001.

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Importance of capital formation

The contribution which the factor capital makes to growth in Germany is more or less the same as in other industrial countries. By way of qualification, however, it must be said that productivity in Germany as a whole is still below that of other European countries or the average of the industrial countries. This is due to the persistently low level of productivity in eastern Germany. Seen from this aspect, one might have expected that Germany would be expanding its capital stock more quickly than these countries. Any contribution to growth by the factor capital that is simply in line with that in other countries is therefore really inadequate.

Interpretation and ...

The extent to which total factor productivity actually reflects technical progress and the factors that influence the contribution of this component to growth play an important role in assessing the outlook for growth in Germany. It must be emphasised, however, that total factor productivity is determined as a residual which therefore also represents a

17 A comparison of Solow breakdowns for a number of industrial nations is provided by C Gust and J Marquez (2000), *Productivity Developments Abroad,* Federal Reserve Bulletin, October 2000, p 665-681 and D W Jorgenson and E Yip (1999), *Whatever Happened to Productivity Growth?,* mimeo, Harvard University.

Sectoral structural change and labour productivity *

Between 1992 and 2001

Item	Real gross value added per person employed	Real gross value added per hour worked by person employed
	Average annual percentage change	
	1.7	2.3
	Percentage points	
Effect of growth	1.2	1.7
Effect of structural change	0.9	0.8
Effect of interaction	– 0.4	– 0.2

Source: Federal Statistical Office. — * Calculated on the basis of six combined economic sectors.

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measure of our lack of knowledge.[18] For example, all measurement errors and inaccuracies or classification problems in connection with the other factors of production are reflected in this variable.

... determinants of total factor productivity

Even so, academic studies provide important information on the determinants of this source of prosperity. For example, there is empirical evidence that new technology is introduced and widely applied more slowly in the European economies than, say, in the United States.[19] Another factor is that in the United States the manufacture of high-tech goods contributes more to value added than in Europe. A study by the European Central Bank found[20] that the spread of new technology was still making no major macroeconomic contribution to the acceleration in productivity growth in the euro area. However, it assumed that the importance of this factor would become greater in future.

Starting points for economic policy

An economic policy which encourages innovation and technical progress as well as the rapid spread of new knowledge and skills can result in a faster increase in total factor productivity. Structural reforms on the goods markets improve the conditions for productivity growth.[21] A cross-section comparison of 20 OECD countries indicated, for example, that a reduction in trade barriers or a decrease in the plethora of regulations on the goods markets has a favourable effect on total factor productivity. The detrimental impact of goods market regulations on productivity momentum is also documented in a new OECD study.[22] The study includes references based on data on individual enterprises which show that the cost of appointments and dismissals has a negative effect on productivity growth in a sector.

Total factor productivity and new economy

A question that is still being discussed intensively both in public and academic circles is the extent to which the comparatively rapid increase in total factor productivity in the

18 For example, C R Hulton (2001), *Total Factor Productivity: A Short Biography* in C R Hulten, E R Dean and M J Harper (ed), *New Developments in Productivity Analysis,* Chicago and London, p 1-54, especially p 12.
19 See European Commission (2000), The EU Economy: 2000 review, *European Economy* No 71, p 85-141.
20 See European Central Bank (2001) New technologies and productivity in the euro area, *Monthly Bulletin,* July 2001, p 37-48.
21 See R Salgado (2002), *Impact of Structural Reforms on Productivity Growth in Industrial Countries,* IMF Working Paper No 02/10, Washington DC.
22 See S Scarpetta, P Hennings, T Tressel and J Woo (2002), *The Role of Policy Institutions for Productivity and Firm Dynamics: Evidence from Micro and Industry Data,* OECD Economics Department, Working Paper No 329, Paris.

United States in the second half of the 1990s reflected the impact of a new economy. What is overlooked here, however, are the comparatively restrictive assumptions on which the usual interpretation of this productivity measurement is based.[23] If other no less plausible assumptions are made (for example, that technical progress cannot be monitored directly), substantial deviations appear in the estimates of total factor productivity. This is also true when total factor productivity is calculated on the basis of developments in real factor costs.[24] If one considers that in the United States the introduction of new technology is accompanied by increased investment in information and communications technology goods, it is likely that the factor capital played a substantial role as the "vehicle" for technical progress.

