Using indicators to monitor real convergence

The study of differences in economic welfare and their determinants is important in order to assess alternative growth patterns and to examine the effects of economic integration. In the case of the Spanish economy, these questions are of particular interest in the current context of participation in Stage Three of EMU. Having concluded the process of nominal convergence and attained macroeconomic stability, the benefits of this participation should now materialise, mainly in the form of increases in per capita income to approach the levels of the most advanced EU countries (a process known as real convergence). This type of analysis is also necessary to identify the potential growth possibilities of the Spanish economy, since the path of per capita income is very closely related to the structural determinants of competitiveness.

This article presents a set of indicators of real convergence that provide information on the differences in the levels of per capita income between Spain and the other EU economies, as well as their main determinants. These indicators were included at the end of May under the heading "Summary indicators" on the Banco de España's website. This article makes an initial presentation of these indicators and briefly describes the basic features of the real convergence of the Spanish economy in recent decades. This line of analysis will be expanded and elaborated upon in forthcoming studies, which will attempt to incorporate the most up-to-date information.

The indicators presented below relate to real GDP per capita (the key variable in the analysis of real convergence) and to the determinants of economic growth: factor endowment, efficiency, innovation and technical progress. For ease of presentation, they have been split into two groups. The first group, which includes the main indicators (see Table 1), provides the necessary information to analyse the composition of real GDP per capita and to assess the contribution to the expansion of output of the primary factors of production (labour and physical capital) and of those others that promote an efficient use of available resources and facilitate the incorporation of technical progress into productive processes, raising total factor productivity.

At the head of the first group are real GDP per capita and its breakdown into the percentage of the total population of working age, the employment rate and labour productivity (1).

(1)

$$GDP_{pc} = \frac{\text{Employment}}{\text{Pop. aged } 15-64} \times \frac{\text{Pop. aged } 15-64}{\text{Total population}} \times \frac{\text{GDP}}{\text{Employment}}$$

TABLE 1

Main indicators of real convergence (a)

	Indicator	Use	Definition	Availability and source
1	GDP per capita	Main indicator of convergence	GDP at constant prices and PPP	Annual 1970-2000 AMECO
2	% of population aged 15-65	Component of GDP	Population aged 15-64 as a percentage of the total population	Annual 1970-2000 AMECO
3	Employment rate	Component of GDP	Number of persons employed as a percentage of the labour force (National Accounts employment)	Annual 1970-2000 AMECO
4	Labour productivity	Component of GDP	GDP, at constant prices and PPP, divided by the number of persons employed (national Accounts employment)	Annual 1970-2000 AMECO
5	Total stock of physical capital per employee (capital-labour ratio)	Helps explain the path of labour productivity. It is needed, along with labour productivity, to calculate TFP	Stock of fixed capital, at constant prices and PPP, divided by employment	Annual 1970-2000 AMECO
6	Total factor productivity	Indicator (more complete than labour productivity) of the productive efficiency of the economy	Difference between the rate of change of GDP and that of the factors of production ("Slow residual")	Annual 1970-2000 (1995=100) AMECO
7	Stock of private physical capital per person employed	Factor explaining TFP	Calculated on the basis of private gross fixed capital formation less R&D expenditure	Annual 1986-1999 FUNCAS (European Studies Programme)
8	Stock of public physical capital	Factor explaining TFP	Calculated on the basis of public gross fixed capital formation less public R&D expenditure	Annual 1986-1999 FUNCAS (European Studies Programme)
9	Stock of technological capital	Factor explaining TFP	Net cumulative expenditure on R&D and technology imports	Annual 1986-1999 FUNCAS (European Studies Programme)
10	Stock of human capital	Factor explaining TFP	Population of working age with a higher education, corrected for quality	Annual 1986-1999 FUNCAS (European Studies Programme)

(a) Information on the 15 countries that make up the EU.

