EUROPEAN CENTRAL BANK

OCCASIONAL PAPER SERIES

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ABSTRACT

The aim of this study is to investigate the extent to which the dispersion of real GDP growth rates has changed over the past few years and whether the synchronisation of business cycles has increased among the euro area countries. The study is divided into two main parts. The first focuses on the dispersion of real GDP growth rates across the euro area countries, while the second studies the synchronisation of business cycles within the euro area. The study shows first that dispersion of real GDP growth rates across the euro area countries in both unweighted and weighted terms has no apparent upward or downward trend during the period 1970-2004 as a whole.

Second, since the beginning of the 1990s, the dispersion of real GDP growth rates across the euro area countries has largely reflected lasting trend growth differences, and less so cyclical differences, with some countries persistently exhibiting output growth either above or below the euro area average. Among other things, this might be due to different trends in demographics, as well as to differences in structural reforms undertaken in the past.

Thirdly, the degree of synchronisation of business cycles across the euro area countries seems to have increased since the beginning of the 1990s. This finding holds for various measures of synchronisation applied to overall activity and to the cyclical component, for annual and quarterly data, as well as for various country groupings. In particular, the degree of correlation currently appears to be at a historical high. In addition to these main findings, certain other stylised facts on dispersion and synchronisation are presented.

JEL classification: *C10, E32, O40*.

Key words: Dispersion of GDP growth across the euro area countries; Trend and Cycle; Synchronisation of business cycles within the euro area.

EXECUTIVE SUMMARY

The creation of the Single Market in 1993 and the inception of EMU in 1999 constitute significant institutional changes that arguably should have affected the evolution of economic activity across the euro area countries. The aim of this study is to investigate the extent to which the dispersion of real GDP growth rates has changed over the past few years and whether the synchronisation of business cycles has increased among the euro area countries. It reviews the main stylised facts behind output growth differentials. A full analysis of the main determinants and causes of output growth differentials across the euro area countries as well as of the related policy implications is beyond the scope of this study.

The study is divided into two main parts. The first focuses on the dispersion of real GDP growth rates across the euro area countries, while the second studies the synchronisation of business cycles within the euro area. In intuitive terms, the dispersion of real GDP growth rates across countries refers to the degree of difference between their output growth rates at a certain point in time. The synchronisation of business cycles refers to the degree of co-movement of business cycles across countries over a certain period of time. These concepts may be related, as a lack of synchronisation of business cycles may also be evident in the dispersion of output growth rates. Analysing both elements is useful for providing a complete picture of the output growth differentials.

There are many ways of measuring dispersion and synchronisation, and none of the methods used in this study is free from controversy and empirical difficulties. For example, for the analysis of output growth differentials, total output must be decomposed into a cyclical and a trend component. However, there is not just one method of obtaining such a decomposition. Consequently, a number of methods have been used to check the robustness of the results. Moreover, the results depend on the selection of certain parameters that need to be predefined homogeneously across countries. They are also affected by the "end-point problem", namely the fact that the estimates at the end of the sample period are conditional on projections, which are required to extend the historical dataset. Analysing the business cycle synchronisation across countries also means that the cycles have to be dated. Similarly, there is more than just one method for doing this, and certain parameters need to be predefined homogeneously across countries.

Additionally, output growth differentials can be analysed in unweighted terms, i.e. by giving equal importance to all countries, or in weighted terms. As the aim of this study is to present some stylised facts on output growth differentials across the euro area countries, measures of dispersion and synchronisation are initially computed in unweighted terms. However, as the euro area is a weighted concept and the ECB's monetary policy is geared to the euro area as a whole, it might also be relevant to consider weighted measures. The study therefore also shows weighted measures of dispersion, serving in turn to test the robustness of some of the results obtained in unweighted terms. The analysis presented in this study has been carried out using conventional statistical techniques. Although no formal econometric tests have been conducted to assess the statistical significance of the results, the study includes a wide range of indicators that support its key findings.

The key findings of the study are as follows:

– Overall, the dispersion of real GDP growth rates across the euro area countries in both unweighted and weighted terms showed no apparent upward or downward trend during the period 1970-2004 as a whole. Since 1999, however, dispersion in annual average terms has declined somewhat. Compared with certain benchmark areas, the current degree of dispersion within the euro area, measured in unweighted terms, does not appear to be significantly different, although it is generally slightly higher than that observed across regions or states within the United States, former West Germany, Spain and Italy. A number of caveats apply to this analysis, primarily the different computational methods, as well as the different number and sizes of the geographical entities considered. In addition, differences in the fiscal framework and the degree of integration of labour markets within the euro area compared with those within individual countries may also need to be taken into account when making such comparisons.

– Since the beginning of the 1990s, the dispersion of real GDP growth rates across the euro area countries has largely reflected lasting trend growth differences, and less so cyclical differences, with some countries persistently exhibiting output growth either above or below the euro area average. Among other things, this might be due to different trends in demographics, as well as to differences in structural reforms undertaken in the past.

– In this context, the degree of synchronisation of business cycles across the euro area countries seems to have increased since the beginning of the 1990s. This finding holds for various measures of synchronisation applied to overall activity and to the cyclical component, for annual and quarterly data, as well as for various country groupings. In particular, the degree of correlation currently appears to be at a historical high.

– To test whether the two key findings above are specific euro area developments or global phenomena, the same analysis was conducted for a sub-set of 12 non-euro area OECD countries. In contrast to the results obtained for the euro area, there has been no increase in the contribution from trend growth differences or in synchronisation for this sub-set. This may indicate that, instead of global forces, EU integration, and more recently EMU, have led to smaller differences in output gaps and to an increase in the synchronisation of business cycles across the euro area countries. However, it should be noted that this group of 12 non-euro area OECD countries may not fully represent global developments.

Other findings of the analysis of dispersion include:

– Looking at individual country developments, some euro area countries have been growing persistently above or below the euro area average. Greece, Spain and Ireland have been persistently outperforming the euro area average since the mid-1990s, which might reflect, at least to some extent, a catching-up process. By contrast, Germany and Italy have been persistently underperforming the euro area average, in growth terms, since around the mid-1990s, possibly reflecting the adverse impact of some long-standing structural factors in these countries.

– Such persistent output growth differentials can also be found within the United States, the former West Germany, Spain and Italy, with some regions or states in these countries continuously overperforming or underperforming.

– The analysis of the business cycle of the individual euro area countries points to a decrease in their volatility (measured as the standard deviation of the output gaps of a certain country over a time period) since the mid-1990s. However, smaller and more open euro area economies appear to display larger output volatility than the rest of the countries, as they are more sensitive to external developments and, in some cases, have a higher degree of specialisation in certain sectors.

– Developments in trend output growth across euro area countries have been somewhat mixed. Eight euro area countries have witnessed a slowdown in their trend growth rates since the 1970s, which has been particularly strong in Germany, Italy, the Netherlands and Portugal.

– An analysis of supply-side factors shows that total factor productivity seems to have played a prominent, albeit diminishing, role in explaining the dispersion of real GDP growth rates over the past 30 years. The contribution from capital, however, has shown an increasing trend, and that of labour a decreasing trend.

– Demographic developments appear to have played an important role in explaining differences in real GDP growth developments since the beginning of the 1990s. In particular, some faster growing economies, such as Spain, Ireland, and Luxemburg have benefited from positive demographic factors, i.e. an increase in the population growth rate and in the working age population rate, partly reflecting immigration flows. Some low growth economies, such as Germany, Italy and the Netherlands, however, seem to have been penalised by demographic changes.

– Looking at dispersion by demand component, it seems that for total investment, exports and imports, there has been a downward trend in dispersion since the mid-1990s. This trend is more pronounced when dispersion is measured in unweighted rather than in weighted terms. However, there are still some notable differences in export performance across the euro area countries. In particular, export growth in Italy has been clearly underperforming the euro area since the mid-1990s, in contrast to the very positive export performance in Germany, Ireland and Luxembourg.

– Looking at dispersion by sector, the agriculture and construction sectors show the highest dispersion of value-added growth across the euro area countries. There is no clear trend in the dispersion of value-added growth in any sector, apart from manufacturing, where a clear decline in dispersion has been visible since the late 1990s, possibly reflecting closer intra-industry links.

Other findings of the analysis of synchronisation include:

– Looking at all the pairwise correlation coefficients among the euro area countries, Belgium and France have the highest degree of business cycle correlation with the rest of the euro area countries, while Greece, Ireland and Finland have the lowest. Since the beginning of the 1990s, the average business cycle correlation in each country with respect to the others has increased in all cases, except in Luxembourg. Greece and Finland remain among the countries with the lowest average correlation, together with Luxembourg. This suggests that, relatively, some smaller economies with a high degree of sectoral specialisation have more idiosyncratic business cycles than larger countries or countries that trade extensively with larger neighbours.

– According to classical business cycle dating, after the well-shared 1993 recession, although the business cycles of the euro area countries have co-moved, some countries have experienced a contraction in real GDP while in others real output has continued to rise, but at a slower pace.

– The business cycle dating also shows that the duration and amplitude of the business cycles across the euro area countries are relatively similar. However, the Netherlands and Finland, in particular, stand out with a longer duration and greater amplitude.

– The study analyses the demand composition of the two latest and most widespread upswings of GDP across the euro area countries, starting in the first quarter of 1993 and the second quarter of 2003. The most striking difference between these two upswings is that the 1993 recovery was characterised by relatively strong private consumption growth in all countries, but in the 2003 recovery, private consumption has been very weak in two countries (Germany and the Netherlands). As regards exports, however, the more recent upswing has shown more similarity across countries than the one in 1993, although export growth performances across countries still vary considerably.

– An analysis of lagged correlations of business cycles across the euro area countries – aimed at ascertaining whether some euro area countries lead or lag cyclical developments compared with the other countries – indicates that the highest correlation across euro area countries occurs without lags, reinforcing the conclusion that the business cycles are highly synchronised. The only exception is Finland.

– Finally, the study analyses which demand components play a prominent role in explaining the business cycle of individual countries. This analysis has shown that, in all countries, the correlation between the cyclical part of each demand component and that of real GDP is very high, except for the export cycle in Spain and Finland. In particular, the investment and export cycles seem to be the most correlated with the real GDP cycle in almost all countries. Moreover, there appears to have been a remarkable increase in the correlation of the export cycles across countries over the 1990s. In this context, exports appear to be the main source of the increase in the co-movement of business cycles across the euro area countries, possibly reflecting the impact of closer trade links.

INTRODUCTION

The diverse developments in economic activity seen across the largest euro area countries at the end of 2004 and at the beginning of 2005 have stimulated a debate on the size of output growth differentials and the perceived consequent difficulties in terms of the implementation of the single monetary policy. One of the potential costs of EMU, as debated among academics and economic commentators before its introduction, was the elimination of national monetary and exchange rate instruments in a group of countries with different economic structures and incomplete synchronisation of business cycles. Six years after the beginning of the third stage of EMU, this debate seems to have gained renewed attention in the light of disappointing growth performance in some euro area countries. Against this background, the aim of this study is to present some stylised facts on real GDP growth differentials across the euro area countries. The first part analyses the dispersion of real GDP growth across the euro area countries, i.e. the degree of difference in the output growth rates across countries at a certain point in time, while the second part studies the synchronisation of business cycles within the euro area, i.e. the co-movement of the business cycles across countries over a certain period of time.

In the first part, the analysis is based on annual data from 1970 to 2004. For the sake of homogeneity and in order to have a complete dataset for the 12 euro area countries, it has been decided to use the "AMECO" database, a well-known and publicly available dataset provided by the European Commission. In the second part, the analysis of synchronisation requires data with a higher frequency. It therefore uses primarily quarterly series, based on the Eurostat database, up to the fourth quarter of 2004.[1] In this case, long-term

1 After the finalisation of this study, new national accounts have been published for most euro area countries, following the implementation of important statistical changes, resulting in some backward revisions. For a detailed explanation, see the Box 6 entitled "Major Changes in Euro Area and Member States' National Accounts", published in the ECB Monthly Bulletin June 2005, pages 50-52.

quarterly series are not available for several countries, namely Greece, Ireland, Luxembourg and Portugal. Consequently, the second part concentrates on developments across the eight largest euro area countries. Since part of the debate appears to be related to developments in some groups of countries, dispersion and synchronisation measures are also computed for the four and eight largest euro area countries, referred to as EA4 and EA8 respectively in the tables and charts.

I DISPERSION OF OUTPUT GROWTH RATES WITHIN THE EURO AREA

I.I REAL GDP GROWTH DIFFERENTIALS: STATISTICAL EVIDENCE

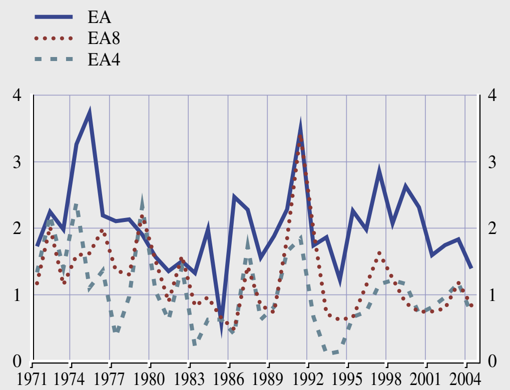
This section assesses the degree of output growth dispersion across the euro area countries. For this purpose, it is helpful to provide some references that can be used to assess the degree of output growth dispersion, as was also done in the study on inflation differentials. A first reference is an internal benchmark, providing a historical perspective of growth differentials. A second reference is an external benchmark, comparing growth differentials observed among regions within some individual countries.

From a historical perspective, as can be seen in Chart 1, the dispersion of the annual average real GDP growth rates across the 12 euro area countries, measured by the unweighted standard deviation, has been fluctuating around a level of 2.0 percentage points since the 1970s. Overall, there is no apparent upward or downward trend for the period 1970-2004 as a whole. The same applies to dispersion across the largest euro area economies, although, in this case, the level of dispersion has been fluctuating around 1.0 percentage point. Since 1999, the degree of dispersion in annual average terms has declined somewhat in the 12 euro area countries, reaching 1.4 percentage points in 2004, while for the largest countries it has remained around 1 percentage point.

The standard deviation is only a summary indicator of the statistical distribution across countries, in this case, of output growth rates. Focusing entirely on the standard deviation may conceal important information. In the case of real GDP growth rates, it might be relevant to complement the information provided by the standard deviation with the average, as well as the maximum and minimum growth rates. The minimum growth rate, in particular, would indicate whether a certain degree of dispersion is accompanied by a recession in the countries.

Chart 1 Dispersion of real GDP growth rates across the euro area countries

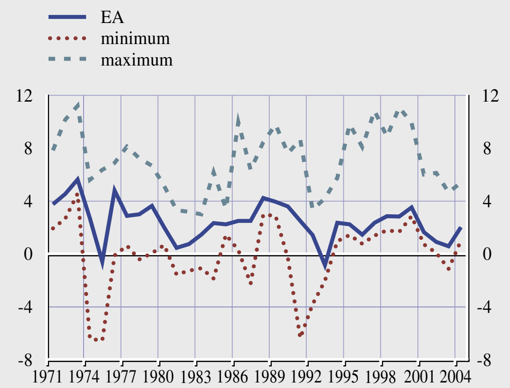
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 2 Euro area real GDP growth and the maximum and the minimum growth rates across the euro area countries

(percentage change)



Source: Own computations based on European Commission database.

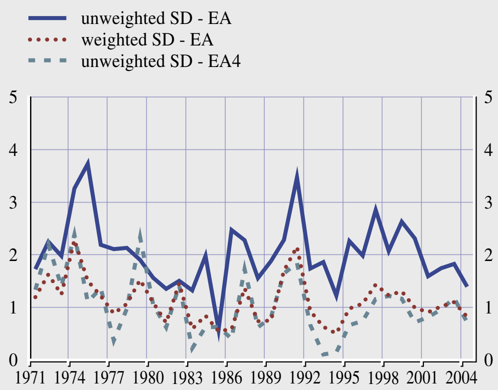
Moreover, the positioning of the average between the minimum and the maximum growth rates would indicate whether a certain degree of dispersion relates to the underperformance (overperformance) of the largest countries according to whether the average is closer to the minimum (maximum). Indeed, as can be seen in Chart 2, in many years, such as 2003 for example, at least one country recorded a contraction in real GDP while others recorded strong increases. At the same time, the average and the standard deviation have remained broadly stable. Interestingly, over the 1970s and the 1980s, the average euro area growth rate was close to the middle of the maximum-minimum range. By contrast, the average euro area growth rate has been very close to the lowest growth rate across the 12 euro area countries since around 1993. As explained in more detail later, this largely reflects the persistent underperformance, in terms of growth, of some large euro area countries.

The analysis conducted above was based on the unweighted standard deviation, as it might be preferable to give equal importance to all countries in a fact-finding analysis. However, it should be borne in mind that there are other measures of dispersion. For instance, it is possible to compute a weighted measure of standard deviation. As the euro area is a weighted concept and the monetary policy of the ECB is geared to the euro area as a whole, it might also be relevant to consider weighted measures. As can be seen in Chart 3, dispersion in weighted terms (measured also by the standard deviation) is lower than the unweighted measure. Moreover, the degree of dispersion, as measured by the weighted standard deviation for the 12 euro area countries, is very similar to the unweighted standard deviation for the four largest economies. This merely reflects the fact that, in GDP terms, these four countries are weighted around 80% in the euro area.

Another well-known measure of dispersion is the coefficient of variation, i.e. the standard deviation scaled by the mean. This is a very useful measure for comparing price level

Chart 3 Dispersion of real GDP growth rates across the euro area countries

(percentage points)



Source: Own computations based on European Commission database.
Note: Measured by the unweighted and the weighted standard deviation (SD).

dispersion between different sectors or countries, where the levels can be substantially different. However, in the case of real GDP growth rates, when the average is close to zero, this measure can be extremely distorted,[2] as shown in Chart 75 (see Appendix A1). Another indicator is the range, i.e. the spread between the maximum and the minimum growth rate. Although this indicator is usually "distorted" by the presence of outliers, its profile for the 12 euro area countries since 1971 is quite similar to that of the unweighted standard deviation (see Chart 77 in Appendix A1).

Finally, instead of focusing on real GDP as a measure of overall economic activity, the dispersion measures can also be applied to real GNP, as in some countries, such as Ireland, this measure has highlighted some differences vis-à-vis the domestic concept or output per capita, as demographics might have also been an important factor. As can be seen in Chart 78 and Chart 79 (at the end of Appendix A1), the degree of output growth dispersion, measured

2 To correct for this distortion, the coefficient of variation can be computed by scaling the standard deviation with an eight-year moving average of real GDP growth rates across the 12 euro area countries (see Chart 76 in Appendix A1). The resulting measure of dispersion exhibits the same profile, but scaled down, compared with that of the unweighted standard deviation.

by the unweighted standard deviation computed for real GDP growth, real GNP growth and real GDP per capita growth for the 12 euro area countries are all quite similar, with the dispersion of real GDP per capita growth being somewhat lower.

1.1.1 DISPERSION IN BENCHMARK AREAS (UNITED STATES, FORMER WEST GERMANY, SPAIN AND ITALY)

This section analyses the dispersion in output growth developments among regions in some individual countries, namely in the United States, the former West Germany,[3] Spain and Italy in order to provide some further references for assessing the degree of dispersion within the euro area. The analysis is conducted only in unweighted terms.

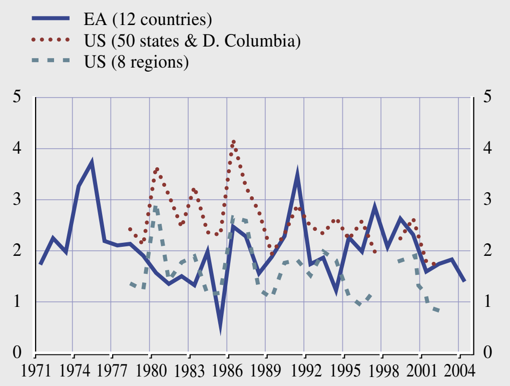
First, however, it should be noted that certain caveats apply when comparing output growth dispersion in the euro area with that in some individual countries. Among others, these include the different computational methods of different statistical institutes, as well as the different number and sizes of the geographical entities considered. Furthermore, the regional GDP data may be subject to revisions, especially for the most recent years and, in particular, for 2004. It may also be worth noting that differences in the fiscal framework and the degree of integration of labour markets within the euro area compared with those within individual countries may also need to be taken into account when making the above comparisons.

As can be seen in Chart 4, the degree of dispersion of real GDP growth rates across the euro area countries generally seems to be slightly lower than that across the United States. However, this comparison might be distorted by the large number of US states (50 plus a district) considered. Overall, the larger the number of geographical entities considered within a country, the higher the degree of dispersion is

3 The analysis focuses on the former West German Länder. This constitutes a more meaningful benchmark than the whole of Germany, as the series are longer and the dispersion measures are affected to a lesser extent by the distortions of the German unification process. In fact, when computed for all of the current 16 German Länder, since 1992, the degree of dispersion rises notably from 1992 to 1994, but thereafter the differences are small.

Chart 4 Dispersion of real GDP growth rates within the euro area and the United States

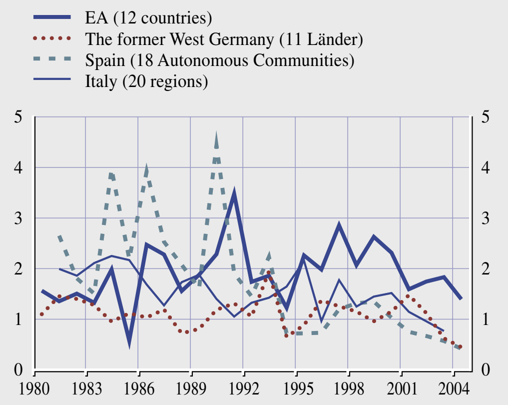
(unweighted standard deviation; percentage points)



Sources: Own computations based on European Commission database and US BEA.
Note: There is a statistical break in the US regional data in 1998. In the US states and regions, the data refer to Gross State Product (GSP). The eight regions are defined by the Bureau of Economic Analysis (BEA) and cover the whole country.

Chart 5 Dispersion of real GDP growth rates within the euro area, the former West Germany, Spain and Italy

(unweighted standard deviation; percentage points)



Sources: Own computations based on European Commission database and the national statistical institutes of Germany (DESTATIS), Spain (INE) and Italy (ISTAT).
Note: For the former West Germany, West Berlin is excluded from the sample in 1991. In Spain the data before 1995 refer to the 1986 base year national accounts.

Table 1 Dispersion of real GDP growth rates

(unweighted standard deviation; percentage points; average over periods)

	1980-2004	1990-2004	1999-2004	2004 or latest available year
Euro area (12 countries)	1.9	2.1	1.9	1.4
United States (50 states & D. Columbia)	2.5	2.2	1.9	1.4
United States (8 regions)	1.5	1.4	1.2	0.7
The former West Germany (11 Länder)	1.1	1.1	1.0	0.4
Spain (18 Autonomous Communities)	1.7	1.3	0.8	0.4
Italy (20 regions)	1.6	1.3	1.2	0.8

Sources: European Commission, US Bureau of Economic Analysis (BEA) and the national statistical institutes of Germany (DESTATIS), Spain (INE) and Italy (ISTAT).
Note: Data coverage: euro area (1980-2004), United States (1978-2004), former West Germany (1980-2004), Spain (1981-2004) and Italy (1981-2003). For the period 1970-2004, the averages for the euro area and for the former West Germany are 2 and 1.1 percentage points, respectively.

likely to be due to the potential presence of outliers. In fact, using the eight statistical regions of the United States, as computed by the Bureau of Economic Analysis, which also cover the whole US economy, the degree of dispersion is lower than that among the US states and that within the euro area. In particular, over the period 1980-2004, the average degree of dispersion of output growth across the euro area countries has been fluctuating around 1.9 percentage points compared with 2.5 percentage points across the US states and 1.5 percentage points across the eight US statistical regions. Since 1999, the degree of dispersion seen within the euro area, also around 1.9 percentage points on average, has been similar to that seen across the US states and somewhat higher than that across the US statistical regions (1.2 percentage points). However, in some specific years, the degree of dispersion among the US statistical regions was much higher than that within the euro area.

As can be seen in Chart 5, compared with certain individual euro area countries, namely the former West Germany, Spain and Italy, the degree of dispersion of real GDP growth across the euro area countries is similar from a long historical perspective – although more recently it seems that dispersion within the euro area has been higher than within these countries. In particular, the degree of dispersion across the euro area countries over the period 1980-2004, has been fluctuating around 1.9 percentage points on average, compared with 1.1 percentage points across the former West German Länder, 1.7 percentage points across the Spanish Autonomous Communities and 1.6 percentage points across the Italian regions (see Table 1). Since 1999, the degree of dispersion seen within the euro area has also been higher than that seen within the former West Germany, Spain and Italy. Interestingly, in some specific years in the past, the degree of dispersion within these individual countries was much higher than that within the euro area, reaching levels of around 4 percentage points in Spain, for example.

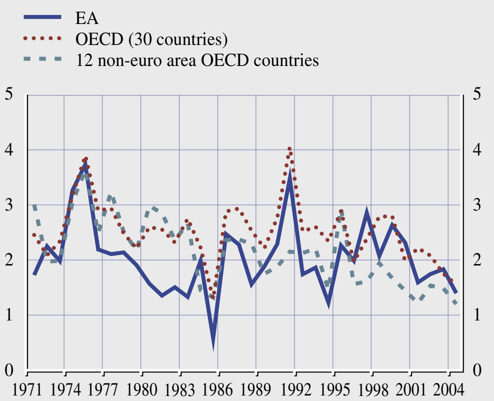
To sum up, given the available data, it could be said that the current degree of dispersion of real GDP growth rates across the euro area countries, as measured by the unweighted standard deviation, does not appear to be significantly different from that observed across regions or states within certain individual countries, such as the United States, the former West Germany, Spain and Italy. However, on average, dispersion in the euro area is somewhat greater than that in the other benchmark areas considered. In some specific years, the degree of dispersion within the latter countries was much higher than that within the euro area.