Productivity developments and structural change

Sectoral breakdown of productivity growth

Macroeconomic productivity is influenced not only by the change in productivity in the individual economic sectors but also by changes in the respective ratios of sectoral employment to overall employment and of sectoral value added to overall value added. If the growth rate of labour productivity in Germany in the period from 1992 to 2001 is broken down in this respect (see the adjacent explanatory notes), it emerges that the

23 For example, it is usually assumed that technical progress is "output-saving" or "Hicks-neutral". See E Gundlach (2001), *Interpreting Productivity Growth in the New Economy: Some Agnostic Notes,* Kiel Working Paper No 1020, Kiel.
24 One then speaks of what is known as the "dual" Solow growth accounting approach.

The "shift-share" breakdown of the rate of change in labour productivity

It is possible to determine how much of the change in labour productivity is due to the sectoral structure change by carrying out a "shift-share" analysis.[1] The following defining equation for determining the rate of change in labour productivity in the economy as a whole ($\hat{y}_t$) is the starting point for this observation.

$$\hat{y}_t = \sum_{i=1}^{I} (\hat{y}_{i,t} + \hat{s}_{i,t} + \hat{s}_{i,t}\hat{y}_{i,t}) r_{i,t-1}$$

Here $\hat{y}_{i,t}$ is the rate of change in labour productivity in the respective economic sector i at time t, $\hat{s}_{i,t}$ is the rate of change in the share of persons employed in the respective economic sector in relation to the total number of employed persons and $r_{i,t-1}$ is the share of gross value added in the sector in relation to the total amount of gross value added in the economy as a whole. The rate of change in labour productivity in the economy as a whole can then be broken down into three factors.

The "growth effect": this can be calculated using the expression

$$\sum_{i=1}^{I} \frac{\hat{y}_{i,t} r_{i,t-1}}{\hat{y}_t}$$

and indicates what the rate of growth in labour productivity would have been if the share of persons employed in the sectors in relation to the total number of persons employed in the economy had been constant.

The "effect of structural change": this is obtained as

$$\sum_{i=1}^{I} \frac{\hat{s}_{i,t} r_{i,t-1}}{\hat{y}_t}$$

and shows what effect the structural change in employment has had on the rate of growth in labour productivity in the economy as a whole.

The "interaction effect":

$$\sum_{i=1}^{I} \frac{\hat{y}_{i,t} \hat{s}_{i,t} r_{i,t-1}}{\hat{y}_t},$$

which as a residual variable reflects those changes which cannot be unequivocally attributed to one of the two other effects.

1 See T von Wachter (2001), *Employment and Productivity Growth in Service and Manufacturing Sectors in France, Germany and the US.* ECB Working Paper No 50, Frankfurt am Main.

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Labour costs and productivity in eastern Germany*

as a percentage of the west German level

* Eastern Germany excluding Berlin, domestic concept. — 1 Real compensation per employee based on the GDP deflator. — 2 Gross domestic product per person employed.

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"structural change" component becomes relatively significant (see the table on page 54). This finding is surprising because it is at variance with the results in other periods and in other countries. It therefore appears that with respect to the growth process in Germany a relatively rapid cross-sector structural change has been a significant factor. The structural change effect is positive, ie employment and value added ratios increased in economic sectors with higher average productivity. This applies, for example, to enterprise-related service providers and the financial sector.

East-west gap

The impact of sectoral structural change on the increase in labour productivity throughout the economy also helps to explain the relatively slow growth in eastern Germany. The chart above shows the comparative levels of productivity and real wage costs in eastern Germany as a percentage of western levels. Two tendencies become apparent here. Firstly, the east-west ratio of wage costs was significantly above the productivity gap throughout the period under review. This exerted tremendous pressure on enterprises to reduce jobs and continues to represent a core problem of the east German labour market. Secondly, it is striking that the initially rapid convergence in productivity slowed down discernibly after the mid-1990s and subsequently came to a standstill. Consequently, the east German productivity gap remained considerable and ultimately amounted to approximately 40% if measured in terms of the west German level. Growth accounting indicates that a lower level of total factor productivity is largely the reason for eastern Germany's lagging behind. Overall factor endowment, by contrast, is playing a minor role.[25] Such a finding suggests that deficits still exist in the case of infrastructure and in the opportunities for improving the organisation of labour; the comparatively small average size of businesses and the sectoral structure could also be important factors.