This type of presentation facilitates the interpretation of the real convergence process and enables the growth in GDP per capita to be related to demographic, labour market and productive efficiency developments. As labour productivity developments summarise the behaviour of the capital-labour ratio and of total factor productivity, information is also provided on each of these variables. It should be noted that the rate of change of total factor productivity is considered a better indicator of the degree of efficiency of an economy than the rate of change of apparent labour productivity, since the former enables the growth in productive capacity not strictly attributable to increases in the use of primary factors of production to be identified. This conceptual superiority of total productivity is, for practical purposes, qualified by the difficulty of estimating it, so that the information it provides must be treated with caution (2). Finally, this first group of indicators includes a set of varia-

(2) The total factor productivity (TFP) series used here is taken from AMECO and is obtained as the residual resulting from subtracting the rate of change in the capital-labour ratio multiplied by the share of non-wage income in national income from the rate of change of labour productivity. Being a residual, it incorporates, in addition to genuine TFP, errors in measuring the factors of production and the effects of changes in the composition of the labour factor and capital across the different branches of the economy.

TABLE 2

Supplementary indicators

	Indicator	Use	Definition	Availability and source
1	Private R&D as % of GDP	Indicates to what extent the change in the stock of technological capital is attributable to the private sector	Private sector R&D expenditure (deflated by the investment deflator) as a percentage of GDP at constant prices	Annual 1985-1998 EUROSTAT
2	Public R&D as % of GDP	Indicates to what extent the change in the stock of technological capital is attributable to the public sector	Public sector R&D expenditure (deflated by the investment deflator) as a percentage of GDP at constant prices	Annual 1985-1998 EUROSTAT
3	Patents used divided by GDP	Indicator of the degree to which investment in R&D is actually applied	Number of domestic and foreign patent applications (registered in the European Patent Office) divided by GDP at constant prices and PPP	Annual 1991-1998 EUROSTAT
4	Investment in venture capital as % of GDP	Indicator of the accessibility of financing for small and medium innovative firms	Deflated investment in risk capital as a percentage of GDP	Annual 1997-1999 European Venture Capital Association (EVCA)
5	Private investment as % of GDP	Supplementary indicator of the change in the stock of physical capital	Private GFCF at constant prices as a percentage of GDP at constant prices	Annual 1970-2000 AMECO
6	Public investment as % of GDP	Supplementary indicator of the change in the stock of physical capital	Public GFCF at constant prices as a percentage of GDP at constant prices	Annual 1970-2000 AMECO
7	Infrastructure investment as % of GDP (non-residential construction)	Indicator of investment by the whole economy in all infrastructure	Public GCF in construction of the whole economy excluding investment in housing, deflated by GDP at constant prices	Annual 1970-2000 EUROSTAT
8	Public expenditure on education per head of population	Indicator of investment in human capital by the public sector	Deflated expenditure on education in PPP divided by the population aged over 65	Annual 1985-1995 EUROSTAT
9	Social expenditure per head of population	Indicator of social welfare	Expenditure on health, pensions, unemployment, family assistance, housing, etc. (deflated and in PPP) divided by the population	Annual 1985-1995 EUROSTAT
10	Rate of unemployment	Indicator of social welfare	Number of persons unemployed divided by the labour force	Annual 1970-2000 AMECO

bles considered relevant to explaining total productivity, since, as mentioned above, they enable the primary productive resources to be used more efficiently and they facilitate the transmission of technical progress. These variables are the stock of public capital, the stock of technological capital and the stock of human capital.

The second group of indicators, included under the heading "supplementary indicators" (see Table 2), provides information on the variables that influence the accumulation of productive stocks, or indirectly illustrate the extent to which the environment is conducive to innovation. These are gross fixed capital formation (private, public and in infrastructure), public expenditure on education, R&D expenditure, patent use and investment in venture capital securities. Also indirect information is given on the level of social welfare through the amount of social expenditure per head and the unemployment rate.

Compilation of these indicators has involved the systematic organisation of data taken from different databases on the 15 EU countries. Sometimes the basic information is only available in current terms, so that it has had to be processed in order to obtain series expressed in