1.1.2 DISPERSION ACROSS THE OECD COUNTRIES

The previous section compared dispersion in the euro area with dispersion across regions or states within certain individual countries. To complement this analysis, it is useful to compare

Chart 6 Dispersion of real GDP growth rates across the OECD countries

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.
Note: The OECD currently consists of 30 countries. Full country data are available only since 1992. Before that, data are available for 26 countries, except for 1991 when data for 28 countries are available. The 12 non-euro area OECD countries with long GDP series, following AMECO database's country names, are: AUS, CAN, CHE, DNK, GBR, ISL, JPN, MEX, NOR, NZL, SWE and USA.

dispersion within the euro area with that across other industrialised countries. Such a comparison would indicate whether the degree of dispersion of output growth rates seen across the euro area countries differs from the level of dispersion across a set of countries, which may differ substantially from a geographical and institutional point of view.

For this purpose, Chart 6 shows the dispersion of real GDP growth rates across the euro area countries, along with the same measure for the 30 OECD countries,[4] and also for a set of 12 non-euro area OECD countries with long data series, namely Australia, Canada, Denmark, Iceland, Japan, Mexico, New Zealand, Norway, Sweden, Switzerland, the United Kingdom and the United States. Comparing the euro area with such a heterogeneous group of industrialised countries allows testing whether there are global or specific factors at play in the euro area.[5] As can be seen, and maybe somewhat surprisingly, dispersion in the euro area over the past 30 years has been broadly similar to the dispersion seen across the OECD countries and to the dispersion across the sub-set of 12 non-euro area OECD countries with full data coverage over the whole sample period. For none of these three groups of countries has there been a clear long-term trend in dispersion. However, considering the period since the end of the 1990s, it is noticeable that the slight decrease in growth dispersion in the euro area seems to be a phenomenon shared with other industrialised countries.

1.1.3 COUNTRY DEVELOPMENTS BEHIND EURO AREA OUTPUT GROWTH DISPERSION

Which euro area countries are mainly responsible for the output growth differentials previously shown? Are there some countries growing persistently below or above the euro area average?

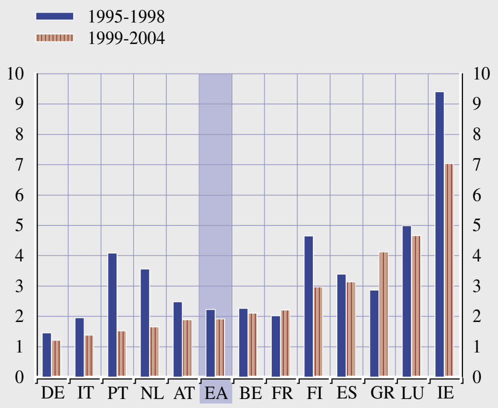
Some euro countries have been consistently over or underperforming in terms of growth compared with other euro area countries. As can be seen in Chart 7, Greece, Spain and Ireland have been outperforming the euro area average which might reflect, at least to some extent, a catching-up process (see Table 2). In particular, output growth in these three countries has been persistently above the euro area average since 1996, 1995 and 1992 respectively. Luxembourg and Finland have also outperformed the euro area average over the period 1999-2004. In fact, excluding the year 2001, output growth in Luxembourg and Finland has been systematically above the euro area average since 1996 and 1994 respectively.

4 The country coverage varies over time. See footnote in Chart 6.
5 This comparison can be considered as meaningful, given that the average growth rate of the euro area and that of this set of 12 non-euro area OECD countries over the period considered are quite similar (see table below).

	Euro area		Non-euro area OECD countries	
	GDP growth rates	Unweighted standard deviation	GDP growth rates	Unweighted standard deviation
1970-1979	3.6	2.3	3.6	2.7
1980-1989	2.2	1.6	2.7	2.2
1990-1998	2.0	2.2	2.4	2.0
1990-94	*1.8*	*2.1*	*1.8*	*2.0*
1995-98	*2.2*	*2.3*	*3.0*	*2.0*
1999-2004	1.9	1.9	2.7	1.4

Chart 7 Real GDP growth rates across the euro area countries

(percentage changes)



Source: European Commission database.
Note: Countries ordered by 1999-2004 averages.

By contrast, Germany and Italy are the two euro area countries that, on average, have had the lowest real GDP growth rate in the euro area over the last few years. Over the period 1999-2004 in particular, Germany and Italy reported an annual average real GDP growth rate of between 1.2% and 1.4%, well below the euro area average. It is important to note that, even prior to 1999, output growth in these two countries was below the euro area average. In Germany, it has been persistently below the euro area average since 1995. In Italy, real GDP growth has been persistently below the euro area average since 1996, excluding the year 2001, when it was very close to the euro area average. Even prior to 1996, however, Italian growth was persistently weak. In fact, excluding the year 1995, output growth in Italy had been weaker than the euro area average since 1988. These country developments suggest that differences in real GDP growth rates seem to be related to structural factors, probably reflecting differences in trend output growth rates (see Section 1.4).

Do such persistently different growth performances also occur across regions within other countries? As can be seen in Appendix A2, which provides a summary of regions or states with long-lasting growth differentials within the United States, the former West Germany, Spain and Italy, persistent output growth differences can also be found for some periods within all of these individual countries. Some regions or states have been persistently (for eight years or more) underperforming or overperforming, in growth terms, compared with the individual country average. In this sense, it does not appear unusual that real GDP growth in some euro area countries is persistently

Table 2 Real GDP growth rates across the euro area countries

(percentage changes)

	1970-79	1980-89	1990-98	1990-94	1995-98	1999-04	1999	2000	2001	2002	2003	2004
Euro area	3.6	2.2	2.0	1.8	2.2	1.9	2.8	3.5	1.6	0.9	0.6	2.0
Belgium	3.6	2.2	2.0	1.8	2.3	2.1	3.2	3.9	0.7	0.9	1.3	2.7
Germany	3.2	1.9	2.2	2.9	1.5	1.2	2.0	2.9	0.8	0.1	-0.1	1.6
Greece	5.5	0.8	1.7	0.8	2.9	4.1	3.4	4.5	4.3	3.8	4.7	4.2
Spain	3.9	2.7	2.5	1.7	3.4	3.1	4.2	4.4	2.8	2.2	2.5	2.7
France	3.7	2.4	1.6	1.3	2.0	2.2	3.2	3.8	2.1	1.2	0.5	2.5
Ireland	4.7	3.1	6.6	4.3	9.4	7.0	11.1	9.9	6.0	6.1	3.7	5.4
Italy	3.8	2.4	1.5	1.1	2.0	1.4	1.7	3.0	1.8	0.4	0.3	1.2
Luxembourg	2.7	4.6	4.9	4.8	5.0	4.7	7.8	9.0	1.5	2.5	2.9	4.2
Netherlands	3.3	2.0	2.9	2.3	3.6	1.7	4.0	3.5	1.4	0.6	-0.9	1.3
Austria	4.1	2.3	2.6	2.7	2.5	1.9	3.3	3.4	0.7	1.2	0.8	2.0
Portugal	5.1	3.4	2.7	1.7	4.1	1.5	3.8	3.4	1.7	0.4	-1.1	1.0
Finland	4.1	3.6	1.2	-1.6	4.6	3.0	3.4	5.1	1.1	2.2	2.4	3.7
Unweighted standard deviation	*2.3*	*1.6*	*2.2*	*2.1*	*2.3*	*1.9*	*2.6*	*2.3*	*1.6*	*1.7*	*1.8*	*1.4*

Source: Own computations based on European Commission database.

at variance with the average growth rate of the euro area as a whole. Thus, in contrast to the findings in the case of the inflation differentials, persistent output growth differentials are not, in this respect, a specific feature of the euro area.

1.2 DECOMPOSING GDP GROWTH DISPERSION INTO CYCLE AND TREND COMPONENTS

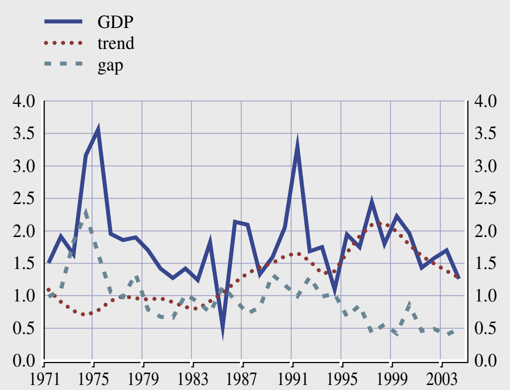
The analysis in the previous section has shown that the dispersion of overall real GDP growth rates has remained relatively stable over a longer time period. However, these results focus on the dispersion of overall real GDP growth rates across the euro area economies and may therefore mask important differences in the development of the cyclical and trend components across countries. In general terms, the real GDP of a certain country may temporarily deviate from its long-term growth pattern (trend). Such deviations from trend developments are referred to as the output gap. There is extensive literature on the decomposition of GDP into its cyclical and trend components (see Appendix A3 for a short review of detrending methods and Appendix A4 for a comparison of estimates by international institutions). It should be noted that to obtain such a decomposition, first, there is more than just one method of doing so; second, the results are conditional on certain parameters; and third, these methods are affected by the end-point problem, namely the fact that the estimates at the end of the sample period are conditional on projections, which are required to extend the historical dataset.

The aim of this section is to analyse how real GDP growth dispersion in the euro area can be explained in terms of its cyclical and trend components. The methodology used is based on a band-pass filter (BP)[6] technique. To ensure that results are comparable across countries, it is common practice to present and analyse the cyclical component as a share of the trend, i.e. as the output gap. Chart 8 shows the dispersion of overall real GDP growth rates since the 1970s, as well as the dispersion of output gaps (cyclical component) and trend growth rates across the 12 euro area countries, using a BP filter. Chart 9 shows a similar decomposition, but using a Production Function (PF) approach. The results are broadly similar for both methodologies. These graphs cannot be analysed in terms of contribution to overall dispersion (trend growth dispersion and output gap dispersion do not add up to real GDP growth

6 More precisely the Baxter and King (1995) approach.

Chart 8 Dispersion of real GDP growth rates, of trend growth rates and of output gaps across the euro area countries – BP filter

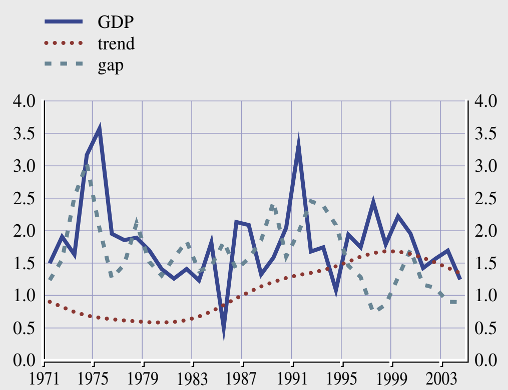
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 9 Dispersion of real GDP growth rates, of trend growth rates and of output gaps across the euro area countries – PF approach

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

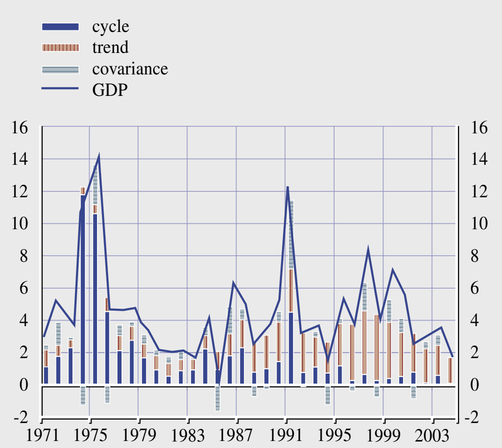
dispersion), but they can be used to illustrate the dynamics of each of these three individual variables. Similar developments are obtained when using a weighted measure of dispersion, as shown in Chart 80 and Chart 81 in Appendix A5.

The main conclusions that can be drawn from this analysis are that, while the dispersion of overall real GDP growth rates seems to have remained broadly stable since the 1970s, some striking developments can be observed for the dispersion of both the output gap and trend growth. The dispersion of the output gap has clearly decreased since the beginning of the 1990s, and, overall, the dispersion of trend growth rates steadily increased between the mid-1980s and the late 1990s. Since then, however, the dispersion in the trend growth component appears to have started to decline somewhat, although it is still above the levels seen in the mid-1980s. In other words, tentatively, it seems that since the early 1990s, less differences in the business cycles across the euro area countries have been compensated by increased differences in potential output growth rates between these economies.

These findings can be better substantiated by computing the contributions of the cyclical and trend components to overall GDP dispersion. For this, the variance, and not the standard deviation, needs to be used as a measure of dispersion in order to obtain the decomposition of real GDP growth dispersion. As can be seen in Chart 10 and Chart 11, the breakdown of the variance of overall real GDP growth rates leads to similar conclusions, namely a decrease in the cyclical component's contribution to dispersion and simultaneously an increase in the contribution stemming from trend growth differences, mainly since the beginning of the 1990s. Consequently, the cyclical component's contribution to dispersion seems to have been relatively limited in the past ten years, with most of the dispersion being explained by differences in trend output growth. Similar developments are revealed if a weighted measure of dispersion is used, as shown in Chart 82 and Chart 83 in Appendix A5. It should be noted that the covariance between trend growth and the cycle is a necessary component of this decomposition. However, as shown in the charts below, it is relatively small and does not affect the overall conclusion.

Chart 10 Contribution to variance of overall GDP growth across the euro area countries – BP filter

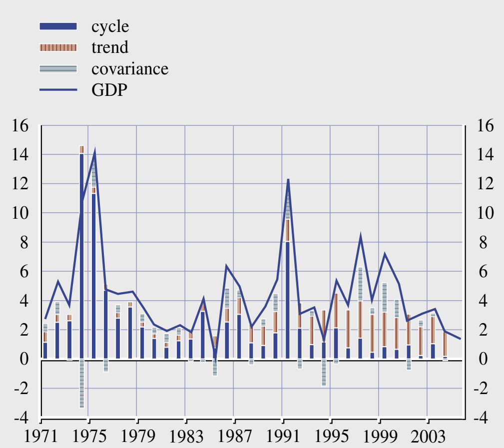
(in unweighted terms; percentage points)



Source: Own computations based on European Commission database.

Chart 11 Contribution to variance of overall GDP growth rates across the euro area countries – PF approach

(in unweighted terms; percentage points)



Source: Own computations based on European Commission database.

To sum up, the dispersion of the output gaps has clearly decreased since the beginning of the 1990s, while the dispersion of trend growth rates has generally increased. In terms of contributions, there has been a decrease in the cyclical component's contribution to dispersion and an increase in the contribution stemming from trend growth differences, mainly since the beginning of the 1990s. Consequently, the cyclical component's contribution to dispersion seems to have been relatively limited in the past ten years, with most of the dispersion being explained by differences in trend output growth. Among other things, this might reflect different trends in demographics, as well as differences in structural reforms undertaken in the past. In other words, the current degree of dispersion in overall real GDP growth largely reflects lasting trend growth differences and not cyclical differences.

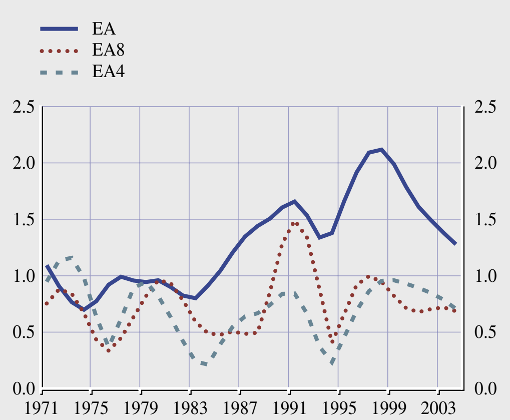
1.2.1 DECOMPOSITION OF REAL GDP GROWTH DISPERSION IN THE LARGEST EURO AREA ECONOMIES

The analysis above has been performed for the 12 euro area countries. However, it might also be interesting to examine dispersion in some groups of euro area countries, particularly among the largest ones. This is done by complementing dispersion measures for the 12 euro area countries (EA) with dispersion measures for the eight largest economies (EA8) and the four largest economies (EA4).

As regards the dispersion of the trend growth rates, developments differ somewhat between the country groups and also depend on the decomposition method used. According to the BP filter method (see Chart 12), the dispersion of trend growth rates across all the euro area countries showed a long-term upward movement up to the late 1990s, but this might have been due to developments in the smaller countries, as the dispersion of trend growth rates among the largest economies remained broadly constant. The role of developments in the smaller economies in the increase in the dispersion of trend growth rates up to the late 1990s is also evident using the PF approach (see Chart 13). The fact that the gap between trend growth dispersion among the 12 euro area countries and that computed for the larger economies has been widening since around 1981, when they were at practically the same level, may reflect an intensification of the catching-up process in some of the smaller economies. However, according to the PF approach, there was also an increase in trend growth dispersion in the

Chart 12 Dispersion of GDP trend growth rates across the euro area countries – BP filter

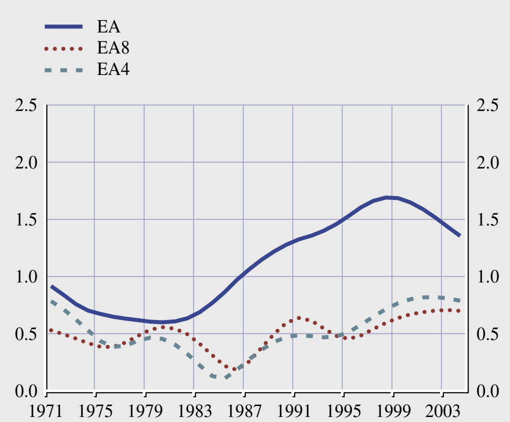
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 13 Dispersion of GDP trend growth rates across the euro area countries – PF approach

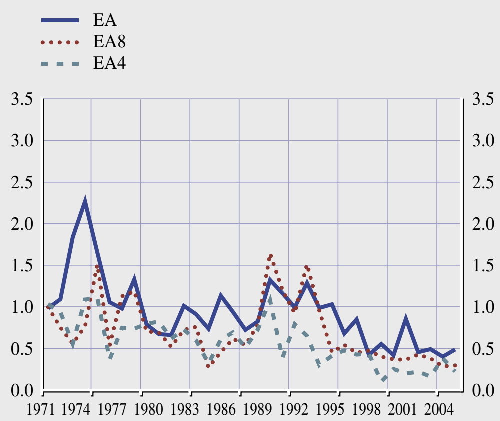
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 14 Dispersion of output gaps across the euro area countries – BP filter

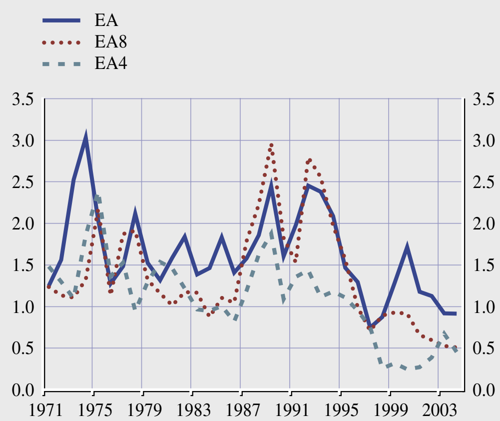
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 15 Dispersion of output gaps across the euro area countries – PF approach

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

largest economies from around the mid-1980s. Interestingly, however, looking at the 12 euro area countries and also the largest economies, trend growth dispersion has decreased somewhat since the late 1990s, although the decrease is much less pronounced in the largest economies.

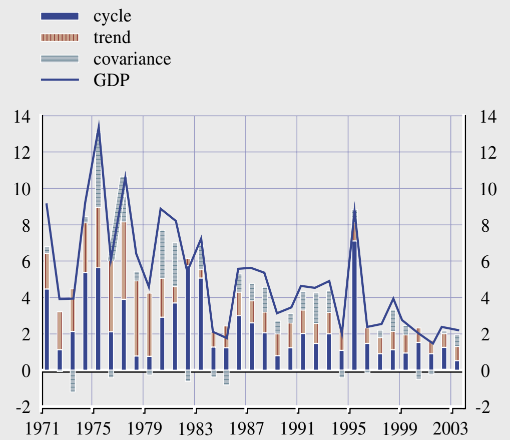
Turning to the output gap, there appears to have been a decline in its dispersion in all three country groups since the 1990s, irrespective of the approach (see Chart 14 and Chart 15). Over a long period of time, this decline might reflect certain factors, such as increasing world trade and enhanced integration of markets in the European Union. The decrease in output gap dispersion within the euro area can probably also be attributed to the increasing integration due to EMU.

1.2.2 DECOMPOSITION OF REAL GDP GROWTH DISPERSION ACROSS NON-EURO AREA OECD COUNTRIES

Section 1.1 showed that the dispersion of overall real GDP growth rates across a set of 12 non-euro area OECD countries with long data series has been broadly similar to dispersion in the euro area over the past 30 years. In the euro area countries (as shown in Chart 10), there has been a decrease in the cyclical component's contribution to dispersion and an increase in the contribution stemming from trend growth differences, mainly since the beginning of the 1990s. Consequently, the cyclical component's contribution to dispersion in the euro area seems to have been relatively limited over the past ten years, with most of the dispersion being explained by differences in trend output growth. To test whether this finding is a specific euro area development or a global phenomenon, a decomposition of real GDP into its cyclical and trend components for the 12 non-euro area OECD countries with long GDP data series has been performed. Chart 16 shows the contributions to total variance of overall GDP growth rates from trend, cycle and from the covariance. The most striking result is that, in comparison with the euro area, the contributions to dispersion from the cyclical component and from the trend component have been broadly equal over the past ten years. This comparison between the euro area and the 12 non-euro area OECD countries with long GDP data series seems to imply that EU integration, and more recently EMU, have led to smaller differences in output gaps across the euro area countries. However, it should be noted that this small group of non-euro area OECD countries

Chart 16 Contribution to variance of overall GDP growth rates across 12 non-euro area OECD countries (BP filter)

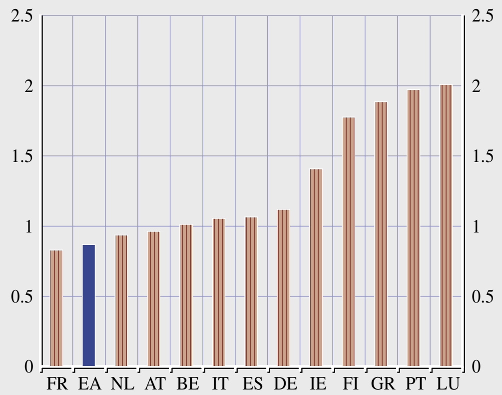
(in unweighted terms)



Source: Own computations based on European Commission database.
Note: The 12 non-euro area OECD countries with long GDP series are: Australia, Canada, Denmark, Iceland, Japan, Mexico, New Zeeland, Norway, Sweden, Switzerland, United Kingdom and the United States.

Chart 17 Standard deviation of the output gap in each euro area country over the period 1971-2004

(percentage points)



Source: Own computations based on European Commission database.
Note: Output gaps are computed using a BP filter over the period 1971-2004. Then, for each euro area country, and also for the euro area as a whole, the standard deviation of the output gap during this period is computed.

may not be fully representative of global developments.[7]

1.3 ANALYSIS OF OUTPUT GAP DEVELOPMENTS IN INDIVIDUAL COUNTRIES

The previous sections investigated output growth dispersion and its composition across the euro area countries. The focus of this section is the main features of the business cycle, as measured by the output gap in each country, while the next section analyses the main features of trend component developments in each country.

In order to present some stylised facts about business cycle developments, it is necessary to look at the standard deviation of the output gap series for a certain country. This measure is often referred to as output volatility. Computing this measure would allow for a comparison of the differences across the business cycles of the various euro area countries.

Taking the whole sample, Chart 17 shows the standard deviation of the output gaps for the 12 euro area countries and for the euro area as a whole. The first remarkable result is that for the entire period 1971-2004, all countries, except France, had, on average, larger output volatility than the euro area as a whole. The reason for this is that a positive output gap in one country is likely to have been compensated by a negative one in another country. Another broad conclusion that can be drawn from the same chart is that larger countries with more diversified economies tend to show smaller output volatility than small open economies with a high degree of specialisation. In particular, Greece, Ireland, Luxembourg, Portugal and Finland stand out with relatively large output volatility. There are, however, also some smaller countries, such as Belgium, the Netherlands and Austria, that have had relatively stable economic developments in terms of low output volatility. The fact that larger countries tend to exhibit lower output volatility may also explain the low output volatility at the euro area level.

7 Furthermore, to fully check the robustness of these results, alternative sub-groupings of the non-euro area OECD countries could have been considered.

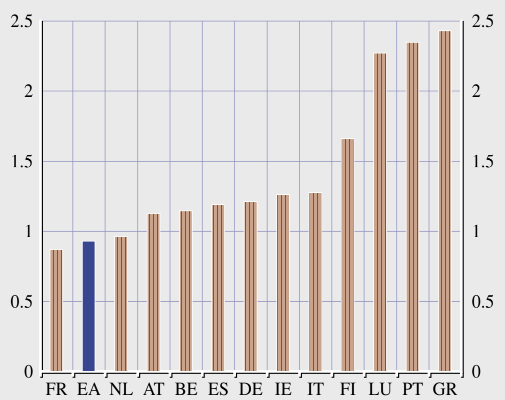
To analyse whether these conclusions have been stable over time, the same measures have been calculated for two sub-periods. Chart 18 and Chart 19 show the whole time period split into two samples: the first embracing the 1970s and the 1980s, and the second spanning from 1990 to 2004. This allows for studying more recent developments but, at the same time, maintaining a sufficiently long and representative time period. As can be seen, average output volatility (horizontal line) is clearly lower for the more recent time period. This observation is consistent with the conclusion drawn previously, namely that the dispersion of output gaps has declined over time. Looking more into the details of the first period (1971-1989), three countries, namely Greece, Luxembourg and Portugal, stand out with much higher output volatility than the euro area average. Finland also saw relatively high output volatility. The rest of the euro area countries are clustered within a relatively narrow range. Only France is slightly below the standard deviation of the euro area as a whole. As to the second time period (1990-2004), while average volatility was clearly lower during this time period, Finland and, to a lesser extent, Ireland, Luxembourg and Portugal, showed above-average volatility. Overall, it seems that the smaller euro area economies have been more sensitive to external developments, and those with a higher degree of specialisation in certain sectors have shown larger output volatility than the largest countries.

To test further whether these findings are sensitive to changes in the sample period, an eight-year rolling standard deviation of the output gap has been computed for every country, and then averaged in both unweighted and weighted terms. Despite some cyclicality, Chart 20 illustrates that output volatility has exhibited a clear long-term downward path. The findings above thus appear to be robust with respect to the various sample periods.