Productivity and the labour market

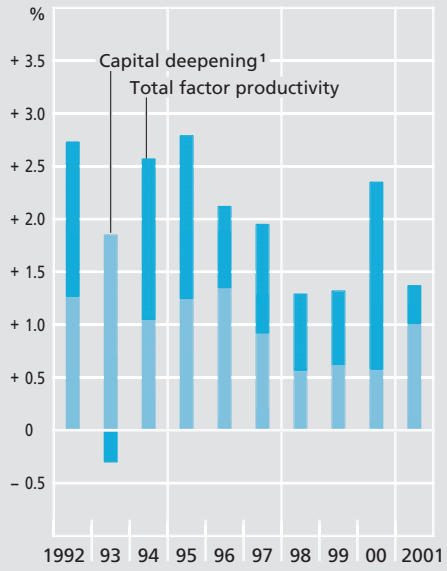
Assessment of productivity progress not clear-cut

Rapid productivity growth is often seen as a mixed blessing, depending on the labour market situation. On the one hand, there are fears that there could be "growth without

25 See, for example, M C Burda and J Hunt (2001), *From Reunification to Economic Integration: Productivity and the Labor Market in Eastern Germany,* Brookings Papers on Economic Activity 2, p 1-92.

jobs", ie that the increase in labour productivity could be too fast. On the other hand, rapid rates of productivity growth create additional real allocation opportunities and enable incomes to grow quickly and working hours to be reduced. What is often overlooked here, however, is the fact that the labour market and productivity change are interdependent: a permanently excessive rise in wage costs creates incentives to replace labour with capital or, alternatively, to reduce jobs where productivity is low or to shift them abroad. As a result, the increase in the amount of capital used for domestic output (capital deepening) exceeds the amount suggested by autonomous technical progress. This effect can be illustrated using the Solow method mentioned above: the rate of change in labour productivity can be expressed as the sum of the rate of total factor productivity and the (weighted) capital deepening. The adjacent chart shows the outcome of such a breakdown for Germany during the period between 1992 and 2001.[26] It is clear that a not insignificant proportion of the increase in labour productivity may be traced back to this capital deepening.

Components of the macroeconomic rate of productivity



1 Rate of change in the capital stock per person employed.

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Determinants of the "employment threshold"

Productivity growth also determines the "employment threshold", ie that particular rate of growth in real GDP at which the level of net employment begins to increase. This threshold is not a natural constant but, instead, depends on a number of conditions. The most important of these conditions is presumably the change in the wage level followed by the wage structure. The more the general wage rise exceeds a hypothetical neutral rate, the higher the "employment threshold" (see the explanatory notes on page 59). However, the measured growth in productivity must not be used without qualification as a measure for wage increases that ensure employment. Instead, the growth in labour productivity is an endogenous variable which has to be adjusted to take account of the "dismissal productivity", ie the rise in productivity that is due to the wage-induced reduction in labour utilisation.[27]

"Employment threshold" in Germany falls

The "employment threshold" as it is understood here refers to gainful employment and denotes the rate of growth in real GDP at which the number of persons employed starts

26 It is assumed in the chart that one-third of the factor capital is income.
27 See also the Council of Experts for the Assessment of Overall Economic Trends (2001), loc. cit. p 228 f.

Gross value added in the corporate sector per person employed compared with that of the United States

Year	Euro area	Germany [1]	France	Italy	Spain	Netherlands	Belgium	Portugal	Ireland	Finland
	OECD purchasing power parities; United States = 100									
1990	90.6	90.3	88.4	88.4	83.3	86.8	94.0	55.7	69.6	67.0
1991	84.9	73.7	90.6	86.1	83.6	86.4	95.5	51.9	73.5	67.4
2000	84.5	80.2	88.9	80.1	70.6	88.9	98.6	45.3	77.9	84.9
2001	83.5	80.2	88.9	78.8	68.9	84.5	97.3	43.7	78.7	82.7
	Percentage change in productivity									
Annual average between 1992 and 2001 [2]	+ 1.7	+ 2.7	+ 1.6	+ 1.0	– 0.1	+ 1.6	+ 2.6	+ 0.1	+ 2.5	+ 3.9

Source: OECD and own calculations. — **1** 1990: western Germany. — **2** For comparison: United States +1.8%.

