

# Investment in the Euro Area

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## Abstract

Reviewing economic performance over the past three decades, it is apparent that GDP growth in the US is faring better than that in the Euro Area. This article aims to identify periods where gaps have emerged between the two economic areas with particular focus on the role of investment as a means of accumulating productive capital stock. The relative importance of capital in GDP growth is assessed for the US, Euro Area aggregate and individual Member States. Investment growth rates for the Euro Area are reviewed on a disaggregated basis, noting the relative contributions of each country to the total.

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## 1. Introduction

The relative economic performances of the US and Euro Area has drawn many reviews in recent past, noting the comparatively strong growth in the former relative to the latter. Comparisons and contrasts between the two economic areas are of interest in understanding differences in performance, giving consideration to business cycles and production function elements. The degree to which US and Euro Area business cycles are related is assessed in Giannone, Lenza and Reichlin (2009) and previously in Giannone and Reichlin (2006), who found that they are very correlated with the Euro Area aggregate business cycle lagging behind that of the US. The issue of business cycles, in particular spillover effects from the US economy on the global economy, is examined in Déés and Saint-Guilhem (2009) and by the IMF (2007). Both these papers consider the role of the US as driver of the global economy and assess the history and evolution of the transmission of US cycles to the rest of the world.

In reviewing the economic performance of the Euro Area relative to that of the US, it also seems appropriate to consider output performance in the context of production function elements. The outputs generated by an economic area reflect the inputs of capital, labour and the technology mixes, or efficiencies employed. A number of studies have analysed the effects of labour inputs to the Euro Area production process. Van Ark, O'Mahony and Timmer review the experiences of the Euro Area relative to the US from a labour productivity perspective with particular focus on the "knowledge economy". Linehan and McQuinn and also McCarthy and McQuinn also address labour market inputs considering the role of the average working week and participation rates respectively. This present article seeks to examine the role of capital stocks.

It is worth noting that the pace of investment in the US significantly outperformed that of the Euro Area over prolonged periods of time. While Euro Area investment growth rates exceeded those of the US during the late 1980s and the turn of the decade, a significant

and substantial gap emerged and was sustained between 1992 and 2000. The most extreme gap was in 1993, where Euro Area investment fell by 6 per cent while in the US investment grew by the same amount. The rest of the 1990s had positive growth rates in the Euro Area, but still lagging behind those in the US by between 2 and 6 percentage points. Following a brief return to a positive gap in 2001-02, US investment growth again moved ahead of that in the Euro Area from 2003 to 2005. In the more recent years under review, 2006-2007, the gap has been positive, with investment in the US moderating while that of the Euro Area has actually picked up. Similarly, the proportion of GDP accounted for by investment rose steeply in the US during the 1992-2000 period. Averaging around 16 per cent up to 1992 and having been below the Euro Area average of around 21 per cent, the US ratio climbed steeply throughout the 1990s to lie within 1-2 percentage points of the Euro Area rate. It seems reasonable to infer that US capital stocks have accordingly accumulated at a far greater pace and that this would go some way toward explaining the somewhat weaker economic performance of the Euro Area.

In this article, we revisit the growth accounting framework analysis used in Linehan and McQuinn (2008) and McCarthy and McQuinn (2008), reviewing the rate of output growth of the US and Euro Area and quantifying the relative impacts of capital, labour and the combined productivity of inputs. The relative evolution of capital stocks and total factor productivity is noted. Investment, as the driver of capital accumulation, is reviewed on a disaggregated country-by-country basis.

The data underlying this analysis is drawn mostly from Cronos (Euro Area countries) and the BEA (US data) and is described in more detail in the data appendix. Due to data limitations, the analysis does not cover Cyprus and Malta. Slovenia is included where possible, but is not covered where the analysis requires a review over longer time periods.

### Accumulation of capital stocks

The stock of capital available for production

purposes at any point in time depends on three things: a starting value, a depreciation rate (or series) and a flow of investment over time.