In conclusion, the analysis of business cycles of individual euro area countries points to a decrease in their volatility (measured as the standard deviation of the output gaps of a certain country over a period of time) since the mid-1990s. However, it seems that smaller and more open euro area economies show larger output volatility than the rest of the countries, as they are more sensitive to external developments and, in some cases, have a higher degree of specialisation in certain sectors.

Chart 18 Average standard deviation of the output gap in each euro area country over the period 1971-1989

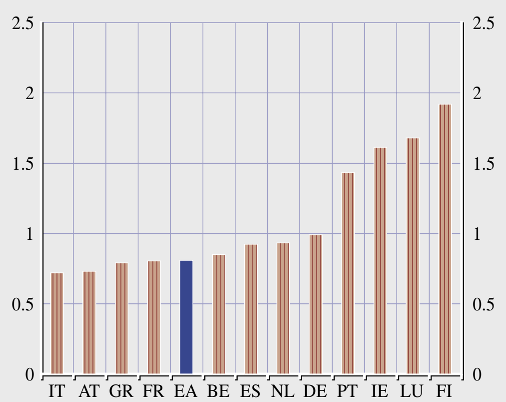
(percentage points)



Source: Own computation based on European Commission database.
Note: See footnote in Chart 17.

Chart 19 Average standard deviation of the output gap in each euro area country over the period 1990-2004

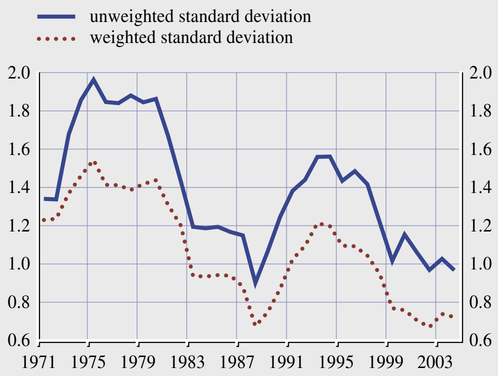
(percentage points)



Source: Own computation based on European Commission database.
Note: See footnote in Chart 17.

Chart 20 Eight-year rolling standard deviation of output gaps

(percentage points)



Source: Own computations based on European Commission database.
Note: Eight-year rolling standard deviation of the output gaps has been computed for every country and then averaged.

1.4 ANALYSIS OF TREND GDP GROWTH DEVELOPMENTS IN INDIVIDUAL COUNTRIES

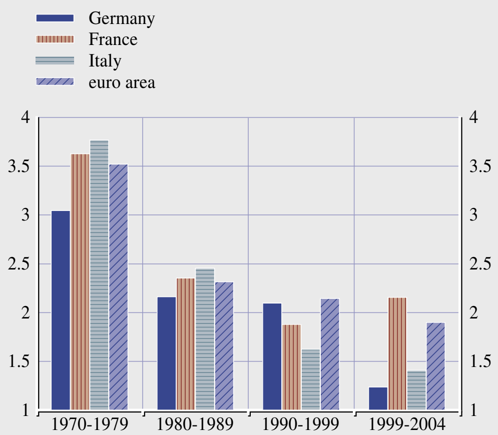
One noticeable feature of the developments of trend GDP growth over the past three and a half decades is that euro area trend output growth has continuously fallen from high rates of around 3% in the 1970s to around 2% in the period after 1999.[8] As can be seen in Chart 21, these developments have been driven primarily by the three largest euro area countries. In particular, the German and Italian economies have seen substantial declines in their trend output growth rates. It should be noted, however, that a slowdown in trend output growth has been visible in eight of the 12 euro area economies. By contrast, Greece, Spain, Ireland and Luxembourg have witnessed an increase in their trend growth rates since the early 1990s. In Finland, the temporary slowdown in trend GDP growth in the 1990s was related to the severe recession at the beginning of 1990[9] (see Table 3).

It may be helpful to group countries according to their potential output growth in order to see how they deviate from euro area GDP growth.

8 This conclusion holds true irrespective of the method used to detrend real GDP. See Appendix A4 for a comparison of potential output growth estimates across different international institutions.
9 Apart from influences from the global downturn, this recession was accentuated by a large loss of external trade following the collapse of the Soviet Union, as well as by the banking crisis and a sharp correction of property prices.

Chart 21 Trend GDP growth rates per decade

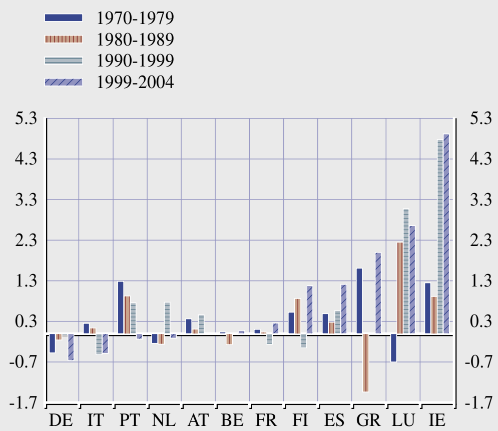
(percentage changes)



Source: Own computations based on European Commission database.
Note: Trend GDP growth rates have been extracted by using a BP filter.

Chart 22 Trend GDP growth differentials with the euro area

(percentage points)



Source: Own computations based on European Commission database.
Note: Trend GDP growth rates have been extracted by using a BP filter. Countries ordered by the size of the average trend growth differential in the period 1999-2004.

Table 3 Trend GDP growth rates (based on BP filter)

(percentage changes)

	1970-1979	1980-1989	1990-1999	1999-2004
Belgium	3.6	2.1	2.1	2.0
Germany	3.0	2.2	2.1	1.2
Greece	5.1	0.9	2.1	3.9
Spain	4.0	2.6	2.7	3.1
France	3.6	2.4	1.9	2.2
Ireland	4.8	3.2	6.9	6.8
Italy	3.8	2.5	1.6	1.4
Luxembourg	2.8	4.6	5.2	4.6
Netherland	3.3	2.1	2.9	1.8
Austria	3.9	2.4	2.6	1.9
Portugal	4.8	3.2	2.9	1.8
Finland	4.0	3.2	1.8	3.1
Euro area	3.5	2.3	2.1	1.9

Source: Own computations based on European Commission database.

Chart 22 shows trend GDP growth differentials against the euro area by sub-periods. Three groups of countries can be broadly identified. The first, which consists of Belgium, France, the Netherlands and Austria, has consistently seen trend output growth largely in line with the euro area average. The second, which includes Greece, Spain, Ireland, Luxembourg and Finland, has seen higher trend output growth compared with the euro area over most of the sub-periods. Portugal belonged to this group up to 1999. The third group, comprising Germany and Italy, has, however, shown negative trend growth rate differentials with the euro area. In Germany, the negative differential has been a permanent feature since the 1970s, with the exception of the years around the German unification. In Italy, however, the relative underperformance has been rather more recent, starting in the 1990s.

The main conclusions of this analysis are the following. First, developments of trend output growth across euro area countries have been somewhat mixed. Eight euro area countries have witnessed a slowdown in their trend growth rates since the 1970s. This slowdown has been particularly marked in Germany, Italy, the Netherlands and Portugal. Secondly, trend growth differentials within the euro area are persisting, with some countries continuously exhibiting trend output growth either above or below the euro area average.

1.5 SUPPLY-SIDE COMPOSITION

The previous sections focused on GDP dispersion by decomposing it into its cyclical and trend components. The next three sections investigate GDP dispersion from a supply-side, demand-side and sectoral decomposition point of view. Since the long-term trends described above seem to be largely determined by supply-side factors, it would be worthwhile looking at these factors in more detail. In essence, supply-side factors are the production factors contributing to overall GDP growth over time.[10]

A standard production function is assumed:

$$(1) \quad Y = TFPf(K, L)$$

where Y is output, K and L are the capital and labour inputs, respectively, and total factor productivity (TFP) is the measure of the level of technology. Under the assumption of perfectly competitive markets and constant returns to

10 The growth accounting exercise is carried out for actual GDP and not for its trend component taken in isolation. There are several reasons behind this choice. First, this kind of exercise, which looks at the evolution of factor inputs (capital, labour and total factor productivity), is carried out using very low frequency data (averages of decades), which implicitly means that business cycles are smoothed out. Secondly, the decomposition of actual and not trend GDP growth is less subject to criticisms on the detrending technique used, which would be required for extracting the trend component of the factors inputs.

scale, the following well-known decomposition can be obtained:

$$(2)\quad \frac{\Delta Y}{Y} = \frac{\Delta TFP}{TFP} + \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

where $\alpha = \dfrac{Y - wL}{Y}$ is the capital income share.

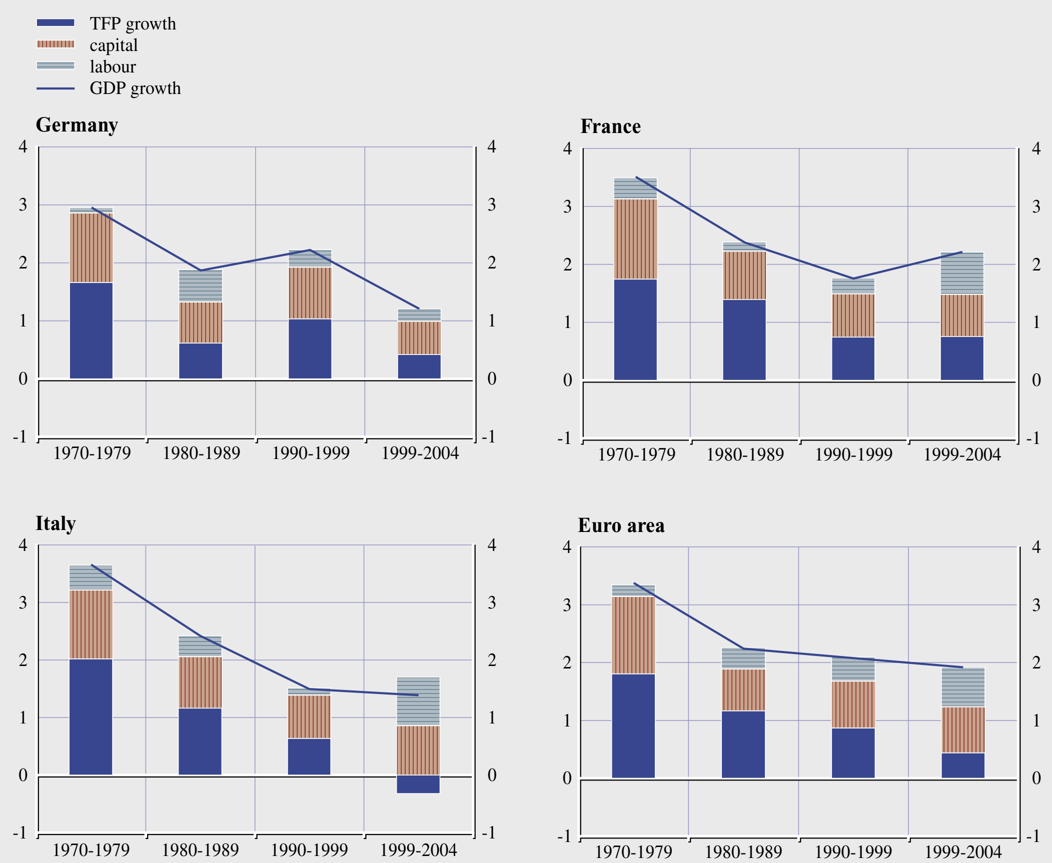
Using this method,

Chart 23 shows the contributions to overall GDP growth from capital, labour and TFP growth for the three largest euro area countries and for the euro area as a whole since the 1970s.

The deterioration in GDP trend growth seems to be explained by a steady slowdown in TFP growth since the 1970s. These developments are shared across the three largest euro area countries and the euro area as a whole, with the exception of Germany during the period 1990-1999, probably due to the unification process. In addition, the contribution from capital also appears to have declined primarily between the 1970s and the 1980s in all these countries.

An examination of developments across all 12 countries (see Chart 24) shows that almost all of the smaller countries also saw a decrease in TFP over the same period (grey lines). The exceptions are Greece, Ireland and Finland. In Greece, TFP deteriorated rapidly in the 1980s,

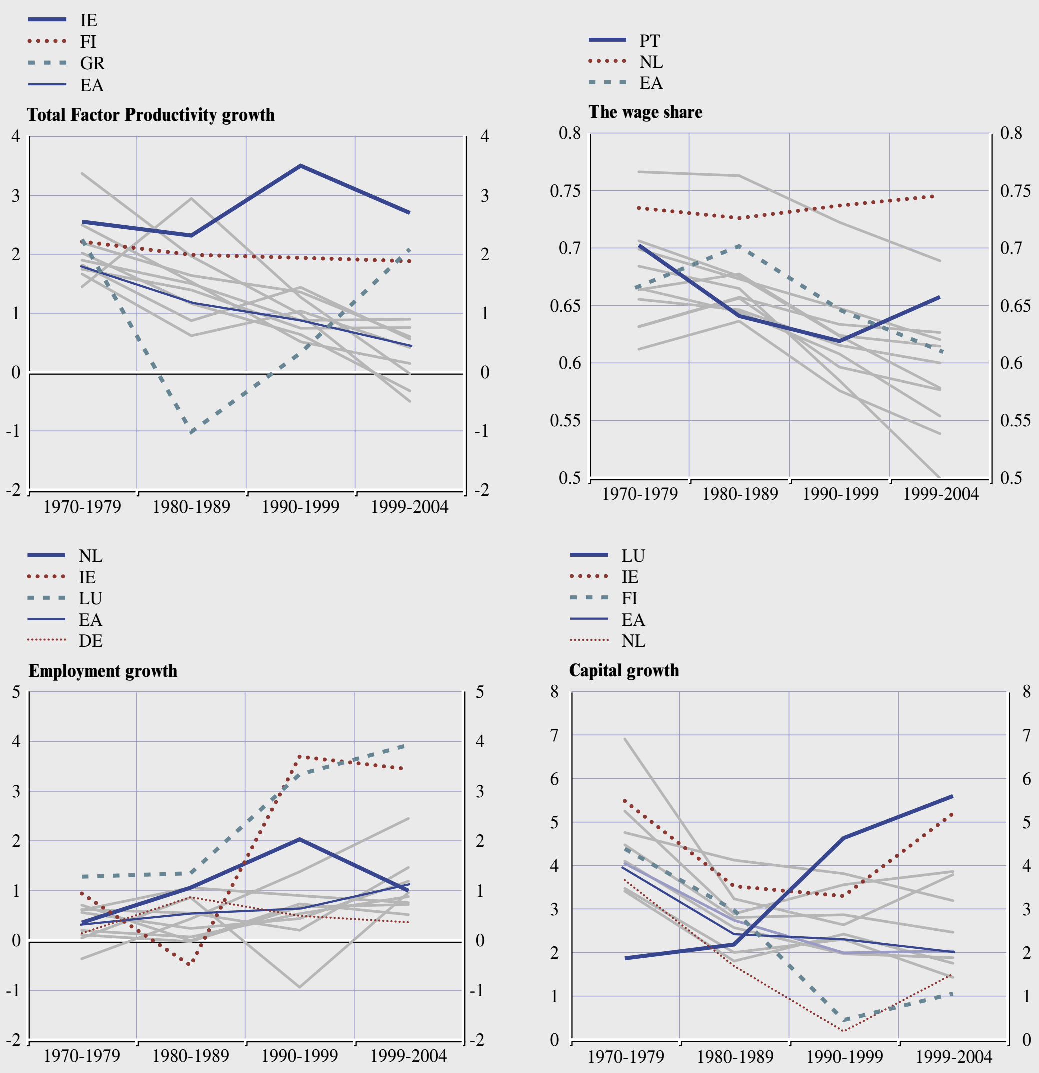
Chart 23 Contribution of factor inputs of production to real GDP growth



Source: Own computations based on European Commission database.
Note: The data on capital stock, employment and labour shares have been taken from the European Commission database.

Chart 24 Evolution of factor inputs across the euro area countries

(percentage changes)



Source: Own computations based on European Commission database.
Note: The data on capital stock, employment and labour shares have been taken from the European Commission database. In the charts above only those countries with exceptionally different profiles have been labelled.

but then recovered to growth rates largely in line with those in the 1970s. In Ireland, the catching-up process from the mid-1980s onwards led to TFP growth significantly above the growth rates of the 1970s. In Finland, TFP growth was broadly constant over the whole period, probably as a result of the sharp growth in productivity in the ICT sector.

Turning to the contribution of labour growth to overall GDP growth, developments across the three largest countries have been different, but without a clear trend. However, since the beginning of the 1990s, the contribution from labour has increased in France, Italy and the euro area as a whole, but remained broadly unchanged in Germany. As can be seen in equation 2, the contribution to GDP growth from labour comprises two factors, namely the wage income share (1-α) and the growth rate of employment $\frac{\Delta L}{L}$. As can be seen in Chart 24, the wage income share has shown a clear downward trend in all countries with the exception of the Netherlands and Portugal, two countries that have recently experienced a loss in competitiveness due to relatively high wage growth. Employment growth, however, has shown increasing growth rates over time in almost all euro area countries, with two notable exceptions, namely Germany and the Netherlands. Both countries have had weak employment growth since the 1990s.

The contribution of capital to overall GDP growth also comprises two parts; the capital income share (α) and the growth rate of the capital stock $\frac{\Delta K}{K}$. The capital income share is not illustrated in Chart 24, which is, per definition, the reverse developments of the wage income shares previously analysed. The growth rates of the capital stock show diverse developments across the euro area countries, but, in all countries, except Ireland and Luxembourg, there seems to have been a general decline in its contribution compared with the 1970s. In Ireland and Luxembourg, the increases can be largely explained by high inflows of foreign capital.

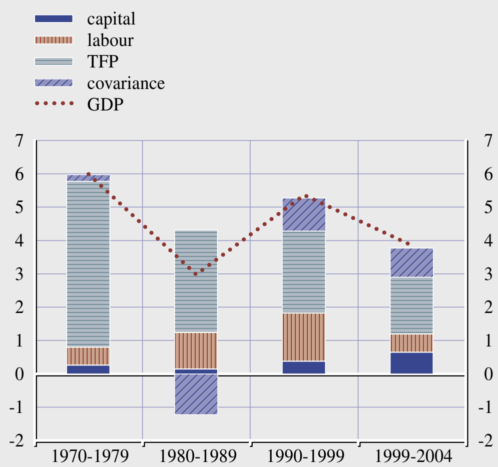
The growth accounting exercise suggests, first, that the slowdown in TFP since the 1970s could be a reason for the downward trend observed in potential output growth in most of the euro area countries. Second, in the most recent period, the decrease in potential output growth also appears to be linked to the shift from more capital intensive towards more labour intensive production means. Indeed, the growth accounting exercise has shown that the majority of euro area countries witnessed an acceleration in labour input along with a deceleration in capital input during the 1990s, probably reflecting lower labour cost developments relative to non-labour factor costs,[11] as suggested by the decline in the wage income share.

Finally, Chart 25 shows the contribution of the supply-side determinants to the variance of overall GDP growth for the euro area in unweighted terms. The chart confirms the prominent role of TFP in explaining the dispersion of real GDP growth rates among the euro area countries. However, since the end of the 1990s, the contribution of TFP to real GDP growth dispersion seems to have decreased. The contribution from capital, however, has shown an increasing trend, while that of labour has shown a decreasing trend. The latter, displaying fewer differences across countries with regard to the labour input in production, may reflect fewer differences in labour markets across countries, possibly as a result of labour market reforms. Similar results are obtained if a weighted measure of dispersion is used, as shown in Chart 26.

11 For a discussion on the substitution between capital and labour in Europe see Blanchard (1998); Caballero and Hammour (1997).

Chart 25 Contribution to variance of overall GDP growth rates from the supply-side across the euro area countries

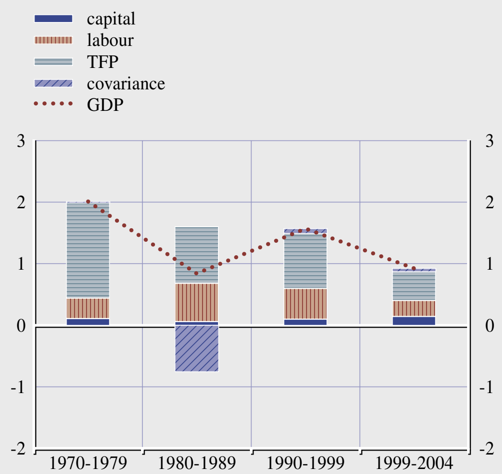
(in unweighted terms; percentage points)



Source: Own computations based on European Commission database.
Note: The 'Covariance' component is the sum of the contributions from *cov(K, L)*, *cov(L, TFP)* and *cov(K, TFP)*.

Chart 26 Contribution to variance of overall GDP growth rates from the supply-side across the euro area countries

(in weighted terms; percentage points)



Source: Own computations based on European Commission database.
Note: The 'Covariance' component is the sum of the contributions from *cov(K, L)*, *cov(L, TFP)* and *cov(K, TFP)*.

In conclusion, TFP seems to have played a prominent role in explaining the dispersion of real GDP growth rates over the past 30 years. However, since the 1990s, the contribution of TFP to real GDP growth dispersion seems to have decreased. The contribution from capital, however, has shown an increasing trend, while that of labour has shown a decreasing trend.

1.6 THE ROLE OF DEMOGRAPHICS IN EXPLAINING OUTPUT GROWTH DIFFERENTIALS

This section further analyses the sources of the differences in output growth rates across the euro area countries as far as demographic developments are concerned. Demographic changes can affect real GDP growth, first, via the population growth rate and, second, via developments in the working age population rate, measured as the proportion of the working age population to the total population, which captures changes in the age structure of the population.[12] To better account for how developments in the population and the working age population may affect real GDP growth, it is useful to break down the real GDP growth into the real GDP per capita growth rate $\Delta\left(\frac{GDP}{POP}\right)$ and the population growth rate $\Delta\,(POP)$:

$$(1)\quad \Delta GDP = \Delta\left(\frac{GDP}{POP}\right) + \Delta(POP)$$

Subsequently, real GDP per capita growth can be expressed as follows:

$$(2)\quad \Delta\left(\frac{GDP}{POP}\right) = \Delta\left(\frac{working\ \ age\ POP}{POP}\right) + \Delta\left(\frac{L}{working\ \ age\ POP}\right) + \Delta\left(\frac{GDP}{L}\right)$$

The above equation shows that real GDP per capita growth can be obtained by adding up three components:

i) The growth rate of the ratio of the working age population (15-64 years) to the total population, $\Delta\left(\frac{working\ \ age\ POP}{POP}\right)$, i.e. the working age population rate, which reflects the effect of changes in the demographic structure on per capita real GDP growth;

ii) The growth rate of the ratio of employed persons to the working age population, $\Delta\left(\frac{L}{working\ \ age\ POP}\right)$, i.e. the employment rate, which reflects the effect of labour utilisation on real GDP per capita growth; and

iii) The growth rate of the ratio of GDP to employed persons, $\Delta\left(\frac{GDP}{L}\right)$ i.e. average labour productivity.

12 Intuitively, an increase in the proportion of the working age population indicates that relatively more of the population is available to work, and this can contribute to higher economic growth by increasing the size of the labour force, which in turn can increase total production.

By substituting equation (2) for equation (1), it is possible to obtain the effect of demographics on real GDP growth.

Chart 27 shows the contribution made to real GDP growth for the period 1999-2004 by population growth, on the one hand, and by the three components of real GDP per capita growth on the other, namely the working age population rate, labour utilisation and labour productivity.

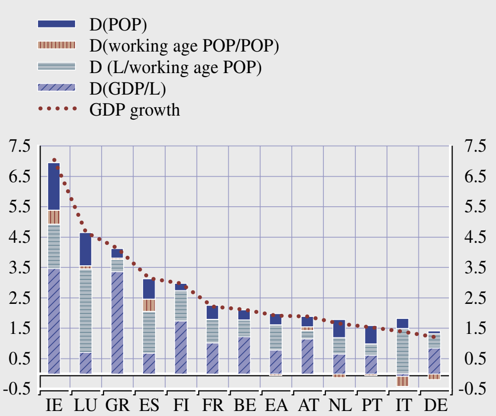
Population growth has played a rather limited role in explaining real GDP growth developments in most of the euro area countries during the past six years, with some notable exceptions. Population growth in Spain, Ireland and Luxemburg has made a relatively high contribution to real GDP growth (higher than 1% on average) over the period 1999-2004.

The working age population rate, which is the second demographic determinant of real GDP growth, has played varying roles in real GDP growth developments across the euro area countries in the past six years. In Spain, Ireland, Luxemburg and Austria, changes in the working age population rate have made a positive contribution to real GDP growth. By contrast, in Germany, France, Italy, the Netherlands and Portugal, changes in the working age population rate have instead acted as a slight drag on growth. This tendency is likely to strengthen in the future owing to a more rapid increase in the proportion of older persons in the total population.

Chart 28 shows the working age population rate in 1990, 1999 and 2004. First, the working age population rates are currently between 65% and 70% in all countries (the euro area average being 67%), except in France, where it is somewhat lower. The chart suggests that, since the beginning of the 1990s, all countries, with the exceptions of Spain, Ireland, Luxembourg and Austria, have seen an increase in share of older people in their total populations. While still increasing, Ireland witnessed a significant deceleration in the working age population rate from 1999 to 2004 compared with the strong increase in the previous decade. Looking forward, this trend suggests that an important factor of long-term growth for that country might fade away. In Spain, the working age population rate has increased steadily over this period, reaching the highest level compared with the other euro area countries in 2004. In

Chart 27 The driving forces of GDP growth

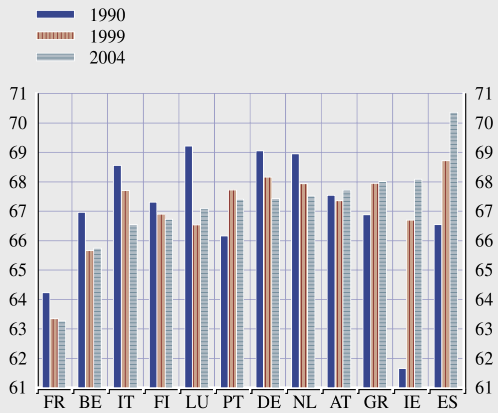
(average percentage changes, 1999-2004)



Source: Own computations based on European Commission database.
Note: Countries have been ordered in descending order in terms of GDP growth.