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to rise. This "critical value" fell in Germany from about 2¾% on an average of the 1970s to about 1½% in the 1990s. It is certain that this development is partly due to the generally more moderate wage increases in the 1990s compared with the 1970s. Another relevant point is that, especially in the 1990s, the ratio of part-time employment to total employment rose substantially. This was principally the result of the sharp increase in low-paid part-time employment (whose earnings ceiling was recently €325). If considered in isolation, an expansion in part-time employment leads to a fall in the "employment threshold" because more persons are employed at a given rate of GDP growth. This effect must not be confused with a fall in the "employment threshold" arising from an easing of the wage pressure. In order to increase the volume of labour in terms of hours worked a GDP growth rate of about 2¼% was necessary on an average of the 1990s – there are currently no comparable data on the volume of labour for the 1970s.

International comparison of productivity trends and levels

International comparisons pose methodology problems

There is an additional methodological problem when comparing productivity levels internationally. For example, the variables have to be converted into a common currency. In order to measure the (value of) performance gaps per person employed (or per hour worked) it is advisable to use purchasing power parities, such as those published by the OECD, instead of the respective exchange

"Employment threshold" and real labour costs

The "employment threshold" has assumed a prominent role in the employment policy debate. It denotes the minimum rate of growth in output that is necessary to increase employment. However, participants in the debate often overlook the fact that the employment threshold is not a constant but depends, in turn, on economic determinants. The considerable importance of the wage formation process can be illustrated using a simple long-term demand-for-labour function. The following long-term demand-for-labour function can be derived on the basis of a CES production function, assuming constant returns to scale:[1]

$$l - q = const - \sigma(w - p) + (\sigma - 1)\lambda \cdot t$$

where l is the (intended) demand for labour, q output and w-p the real cost of labour, in logarithmic form in each case, σ is the elasticity of substitution between labour and capital, λ is the rate of (autonomous) technical progress and t is time. Such an approach can be estimated using, for example, the dynamic ordinary least-squares regression method (DOLS) as a cointegration relationship:

$$l_t - q_t = \beta_0 + \beta_1 (w - p)_t + \beta_2 t + u_t$$

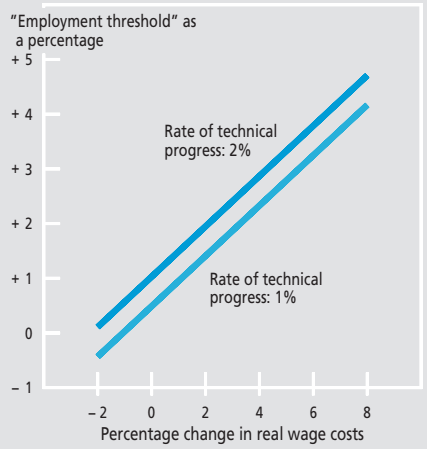
If the number of employed persons is used as the measure of employment, real gross domestic product as output, real compensation per employee as an approximation of labour costs and the deflator of gross domestic product as the general price level, estimating a cointegration relationship using the so-called DOLS method and on the basis of annual German[2] data between 1970 and 2001 gives the following results:

$$l_t - q_t = \underset{(-4.87)}{-2.07} - \underset{(-3.25)}{0.46}(w - p)_t - \underset{(-6.00)}{0.010}t + \hat{u}_t$$

The coefficient of determination (R^2) amounts to 0.99. The values in brackets are t-values based on the long-term variance. If subjected to the usual tests and allowing for a 5 % error probability, the null hypothesis of a cointegration relationship cannot be rejected.

The estimate for the long-term elasticity of substitution therefore amounts to 0.46 and the estimated rate of (neutral) technical progress to 1.85 % per year. This rate represents the "employment threshold" when the increase in wages has no effect on the level of employment. If the increase in wages is greater than that, employment falls *ceteris paribus* by 0.46 % for every additional percentage-point increase in real labour costs. The empirically measured "employment threshold" increases accordingly. This interrelationship is illustrated in the chart showing two alternative rates of technical progress. It must be remembered when interpreting the estimates that they are averages for the whole of the period under review. If the data from the more recent past are taken as a basis, the increase in wages which will have no effect on the level of employment is smaller.