While there are no official data available for capital stocks in the Euro Area, we apply the assumption that capital at the start of the sample period was at the steady-state value implied from the Solow growth model, i.e.,

$$K_{1980} = \frac{ITR_{1980}}{\frac{g}{(1-\alpha)} + n + \delta}$$

Where K is the capital stock, ITR is (filtered) real investment, g is the mean growth rate  $\alpha$ , is the weight of capital in the production function, n is labour force growth and  $\delta$  is the depreciation rate. From this starting value, capital stocks are rolled forward by the

perpetual inventory method using an annual depreciation rate of 6 per cent:

$$K_t = (1 - \delta) * K_{t-1} + ITR_{t-1} .$$

Capital stocks for the US are accumulated in the same fashion.

The capital stocks generated in this manner are graphed in Figure 1. It is clear from the graph that US capital stocks have accelerated at a much faster pace than aggregate Euro Area capital stock. Given the standardised assumptions in relation to starting values and depreciation rates, this divergence is a stark reflection of the difference in investment patterns in the two economic areas. Furthermore, it is evident that, had Euro Area investment growth rates matched those of the US, such a gap between the capital stocks as generated here would not have emerged.

Figure 1: Euro Area and US Capital Stocks

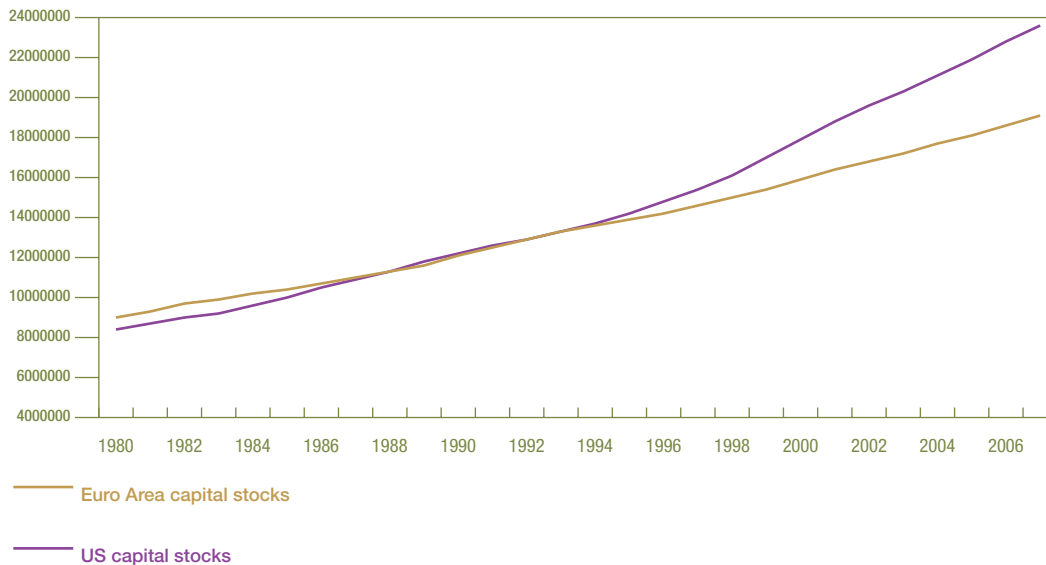


Table 1: Euro Area and US GDP growth rates

	Euro Area GDP growth	US GDP growth
1981-1991	2.42	2.97
1992-1999	1.99	3.67
2000-2001	2.88	2.21
2002-2005	1.36	2.67
2006-2007	2.7	2.4

## Output differentials and the growth accounting framework

A quick glance at GDP performance of the Euro Area and the US reveals significantly stronger GDP growth in the US for much of the sample under consideration. Figure 2 shows real GDP in levels, where clearly US GDP can be seen to accelerate at a faster pace than that

of the Euro Area. The 1992-1999 period shows, particularly, that US GDP growth rose significantly in comparison to that of the Euro Area, as is the case in the interval 2002-2005. These periods of relative acceleration coincide with rapid investment growth: as previously noted, investment grew strongly in the US in these years, and as a component of national income, this fuelled GDP growth.