Chart 28 Working age population

(percentage changes)



Source: European Commission.
Note: Countries have been ordered in ascending order for 2004.

contrast, Germany, Italy and the Netherlands have witnessed a steady and significant decline in their working age population rates since 1990. This pattern may, at least partly, help to explain the relatively low potential growth rate in these countries compared with the rest of the euro area.

The contribution of demographics (ageing, in particular) across euro area countries to explaining output growth differentials does not seem to conflict with the conclusion drawn in the previous section that, in recent years, there has been a fall in the contribution of labour input to real GDP growth dispersion. In fact, employment growth developments appear to have become more homogeneous across euro area countries, while the demographic structure has continued to diverge somewhat.

The two remaining determinants of real GDP growth and per capita real GDP growth, as identified in equation (2), are changes in the labour utilisation rate and changes in labour productivity. Chart 27 shows that labour utilisation, which measures the share of employed persons in the working age population, explains a significant fraction of real GDP growth in many countries. In particular, in Spain, Italy and Luxemburg, labour utilisation has been a key explanatory variable of real GDP growth in 1999-2004. Finally, with the notable exception of Italy and, to a lesser extent, Spain and Luxemburg, labour productivity growth has accounted for more than one third of the real GDP growth rate on average in 1999-2004 in most euro area countries.

To summarise, demographic developments appear to have played an important role in explaining differences in real GDP growth developments since the beginning of the 1990s. Demographic changes can affect real GDP growth, first, via the population growth rate and, second, via developments in the working age population rate, measured as the share of the working age population to the total population, which captures changes in the age structure of the population. In particular, some faster-growing economies, such as Spain, Ireland and Luxembourg, have benefited from these demographic factors, partly reflecting immigration flows, while some lower growth economies, such as Germany, Italy and the Netherlands, seem to have been negatively affected by demographic changes. Consequently, dispersion in real GDP per capita growth is somewhat lower than dispersion in real GDP growth.

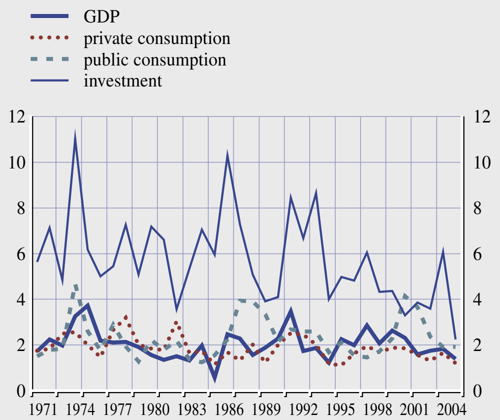
1.7 DEMAND-SIDE COMPOSITION

To complete the analysis of dispersion, a breakdown of the demand side is required. Chart 29 and Chart 30 below illustrate how dispersion, as measured by the unweighted standard deviation, has evolved over time for private consumption, public consumption, total investment and exports and imports. Similar results are obtained when using a weighted measure of dispersion, as shown in Appendix A6, which also includes some charts of demand components by groups of countries.

These charts should not be taken as showing the contribution of the various demand components to the dispersion of real GDP growth, but simply as indicating the evolution of the dispersion of growth rates of the various demand components over time. Regarding the dispersion of private consumption growth rates, developments have been largely stable over time, in line with the dispersion of overall GDP. This result is hardly surprising given the large weight of private consumption in overall GDP. It is also difficult to identify a clear trend of dispersion for public consumption growth rates. Interestingly, however, it seems that for total investment and export and import growth, there has been a downward trend in dispersion since the mid 1990s. This trend is more pronounced when dispersion is measured in unweighted rather than in weighted terms (see Appendix A6). In the case of investment, the downward trend in dispersion may reflect factors such as, inter alia, more similar economic policies. In this regard, foreign direct investment statistics indicate a substantial increase in cross-border linkages in the euro area in the late 1990s.

Chart 29 Dispersion of real GDP growth rates and domestic demand components across the euro area countries

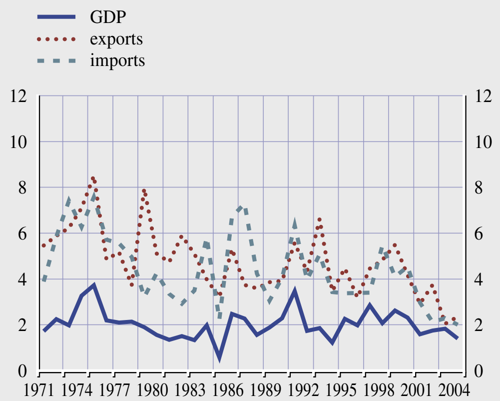
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 30 Dispersion of real GDP growth rates and external demand components across the euro area countries

(unweighted standard deviation; percentage points)



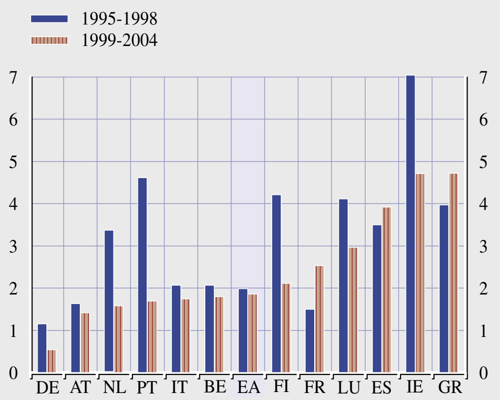
Source: Own computations based on European Commission database.

What is the country composition of the overall dispersion developments across demand components? Chart 31 to Chart 35 focus on the more recent years and provide a cross-country perspective of growth developments in domestic demand and net exports across countries by comparing two recent periods: 1995-1998 and 1999-2004 (in Appendix A7, several tables provide the growth rates of the demand components for several sub-periods since the 1970s).

As can be seen in Chart 31, Germany and, to a lesser extent, Austria have been clearly underperforming compared with other countries in the euro area since 1995 in terms of the contribution of domestic demand to growth. On the other hand, domestic demand has made a much higher contribution in Greece, Spain and Ireland. These developments are also largely seen in private consumption and investment growth (see Chart 32 and Chart 33), where Germany stands out with the lowest growth rate in both of these demand components. In the case of German investment, a key factor governing its weakness has been the developments in the construction sector following the boom after reunification. Interestingly, since 1999, the growth rate of investment has fallen significantly in Ireland, the Netherlands, Portugal and Finland. The reasons for these developments are very country-specific. In Portugal, the decline in investment growth resulted from the adjustment process following the high levels of indebtedness of the private sector at the end of the 1990s. In Ireland and Finland, the slowdown was related to lower investment in the high-tech sector. In

Chart 31 Contribution of domestic demand (excluding stockbuilding) to GDP growth

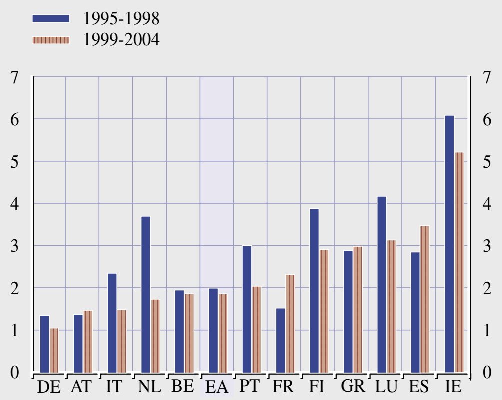
(percentage points)



Source: European Commission.
Note: Countries ordered by the 1999-2004 average.

Chart 32 Growth rates of private consumption across the euro area countries

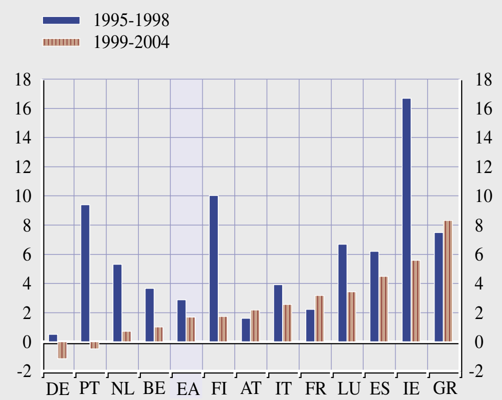
(percentage changes)



Source: European Commission.
Note: Countries ordered by the 1999-2004 average.

Chart 33 Growth rates of total investment across the euro area countries

(percentage changes)



Source: European Commission.
Note: Countries ordered by the 1999-2004 average.

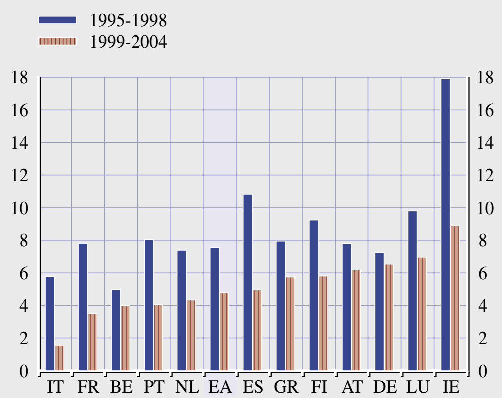
the Netherlands, it maybe related to the sharp correction in real asset prices since 2001.

With regard to external demand, as can be seen in Chart 34, export growth in Italy has been clearly underperforming compared with the euro area since 1995. This contrasts with the very positive export performance in Germany, Ireland and Luxembourg. Despite this very weak export performance, Italy does not rank last in the contributions of net trade to GDP growth among the euro area countries. Chart 35 shows that the net trade contribution to growth has been much worse in Greece and Spain than the euro area average, reflecting strong domestic demand and its high import content.

In conclusion, looking at the dispersion in the growth rates of the various components of demand, it seems that for total investment and

Chart 34 Growth rates of exports across the euro area countries

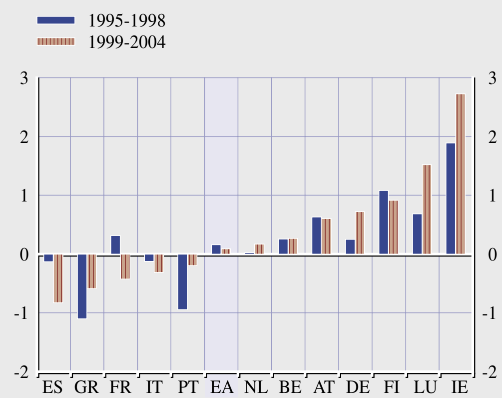
(percentage changes)



Source: European Commission.
Note: Countries ordered by the 1999-2004 average.

Chart 35 Contribution of net trade to GDP growth

(percentage points)



Source: European Commission.
Note: Countries ordered by the 1999-2004 average.

exports and imports there has been a downward trend in dispersion since the mid 1990s. In the case of investment, the downward trend in dispersion may reflect factors such as, inter alia, more similar economic policies. In the case of trade, the developments can probably be linked to increasing trade flows and more integrated markets for goods and services. As regards the country composition of the overall dispersion developments across demand components, Germany and, to a lesser extent, Austria have been clearly underperforming the euro area since 1995 in terms of the contribution of domestic demand to growth, while on the other hand, domestic demand has made a much higher contribution to growth in Greece, Spain and Ireland. As regards external demand, export growth in Italy has been clearly underperforming compared with the euro area since 1995, in contrast to the very positive export performance in Germany, Ireland and Luxembourg.

1.8 SECTORAL COMPOSITION

Further insight into the sources of dispersion in output growth rates across the euro area countries can be obtained by decomposing real GDP in sectoral value added in each country and then computing the dispersion in the growth rate of the sectoral value added across countries.

For this purpose, four main sectors are considered: agriculture (including forestry and fishery products); industry, excluding construction; construction and services.[13] The manufacturing industry, which is a sub-sector of the industry excluding construction, is also analysed. For detailed tables showing a comparison across countries of the GDP composition by sector see Appendix A8.

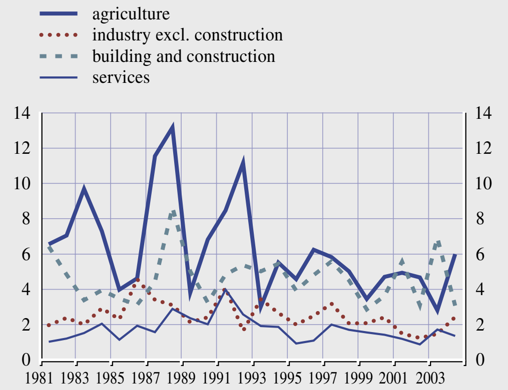
As can be seen in Chart 36, the agriculture and the construction sectors exhibit the highest degree of dispersion in value-added growth rates across countries, nearly twice that in industry (excluding construction) and services. Similar results are obtained when using a weighted measure of dispersion as shown in Chart 37 (it should be noted that these charts do not show the contribution of the various sectoral components to the dispersion of real GDP).

In more detail, Chart 38 shows the dispersion measured by the unweighted standard deviation in the real value-added growth rate of the agriculture sector by various country groupings. This sector accounts on average for around

13 The analysis is based on the European Commission database. Data for Ireland are only available for the manufacturing sector.

Chart 36 Dispersion of real value-added growth rates across sectors

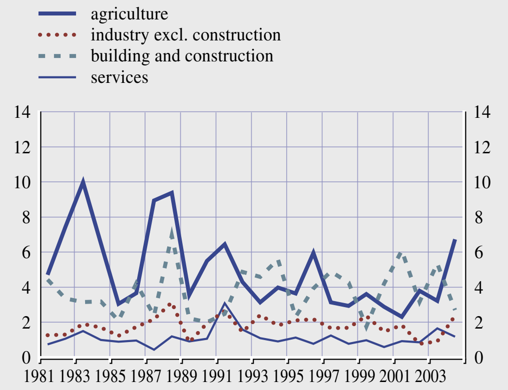
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 37 Dispersion of real value-added growth rates across sectors

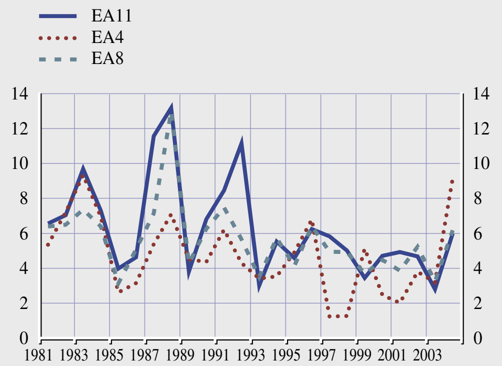
(weighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 38 Dispersion of real value-added growth rates of the agriculture, forestry and fishery sector

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.
Note: Data are not available for Ireland.

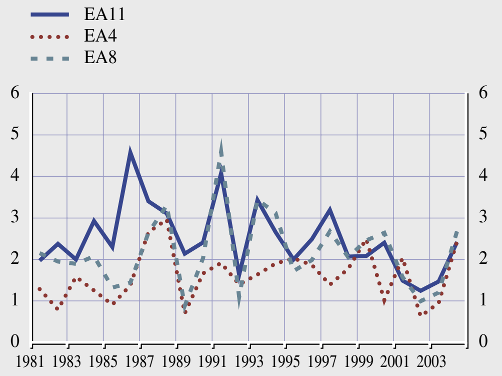
2.5% of the total value added in the euro area countries. Across countries, this sector has the lowest weight in total value added in Luxembourg (0.6%) and the highest in Greece (6.7%). The chart below shows that, notwithstanding a clear cyclicality, dispersion in the value-added growth in this sector across the euro area countries has diminished from an average of 7.8 percentage points in the 1980s to an average of 4.5 percentage points in the 1990s.

Chart 39 and Chart 40 show dispersion, measured by the unweighted standard deviation, in the real value-added growth rate of the industry sector, excluding building and construction, and in the real value-added growth rate of the manufacturing sector, respectively. The manufacturing sector excludes mining and energy products. The industry sector, excluding building and construction, accounts on average for 22.5% of the total value added in the euro area countries, while this share is equal to 20.3% for the manufacturing sector. Across countries, the industry and manufacturing shares in total value added is largest in Finland (30.3% in the case of industry and 27.4% in the case of manufacturing) and lowest in Greece and Luxembourg (around 14% in the case of industry and 11% in the case of manufacturing). The charts below show that, in contrast with the agriculture sector, in the case of industry there is not a clear downward trend in dispersion. Indeed, since the 1980s, the dispersion of value-added growth in the industrial sector has been around 2.2 percentage points.

Interestingly, in contrast with the result obtained for total industry, excluding building and construction, in the manufacturing sector, a downward trend in dispersion appears to be

Chart 39 Dispersion of real value-added growth rates of the industry sector, excluding building and construction

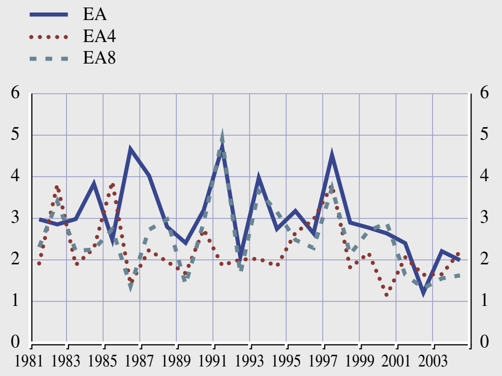
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.
Note: Data are not available for Ireland.

Chart 40 Dispersion of real value-added growth rates of the manufacturing sector

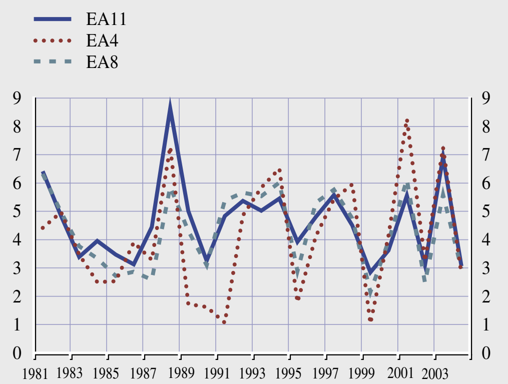
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 41 Dispersion of real value-added growth rates in the building and construction sector

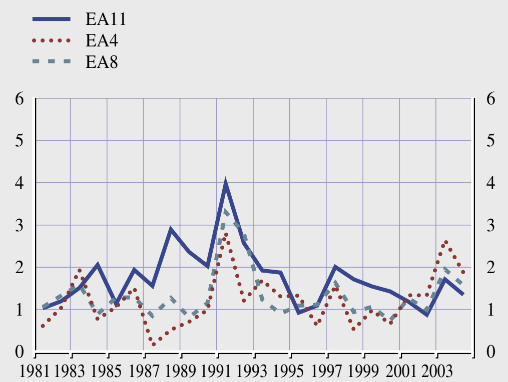
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.
Note: Data are not available for Ireland.

Chart 42 Dispersion of real value-added growth rates in the service sector

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.
Note: Data are not available for Ireland.

clearly visible since the late 1990s (see Chart 40), possibly reflecting closer intra-industry links. This result also holds for the two country groupings EA4 and EA8.

The difference in dispersion between total industry, excluding building and construction, and manufacturing may be attributed to the energy sector, which is part of total industry, but not part of manufacturing and is characterised by a high degree of volatility.

Chart 41 shows the dispersion, measured by the unweighted standard deviation, in the real value-added growth of the building and construction sector. This sector accounts on average for 5% of the total value added in the euro area countries, the highest being in Spain (8.2% of the total value added) and the lowest in Finland (4.2% of the total value added). The chart below shows high cyclicality in the evolution of dispersion in the building and construction sector, without any clear sign of a trend.

Finally, Chart 42 shows the dispersion in the real value-added growth of the service sector. This sector accounts on average for 70% of the total value added in the euro area countries, with the highest in Luxembourg (about 80% of the total value added) and the lowest in Finland (about 62% of the total value added). From the beginning of the 1980s to the early 1990s, dispersion in the service sector accelerated significantly. This related to the transformation of the productive structure in some catching-up countries, which may have witnessed intensification in the production of services. Despite some cyclicality, dispersion in the service sector has remained broadly stable since the early 1990s.

In conclusion, looking at dispersion by sector, the agriculture and construction sectors show, as expected, the highest dispersion in value-added growth across the euro area countries, with nearly twice the dispersion seen for total industry, excluding construction, and for services. No clear trend in dispersion in value-added growth can be seen in any sector, with the exception of manufacturing, where a clear decline in dispersion in this sector has been visible since the late 1990s, possibly reflecting closer intra-industry links.

1.9 THE ROLE OF "INITIAL CONDITIONS" IN GDP PER CAPITA IN EXPLAINING GROWTH DIFFERENTIALS

To complete the analysis of long-term growth differentials, the question remains as to whether different initial conditions, i.e. different levels of GDP per capita in the various euro area countries, have been key in triggering a catching-up process, leading to faster growth in some countries. This can be checked by plotting the level of real GDP per capita at a starting year versus the cumulated growth rates of trend real GDP from that starting year. The potential effect of the catching-up process may then be captured by a negative relationship between initial conditions and trend GDP growth. Chart 43 and Chart 44 consider two starting years for the level of real GDP per capita (euro area =100), namely 1990 and 1998, and the average growth rates of trend real GDP after these two years. In both charts, a rather weak negative relationship emerges, in part due to two outliers: Ireland and Luxembourg. In the case of Ireland, in contrast with the other catching-up economies, namely Greece, Spain and Portugal, started at a similar level of real GDP per capita in 1990 but its trend real GDP grew three times faster. As a result, the level of GDP per capita in Ireland increased considerably in 1998. This suggests that Ireland's catching-up process has been much more dynamic than that of Greece, Spain and Portugal. Luxembourg is an outlier in the sense that it combines very high starting conditions and very high levels of growth in trend GDP.[14]

Concluding, on the basis of the above analysis, it seems that only for some countries have different initial conditions (that is different levels of GDP per capita in the various euro area countries) been key in triggering a catching-up process, leading to faster growth.

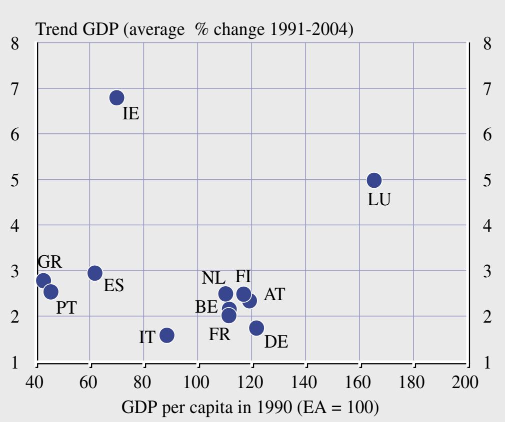
2 SYNCHRONISATION OF BUSINESS CYCLES WITHIN THE EURO AREA

2.1 MEASURES OF BUSINESS CYCLE SYNCHRONISATION

The synchronisation of business cycles indicates the degree of co-movement of the business cycles across countries over a certain period of time. This concept is distinct from dispersion,

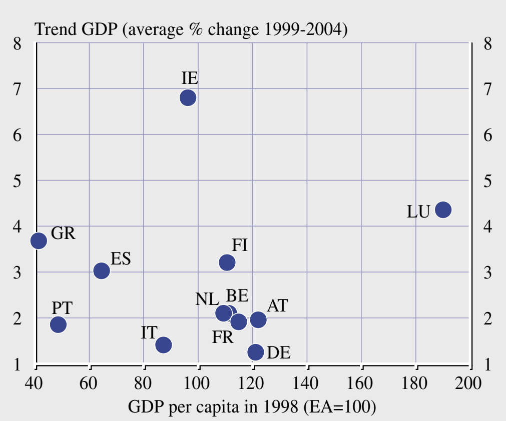
14 In the case of Luxembourg, GDP per capita computations are distorted by the large numbers of non-residents working in the country. These non-residents contribute to GDP, but are not part of the population data.

Chart 43 Per capita GDP in 1990 and cumulated trend output growth (1991-2004)



Source: Own computations based on European Commission database.

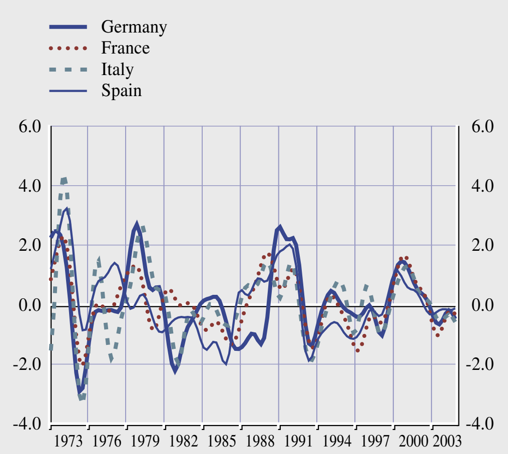
Chart 44 Per capita GDP in 1998 and cumulated trend output growth (1999-2004)



Source: Own computations based on European Commission database.

Chart 45 Output gaps in the four largest euro area countries

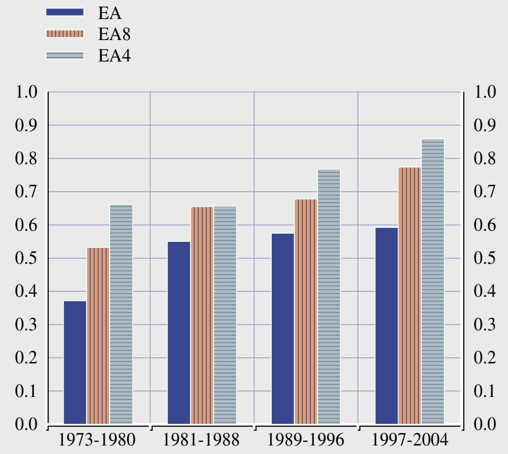
(percentages of trend GDP)



Source: Own computations based on Eurostat database.
Note: Output gaps have been obtained by using the BP filter.

Chart 46 Average of the correlation coefficients of real GDP growth rates between the euro area countries by sub-periods

(fixed periods of eight years)



Source: Own computations based on European Commission database.

which captures the degree of difference in output growth rates at a certain point in time.