Real labour costs and the "employment threshold"[3]



1 See G Hansen (1993), *Quantitative Wirtschaftsforschung*, Munich, p 49 ff. The account given here is based on extremely simplified assumptions. An analysis using more general criteria is provided by, for example, G Flaig and H Rottmann (2001), *Input demand and the short-run and long-run employment thresholds: an empirical analysis for the German manufacturing sector*, German Economic Review 2, p 367-384. — **2** Up to 1990 western Germany. The data have been adjusted through chain-linking to eliminate the effect of German reunification. For the estimation method used and its features see J H Stock and M Watson (1993), *A Simple Estimator of Cointegration Vectors in Higher Order Integrated Systems*, Econometrica 61, p 783-820. Similar results for Germany and other OECD countries based on quarterly data are provided by T Knetsch (2002), *A Theoretical and Empirical Analysis of Labour Market Structures - Time Series Evidence from OECD Countries*, Aachen, p 130 ff. —**3** Assuming a constant return to scale and an elasticity of substitution of 0.46.

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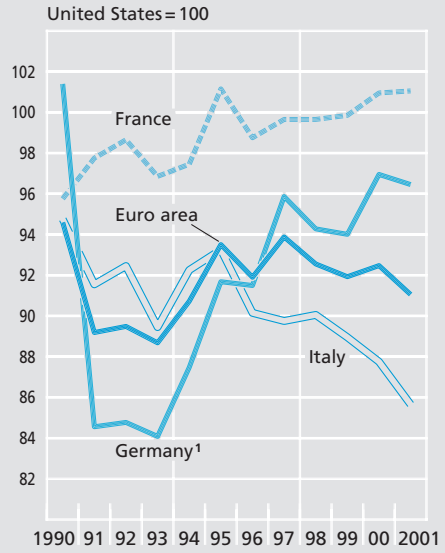
Hourly productivity* compared with that of the United States



* Gross national product (corporate sector) per hour worked by person employed on the basis of purchasing power parities; source: OECD. — **1** 1990: western Germany.

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rates, which are often subject to considerable fluctuations.

Comparison between productivity per person employed…

According to these calculations on purchasing power parities, the nominal gross value added per person employed in the US corporate sector was, at US$61,700, much greater in 2001 than the comparable values for the euro-area average (US$51,500) and for Germany (US$49,500). This comparison also shows that productivity per person employed in Germany declined following reunification from 90% of the US level in 1990 to 74% a year later (see the table on page 58). Later in the 1990s, however, productivity increased again and in 2000-01 was 80% of the US level.

… and productivity per hour worked

Following the absolute and relative decline in productivity in 1991, the nominal gross value added per hour worked in the corporate sector in Germany has now almost reached the US level again (see the adjacent chart). By contrast, the gap between Spain and Italy, on the one hand, and the United States, on the other, has increased considerably in the past decade. France, the Netherlands and Belgium fare fairly well in a comparison of hourly productivity with the United States. However, the fact that these countries' value added per person employed is considerably less than US productivity may also be seen as a sign of their preference for shorter working hours, ie it must not be interpreted as economic inefficiency. The situation in the southern euro-area countries is different. Despite there being virtually no change in working hours, Spain and Italy have hardly improved their levels of productivity per hour worked compared with that of the USA during the past decade, and Portugal's position has actually deteriorated slightly. By contrast, Ireland and Finland have clearly gained ground even though they have been unable to draw level with the United States.

Need for action by economic policymakers

The comparison of the productivity levels on the basis of the hours worked per person employed has shown that the gap between Germany and the United States is smaller than is frequently assumed. Even so, the analysis suggests that there is a need for action by economic policymakers in Germany. This can be seen from the fact that the German economy has returned to lower productivity growth rates now that the reunification boom has disappeared. By contrast, product-

ivity growth in the United States increased during the second half of the 1990s. It was possible in the process to increase employment substantially and thereby to integrate "marginal" or less productive members of the labour force into the economic process. This is all the more surprising given the fact that the manufacturing industry, which traditionally achieves above-average productivity growth rates, has a much smaller weight in the United States than in Germany. It would be desirable in the light of this to increase German growth in total factor productivity. The introduction and spread of new technology may be encouraged by reducing the array of regulations, for example. A technology-related increase in the productivity of labour would also increase the options of distribution that are available over the long term. At the same time, real labour cost developments should provide an incentive to lower the "employment threshold" through a less capital-intensive growth process. Greater flexibility and differentiation in wages as well as a reduction in non-wage labour costs would be appropriate here.