Figure 2: Euro Area and US GDP

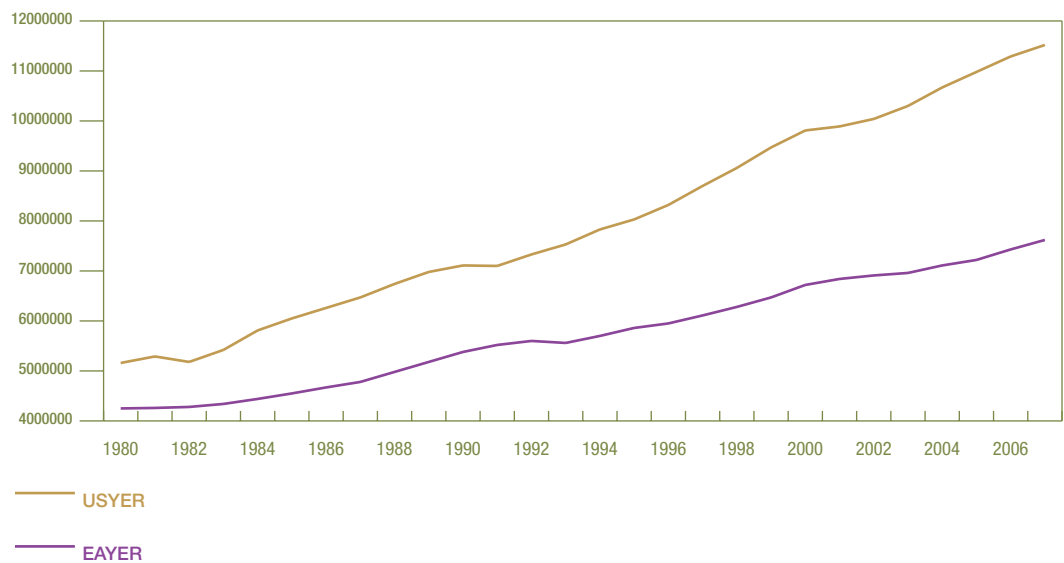


Table 1 confirms these periods of strong growth in the US relative to the Euro Area. It contains average GDP growth rates over these periods of strong growth, relative to average growth rates of the rest of the sample period. While average growth rates for the intervals 1981-1991, 2000-2001 and 2006-2007 are not starkly different, US growth rates are twice those of the Euro Area for 1992-1999 and 2002-2005.

The question of interest is this: while we can observe that these higher growth rates in GDP are associated with higher growth in investment, to what degree are the resulting gains in productive capital contributing to GDP growth? More generally, what are the relative contributions of capital, labour and the combined productivity of inputs to GDP growth? These questions lead us to the issue of growth accounting.

We revisit the growth accounting framework analysis used in Linehan and McQuinn (2008) and McCarthy and McQuinn (2008), starting

with a standard Cobb-Douglas production function for each country:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha},$$

where Y is real GDP, K is the capital stock and L is labour input. A is defined as total factor productivity (TFP) and captures technology mixes and efficiencies. As A is not directly observable, it is calculated by residual. The weight of capital in the production function,  $\alpha$ , is set at  $\frac{1}{3}$ . The growth in output generated by this production function decomposes into its constituent parts:

$$\frac{dY_t}{Y_t} = \frac{dA_t}{A_t} + \alpha \frac{dK_t}{K_t} + (1-\alpha) \frac{dL_t}{L_t}.$$

We have previously seen that, over much of our sample period, US GDP growth and capital accumulation has exceeded that of the Euro Area: for completeness, Figures 3 & 4 illustrate the paths of labour and TFP.