For illustrative purposes, Chart 45 below shows how the output gaps of the largest euro area economies have evolved over time. A visual inspection indicates that between the early 1970s and the late 1990s, the synchronisation of the business cycles between these economies was relatively limited. However, since the late 1990s, there seems to be a striking degree of co-movement between the business cycles of these economies. *Is this visual finding correct? Has business cycle synchronisation across the euro area countries increased since the late 1990s?* This section explores the main stylised facts on business cycle synchronisation across the euro area countries.[15]

A variety of methods are used to measure synchronisation. One option is to correlate the annual GDP growth rates across countries. For that purpose, as a first measure of business cycle synchronisation, the pairwise correlation coefficients of annual real GDP growth rates are computed across all the euro area countries. In a group of 12 countries, there are 66 pairwise correlation coefficients.[16] These pairwise correlation coefficients are computed over fixed periods of eight years, the average length of a standard cycle. In order to provide a synthetic measure of correlation across countries, the unweighted average of all these pairwise correlation coefficients is computed for each eight-year period. As can be seen in Chart 46, this synthetic correlation measure confirms that the synchronisation of output growth between the euro area economies seems to have increased steadily over the four periods selected and for all country groupings considered.[17] When excluding the four smallest euro area economies, the correlation coefficients of annual real GDP growth rates are notably larger. Specifically, over the most recent period (1997-2004), the average correlation for the largest euro area economies is relatively high, at around 0.8.

15 For an analysis of the determinants of business cycle synchronisation across the euro area countries, see Böwer and Guillemineau (2006).
16 In the case of eight countries, there are 28 pairwise correlation coefficients. In the case of four countries, there are only six pairwise correlation coefficients.
17 It should be noted that no formal test of statistical significance regarding the increase in the correlation coefficient has been carried out.

However, it could be argued that the time periods chosen above are somewhat arbitrary, so they could give a misleading impression. In order to cross-check the previous finding, an eight-year moving average of the unweighted average of all these pairwise correlation coefficients is calculated. The results are presented in Chart 47, where it can be observed that, despite some volatility, there seems to be a trend towards a higher correlation of real GDP growth rates across the euro area economies since the beginning of the 1990s, confirming the previous findings.

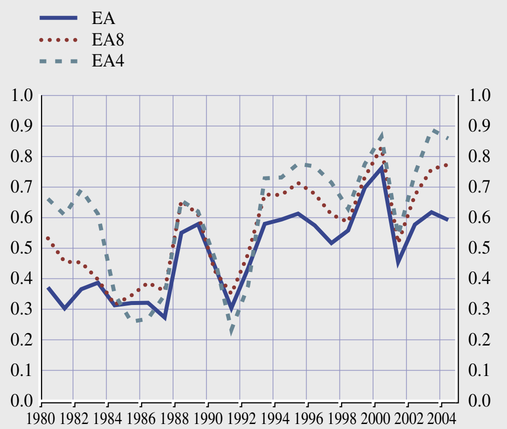
However, looking at synchronisation measures based only on the annual GDP growth rates might not appropriately capture the business cycle, as annual GDP growth rates also capture trend developments. It may therefore be preferable to compute the average correlation of the output gaps across all the euro area economies. As can be seen in Chart 48, the increase in correlation of the business cycle, as measured by the output gaps, now shows a clearer upward trend than that computed for real GDP growth rates. More importantly, there has been an increase in the synchronisation of the output gaps across the euro area economies since the beginning of the 1990s. In fact, the degree of correlation currently appears to be at a historical high.

In order to explore whether any country or countries stand out with some peculiarly different correlation of their business cycles with the rest of the euro area economies, Chart 49 shows the average correlation of the output gap of each euro area country with the other eleven countries over the whole sample (1970-2004) and also over a more recent period (1990-2004), which captures around two full cycles.

The chart allows several interesting observations. First, in all cases, except Luxembourg, the correlation between the national business cycle and the cycles of the rest of the countries seems to have increased in the most recent period. This finding reinforces the previous one that the average of the business cycle correlations within the euro area has increased, an observation that seems to hold for almost all individual countries. Second, looking at the whole time period, Belgium and France are the two countries with the highest correlation coefficients between their business cycles and those of the

Chart 47 Average correlation eight-year rolling of real GDP growth rates across the euro area countries

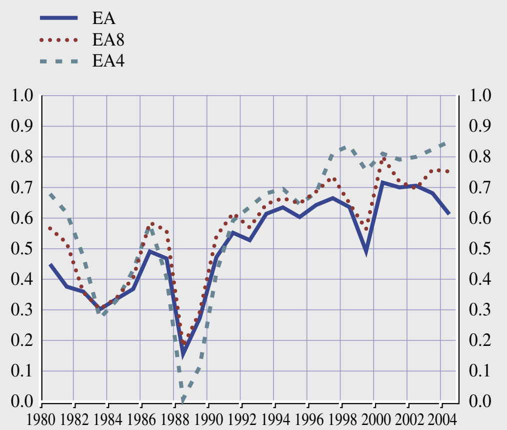
(unweighted, based on annual data)



Source: Own computations based on European Commission database.

Chart 48 Average correlation eight-year rolling of output gaps across the euro area countries

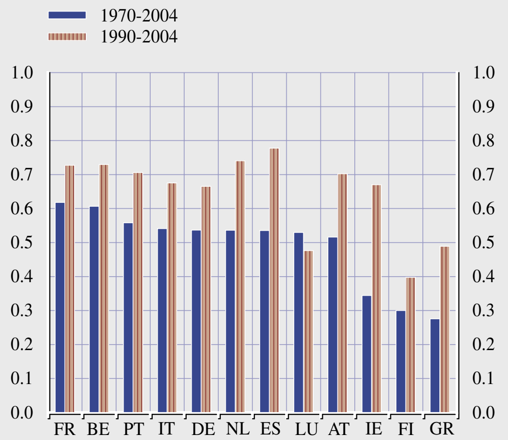
(unweighted, based on annual data)



Source: Own computation based on European Commission database.
Note: Output gaps have been obtained by using the BP filter.

Chart 49 Average output gap correlation between each euro area country and the other eleven countries

(unweighted, based on annual data)



Source: Own computations based on European Commission database.
Note: The output gaps are computed using the BP filter. Countries ordered by the average size of the correlation coefficient over the full sample (1970-2004).

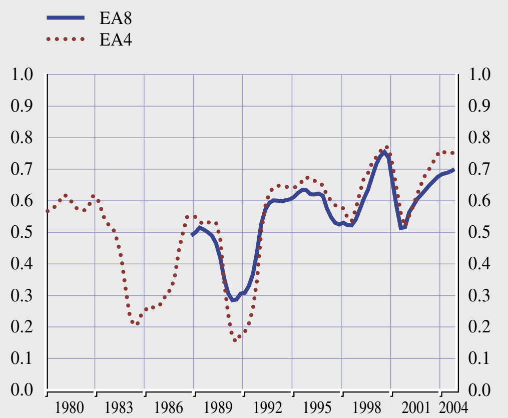
other countries, while Greece, Ireland and Finland show the lowest average correlation with the rest of the countries. In the more recent period, Ireland shows a notable increase in its business cycle correlation with the other countries. Greece and Finland continue to have the lowest levels of business cycle correlation, together with Luxembourg, which is the only country to show a decline in its business cycle correlation with the rest of the countries, on average. These results are very much in line with the analysis on output gap developments (output volatility analysis) in the first part of this study, suggesting that small countries with a high degree of sectoral specialisation display relatively more volatile business cycle behaviour than large countries or countries that specialise in trade with larger neighbours.

The previous analysis was performed using annual data only. However, it could be argued that analysing synchronisation might require higher frequency data to better capture the co-movement across variables. Unfortunately, only the eight largest euro area countries have sufficiently long quarterly GDP data series. Similar measures[18] of average correlation (rolling eight years) have been computed for the eight and the four largest euro area economies using available quarterly GDP series. This also allows the robustness of the above findings for

18 The pairwise correlation coefficients of quarterly real GDP growth rates are computed across all the euro area countries for rolling eight-year periods. In order to provide a synthetic measure of correlation across countries, the unweighted average of all these pairwise correlation coefficients for each eight-year period is computed.

Chart 50 Average correlation eight-year rolling of real GDP growth across the euro area countries

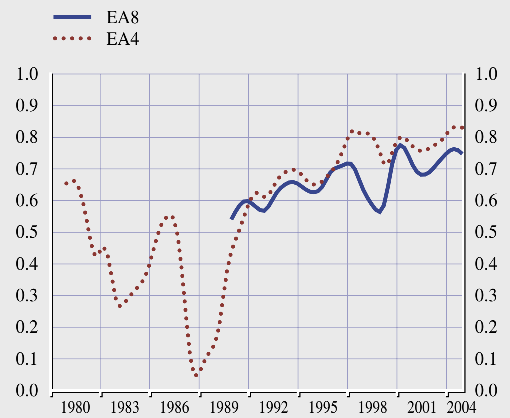
(unweighted, based on quarterly data)



Source: Own computations based on EUROSTAT database.

Chart 51 Average correlation eight-year rolling of output gaps across the euro area countries

(unweighted, based on quarterly data)



Source: Own computations based on EUROSTAT database.
Note: The output gaps are computed using the BP filter.

the annual GDP series to be tested. As can be seen in Chart 50 and Chart 51 the same results are broadly obtained, with an increase in synchronisation of business cycles among the largest euro area economies since the beginning of the 1990s.

To summarise, various measures of co-movement of economic activity among the euro area countries, based either on actual real GDP growth rates or on output gaps, indicate increased synchronisation since the beginning of the 1990s. These results hold both for annual and quarterly data and for various country groupings. In fact, the degree of correlation appears to currently be at its historically highest level. Looking at all the pairwise correlation coefficients among the euro area countries, over the period 1970-2004, Belgium and France show the highest levels of business cycle correlation with the rest of the euro area countries, while Greece, Ireland and Finland show the lowest degree of correlation. Since the 1990s, the average business cycle correlation in each country with respect to the rest has increased in all cases, except in Luxembourg, with Ireland showing a notable increase in its business cycle correlation. Greece and Finland remain among the countries with the lowest average correlation, together with Luxembourg. These results are very much in line with the analysis on output volatility, in the first part of this study, suggesting that cyclical convergence increased and that, overall, small countries exhibit more idiosyncratic business cycles.

2.2 COMPARISON WITH SYNCHRONISATION OF NON-EURO AREA COUNTRIES

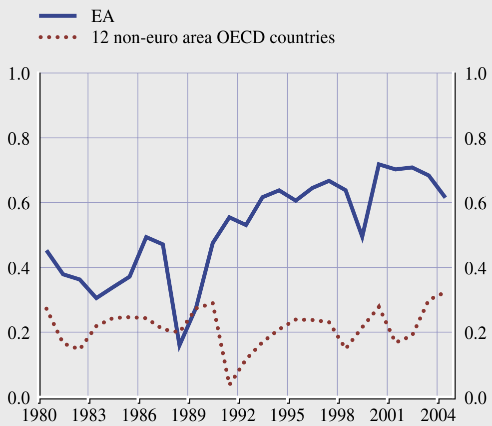
According to the above analysis, there seems to be an increase in business cycle synchronisation within the euro area. One could, however, argue that the increased degree of co-movement seen within the euro area is not unique and that increasing world trade and generally stronger linkages between industrialised countries may have led to more similarity in the worldwide cycles. There have been several studies attempting to answer the question as to whether the increase in synchronisation over time has been unique to the euro area. So far, the evidence remains relatively inconclusive. Camacho and Pérez-Quirós (2004) concluded that the relative co-movement between euro area countries had also been seen prior to the establishment of the monetary union. However, the study mainly uses monthly industrial production data as a proxy for the whole economy, when this sector only accounts for around 20% of GDP. Furthermore, the data included in the analysis end in 2002. Another paper by Canova, Ciccarelli and Ortega (2004) studies the properties of business cycles in the G7 countries using a Bayesian panel VAR. While the authors find evidence of an increase in synchronicity in the G7, they do not support the view that a distinct euro area cycle has emerged. However, other studies, such as those by Lumsdaine and Prasad (2003) and Valle and Koopman (2003), point in the opposite direction, finding evidence for an increase in synchronisation between business cycles in the euro area.

While in this study the topic of a possible world cycle is not thoroughly investigated, the two charts below show the eight-year rolling average output gap correlation (the same measure previously discussed for the euro area countries) calculated for the 12 non-euro area OECD countries with long data series, namely Australia, Canada, Denmark, Iceland, Japan, Mexico, Norway, New Zealand, Sweden, Switzerland, the United Kingdom and the United States (Chart 52) as well as for the G7 countries[19] (Chart 53). Comparing the euro area with such a heterogeneous group of industrialised countries allows for the question of whether there are global or specific euro area factors behind the increased degree of synchronisation in the euro area to be tested. Interestingly, the increase in synchronisation observed in the euro area since the beginning of the 1990s does

19 The pairwise correlation coefficients of quarterly real GDP growth rates are computed across all the euro area countries for rolling eight-year periods. In order to provide with a synthetic measure of correlation across countries, the unweighted average of all these pairwise correlation coefficients for each eight-year period is computed.

Chart 52 Average correlation eight-year rolling of output gaps across countries

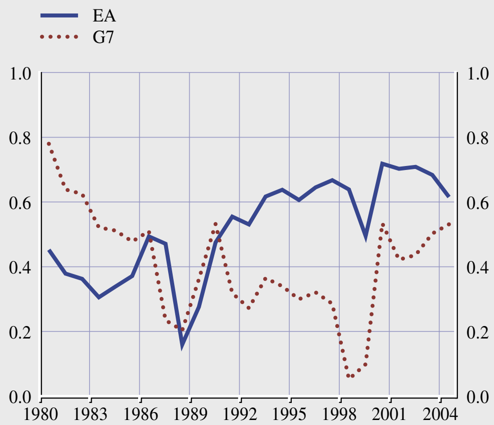
(unweighted averages, based on annual data)



Source: Own computations based on European Commission database.
Note: The output gaps are computed using the BP filter. The 12 non-euro area OECD countries with long GDP series are: Australia, Canada, Denmark, Iceland, Japan, Mexico, New Zeeland, Norway, Sweden, Switzerland, United Kingdom and the United States.

Chart 53 Average correlation eight-year rolling of output gaps across countries

(unweighted averages, based on annual data)



Source: Own computations based on European Commission database.
Note: The output gaps are computed using the BP filter.

not seem to have occurred across other industrialised countries. For the 12 non-euro area OECD countries, the degree of synchronisation has remained practically unchanged since the 1980s. As for the G7 countries, a decline in synchronisation can be observed up to 1999, in contrast with the euro area countries. However, since 2000 there also seems to have been an increase in co-movement across the G7 countries, but this is mostly due to developments in Germany, France and Italy.

In conclusion, the above analysis indicates that the increased degree of co-movement seen within the euro area since the early 1990s does not seem to be shared by other groups of industrialised countries. This seems to imply that EU integration and more recently EMU have led to smaller differences in output gaps across the euro area countries and an increased degree of synchronisation. However, a caveat to this conclusion is that this small group of non-euro area OECD countries may not be fully representative of global developments.[20]

2.3 BUSINESS CYCLE DATING

The measures of correlation discussed above summarise in a single statistic two important pieces of information, namely the amplitude and the duration of the business cycle. The amplitude of the business cycle indicates the amount of GDP lost during a downturn or the amount of GDP gained during an upturn or the amount of GDP gained during a full cycle (all measured as a percentage of GDP). The duration of the business cycle indicates the time that elapses between a peak and a trough or between a trough and a peak or between two peaks or two troughs, namely the full cycle. In order to deepen the analysis of synchronisation, it is important to disentangle these two elements. In fact, the observation that the co-movement of business cycles has increased over time might reflect the fact that the amplitude of cycles have become more similar or it might be the result of

20 Furthermore, to fully check the robustness of these results, alternative sub-groupings of the non-euro area OECD countries could have been considered.

more similar durations or a combination of the two elements. For instance, if it were the case that only the duration of cycles had converged, this would mean that despite the observed increase in co-movement, at the same point in time, some countries could be facing a mild downturn and others a "technical recession". From a policy point of view, it is important to know if countries are simultaneously in a technical recession.[21]

In order to be able to disentangle the amplitude and duration of business cycles and compute an alternative measure of synchronisation with more focus on severe recession phases, a business cycle dating exercise is carried out in this section. The idea behind business cycle dating[22] is that the business cycle can be described in a dual state model whereby at any point in time the economy is either in expansion or in contraction (recession). Dating the periods of recessions is per se an alternative way to describe synchronisation by considering how many countries are simultaneously in the same phase, i.e. recession or expansion. Moreover, after having identified periods of recession (and thus also expansion), one may calculate the related measures of amplitude and duration.

There are different ways to perform business cycle dating. In the United States, the semi-official reference is the NBER recession dating. While no such official series exists for the euro area countries, several academic papers have attempted to generalise the NBER business cycle dating with statistical methods. There are two main streams of academic literature on this topic. The first focuses on non-linear filtering techniques, such as the Kalman filter (e.g. Stock and Watson, 1988), and the second focuses on definitions of turning points in macroeconomic data. The latter approach builds on Burns and Mitchell's work from 1946. The most commonly proposed technique in the more recent literature is that by Harding and Pagan (1999).

The business cycle dating used in this study adopts the latter approach applied to real GDP. The algorithm requires quarterly data. Therefore, the analysis is performed only for the eight largest euro area economies for which long quarterly GDP series are available.

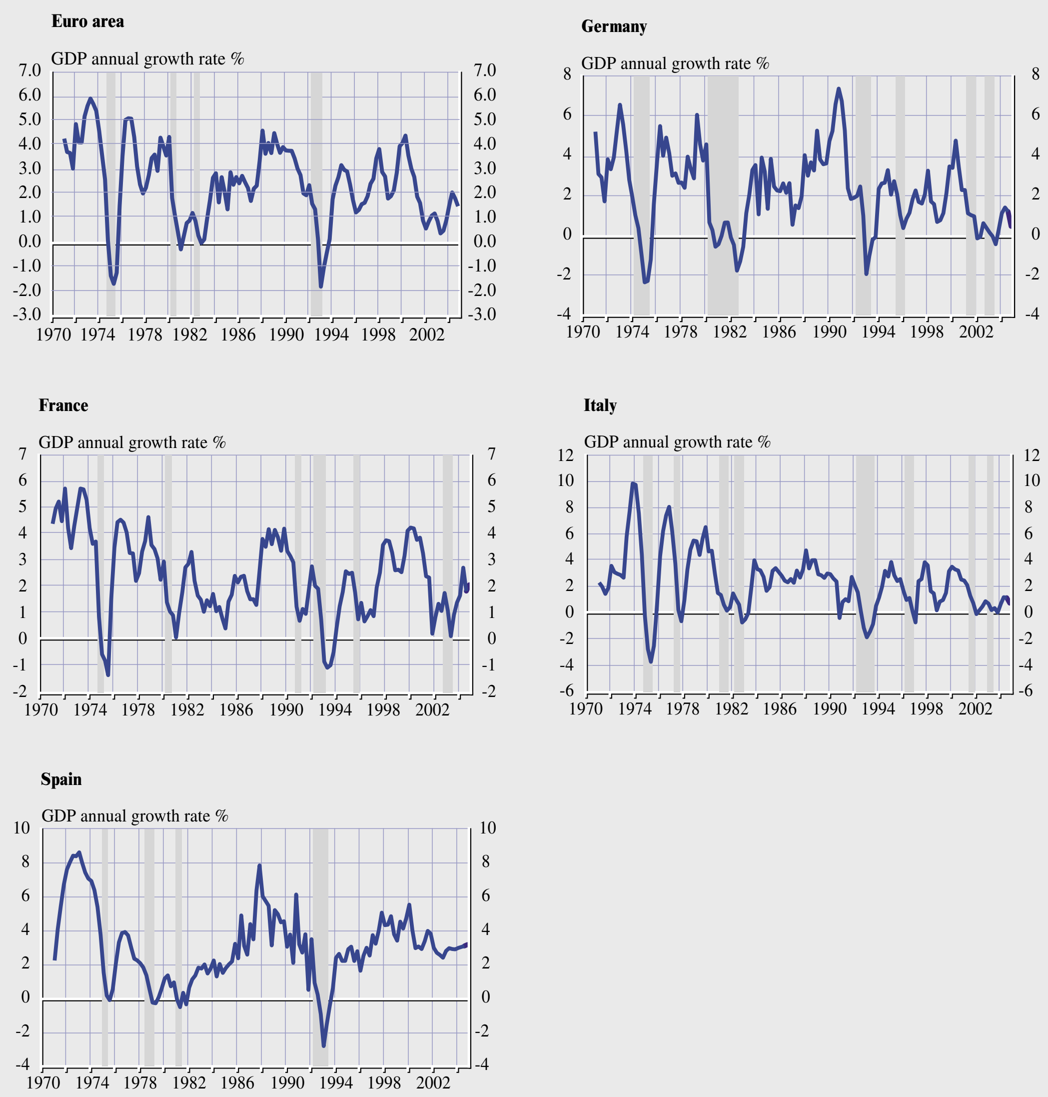
The Harding and Pagan business cycle algorithm dates the "classical cycle", which refers to the level of real GDP. Subject to a number of criteria based on the first difference of the data series, turning points in the underlying data can be identified. In simplified terms, this procedure starts by identifying preliminary turning points from expansion to recession when the level of real GDP in a certain quarter is larger than in both of the two following quarters. In a symmetric way, preliminary turning points from recession to expansion are identified. Thereafter, these preliminary turning points are analysed to make sure that peaks and troughs alternate and that a full cycle consists of at least five quarters. Turning points that violate these criteria are removed from the final results (for a more detailed description, see Appendix A9). It is important to stress that, hereafter, the term "recession" should be not be understood with a specific economic interpretation, but as the technical outcome of the criteria described above.

This algorithm has been applied to real GDP in the United States and in the euro area. As a robustness test of the Harding and Pagan procedure, it can be seen in Appendix A10 that the results obtained are in line with the business cycle dating for the United States and for the euro area business cycles published by the NBER and CEPR, respectively.

21 When using the term "technical recession", an important caveat should be borne in mind. In principle, a technical recession could also occur with consecutive growth rates of -0.1%. In economic and policy terms, this case may not be that different from a situation of positive but close to zero growth rates. In this respect, appropriate business cycle dating also requires the use of other conjunctural information.

22 While the business cycle extracted from statistical filters is based on the assumption that expansions and contractions are symmetric, the idea behind the dating is that economic agents have different behaviour when the economy contracts compared with when it is in an expansionary phase. This allows for a non-symmetric path of expansions and contractions.

Chart 54 Business cycle dating: largest euro area countries

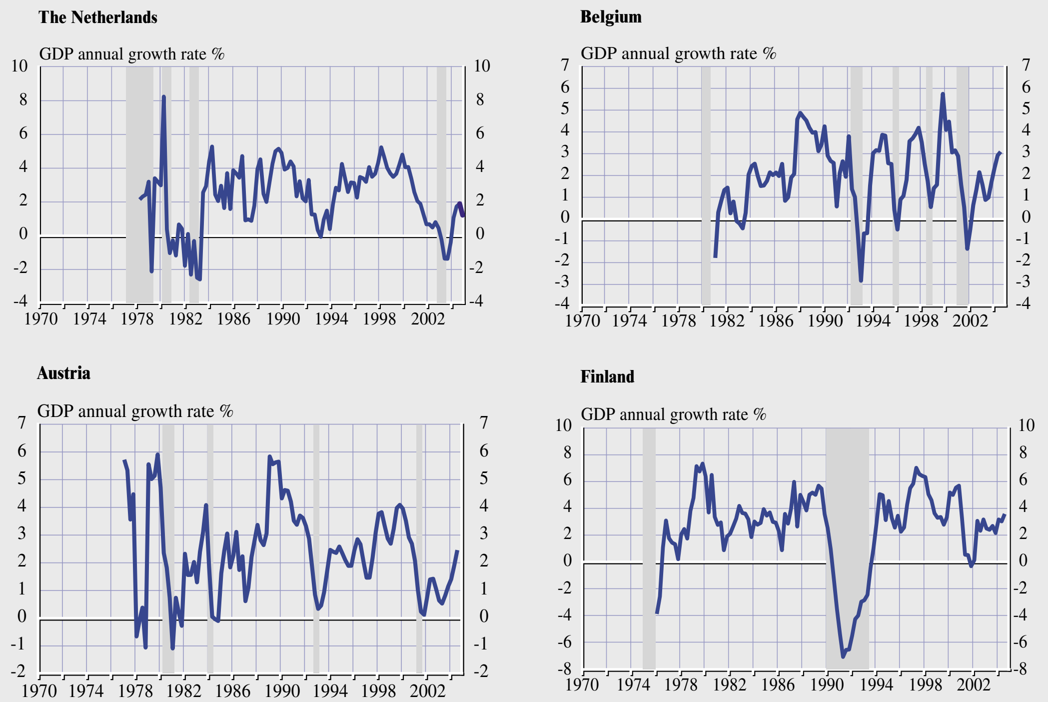


Source: Own computations based on Eurostat database.
Note: The shaded areas in the charts refer to 'technical recessions' according to the Harding and Pagan dating procedure applied to real GDP. The bold lines depict the year-on-year growth rate of real GDP.

Following the Harding and Pagan dating procedure applied to real GDP, periods of expansion and technical recession for the euro area and the eight largest countries are presented in Chart 54 and a summary of peaks and troughs given in Table 4. As a reference, the graphs also show the year-on-year growth rates of the GDP series.

As can be seen in the graphs below, there are significant differences in the patterns of technical recessions across countries. While some countries, such as Belgium, Germany, France and Italy, have had numerous short technical recessions, other countries, such as Spain, the Netherlands, Austria and Finland, have had fewer contraction phases. In the cases

Chart 54 cont')



Source: Own computations based on Eurostat database.
Note: The shaded areas in the charts refer to 'technical recessions' according to the Harding and Pagan dating procedure applied to real GDP. The bold lines depict the year-on-year growth rate of real GDP.