FIGURE 1

Indicators of real convergence on the Banco de España's website

SUMMARY ECONOMIC INDICATORS: 1.3 REAL CONVERGENCE SPAIN-EU (a)
a) LEVELS. SPAIN ***15-November-2001 11:30:59***

	1960	1965	1970	1975	1980	1985	1990	1995	penultimate figure available	latest figure available	year of latest figure
1. SPAIN											
I. GDP per capita and components											
GDP per capita (EUR thousands, PPP)	4.9	6.9	8.9	11.0	11.4	12.0	14.7	15.6	17.9	18.6	2000
Population aged 16-64/ total population (%)	64.8	63.8	62.8	62.5	63.3	64.7	66.5	68.1	68.2	68.2	2000
Employment rate (%) (b)	65.1	64.4	64.3	62.7	54.1	47.6	53.8	50.9	56.4	58.1	2000
Labour productivity (EUR thousands, PPP, per person employed) (c)	11.5	16.9	22.0	28.0	33.2	38.8	41.2	45.0	46.6	47.1	2000
II. Total factor productivity and stocks of capital											
Total factor productivity (1995=100) (d)	39.6	55.2	66.5	77.4	83.8	92.1	97.1	100.0	102.3	103.0	2000
Total capital stock/ employment (EUR thousands, PPP) (d)	31.9	37.0	47.7	63.0	84.0	101.7	103.9	125.4	127.5	128.9	2000
Stock of private physical capital/ employment (EUR thousands, PPP)(e)	...	...	...	...	...	...	72.6	89.0	91.6	91.3	1999
Stock of technological capital/ GDP (%) (e)	...	...	...	...	...	...	4.3	6.4	6.2	6.2	1999
Stock of human capital/ population aged 16-64 (%) (e)	...	...	...	...	...	...	28.1	32.3	35.1	36.3	1999
Stock of public capital/ population (EUR thousands, PPP) (e)	...	...	...	...	...	...	3.4	4.6	4.9	5.0	1999
III. Supplementary indicators											
R&D expenditure/ GDP (%)	...	...	...	...	...	0.5	0.8	0.9	0.9	0.9	1998
Public R&D expenditure/ GDP (%)	...	...	...	...	...	0.1	0.2	0.2	0.2	0.2	1998
Private R&D expenditure/ GDP (%)	...	...	...	...	...	0.4	0.6	0.7	0.7	0.7	1998
Patents granted at EPO/ population (units per million) (f)	...	...	...	...	...	...	...	2.8	3.7	3.2	1998
Domestic patent applications/ population (units per million)	...	...	...	...	...	60.0	60.0	53.0	53.0	59.0	1996
External patent applications/ population (units per million)	...	...	...	...	...	...	122.2	257.3	257.3	430.7	1996
Venture-capital capitalisation/ GDP (%)	...	...	...	...	...	...	...	...	0.1	0.1	1999
Gross fixed capital formation/ GDP (%)	...	...	24.1	23.6	19.9	17.6	24.3	22.0	24.4	25.0	2000
Private GFCF/ GDP (%)	...	...	21.9	21.4	18.4	14.4	19.6	18.3	21.1	21.7	2000
Public GFCF/ GDP (%)	...	...	2.2	2.2	1.5	3.1	4.7	3.7	3.3	3.2	2000
GFCF in non-residential construction/ GDP (%)	...	...	5.1	5.6	5.3	5.0	8.3	8.1	7.5	7.9	1999
Public expend. on education/pop.aged 16-64 (EUR thousands, PPP)	...	...	...	...	...	0.7	0.9	1.1	1.1	1.1	1996
Total social expenditure per inhabitant (EUR thousands, PPP)	...	...	...	...	...	2.4	3.3	3.5	3.5	3.6	1996
Health expenditure per inhabitant (EUR thousands, PPP)	...	...	...	...	...	0.5	0.8	0.9	0.9	0.9	1996
Social benefits expend. per inhabitant (EUR thousands, PPP)	...	...	...	...	...	1.7	2.2	2.4	2.4	2.4	1996
Public expend. on housing per inhabitant (EUR thousands, PPP)	...	...	...	...	...	0.2	0.3	0.3	0.3	0.3	1996
Unemployment rate (%)	...	...	2.5	4.4	11.2	21.0	15.9	22.7	15.8	14.0	2000

Sources: Eurostat, Ameco, Fundación de Cajas de Ahorros (European Studies Programme), European Ventury Capital Association and the Banco de España.
(a) The EU aggregate includes Spain. All the monetary variables are measured in constant 2000 prices in thousands of PPP-based euro, except the capitalisation of venture-capital securities, which is measured in current prices.
(b) Employment (National Accounts series) as a percentage of the population aged 16-64.
(c) GDP divided by employment (National Accounts series)
(d) Total factor productivity: calculated as the difference between the rate of change of GDP and the rate of change of factors of production. The latter is estimated as the average of the rates of change of employment and of the capital stock, weighted by the income shares of these factors. The capital stock is calculated using the perpetual inventory method, considering the GFCF of the total economy as investment and fixed capital consumption as depreciation (Eurostat).
(e) Private physical capital stock: considering investment as private GFCF less R&D expenditure. Public stock of capital: considering investment as public GFCF less public R&D expenditure. Technological capital stock: considering investment as R&D expenditure and technology imports. Human capital stock: percentage of working population with quality adjusted comparable university education (FUNCAS).
(f) EPO: European Patent Office.