Figure 3: Euro Area and US Labour Input

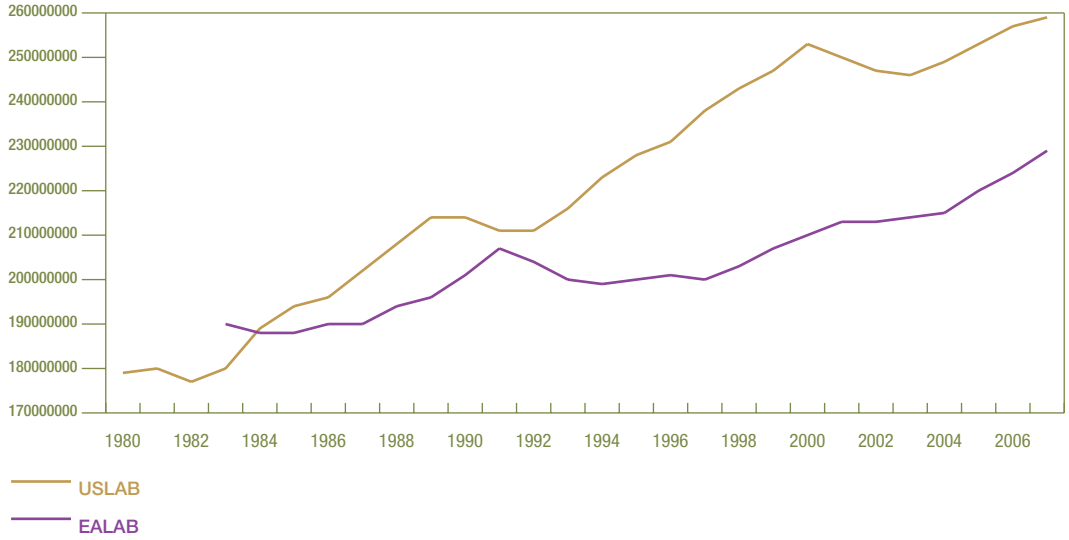
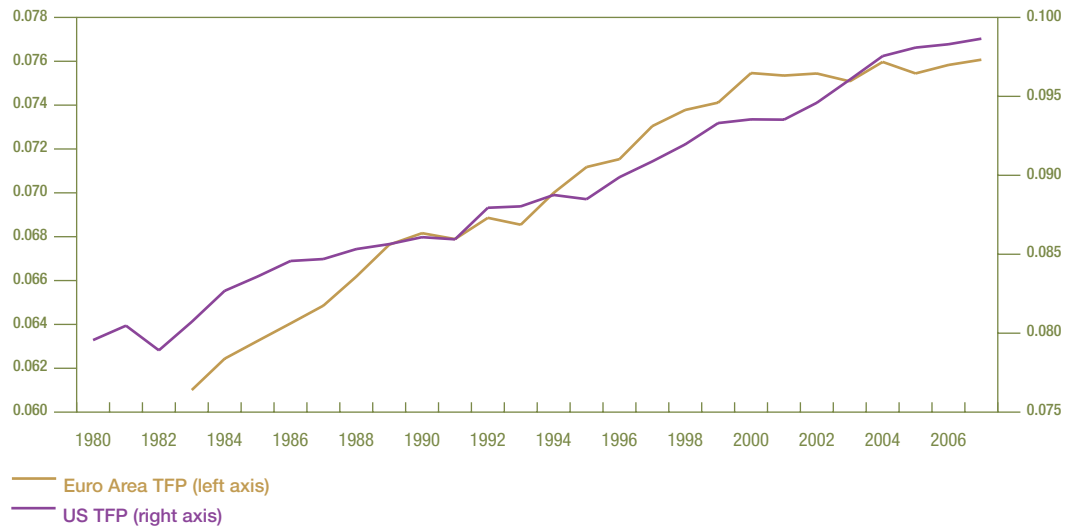


Figure 4: Euro Area and US TFP



Turning our focus to the contribution of the capital stock to GDP growth, we note that

$$\begin{aligned} dK_t &= K_t - K_{t-1} \\ &= ITR_{t-1} - \delta K_{t-1} . \end{aligned}$$

We can see that, at a constant rate of depreciation, changes in capital are directly attributable to investment and that average depreciation over  $n$  periods may be described as average investment minus average depreciation, both relative to the original capital stock:

$$\frac{1}{n} \left( \frac{K_n - K_0}{K_0} \right) = \frac{1}{nK_0} \sum_{t=0}^{n-1} I_t - \frac{\delta}{nK_0} \sum_{t=0}^{n-1} K_t .$$

Applying these frameworks to the data for each Euro Area country, the Euro Area aggregate and the United States generates a

decomposition of the growth rate of GDP into its constituent parts, namely the growth generated by gains in TFP, labour and capital. Capital gains are further subdivided into gross investment accumulation and depreciation losses. The results of this contribution analysis are presented in Tables 2-4, where the data represent average growth rates per annum. The intervals chosen are (i) 1983-1991, (ii) 1992-2000 and (iii) 2001-2007. These intervals were selected firstly as they break the sample into 3 roughly even sized periods but also as they coincide with phases of relative GDP growth. The first interval, 1983-1991, reflects a period of approximately comparable GDP growth — as noted in Table 1 above. The second interval, 1992-2000, covers the period of relatively strong growth in both investment and output in the US, while the third interval covers the remaining years, a more volatile mix in terms of relative GDP performance.