Table 4 Quarterly chronology of peaks and troughs of the GDP recession dating exercise across the euro area countries

(according to the Harding and Pagan dating algorithm)

	1970s		1980s		1990s		2000s	
	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough
Germany	74Q1	75Q2	80Q1	82Q3	92Q1	93Q2	01Q1	01Q4
					95Q2	96Q1	02Q3	03Q2
France	74Q3	75Q1	80Q1	80Q3	90Q3	91Q1	02Q3	03Q2
					92Q1	93Q1		
					95Q2	95Q4		
Italy	74Q3	75Q2	80Q4	81Q3	92Q1	93Q3	01Q2	01Q4
	77Q1	77Q3	82Q1	82Q4	96Q1	96Q4	02Q4	03Q2
Spain	74Q4	75Q2	80Q4	81Q2	92Q1	93Q2		
	78Q2	79Q1						
The Netherlands	76Q4	79Q1	79Q4	80Q3			02Q3	03Q2
			82Q1	82Q4				
Belgium			79Q4	80Q4	92Q1	93Q1	00Q4	01Q4
					95Q3	96Q1		
					98Q2	98Q4		
Austria			80Q1	81Q1	92Q3	93Q1	01Q1	01Q3
			83Q4	84Q2				
Finland	74Q4	75Q4			89Q4	93Q2		
euro area	74Q3	75Q2	80Q1	80Q3	92Q1	93Q1		
			82Q1	82Q3				

Note: Harding and Pagan algorithm homogeneously applied to all countries and the euro area as a whole, based on quarterly GDP series. No judgement has been applied on the specific dates selected by the algorithm. Other indicators, such as employment, investment or monthly frequency data have not been taken into account.

of Spain and Finland, the contraction phases tended to be fewer, but longer than in the other countries. In fact, neither of these two countries has experienced a technical recession since the beginning of the 1990s, while all the other six countries with quarterly national accounts have suffered at least one technical recession since 1999.

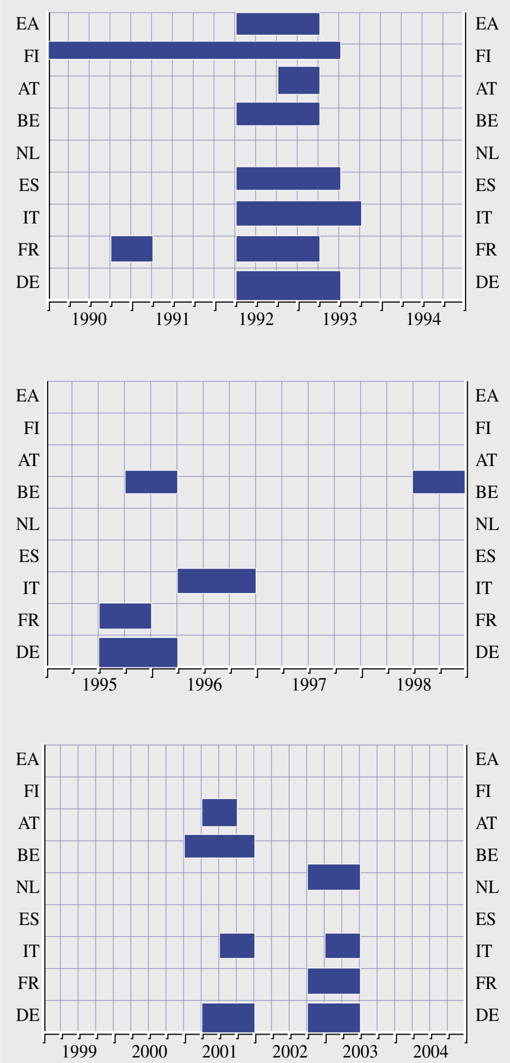
While the charts below present in detail the business cycles in individual countries since the 1970s, Chart 55 allows for a visual study of the synchronisation of recessions across these countries since 1990. The recession in the period 1992-93 was remarkably shared across countries, with the Netherlands being the only exception. In fact, this appears to be the most synchronised contraction identified in the whole sample. Since 1993, the periods of synchronised contractions have involved fewer countries. In particular, since 1999, only four out of the eight largest euro area countries have simultaneously been in a technical recession.

As can be seen in the above graphs, there are large differences in the patterns of technical recessions across countries. While some countries, such as Belgium, Germany France and Italy have had numerous short technical recessions, other countries, such as Spain, the Netherlands, Austria and Finland have had fewer contraction phases. In the cases of Spain and Finland, the contraction phases tended to be fewer but longer than in the rest of the countries. In fact, neither of these two countries has experienced a technical recession since the beginning of the 1990s, while all the other six countries with quarterly national accounts have suffered at least one technical recession since 1999.

While the above charts present in detail the business cycles in individual countries since the 1970s, Chart 55 allows for a visual study of the synchronisation of recessions across these countries since 1990. The recession in 1992-93 was remarkably shared across countries, with the Netherlands being the only exception. In fact, this appears to be the most synchronised

Chart 55 Periods of recession across the euro area countries since 1990

(according to the Harding and Pagan dating algorithm)

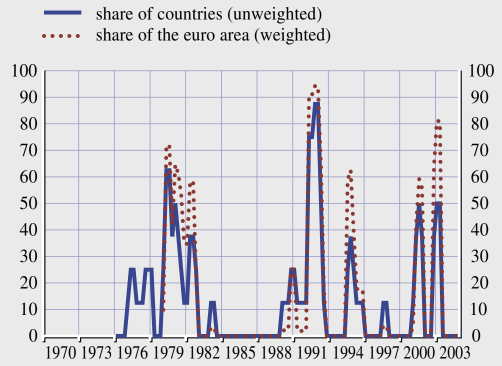


contraction identified in the whole sample. Since 1993, the periods of synchronised contractions have involved fewer countries. In particular, since 1999, only four out of the eight largest euro area countries have been in a technical recession simultaneously.

In addition to the visual inspection of the periods of contraction, the dating also allows for the calculation of several measures that are interesting for the analysis of synchronisation

Chart 56 EA8 countries – Share of countries in GDP recession

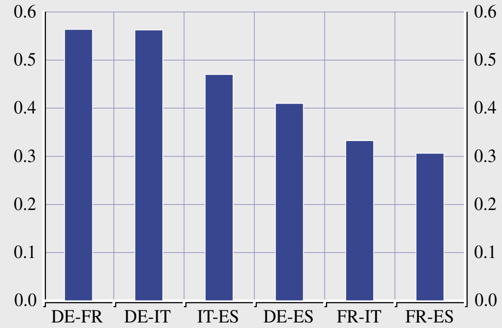
(following Harding and Pagan business cycle dating methodology)



Source: Own computations based on Eurostat database.

Chart 57 Bivariate correlation coefficients of reference cycles across the four largest euro area countries

(1970-2004)



Source: Own computation based on Eurostat database.
Note: The reference cycle refers to the binary series obtained from the Harding and Pagan dating algorithm. This measure gives an overall indication of which countries are likely to be in the same phase of the cycle at a particular point in time.

within the euro area. In particular, Chart 56 shows the proportion of euro area countries, in weighted and unweighted terms, in technical recession. The highest degree of synchronisation is reached when either all of the countries or no countries at all are contracting. From this point of view, again the recession of 1992-1993 was highly synchronised across countries, while since then there has been a relatively lower degree of synchronisation from a recession-dating point of view.

Another more formal measure of synchronisation based on recession dating is to calculate the correlation coefficients of the reference cycle (see Harding and Pagan, 2002). The reference cycle is a binary GDP series for each country, with +1 representing an expansionary phase and -1 representing a contraction. Once the reference cycles for the eight largest euro area countries have been computed, the bilateral correlations coefficients of these series can then be calculated. Chart 57 shows this measure between 1970 and 2004 for the four largest euro area countries computed for every country pair. As can be seen, over this long period, the pairs Germany-France and Germany-Italy appear to show the highest levels of correlation as far as

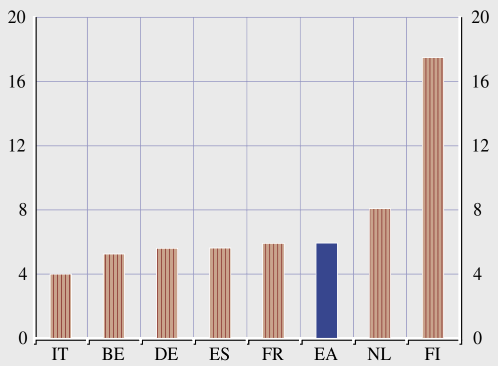
Table 5 Business cycle characteristics for the euro area countries

	Belgium	Germany	Spain	France	Italy	The Netherlands	Finland	euro area
Mean duration (quarters)								
PT	3.0	4.8	3.0	2.5	3.0	3.0	14.0	2.8
TP	18.0	17.6	20.7	20.0	13.0	29.3	56.0	21.0
Cycle	21.0	22.4	23.7	22.5	16.0	32.3	70.0	23.8
Mean amplitude (%)								
PT	-1.5	-1.6	-1.1	-0.9	-1.4	-2.5	-14.6	-1.3
TP	12.1	13.1	14.5	12.8	9.9	21.9	48.6	15.3
Cycle	10.4	11.3	13.2	11.8	8.4	18.8	26.9	13.8

Note: Peak to Trough (PT) and Trough to Peak (TP). Based on the Harding and Pagan business cycle dating algorithm.

Chart 58 Average duration of a complete cycle

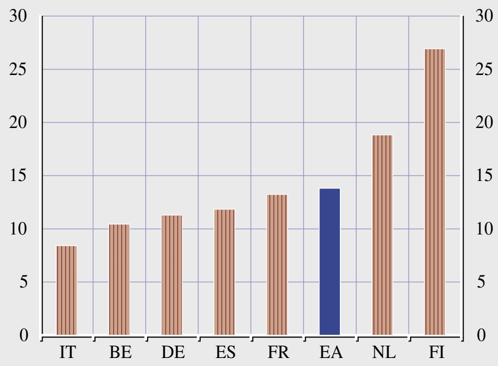
(years)



Note: Based on the Harding and Pagan business cycle dating algorithm.

Chart 59 Average amplitude of a complete cycle

(%)



Note: Based on the Harding and Pagan business cycle dating algorithm.

phases in the cycle are concerned. However, while this measure gives an indication of which countries are likely to be in the same phase of the cycle at a particular point in time, it is not easily adapted to shorter time periods, since these periods might lack recessions altogether.

Another benefit of recession dating is that it allows for a simplified description of the cycle in terms of duration and amplitude, measured in quarters (see Table 5). The duration and amplitude measures, ordered from the lowest to the highest, across countries are also shown in Chart 58 and Chart 59. As expected in a classical cycle dating approach, when applied to the level of real GDP, the business cycle phases are not symmetrical. In particular, periods of expansion last much longer than contraction periods, which tend to be relatively short. As can be seen, most euro area countries share relatively similar duration and amplitude measures. In particular, the mean duration of a complete cycle is about 24 quarters[23]. However, the Netherlands and, more markedly, Finland deviate with longer durations and higher amplitudes than the rest of the countries.

To summarise, the results of the dating across the eight largest euro area countries show that since the well-shared contraction in the period 1992-93, contractions have not been fully shared across countries. Is this result inconsistent with the increased synchronisation found earlier? Although an increase in the degree of co-movement of the cyclical GDP component across the euro area countries since the beginning of the 1990s has been found, there have been differences in the relative position of countries in the cycle. This means that after 1993 some countries experienced a contraction in real GDP while in other countries real output continued to rise but at a slower pace.

Importantly, the business cycle dating shows that the euro area countries share very similar business cycle duration and amplitude measures. In particular, the mean duration of a complete cycle is about six years and the mean amplitude is about 14% of GDP. However, the Netherlands and, particularly, Finland stand out with a longer duration and higher amplitude.

23 It is important to stress that this average duration of a business cycle has been obtained by applying homogeneously the Harding and Pagan to real GDP across countries. However, a more comprehensive procedure that includes economic judgement, such as the one applied by the CEPR for the euro area, would result in a longer duration of around 36 quarters.

2.4 DEMAND COMPOSITION OF THE TWO LATEST UPSWINGS

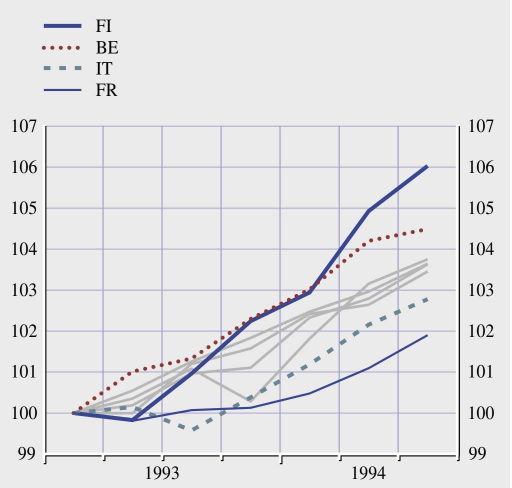
In order to deepen the analysis of business cycle synchronisation, it may also be useful to consider which demand components drive an upturn across the euro area countries or, in other words, the homogeneity of the demand composition of an upturn. For that purpose, the demand composition of the two last and most shared upswings of GDP in euro area countries are compared.

The upturns starting in the first quarter of 1993 and the second quarter of 2003 are considered in order to study the evolution of the demand components during the first six quarters after the trough. As can be seen in Chart 60 and Chart 61, the 2003 recovery was much milder than the one at the beginning of the 1990s. This can largely be explained by the more muted recovery patterns in the cases of Germany, Italy and the Netherlands. By contrast, the 1993 recovery was characterised by a few countries rebounding extremely quickly. This was particularly the case for Finland, which benefited from the improvement in the international environment and grew quickly after a long recession.

Looking at the composition of these two upswings, one noticeable difference is that while the upturn in the early 1990s was characterised by relatively strong recoveries of private consumption in all countries,[24] the one that started in the second quarter of 2003 has so far failed to feed into private consumption growth in Germany and the Netherlands. In Spain, on the other hand, private consumption has been strong. As regards the upswings in investment, very few stylised facts can be found, since quarterly data on investment are usually very "noisy" and the time-span considered (six quarters after the trough) is probably too limited to identify any homogeneity across countries. One important difference between the two upswings is the apparent lack of investment growth in Germany from 2003 onwards (see Chart 65) compared with the high level of investment growth during the previous rebound

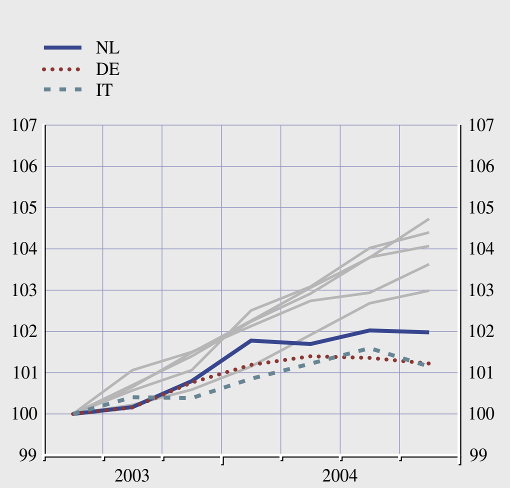
24 While Italy appears to be an outlier, this is more the outcome of a slightly different timing of the trough than a difference in composition. This also applies to the upswing in real exports.

Chart 60 Recovery of real GDP from its trough in 1993 Q1



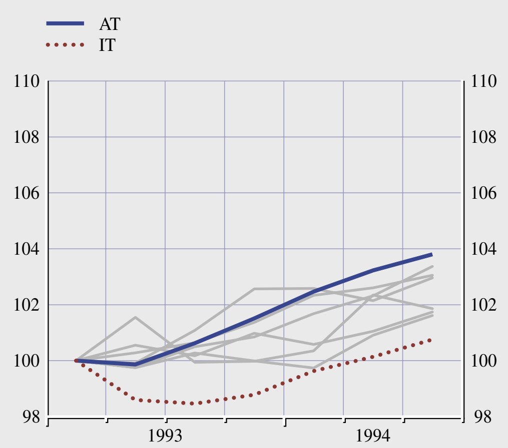
Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

Chart 61 Recovery of real GDP from its trough in 2003 Q2



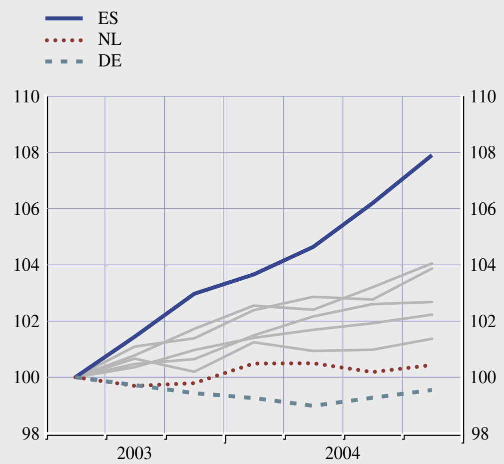
Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

Chart 62 Recovery of real private consumption from the GDP trough in 1993 Q1



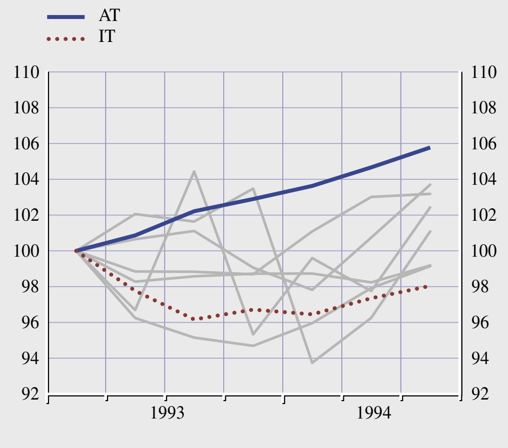
Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

Chart 63 Recovery of real private consumption from the GDP trough in 2003 Q2



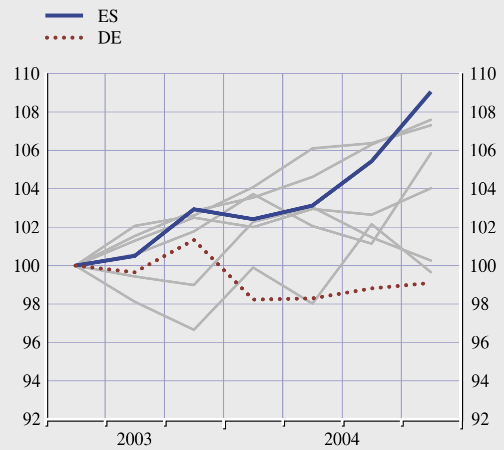
Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

Chart 64 Recovery of real investment from the GDP trough in 1993 Q1



Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

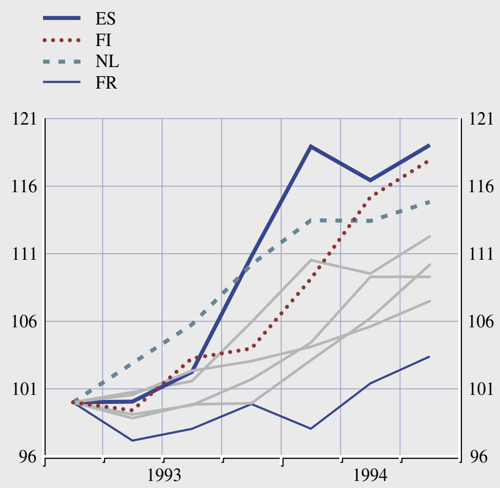
Chart 65 Recovery of real investment from the GDP trough in 2003 Q2



Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

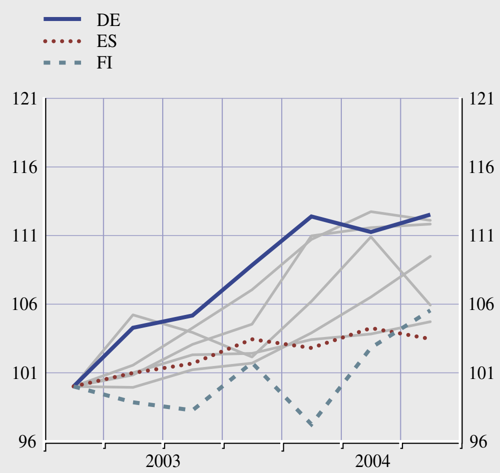
in 1993. Finally, as regards exports, some interesting patterns can be identified. In 2003, the recovery pattern was much more similar than during the upswing in the early 1990s, when some countries like Spain, the Netherlands and Finland saw extraordinary export growth, while French exports were relatively sluggish. Since 2003, differences in the exports performance across countries have been smaller. However, Germany, the Netherlands and Austria stand out with a stronger rebound in exports. In the case of the Netherlands, it should be noted,

Chart 66 Recovery of real exports from the GDP trough in 1993 Q1



Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

Chart 67 Recovery of real exports from the GDP trough in 2003 Q1



Source: Own computations based on Eurostat database.
Note: In the charts above only those countries with exceptionally high or low recovery profiles have been labelled.

however, that a large part of the recovery in exports results from re-exported goods that have a low propensity to drive up domestic demand. This could help to explain why private consumption has not yet rebounded in that country.

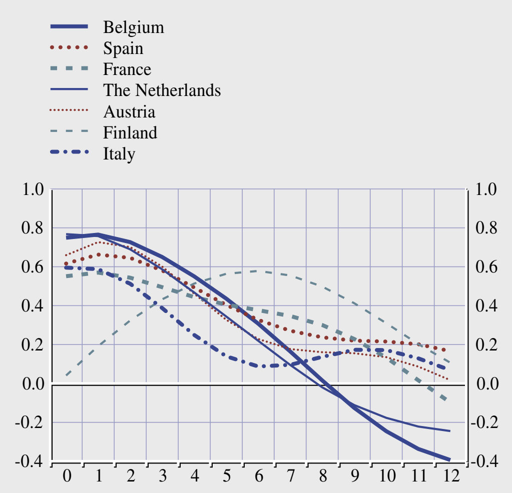
In short, the most striking difference between the two latest upswings is that, while the 1993 recovery was characterised by relatively strong private consumption growth in all countries, in the 2003 recovery two countries (Germany and the Netherlands) have had very weak private consumption growth. As regards exports, on the other hand, the more recent upswing showed more similarity across countries than the one in 1993, although export growth performances across countries vary notably.

2.5 CROSS-CORRELATION ANALYSIS OF BUSINESS CYCLES

Some further interesting information on the co-movement of business cycles can be obtained by computing lead/lag correlations among the cyclical components of real GDP using available quarterly series starting in 1980. The idea is to see whether some euro area countries lead or lag cyclical developments compared to other euro area countries. Chart 68 to Chart 71 show the correlation of a certain country's business cycle position at time t with that of the rest of the euro area countries at time $t+i$, $i=0,1,2,\ldots$ Chart 68 shows the correlation of the German business cycle in a certain quarter with that of the rest of the euro area countries in the same quarter (time in the horizontal axes equal to 0) and then in the following quarter (time = 1) and so on. With the exception of Finland, the German business cycle presents a very high contemporaneous correlation (time = 0) with all countries. Finland's business cycle does not appear to be at all synchronised with that of Germany. For the other countries, the contemporaneous correlation of the German cycle is highest with that of Belgium and the Netherlands (around 0.8) and lowest with that of France and Italy (around 0.6). Moving ahead in time, the correlation remains significantly high with all countries, except Finland, over the three consecutive quarters.

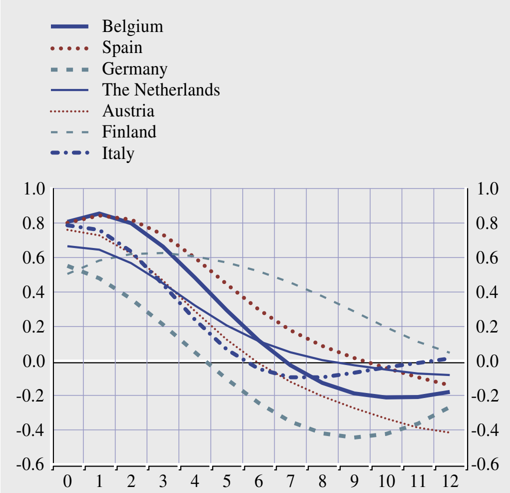
Chart 69 shows the same lead correlation for the French business cycle. Although the correlation with the Finnish business cycle is also very low, the Finnish business cycle appears to co-move much more in line with the French cycle than with the German one. For the other countries, the contemporaneous correlation of the French cycle is highest with that of Belgium, Spain and Italy (around 0.8) and lowest with that of Germany (around 0.6). Moving ahead in time, the correlation remains significantly high with all countries in the three consecutive quarters, except with Germany, where the correlation falls to very low values after two quarters.

Chart 68 Correlation of the German business cycle at time *t* with other euro area countries at time t + i, i = 0, 1, 2,..



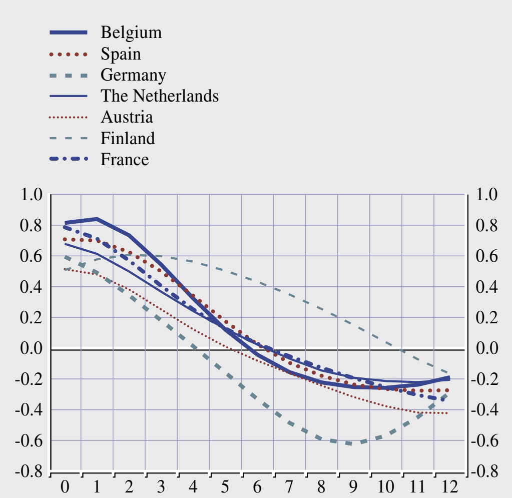
Source: Own computations on Eurostat database.

Chart 69 Correlation of the French business cycle at time *t* with other euro area countries at time t + i, i = 0, 1, 2,..



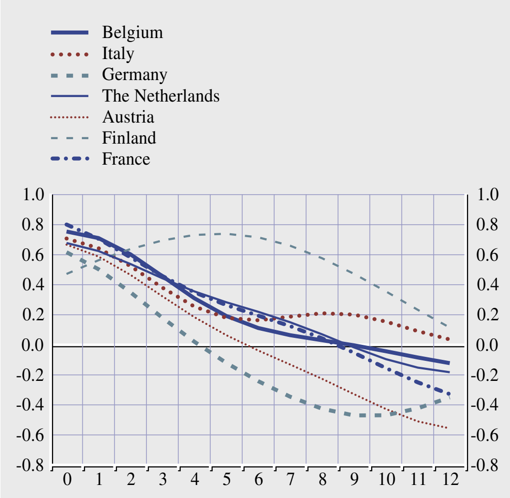
Source: Own computations on Eurostat database.

Chart 70 Correlation of the Italian business cycle at time *t* with other euro area countries at time t + i, i = 0, 1, 2,..