constant pesetas and, when necessary, in terms of purchasing power parity. The indicators of the first group have been compiled with information from AMECO (3), except the stocks of private physical, technological, human and public capital, for which FUNCAS estimates (4) are used. The indicators of the second group have been compiled with information from EUROSTAT and AMECO. Tables 1 and 2, already mentioned above, set out in detail the definition of the variables selected and their sources, while Figure 1 corresponds to one of the website summary indicators tables and summarises the position of Spain relative to the EU in terms of the different variables considered (5).

Charts 1, 2 and 3 show in graphical and summary form the paths of the selected indicators. As seen in Chart 1, which shows the

(3) AMECO (Annual Macro Economic) is a macroeconomic database compiled by the Directorate General Economic and Financial Affairs (DG ECFIN) of the European Commission.

(4) For a detailed explanation of their compilation see *Series de indicadores de convergencia real para España, el resto de países de la UE y EEUU,* Estudios de la Fundación de las Cajas de Ahorros Confederadas (FUNCAS).

(5) Time series for all the selected indicators are available on the Banco de España's website. These will be updated as and when new information becomes available. Note that for some variables the lags with which information becomes available are long. Attempts will be made in future to reduce these lags, wherever possible.

path of GDP per capita in Spain relative to the EU and those of its components, over the forty years for which information is available, the difference between Spain's GDP per capita and the EU's was cut by 25 percentage points, so that in 2000 Spain's GDP per capita was 83% of the EU's. This process was not a steady one, however, either in terms of its rate or of the factors identified as driving it (6). In particular, the process was interrupted between 1975 and 1985, coinciding with the unfolding of the two major energy crises, against a background of sharp reductions in the employment rate in Spain. This involved a return to the relative welfare levels of fifteen years earlier.

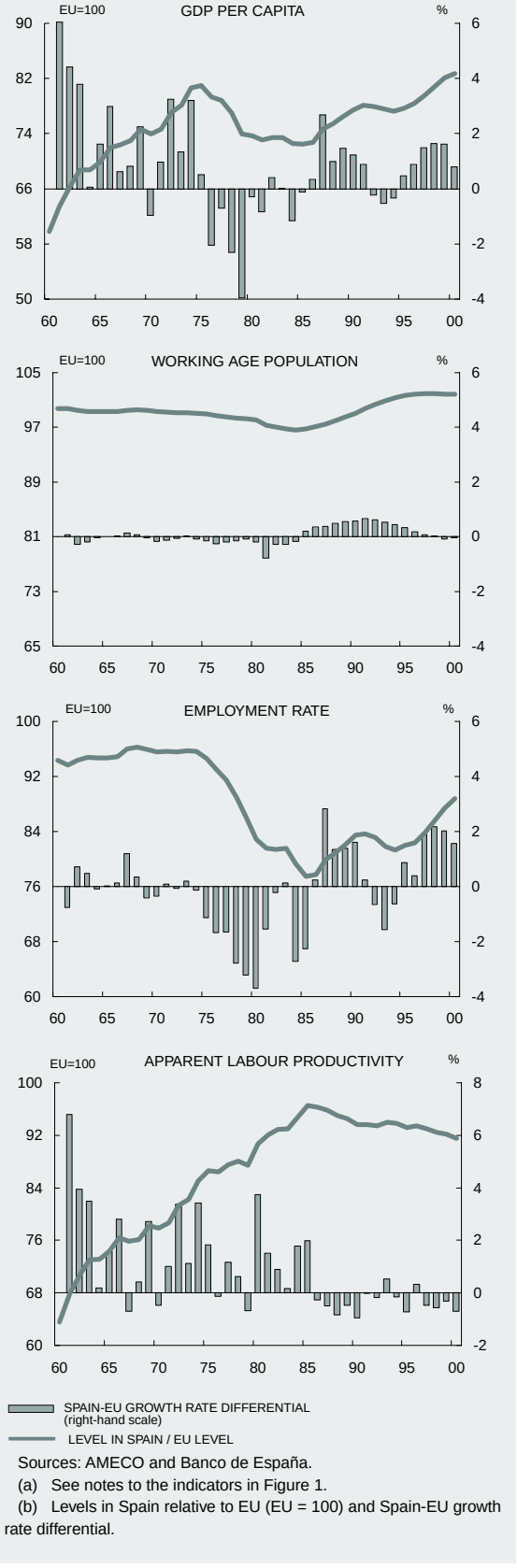
Spain's accession to the EU in 1986 gave a fresh boost to real convergence. Over the 15 years since, Spain's GDP per capita has increased by a total of 51.6% (18 percentage points more than the EU's).