**Table 2: Decomposition of GDP growth, 1983-1991**

Country	$\Delta y$	$\Delta a$	$\Delta k$	$\Delta l$	$\Delta inv$	$\Delta deprec$
Austria	2.6	N/A	0.9	N/A	3.2	-2.2
Belgium	2.6	1.2	0.9	0.5	3.2	-2.1
Germany	3.4	1.9	0.8	0.7	3.0	-2.1
Spain	3.6	N/A	1.3	N/A	3.6	-2.2
France	2.5	1.6	0.9	0.1	3.2	-2.2
Finland	2.0	N/A	1.1	N/A	3.4	-2.2
Greece	1.7	1.1	0.6	0.0	2.8	-2.1
Ireland	3.0	1.4	0.5	1.1	2.7	-2.1
Italy	2.9	1.7	0.9	0.2	3.2	-2.2
Luxembourg	6.6	4.6	1.2	0.9	3.5	-2.2
The Netherlands	3.1	0.6	1.0	1.5	3.3	-2.2
Portugal	4.1	N/A	0.9	N/A	3.2	-2.1
Slovenia	N/A	N/A	N/A	N/A	N/A	N/A
Euro	3.0	1.3	1.0	0.7	3.2	-2.2
US	3.4	0.8	1.3	1.3	3.6	-2.3

**Table 3: Decomposition of GDP growth, 1992-2000**

Country	$\Delta y$	$\Delta a$	$\Delta k$	$\Delta l$	$\Delta inv$	$\Delta deprec$
Austria	2.4	N/A	1.1	N/A	3.4	-2.2
Belgium	2.5	1.0	1.0	0.5	3.3	-2.2
Germany	1.7	1.4	0.9	-0.6	3.2	-2.2
Spain	3.3	0.4	1.2	1.7	3.6	-2.2
France	2.2	1.5	0.7	-0.1	2.9	-2.1
Finland	3.7	N/A	0.1	N/A	2.2	-2.0
Greece	2.4	0.7	0.7	1.1	2.8	-2.1
Ireland	7.9	4.2	1.3	2.5	3.5	-2.2
Italy	1.7	1.0	0.6	0.0	2.8	-2.1
Luxembourg	6.6	4.4	1.7	0.5	4.4	-2.3
The Netherlands	3.4	1.1	1.1	1.1	3.5	-2.2
Portugal	3.5	1.7	1.4	0.5	3.9	-2.2
Slovenia	4.3	N/A	1.4	N/A	3.7	-2.2
Euro	2.3	1.1	0.9	0.3	3.1	-2.2
US	3.6	0.8	1.4	1.5	3.6	-2.2

Table 4: Decomposition of GDP growth, 2001-2007

Country	$\Delta y$	$\Delta a$	$\Delta k$	$\Delta l$	$\Delta inv$	$\Delta deprec$
Austria	2.4	0.5	0.8	1.1	3.0	-2.1
Belgium	2.1	0.4	0.9	0.8	3.1	-2.1
Germany	1.2	0.4	0.5	0.3	2.6	-2.1
Spain	3.3	0.1	1.6	1.6	4.0	-2.2
France	1.8	0.1	0.9	0.8	3.1	-2.1
Finland	3.2	2.2	0.7	0.2	2.9	-2.1
Greece	4.2	1.6	1.7	0.8	4.1	-2.2
Ireland	5.3	1.3	2.0	2.0	4.7	-2.3
Italy	1.0	-0.6	0.8	0.8	2.9	-2.1
Luxembourg	4.3	1.8	1.8	0.8	4.3	-2.3
The Netherlands	1.9	0.4	0.9	0.6	3.2	-2.1
Portugal	0.9	-0.2	1.1	0.1	3.4	-2.2
Slovenia	4.6	2.3	1.8	0.5	4.4	-2.2
Euro	1.8	0.2	0.9	0.8	3.0	-2.1
US	2.5	0.9	1.3	0.4	3.6	-2.2

### Results of the decomposition analysis

Focusing initially on the Euro Area and US results, there are a number of points to be noted in the tables. First, while the tables cover three different intervals in terms of relative economic performance, there is no single driving factor that one can identify as primarily and consistently closing or widening the gap in GDP growth. The interplay of the three production function components shifts significantly over time. Second, as noted in Linehan and McQuinn and also McCarthy and McQuinn, the contribution of labour to GDP growth has been quite limited in the Euro Area, although this has picked up somewhat in recent years. A thorough discussion of the drivers of labour inputs is contained in these two articles and it is not proposed to revisit these here.