Source: Own computations on Eurostat database.

Chart 71 Correlation of the Spanish business cycle at time *t* with other euro area countries at time t + i, i = 0, 1, 2,..



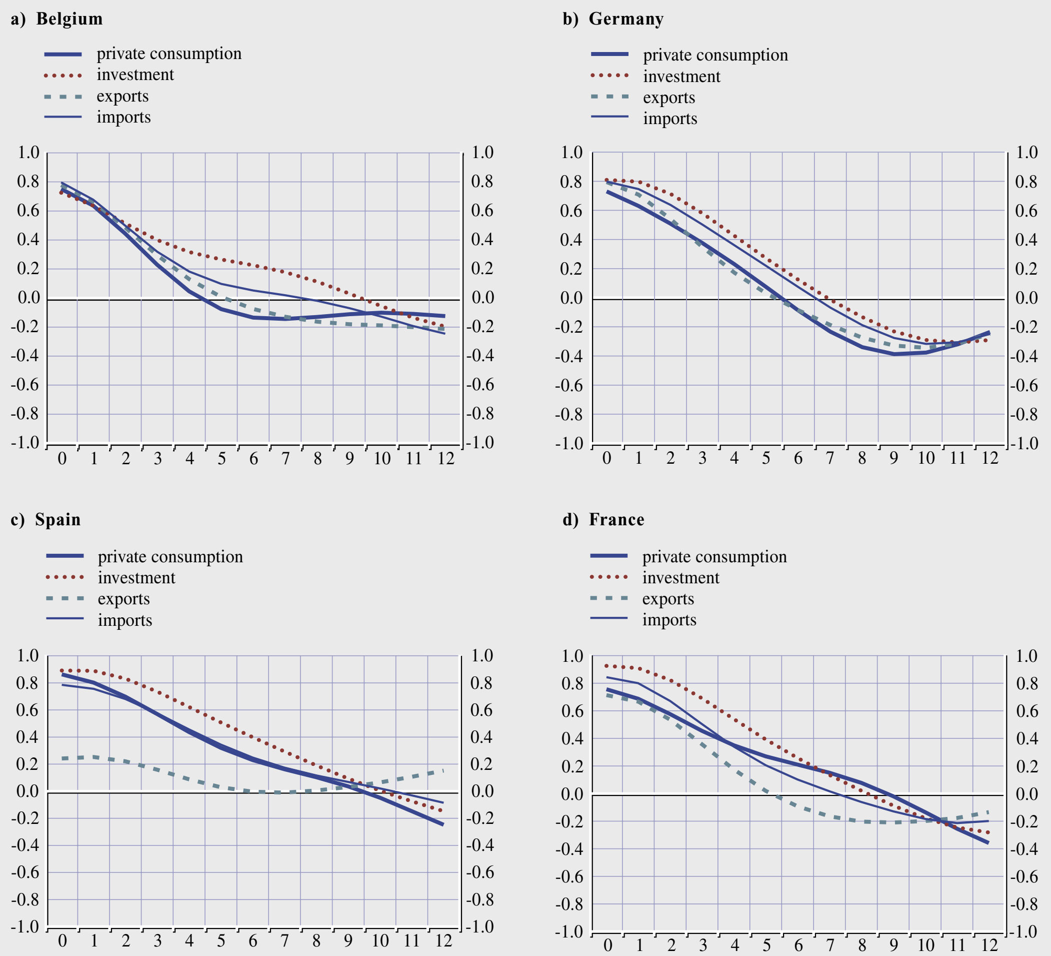
Source: Own computations on Eurostat database.

Chart 70 shows the correlations through time for the Italian business cycle. The contemporaneous correlation of the Italian cycle is relatively high with respect to all the euro area countries considered. In particular, the correlation is highest with Belgium and France (around 0.8) and lowest (around 0.5) with Austria and Finland.

Finally, Chart 71 shows the correlations through time for the Spanish business cycle. Also in this case, with the exception of Finland, the Spanish business cycle presents a very high contemporaneous correlation with all countries.

In conclusion, the lead/lagged correlation analysis of business cycles indicates that the highest correlation across euro area countries occurs without lags, which reinforces the conclusion that the business cycles are highly synchronised. The only exception is Finland, whose business cycle does not seem to be synchronised with the rest of the countries – this result may relate in part to the severe crisis suffered by Finland in the early 1990s. This analysis does not reveal any leading properties of the business cycles of the four largest euro area countries on the remainder of the euro area countries. The only exceptions seem to be

Chart 72 Correlation of each demand component at time *t* with the cycle of real GDP at time t + I, i = 0, I,...



Source: Own computations on Eurostat database.

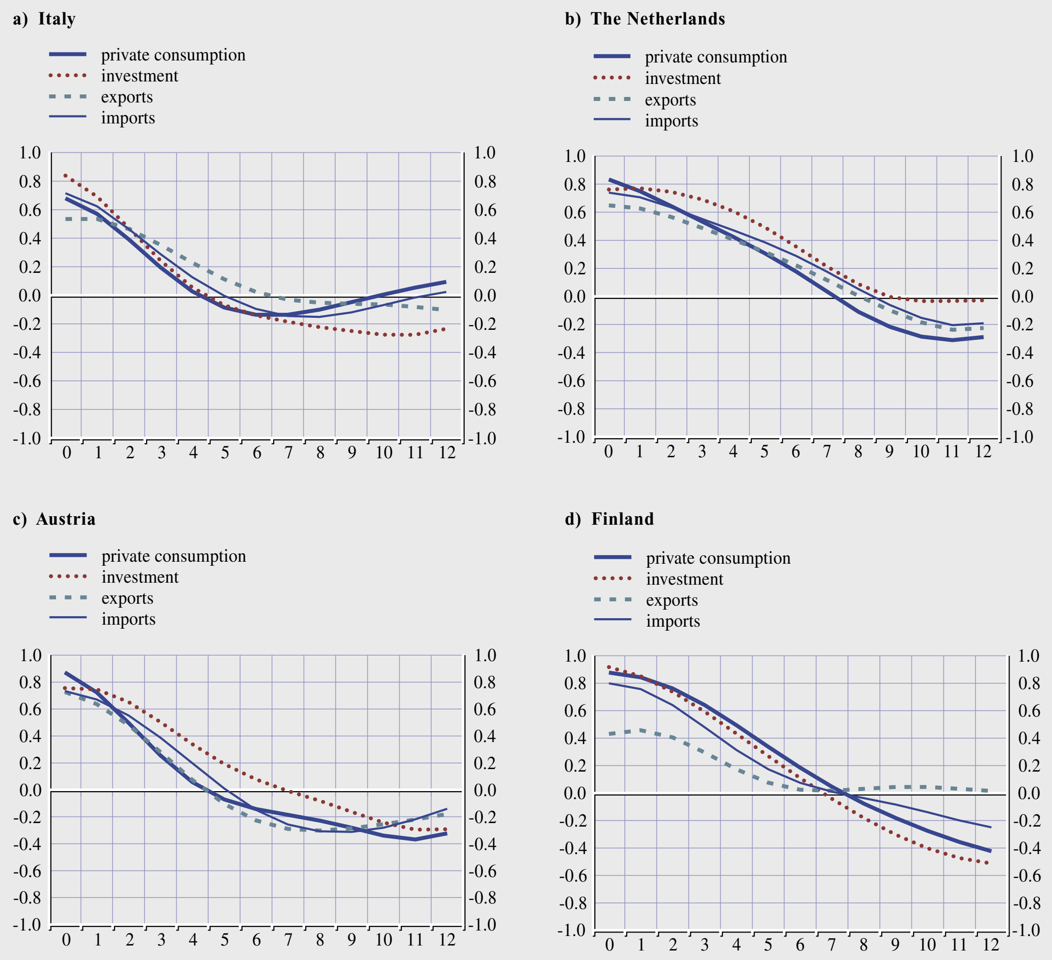
Germany and Austria: in these cases, the highest correlation between the two business cycles is not reached contemporaneously, but with a lag of a quarter.

2.6 CROSS-CORRELATION ANALYSIS OF COUNTRIES' BUSINESS CYCLES WITH EACH DEMAND COMPONENT

A further complement to the study of the synchronisation of business cycles is to analyse the correlation between the cycles of real GDP with that of each demand component across the euro area countries. The idea is to identify which demand components could have a prominent role in explaining movements in the business cycle of individual countries. Having identified these components of demand, the second step is to investigate whether they co-move across countries, therefore explaining the synchronisation of output developments.

To start with, contemporaneous and lagged correlations between the cyclical part of each demand component and the cyclical part of real GDP for each of the largest euro area country are computed. Chart 72 to Chart 73 show that in all countries the contemporaneous correlation

Chart 73 Correlation of each demand component at time *t* with GDP at time t + i, i = 0,1,...



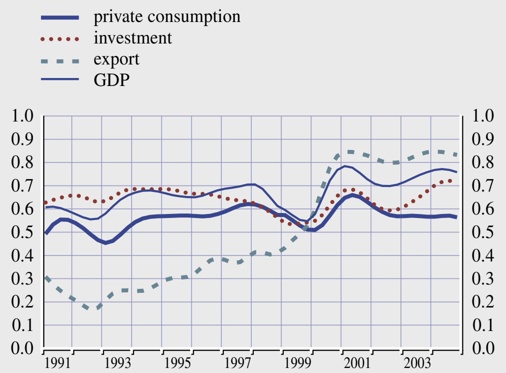
Source: Own computations on Eurostat database.

between the cyclical part of each demand component and that of real GDP is very high, ranging between 0.6 and 0.9, with the exception of the export correlation in Spain and Finland.

Looking within countries, in Germany, for any lead and lag, the cycle of real GDP is more correlated with the cycle of investment and imports than with that of exports and private consumption (Chart 72b). Also in Spain and France, for any lead and lag, the investment cycle presents the highest correlation with the cycle of real GDP (see Chart 72c and Chart 72d). In Italy, the investment cycle presents the highest contemporaneous correlation. However, moving ahead in time (three quarters), the export cycle shows a higher correlation with the real GDP cycle (Chart 73a). A feature shared by Spain and Finland is the very low level of correlation, for any lead and lag, between the export cycle and the GDP cycle. In general, this analysis indicates that the investment and export cycles are mostly correlated with the real GDP cycles in almost all countries.

Once it has been determined that the investment and export cycles play a key role in explaining business cycle developments in individual countries, the next step is to investigate the degree of co-movement of these variables across countries. Chart 74 shows an eight-year moving average of the unweighted average of all pairwise correlation coefficients between the cyclical parts of the various demand components across countries.[25] As can be seen, the correlation of the investment cycles across countries is higher than that for private consumption, reflecting the fact that national idiosyncrasies play a more important role in the case of private spending. More importantly, there is a notable increase in the correlation of export cycles across countries, especially since 1999. It is likely that this reflects the increase in trade linkages, which is a well-known channel of business cycle synchronisation.

Chart 74 Average correlation eight-year rolling of output gap and the cyclical part of demand components



Source: Own computations on Eurostat database.
Note: The cyclical components are computed by using the BP filter.

In conclusion, this analysis has shown that, in all countries, the correlation between the cyclical part of each demand component and that of real GDP is very high, except for the export cycles in Spain and Finland. In particular, the investment and export cycles seem to be most correlated with the real GDP cycles in almost all countries. Moreover, a remarkable increase in the correlation of the export cycles across countries appears to have taken place over the 1990s. In this sense, exports appear to be the main source of the increase in the co-movement of business cycles across euro area countries, possibly reflecting the impact of closer trade linkages.

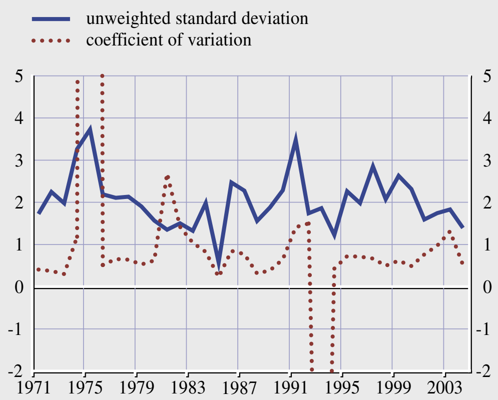
25 The pairwise correlation coefficients of quarterly real GDP growth rates are computed across all the euro area countries for rolling eight-year periods. In order to provide a synthetic measure of correlation across countries, the unweighted average of all these pairwise correlation coefficients for each eight-year period is computed.

APPENDICES

APPENDIX A1 OTHER MEASURES OF DISPERSION

Chart 75 Dispersion of real GDP growth rates across the euro area countries measured by the unweighted standard deviation and the coefficient of variation

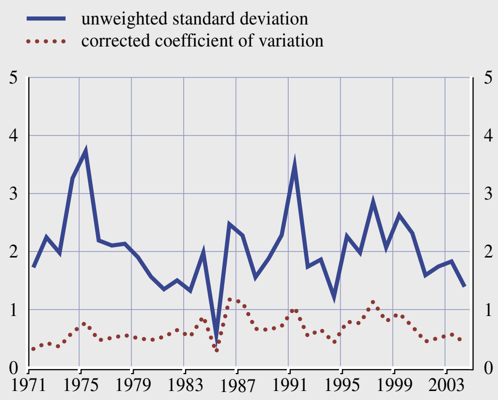
(percentage points)



Source: Own computations based on European Commission database.
Note: The presence of very high positive or negative values in the case of the coefficient of variation in 1974 and 1993 is due to the fact that average real GDP growth rates have been close to zero in these two years.

Chart 76 Dispersion of real GDP growth rates across the euro area countries measured by the unweighted standard deviation and a corrected coefficient of variation

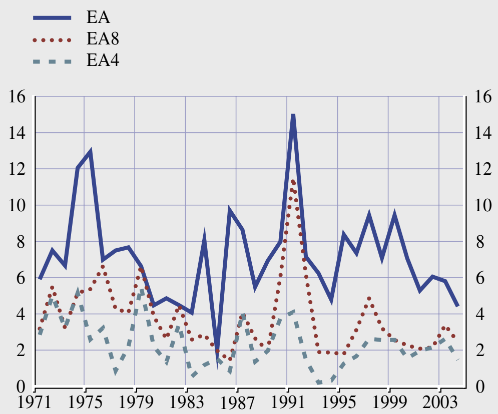
(percentage points)



Source: Own computations based on European Commission database.
Note: In the case of the coefficient of variation, in order to avoid the problem of very high positive and negative values, an alternative method consists of using as a denominator an eight-year moving average of real GDP growth rates across the 12 euro area countries. The chart shows that with this correction the coefficient of variation gives a similar result to that obtained by using the unweighted standard deviation.

Chart 77 Dispersion of real GDP growth rates across the euro area countries – Spread between the maximum and the minimum growth rate

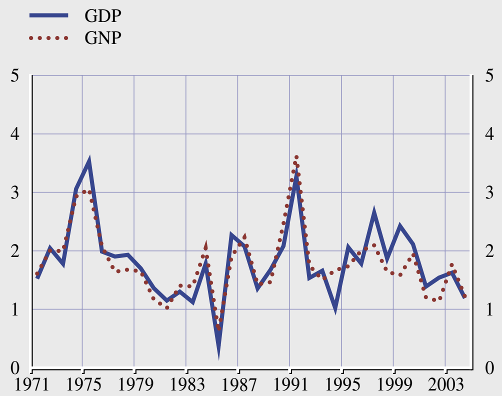
(percentage points)



Source: Own computations based on European Commission database.

Chart 78 Dispersion of real GDP growth rates and real GNP growth rates across the euro area countries

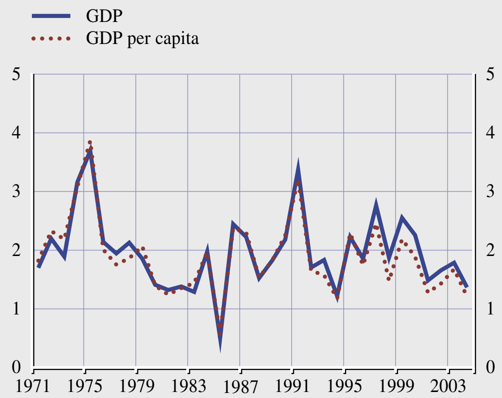
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 79 Dispersion of real GDP growth rates and real GDP per capita growth rates across the euro area countries

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

APPENDIX A2 OUTPUT GROWTH DIFFERENTIALS WITHIN THE UNITED STATES, FORMER WEST GERMAY, SPAIN AND ITALY

Summary of regions within the United States, West Germany, Spain and Italy with long-lasting output growth differentials with respect to the whole country

A. Below the average output growth rate in the country

Country	State/region	Period	Number of years	Output growth differential to the country (average over the selected period in persentage points)
US states (50 & D. Columbia)	D.Columbia	1978-1988	11	-2.0
	Illinois	1978-1985	8	-1.6
	Louisiana	1982-1989	8	-2.8
	Maine	1989-1997	9	-1.8
	Maryland	1990-1997	8	-1.4
	New York	1989-1997	9	-1.5
	Oklahoma	1983-1990	8	-3.9
	Oregon	1980-1987	8	-2.1
	Pennsylvania	1978-1986	9	-1.5
	W. Virginia	1978-1990	13	-2.3
	Wisconsin	1980-1987	8	-1.2
	Wyoming	1982-1989	8	-4.2
US regions (8)	Mid East	1989-1997	9	-1.2
The former West German Länder (11)	Berlin	1994-2004	11	-1.9
	Nordrhein-Westfalen	1975-1984	10	-0.9
		1986-1994	9	-0.6
	Saarland	1982-1993	12	-1.0
Italian regions (20)	Liguria	1991-1998	8	-0.9
Spanish Autonomous Communities (18)	Asturias	1993-2004	12	-1.1
	Castilla y León	1995-2004	10	-0.8

Notes: Regions are selected when they have been growing at higher/lower growth rates than the whole country continuously, every year, for eight or more years. In the case of Germany, the differentials are computed with respect to the average growth rate in the former West Germany.
Data periods used: In the United States only for 1978-1997, due to a break in 1998. In the former West Germany: 1970-2004. In Italy: 1981-2003 and in Spain: 1981-2004.

B. Above the average output growth rate in the country

Country	State/region	Period	Number of years	Output growth differential to the country (average over the selected period in persentage points)
US states (50 & D. Columbia)	California	1978-1990	13	1.5
	Colorado	1990-1997	8	2.4
	Florida	1978-1993	16	2.0
	Georgia	1978-1987	10	2.1
	Idaho	1988-1995	8	3.5
	Maryland	1982-1989	8	1.3
	Massachusetts	1978-1988	11	1.8
	Nevada	1985-1997	13	3.5
	New Hampshire	1978-1987	10	4.2
	Oregon	1988-1997	10	2.5
	Texas	1988-1997	10	1.5
	Utah	1978-1985	8	1.4
US regions (8)	South East	1978-1987	10	0.6
	South West	1990-1997	8	1.7
	Rocky Mountains	1990-1997	8	2.1
	Far West	1978-1990	13	1.2
The former West German Länder (11)	Baden-Württemberg	1994-2001	8	0.5
	Bayern	1975-1984	10	1.1
		1996-2004	9	0.8
	Hessen	1982-1993	12	0.9
Italian regions (20)	Basilicata	1992-1999	8	1.8
Spanish Autonomous Communities (18)	Baleares	1990-1997	8	1.5
	Cataluña	1988-1996	9	0.7

APPENDIX A3 DETRENDING METHODS: A SHORT REVIEW

i) The band-pass filter approach

The band-pass (BP) filter used relies on the "approximate" band-pass filter suggested by Baxter and King (1995). A band-pass filter is a particular moving average which "transforms" macroeconomic data to obtain the "business-cycle" component. The definition of business cycle adopted by Baxter and King (1995) corresponds to that of Burns and Mitchell (1946). Burns and Mitchell (1946) specified that the business cycle entailed cyclical components of no less than six quarters in duration, and they found that a United States business cycle typically lasted fewer than 32 quarters.[27] Since the exact band-pass filter is a moving average of infinite order, applying this filter would require a dataset of infinite length. For practical application, therefore, an approximation is needed. The moving average that used is based on three years of past data and three years of future data, as well as the current observation.[28] Once the cycle is obtained, the trend results from the difference between raw data and the cyclical component.

This approximate band-pass filter has several characteristics. First, it applies symmetric weights on leads and lags in order to avoid a phase shift of the filtered series, i.e. for not altering the timing relationships between series at any frequency. Second, the approximate band-pass filter results in a stationary time series if the underlying time series is integrated of order one or two. Third, the method yields business-cycle components that are unrelated to the length of the sample period. This means that the moving averages are time invariant, so that the coefficients do not depend on the points in the sample. One of the major problems of the filter is the end-point bias, as at the beginning and at the end of the sample filtered data are more affected by the cyclicality of the data. To avoid the end-point bias, twelve observations were dropped from the beginning and end of the sample. In order not to loose current year data and the data in the forecasting period, i.e. 2005-2007, three more years of observations were added, by extending the forecast made in the last quarter of 2007. A second problem relates to the length of the business cycle which, in the filter, was set to be the same for all countries. Third, the choice of the truncation point, that is the length of the moving average, is arbitrary.

Finally, this filter performs well for relatively stable economies, in the absence of large shocks, and less well for interpreting extraordinary circumstances, where the economic methods for calculating the trend should have an advantage.

ii) The production function approach

The production function (PF) approach focuses on the supply potential of an economy and has the advantage of providing a more direct link to economic theory than a statistically-based approach. The disadvantage is that it requires assumptions on the functional form of production, on the returns to scale, on the trend technical progress and on the representative utilisation of production factors. In this study, potential output estimates based on the PF approach are taken from the European Commission. In more formal terms, real GDP (Y) is represented by a combination of factor inputs – labour (L) and the capital stock (K) – adjusted for the level of technology referred to as total factor productivity (TFP), which is more generally an "efficiency index". The same Cobb-Douglas specification is chosen for the functional form in all countries. Thus GDP is given by $Y = (TFP)\ L^{a}\ K^{1-a}$.

Factor inputs are measured in physical units. An ideal physical measure for labour would be hours worked. Unfortunately this information is not available for most of the euro area countries. Therefore, we measure labour input simply by

27 Technically this implies selecting the shortest and longest cycle length passed by the band-pass filter to be equal to 6 and 32.

28 Technically this implies selecting the truncation point at 12 (i.e. 12 quarters). By choosing an approximating moving average with maximum lag length 12, implementing the filter means that we lose 24 observations. There is no "best" value for the truncation point; increasing it leads to a better approximation of the ideal filter, but result in more lost observations.

using total employment. This implies that any changes in working hours are reflected in the efficiency index (i.e. TFP). For the capital stock, we use the OECD series which include spending on structure and equipment of the business sector.

The production function is characterised by constant returns to scale. Under this assumption the output elasticities can be equated to their respective factor shares. Therefore output elasticities for labour and capital have been estimated by the wage share in each country.

In order to be able to estimate potential output, it is required to measure the use of production factors (K, L) and the trend level of efficiency of the factor inputs (TFP). Starting with capital, since it is an indicator of overall capacity, there is no need to smooth this series in order to assess its potential degree of utilisation. Regarding labour, it is more difficult to assess the potential degree of utilisation of this factor of production. The definition that we apply is the level of employment consistent with stable, non accelerating (wage) inflation (NAIRU). Therefore, for each country, potential employment is set to be equal to a smoothed labour force[29] minus the NAIRU estimates. To estimate the NAIRU we have applied the Kalman filtering technique. Unemployment is assumed to be composed of an unobserved cyclical and trend component. The Kalman filter extracts these components subject to certain general specifications of the processes generating the cyclical and trend components. The cyclical component of unemployment is identified using a Phillips curve relating changes in wage inflation and cyclical unemployment. Conversely, a time-series model is used for the trend component of unemployment, which is regarded as unobservable.[30]

The trend TFP has been obtained by HP filtering the Solow residual. Thus potential GDP can be represented as: $Y^P = (TFP)^P\ (L^P)^a\ K^{1-a}$, where p stands for potential.

The fact that HP filtering is used to obtain trend TFP makes the PF estimates partially subject to the same critiques which apply to statistical methods (see above). Moreover a general caveat should be expressed in relation to the arbitrary choice of the functional form of the production technology (Cobb Douglas), returns to scale (constant) and factor price elasticities (equal to one). The unit elasticity assumption is consistent with the relative constancy of nominal factor shares. For some countries there is evidence, however, that the labour share has been on a downward trend since the 1970s.

29 The smoothed labour force series is generated by applying the HP filter participation rate to the working age population series.

30 The observed unemployment rate (U_t) is decomposed into a trend (T_t) and a cyclical component (C_t): (1) $U_t = T_t + C_t$. To obtain the cyclical component, we postulate a Phillips curve relationship linking the change in compensation per employee (Δw_t) to C_t plus other exogenous variables X_t such as lagged changes in the unemployment rate and the real exchange rate. Other unobserved shocks are captured by the error term u_t: (2) $\Delta w_t = constant + \beta C_t + \gamma X_t + u_t$. Besides having predictive power for wage inflation, the cyclical component of unemployment must also obey certain business cycle restrictions; i.e. it should be a stationary auto-correlated process with sample mean of zero. Such a process is characterised by the following equation: (3)$C_t = \phi_1 C_{t-1} + \phi_2 C_{t-2} + \nu_t$, where ν_t is the error term. Finally the model is closed by specifying the trend component, which is simply modelled as a random walk with drift: (4)$T_t = constant + T_{t-1} + z_t$, where z_t is the error term. Equations (1) - (4) are estimated with maximum likelihood on quarterly data over the period 1970-I to 2003-IV.