The narrowing of the gap in economic welfare relative to the EU has basically stemmed from the higher rate of job creation in Spain and, to a lesser extent, from the somewhat higher growth in Spain's working age population. The contribution of the latter factor has been declining in strength since it began to reflect the drastic fall in the birth rate of the early eighties. The employment rate meanwhile has been marked by the successive reforms of the labour market, which have tended to increase the capacity of the Spanish economy to generate employment, especially in the latter years of the period analysed. It should be noted, however, that the rate of unemployment has not fallen by as much as the employment rate has increased. This is because of the significant rise in the activity rate as women have increasingly participated in the labour market. Finally, the growth in labour productivity has been more moderate and, almost in every year, less than the average EU rate, owing to the fact that the differential in job creation has been greater than that in real growth.

During the last 15 years, a significant effort has been made to accumulate physical capital and high rates of gross capital formation have been sustained (generally exceeding the average EU rates). As a result of all this, the stock of physical capital has increased continuously since 1986, at a systematically higher rate than in the EU. However, over the whole 15-year period, the capital-labour ratio has hardly im-

CHART 1

Spain-EU real convergence
GDP per capita: components (a) (b)

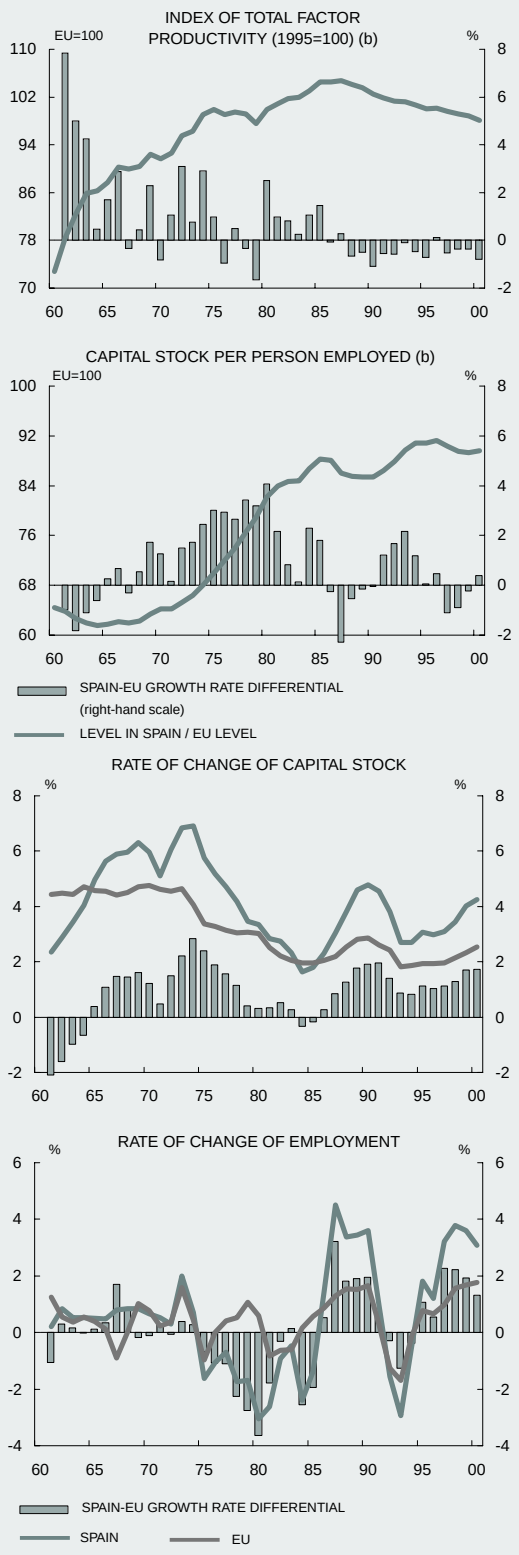


Sources: AMECO and Banco de España.
(a) See notes to the indicators in Figure 1.
(b) Levels in Spain relative to EU (EU = 100) and Spain-EU growth rate differential.