Third, the relative roles of TFP are diverging over time in the two economic areas. Initially, TFP was a strong driver of GDP growth in the Euro Area — in particular, the second table covering 1992-2000 shows that TFP gains contributed to about half of GDP growth in percentage point terms. This fell drastically to about one ninth in the third interval reflecting the stagnation visible in Figure 4. Conversely, US TFP accounted for around 22 per cent of GDP growth over the first two intervals, rising to over a third in the final period under review. Clearly, this reversal of fortunes in relation to TFP can go some way to explaining the output differential between the US and the Euro Area in the 2001-2007 period, particularly as it is

outweighing the relative improvement in Euro Area labour input over the same period.

Finally, while at first glance there seems not to be much variation in capital contributions to GDP growth, it is worth a closer look at the numbers. For both the Euro Area and the US, the relative contribution of capital stocks to economic growth was around one third for much of the sample. However, in 2001-2007, it is estimated here that the amount of GDP growth accounted for by gains in the capital stock had increased for both economic areas to about 50 per cent. Moreover, it is noted that the largest gap in the relative GDP growth rates recorded in the tables, for the interval 1992-2000, is associated with the largest gap in capital contribution: while only half a percentage point, it is worth recalling that, due to the weight in the production function, this implies that growth in capital stocks was one and a half percentage points stronger per annum over the period in the US than the Euro Area. This capital stock gain is associated with the strong investment growth already noted. This strong investment growth is not immediately evident from the results in the table, as the contribution to GDP growth from investment is calculated relative to the capital stock and is weighted by  $\alpha = \frac{1}{3}$ , but it is apparent that US investment growth has consistently outperformed that of the Euro Area across all time periods in relation to its contributions to GDP growth via the capital stock.

Turning to the results of individual country

decompositions, it is evident that the Euro Area aggregates are reflecting a sometimes diverse range of country experiences. Over the full sample period, there have been marked differences between both the GDP growth rates and the balance of relative contributions from the production function components.

Of the three intervals under review, the first (Table 2, 1983-1991) records the highest Euro Area GDP growth on average over the period: expanding by 3 per cent on average per annum, it can be seen that most countries were clustered around this value. Finland and Greece recorded comparatively slow growth, while that of Luxembourg and Portugal were markedly higher. Similarly, the estimated average values for the absolute contribution of gains in the capital stock to GDP growth are all quite similar: relative to the Euro Area value of 1 percentage point, most countries fall close to this, with Spain and Ireland being the extreme values of the estimates at 1.3 and 0.5 percentage points respectively. This is reflecting the fairly comparable contributions of investment to GDP growth, with all countries falling within  $\pm 0.5$  of the Euro Area value of 3.2 percentage points. As one would expect, Spain and Ireland again account for the extreme values of 3.6 and 2.7 percentage points respectively.

In relative terms, for many countries, the contribution of capital to GDP growth during 1983-1991 has been roughly  $\frac{1}{3}$ . There are some exceptions to this: the contribution of the capital stock in Germany, Ireland, Luxembourg and Portugal to GDP growth was somewhat lower. In Germany, which recorded an average GDP growth rate of 3.4 per cent, expansion of the capital stock only contributed an average of 0.8 per cent per annum to this growth. TFP gains accounted for the bulk of this growth. Similarly, Luxembourg in particular appeared to be experiencing strong TFP gains, with very limited contribution from growth in the capital stock. Conversely, Finland, while recording lower GDP growth per annum than most other countries, experienced a higher contribution from capital stocks in relative terms, with 1.1 percentage points of the 2 per cent growth accounted for by the capital stock. With the

exception of The Netherlands, the contribution of labour input has been modest, while TFP gains have had a notable impact as mentioned in Germany and Luxembourg, but also in France and Italy.