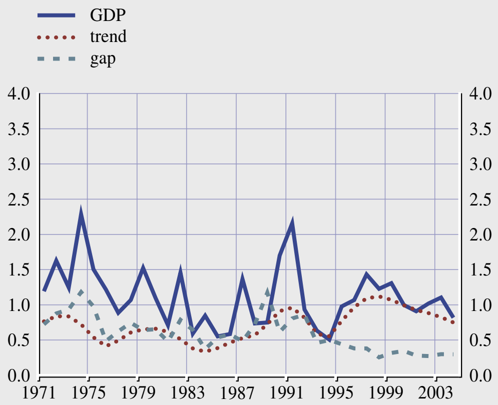
Table 6 Comparison of potential output estimates by international institutions

			euro area					Belgium	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	3.3	-	-	By decades	1970-1979	3.3	3.1	-
	1980-1989	2.3	2.0	2.1		1980-1989	2.0	2.1	2.0
	1990-1999	2.2	2.6	2.1		1990-1999	2.2	2.1	2.2
Recent periods	1995-1998	2.1	1.9	2.1	Recent periods	1995-1998	2.2	1.9	2.1
	1999-2004	1.9	2.0	2.0		1999-2004	2.1	2.1	2.1
			Germany					Greece	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	2.8	2.7	-	By decades	1970-1979	4.6	-	-
	1980-1989	2.3	1.9	1.2		1980-1989	1.0	1.0	1.7
	1990-1999	2.0	3.4	3.1		1990-1999	2.3	2.3	2.1
Recent periods	1995-1998	1.7	1.3	1.7	Recent periods	1995-1998	2.8	2.5	2.6
	1999-2004	1.2	1.4	1.3		1999-2004	3.7	3.6	3.9
			Spain					France	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	3.7	-	-	By decades	1970-1979	3.5	3.1	-
	1980-1989	2.4	2.1	2.4		1980-1989	2.2	2.2	2.3
	1990-1999	2.9	2.9	2.9		1990-1999	2.0	1.9	1.9
Recent periods	1995-1998	3.0	2.9	3.1	Recent periods	1995-1998	2.0	2.2	1.8
	1999-2004	3.0	3.0	3.1		1999-2004	2.1	2.2	2.2
			Ireland					Italy	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	4.5	-		By decades	1970-1979	3.7	3.8	-
	1980-1989	3.4	-	3.1		1980-1989	2.4	2.5	2.6
	1990-1999	6.8	-	6.8		1990-1999	1.7	1.5	1.6
Recent periods	1995-1998	7.7	-	8.3	Recent periods	1995-1998	1.6	1.4	1.9
	1999-2004	6.8	-	6.8		1999-2004	1.4	1.4	1.6
			Luxemburg					The Netherlands	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	2.6	-	-	By decades	1970-1979	3.1	3.0	-
	1980-1989	4.5	-	4.0		1980-1989	2.1	1.7	2.1
	1990-1999	5.3	-	5.3		1990-1999	2.8	2.8	2.9
Recent periods	1995-1998	5.2	-	5.2	Recent periods	1995-1998	2.8	2.8	3.0
	1999-2004	4.4	-	4.3		1999-2004	1.9	2.5	2.2
			Austria					Portugal	
		EC	OECD	IMF			EC	OECD	IMF
By decades	1970-1979	3.6	2.9	-	By decades	1970-1979	4.5	5.1	-
	1980-1989	2.5	2.3	2.0		1980-1989	3.1	3.1	3.5
	1990-1999	2.5	2.4	2.4		1990-1999	2.9	2.8	3.3
Recent periods	1995-1998	2.4	2.0	2.2	Recent periods	1995-1998	2.8	2.7	3.1
	1999-2004	2.0	2.4	2.1		1999-2004	1.9	2.5	2.5
			Finland						
		EC	OECD	IMF					
By decades	1970-1979	4.0	-	-					
	1980-1989	2.5	3.0	2.8					
	1990-1999	2.1	1.9	2.8					
Recent periods	1995-1998	2.8	2.3	3.0					
	1999-2004	3.2	2.7	3.6					

APPENDIX A5 DECOMPOSITION OF GDP GROWTH DISPERSION INTO CYCLE AND TREND IN WEIGHTED TERMS

Chart 80 Dispersion of real GDP growth rates, trend growth rates and output gaps across the euro area countries – BP filter

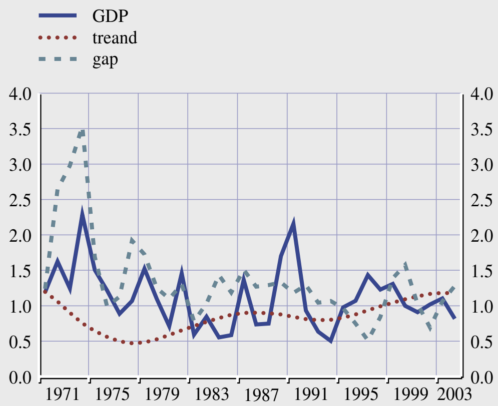
(weighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 81 Dispersion of real GDP growth rates, trend growth rates and output gaps across the euro area countries – PF approach

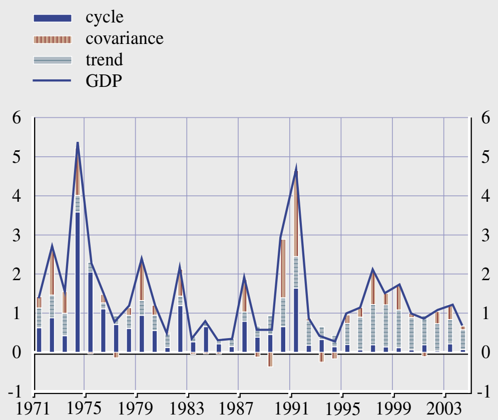
(weighted standard deviation; percentage points)



Source: Own computations based on European Commission database

Chart 82 Contribution to variance of overall GDP growth across the euro area countries – BP filter

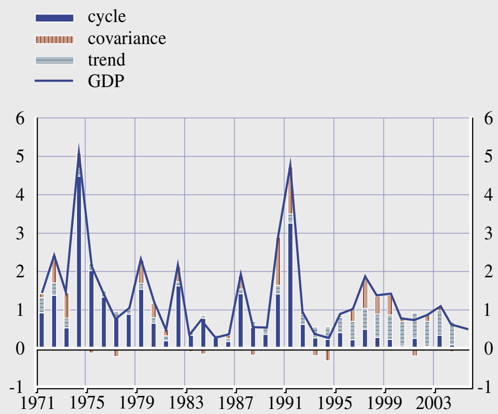
(in weighted terms; percentage points)



Source: Own computations based on European Commission database.

Chart 83 Contribution to variance of overall GDP growth across the euro area countries – PF approach

(in weighted terms; percentage points)

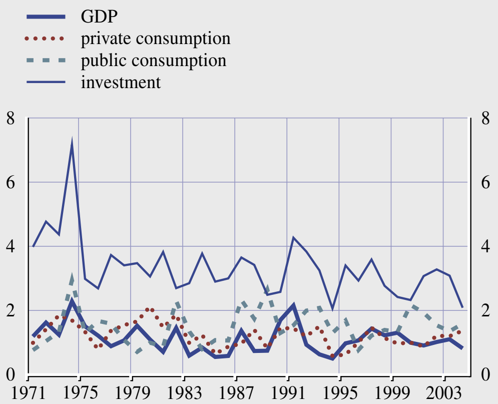


Source: Own computations based on European Commission database.

APPENDIX A6 DISPERSION OF DEMAND COMPONENTS: SOME ADDITIONAL CHARTS

Chart 84 Dispersion of real GDP growth rates and domestic demand components across the euro area countries

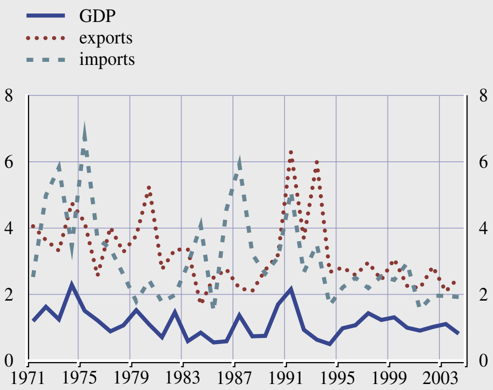
(weighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 85 Dispersion of real GDP growth rates and domestic demand components across the euro area countries

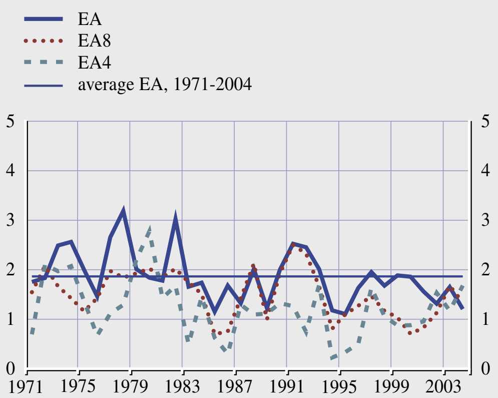
(weighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 86 Dispersion of private consumption growth rates across the euro area countries

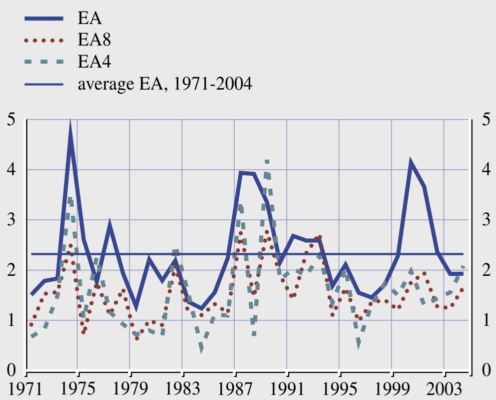
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 87 Dispersion of public consumption growth rates across the euro area countries

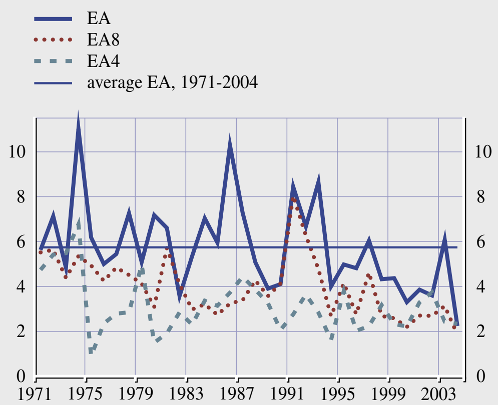
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 88 Dispersion of investment growth rates across the euro area countries

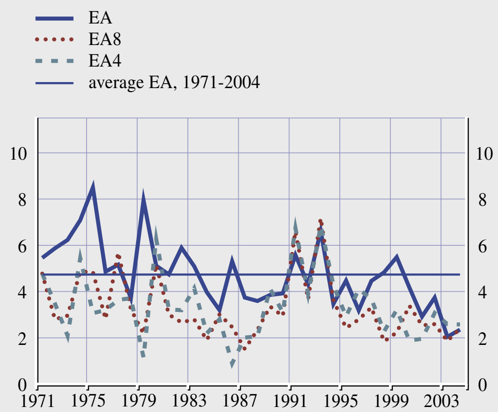
(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

Chart 89 Dispersion of exports growth rates across the euro area countries

(unweighted standard deviation; percentage points)



Source: Own computations based on European Commission database.

APPENDIX A7 SUMMARY GROWTH RATES OF DEMAND COMPONENTS 1970-2004. TABLES

Table 7 Contribution of domestic demand (excluding stockbuilding) to real GDP growth

	1970-1979	1980-1989	1990-1998	1990-1994	1995-1998	1999-2004
Euro area	3.6	2.2	1.7	1.5	2.0	1.9
Belgium	3.8	1.7	1.7	1.5	2.1	1.8
Germany	3.6	1.6	2.0	2.7	1.2	0.5
Greece	5.6	0.9	2.4	1.2	4.0	4.7
Spain	3.8	3.0	2.4	1.4	3.5	3.9
France	3.6	2.4	1.3	1.0	1.5	2.5
Ireland	5.8	1.0	4.5	2.4	7.0	4.7
Italy	3.4	2.7	1.1	0.4	2.1	1.7
Luxembourg	3.6	3.4	3.6	3.2	4.1	3.0
Netherlands	3.3	1.5	2.3	1.5	3.4	1.6
Austria	4.1	2.2	2.4	3.0	1.6	1.4
Portugal	4.9	3.2	3.9	3.3	4.6	1.7
Finland	3.7	3.9	-0.2	-3.8	4.2	2.1

Source: European Commission.

Table 8 Contribution of net trade to real GDP growth

	1970-1979	1980-1989	1990-1998	1990-1994	1995-1998	1999-2004
Euro area	0.0	0.0	0.3	0.3	0.2	0.1
Belgium	-0.1	0.5	0.2	0.2	0.3	0.3
Germany	-0.3	0.2	0.1	0.1	0.3	0.7
Greece	-0.2	-0.4	-0.6	-0.3	-1.1	-0.6
Spain	0.2	-0.3	0.1	0.3	-0.1	-0.8
France	0.2	0.0	0.3	0.4	0.3	-0.4
Ireland	-0.8	1.4	1.9	2.0	1.9	2.7
Italy	0.4	-0.3	0.3	0.7	-0.1	-0.3
Luxembourg	-0.5	0.5	1.3	1.8	0.7	1.5
Netherlands	0.1	0.4	0.5	0.9	0.0	0.2
Austria	-0.2	0.3	0.2	-0.2	0.6	0.6
Portugal	-0.1	0.1	-1.1	-1.2	-0.9	-0.2
Finland	0.1	-0.4	1.5	1.9	1.1	0.9

Source: European Commission.

Table 9 Growth rate of real private consumption across the euro area countries

	1970-1979	1980-1989	1990-1998	1990-1994	1995-1998	1999-2004
Euro area	4.0	2.2	1.8	1.6	2.0	1.9
Belgium	4.2	1.9	2.0	2.0	2.0	1.9
Germany	4.1	1.9	2.0	2.5	1.4	1.1
Greece	6.1	2.1	2.3	1.8	2.9	3.0
Spain	4.2	2.4	2.1	1.6	2.8	3.5
France	3.8	2.1	1.2	1.0	1.5	2.3
Ireland	4.0	2.1	4.1	2.5	6.1	5.2
Italy	4.1	2.8	1.6	1.0	2.3	1.5
Luxembourg	4.4	2.8	3.5	2.9	4.2	3.1
Netherlands	3.9	0.9	2.6	1.7	3.7	1.7
Austria	4.2	2.9	2.3	2.9	1.4	1.5
Portugal	3.9	2.5	3.3	3.5	3.0	2.0
Finland	3.6	3.9	0.6	-2.1	3.9	2.9

Source: European Commission.

Table 10 Growth rate of real total investment across the euro area countries

	1970-1979	1980-1989	1990-1998	1990-1994	1995-1998	1999-2004
Euro area	2.3	2.2	1.5	0.5	2.9	1.7
Belgium	2.6	2.0	2.0	0.7	3.7	1.0
Germany	2.0	1.0	2.1	3.4	0.5	-1.1
Greece	5.4	-0.7	3.4	0.1	7.5	8.3
Spain	2.1	5.4	2.4	-0.6	6.2	4.5
France	2.9	3.1	0.5	-0.9	2.2	3.2
Ireland	6.2	-0.4	8.7	2.4	16.7	5.6
Italy	1.8	1.7	0.9	-1.4	3.9	2.6
Luxembourg	2.3	4.9	5.7	4.9	6.7	3.4
Netherlands	1.2	2.2	2.6	0.5	5.3	0.7
Austria	4.6	1.4	2.7	3.5	1.6	2.2
Portugal	4.7	3.0	5.6	2.5	9.4	-0.5
Finland	2.7	4.4	-2.0	-11.7	10.0	1.7

Source: European Commission.

Table 11 Growth rates of real exports across the euro area countries

	1970-1979	1980-1989	1990-1998	1990-1994	1995-1998	1999-2004
Euro area	6.7	4.5	6.5	5.6	7.6	4.8
Belgium	5.9	4.6	4.3	3.8	5.0	4.0
Germany	5.3	4.6	6.3	5.5	7.2	6.5
Greece	14.6	2.4	5.2	3.1	7.9	5.8
Spain	8.8	5.5	9.8	9.0	10.8	5.0
France	8.3	4.3	6.1	4.7	7.8	3.5
Ireland	8.7	8.6	13.9	10.6	17.9	8.9
Italy	7.7	4.2	6.1	6.5	5.8	1.6
Luxembourg	4.5	6.4	7.7	6.0	9.8	7.0
Netherlands	6.2	4.3	6.3	5.5	7.4	4.3
Austria	8.0	4.0	5.2	3.1	7.8	6.2
Portugal	6.2	7.8	5.7	3.8	8.0	4.0
Finland	6.2	2.7	7.9	6.8	9.2	5.8

Source: European Commission.

Table 12 Agriculture, forestry and fishery products

(valued added shares in %)

	1970-1979	1980-1989	1990-1998	1999-2004
Euro area	3.2	3.0	2.8	2.5
Belgium	1.5	1.5	1.6	1.5
Germany	1.4	1.3	1.3	1.3
Greece	21.3	13.8	9.3	7.7
Spain	-	4.9	4.9	4.1
France	3.9	3.5	3.3	3.0
Ireland	-	-	-	-
Italy	4.5	3.7	3.3	3.1
Luxembourg	-	2.4	1.9	1.3
Netherlands	2.5	3.1	3.4	3.1
Austria	2.6	2.6	2.7	2.6
Portugal	-	6.7	5.1	4.1
Finland	7.3	6.1	4.5	3.9

Source: European Commission.
Note: Euro area obtained as the sum of the available countries in each sub-period.

Table 13 Industry excluding building and construction

(valued added shares in %)

	1970-1979	1980-1989	1990-1998	1999-2004
Euro area	27.4	25.3	23.5	22.5
Belgium	22.7	24.2	23.8	23.6
Germany	33.1	30.1	26.5	23.6
Greece	13.5	16.4	16.3	15.3
Spain	-	23.3	22.2	22.4
France	22.9	21.7	20.7	21.7
Ireland	-	-	-	-
Italy	26.9	25.1	24.4	23.7
Luxembourg	-	17.5	15.4	13.2
Netherlands	24.5	23.2	22.3	20.5
Austria	24.9	24.2	22.8	24.0
Portugal	-	25.5	23.6	23.1
Finland	23.1	24.2	26.1	30.2

Source: European Commission.
Note: Euro area obtained as the sum of the available countries in each sub-period.

Table 14 Manufacturing

(valued added shares in %)

	1970-1979	1980-1989	1990-1998	1999-2004
Euro area	25.6	21.9	20.8	20.4
Belgium	20.3	21.1	20.6	20.3
Germany	28.7	26.1	23.4	21.2
Greece	12.8	14.3	13.3	12.1
Spain	-	18.9	18.3	18.4
France	19.3	17.9	18.3	19.3
Ireland	17.1	19.0	26.1	32.1
Italy	23.4	21.9	21.7	20.7
Luxembourg	-	15.7	13.4	11.6
Netherlands	18.0	17.8	17.5	16.4
Austria	21.1	20.5	19.5	20.7
Portugal	-	22.4	20.0	19.5
Finland	20.8	21.5	23.6	27.4

Source: European Commission.
Note: Euro area obtained as the sum of the available countries in each sub-period.

Table 15 Building and construction

(valued added shares in %)

	1970-1979	1980-1989	1990-1998	1999-2004
Euro area	8.6	6.7	6.0	5.2
Belgium	7.3	5.2	5.2	4.9
Germany	9.3	7.3	6.5	5.0
Greece	9.5	7.2	6.9	7.4
Spain	-	7.3	7.6	8.2
France	8.4	6.2	5.3	4.2
Ireland	-	-	-	-
Italy	7.4	6.2	5.4	5.1
Luxembourg	-	6.9	6.2	6.0
Netherlands	9.5	6.6	5.6	5.0
Austria	9.7	7.5	7.7	7.4
Portugal	-	6.7	6.5	6.3
Finland	8.5	7.1	5.6	4.3

Source: European Commission.
Note: Euro area obtained as the sum of the available countries in each sub-period

Table 16 Services

(valued added shares in %)

	1970-1979	1980-1989	1990-1998	1999-2004
Euro area	59.6	64.2	66.8	68.2
Belgium	67.1	69.1	69.7	70.2
Germany	56.0	61.4	66.1	70.2
Greece	51.4	61.0	67.7	69.7
Spain	-	64.5	65.3	65.4
France	63.8	68.6	70.7	71.1
Ireland	-	-	-	-
Italy	60.8	65.3	66.9	68.5
Luxembourg	-	73.3	77.7	80.1
Netherlands	64.1	67.1	68.9	71.8
Austria	62.7	65.7	66.8	65.7
Portugal	-	60.9	64.8	66.7
Finland	60.4	61.7	62.9	61.5

Source: European Commission.
Note: Euro area obtained as the sum of the available countries in each sub-period.

APPENDIX A9 TECHNICAL DETAILS OF THE HARDING AND PAGAN DATING PROCEDURE

The Harding and Pagan dating is performed by analysing the properties of the first difference of a time series. Subject to a number of criteria based on the differenced series, turning points in the original data can be identified. These criteria are ordered in three separate steps:

1) **Determination of a potential set of turning points** (peaks and troughs)
   The end of an expansion phase is defined as (the Expansion Terminating Sequence) $ETS = \{\Delta y_{t+1} < 0, \Delta y_{t+2} < 0\}$

   Similarly, the end of a contraction phase (the Contraction Terminating Sequence) is defined as $CTS = \{\Delta y_{t+1} > 0, \Delta y_{t+2} > 0\}$

2) **A procedure to ensure that peaks and troughs alternate**

3) **Censoring rules** which make sure that the phases of expansion and contraction fulfil pre-determined criteria for the duration. In this case, in line with Harding and Pagan, the minimum length of a full cycle is set at five quarters and the minimum length of a phase (contraction or expansion) to be at least two quarters.

APPENDIX A10 THE HARDING AND PAGAN DATING PROCEDURE APPLIED TO THE UNITED STATES AND THE EURO AREA

The Harding and Pagan dating algorithm, in some respects, differs from the judgemental recession chronology for the United States produced by the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER).[31] Importantly, the Harding and Pagan filter only analyses the evolution of real GDP and does not take into account other important macroeconomic variables such as industrial production and employment. Moreover, the NBER Business Cycle Dating Committee produces a monthly chronology as opposed to the quarterly output of the Harding and Pagan algorithm.

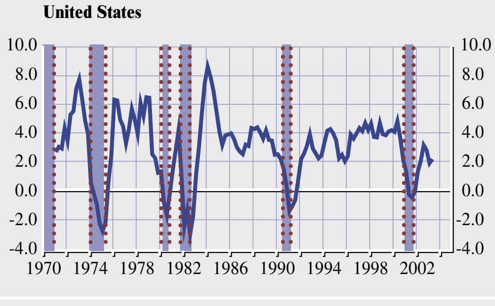
As regards the euro area, no harmonised and universally accepted recession chronology exists for the individual countries, but the Business Cycle Dating Committee of the Centre for Economic Policy Research (CEPR) dates the business cycle of the euro area.[32] The methodology involves economic judgement based on a broad range of economic variables and the approach is therefore relatively similar to the NBER recession dating, the main exception being that the CEPR chronology is reported at a quarterly frequency.

In order to check the robustness of the Harding and Pagan algorithm used in this study, its results applied to real GDP for the United States and for the euro area are compared with the chronologies of the NBER and CEPR, respectively. With regard to the United States, as can be seen in Chart 90 and Table 16, the Harding and Pagan method successfully reproduces the NBER chronology in almost all cases. For the euro area, the results are similar, except for the period from the second quarter of 1980 – and the third quarter of 1982. While the CEPR classifies this whole period as a recession, the Harding and Pagan algorithm identifies two separate recessions with an expansionary phase in-between. The reason for this difference is that, while overall real GDP in the euro area was on an expansionary path between the fourth quarter of 1980 and the first quarter of 1982, the economy still suffered from recession-like symptoms, such as decreasing investment and employment; elements that were also considered by the CEPR.

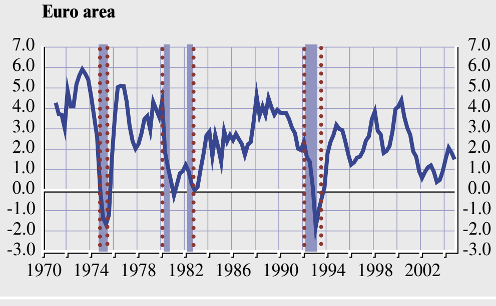
31 See http://www.nber.org/cycles/recessions.html
32 See http://www.cepr.org/data/Dating/

Chart 90 Business cycle dating in the United States and the euro area

(GDP annual growth rate %)



Note: The shaded areas in the chart refer to technical recessions in the United States according to the Harding and Pagan dating procedure, own calculations. Areas between vertical discontinued lines refer to official recession periods according to the Business Cycle Dating Committee of the National Bureau of Economic Research. The bold line depicts the year-on-year growth rate of real GDP.



Note: The shaded areas in the chart refer to technical recessions in the euro area according to the Harding and Pagan dating procedure, own calculations. Areas between vertical discontinued lines refer to recession periods in the euro area according to the Business Cycle Dating Committee of the Centre for Economic Policy Research. The bold line depicts the year-on-year growth rate of real GDP.

Table 16 Business cycle dating in the United States and the euro area

Comparison between the official NBER business cycle dating and the Harding and Pagan dating algorithm for the United States

	Peaks	Troughs
NBER [1]	69Q4	70Q4
Harding&Pagan [2]	„	„
NBER [1]	73Q4	75Q4
Harding&Pagan [2]	„	„
NBER [1]	80Q1	80Q3
Harding&Pagan [2]	„	„
NBER [1]	81Q3	82Q4
Harding&Pagan [2]	„	’Q3
NBER [1]	90Q3	91Q1
Harding&Pagan [2]	’Q2	„
NBER [1]	01Q1	01Q4
Harding&Pagan [2]	00Q4	’Q3

1) According to the Business Cycle Dating Committee of the National Bureau of Economic Research.
2) Own calculations using quarterly GDP data from NBER, applying Harding & Pagan’s algorithm.

Comparison between the CEPR business cycle dating and the Harding and Pagan dating algorithm for the euro area

	Peaks	Troughs
CEPR [1]	74Q3	75Q1
Harding&Pagan [2]	„	’Q2
CEPR [1]	80Q1	82Q3
Harding&Pagan [2]	„	80Q3
Harding&Pagan [2]	82Q1	82Q3
CEPR [1]	92Q1	93Q3
Harding&Pagan [2]	„	’Q1

1) According to the Business Cycle Dating Committee of the Centre for Economic Policy Research.
2) Own calculations using quarterly GDP data, applying Harding & Pagan’s algorithm.

In overall terms, the Harding and Pagan algorithm is a reliable procedure for dating the cycle of real GDP. However, it has to be stressed that dating of a country’s business cycle requires that other variables such as employment and investment are also taken into account.

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