(6) For an analysis of the nature of this process, see Box 1.3 of the year 2000 Annual Report of the Banco de España: "Spain-EU convergence: 1960-2000. The contributions of the employment rate and labour productivity".

CHART 2

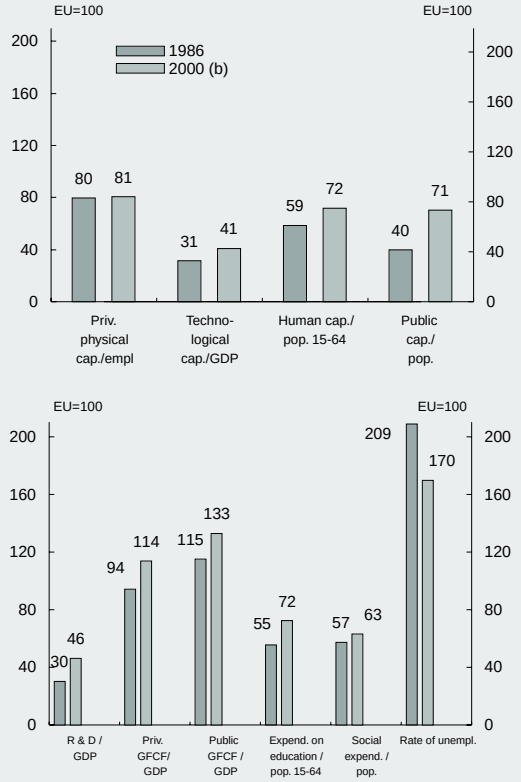
Spain-EU real convergence
Main determinants of labour productivity (a)



Sources: AMECO and Banco de España.
(a) See notes to the indicators in Figure 1.
(b) Levels in Spain relative to EU (EU = 100) and Spain-EU growth rate differential.

CHART 3

Spain-EU real convergence
Supplementary indicators (a)



Sources: Eurostat, AMECO, Departamento de Estudios Europeos de la FUNCAS and Banco de España.
(a) Level in Spain relative to EU (EU = 100).
(b) Or latest year available.

proved relative to the EU, an important factor here being the difficulty, during these years, of achieving a rate of growth of physical capital commensurate with the rate of job creation (7) (see Chart 2).

Since Spain's accession to the EU, its endowments of infrastructure and technological and human capital have expanded significantly. As can be seen in Chart 3, this has been reflected in a significant narrowing of the gaps that existed between Spain and the EU in the mid-eighties. Especially notable have been the growth in the stock of public capital, involving a considerable improvement in the endowment of infrastructure, and the increase in the stock of technological capital, which nonetheless remains well below the European average. As for

(7) For a more detailed analysis of developments in the capital-labour ratio of the Spanish economy during the period 1981-1995 see: "La contribución de los factores productivos al crecimiento económico en España: un análisis desagregado", *Boletín económico,* February 2001, Banco de España.

human capital, progress has also been significant, although somewhat less pronounced. In recent years there has been a discernible rise in the levels of training and qualifications of the different segments of the Spanish population, so that 73% of the employed population had completed secondary or higher education in 2000. In all three cases, however, investment activity can be seen to have tailed off somewhat in recent years, which can be attributed to the adjustment in the relevant items of public expenditure, against the background of fiscal consolidation during the run-up to Stage Three of EMU.

The increase in the endowment of factors of production during this period explains the observed growth in total factor productivity. However, as in the case of apparent labour productivity, the rate of growth of this variable has been somewhat less in Spain than in the EU as a whole (see Chart 2).

To sum up, the cumulative increase in income since Spain's accession to the EU has taken the level of its GDP per capita significantly closer to the EU average. The gap that still exists (approximately 17% of average EU income per capita) is attributable to the differences in the rates of employment (the Spanish rate is 88% of the EU average) and labour productivity (92%). To continue making progress in real convergence it is therefore necessary to promote, through the most appropriate economic policies, a pattern of growth that continues to benefit from positive employment rate contributions, but which is also based on business investment and an increase in total factor productivity.

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