Moving on to the second interval of interest (Table 3, 1992-2000), the Euro Area GDP growth averaged at 2.3 per cent per annum, a little less than the preceding period. This slight fall off in growth rates was mirrored in many countries, but four countries recorded gains in GDP growth rates on average for this period. Finland, Greece, the Netherlands and most notably Ireland had higher GDP growth during the second interval. The Celtic Tiger period dominates the sample for Ireland, with six consecutive years of growth rates in excess of 9 per cent. It is fair to say that there was a good deal more heterogeneity across the region in this interval, relative to the first, with considerable variation across countries relative to the Euro Area average. This is also the case with absolute contributions from the capital stocks: values range from as little as 0.1 percentage points (Finland) to 1.7 percentage points in the case of Luxembourg. Ireland, Portugal, Slovenia and Spain also record high absolute contributions of capital to GDP growth. Similarly, investment contributions vary significantly, ranging from Finland at 2.2 percentage points, which just covered the replacement rate of capital, to 4.4 percentage points in the case of Luxembourg. As with capital, Ireland, Portugal, Slovenia and Spain have high contribution rates from investment, as does the Netherlands.

As one might expect from the increased diversity throughout the 1992-2000 interval, there are fewer countries with similar relative contributions from the capital stock to GDP growth. Five countries record capital stock contribution to GDP growth at around  $\frac{1}{3}$ , as before, however the ratio for Austria, Belgium, Germany and Portugal has risen to 40 per cent or more. Four countries have experienced declines in the rate of capital contribution, albeit for different reasons. In the cases of France and Greece, investment contributions to GDP growth were a little below the Euro Area average, as were capital contributions.



However, the poor performance of labour input in France prevented the relative capital contribution from falling dramatically, while the labour input in Greece outperformed the other two inputs, pushing down the capital and TFP contributions in relative terms. In Finland, investment was quite sluggish over the period and capital stocks levelled off. The investment contribution was just covering the depreciation of capital, so net accumulation of capital did not trigger much GDP growth. However, in the case of Ireland, investment contributions were significantly above that of the Euro Area. The contribution from capital stock was 1.3 percentage points on average. But in addition, Ireland — similarly to Luxembourg — experienced pronounced gains in GDP, driven by TFP gains, which swamped the effects of the capital stock, reducing its impact to below that of other countries. In general, the Euro Area TFP gains as seen in Figure 4 are apparent in the results and reflected across many countries.

Turning to the third interval in the analysis (Table 4, 2001-2007), the diversity of performance of the countries of the Euro Area is again apparent. Most countries experience a levelling or fall in the average rate of GDP growth, with only Greece and Slovenia recording increases in the rates of growth. Indeed, Greece is the only Euro Area country whose average growth rates have continued to rise over the three periods. There is substantial divergence relative to the Euro Area GDP growth rate of 1.8 per cent: Ireland, Slovenia, Luxembourg and Greece have growth rates more than double the average, while Germany, Italy and Portugal are lying below at 1.2, 1.0 and 0.9 per cent respectively. Only the growth rates of three countries — France, The Netherlands and Belgium, lie close to the Euro Area rate. It is unsurprising then, that the range of values for the contributions of capital to growth rates is also scattered through a range of 0.5 (Germany) to 2.0 (Ireland) percentage points. As in the previous period, Spain, Ireland, Luxembourg and Slovenia record the highest contributions in absolute terms, as does Greece, reflecting the high contribution rates from investment. Five countries lie within  $\pm 0.1$  of the Euro Area average investment

contribution — Austria, Belgium, France, Finland and Italy, while The Netherlands is also a little above. Germany lies below the average at 2.6 percentage points.

The 2001-2007 interval also marks a strengthening across a range of countries in the relative contribution of capital to GDP growth. As previously noted, the amount of Euro Area growth attributable to capital increased from  $\frac{1}{3}$  to  $\frac{1}{2}$ : this reflects rises in the rate of capital contribution in all but two countries, Austria and Germany. Nine countries record capital contribution rates of 40 per cent or more. Only one country, Finland, has a contribution rate less than  $\frac{1}{3}$  and this was a considerable rise relative to the previous period. In the case of Portugal, the gains arising from capital accumulation actually exceed growth in GDP, being offset by losses in TFP. These rises reflect a maintenance or improvement of the percentage points growth generated by capital accumulation, compared against no improvement at best and in many cases moderation of the rate of growth in GDP. Indeed, it seems an inevitable conclusion that the stagnation of TFP performance in the Euro Area visible in Figure 4 has had a significant part to play in the disappointing performance of the Euro Area relative to the US. The amount of GDP growth attributable to TFP gains was less than half a percentage point for eight countries during this period, with two countries showing TFP losses. In stark contrast, the remaining five countries perform quite well in TFP terms, with four countries (Finland, Greece, Luxembourg and Slovenia) attributing more than 1.5 percentage points of GDP growth to TFP gains.

### Euro Area Investment

The range of values yielded by the decomposition analysis invites the question of how the Euro Area aggregate reflects the underlying country experiences. In understanding the aggregate, it seems prudent to be aware of the individual country contributions to the Euro Area total. A more disaggregated look at where investment growth is coming from may indicate whether Euro Area growth rates are representative of the full set of Member States or whether they are best

viewed as an average capturing a diverse range of country experiences. This is a particularly interesting question during periods of comparatively poor Euro Area growth relative to that in the US.

Recalling that the intervals 1992-1999 and

2002-2005 were periods of disappointing GDP growth in the Euro Area relative to the US and also that the decomposition analysis suggests that capital accumulation through investment had a strong explanatory role to play particularly in recent past, we note here in Table 5 the average investment growth rates for the Euro Area and the US.

**Table 5: Euro Area and US investment growth rates**

	Euro Area GDP growth	US GDP growth
1980-1991	2.29	2.7
1992-1999	2.11	7.16
2000-2001	2.72	2.15
2002-2005	1.29	2.89
2006-2007	4.93	-0.03

It seems fair to remark that the gap in GDP growth which opened during 1992-1999 was driven by exceptionally high investment rates in the US which were not mirrored in the Euro Area. That said, some of the most disappointing investment growth rates over the full sample were recorded during the years 1992-1997, most notably at minus 6 per cent in 1993. Although investment picked up strongly in the Euro Area in 1998 and 1999, the growth

rates still lay well below the equivalent US values. Conversely, the US enjoyed growth rates in investment of between 5 per cent and 10 per cent over eight consecutive years, leading to the strong capital stock growth already noted. This also resulted in a pronounced increase in the proportion of GDP attributable to investment, as shown in Figure 5.

**Figure 5: Euro Area and US investment share of GDP**

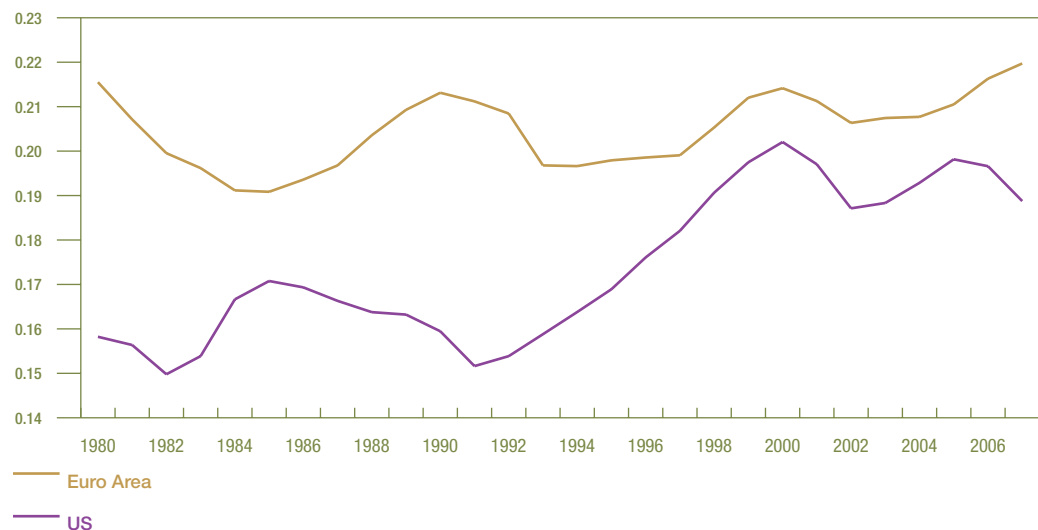
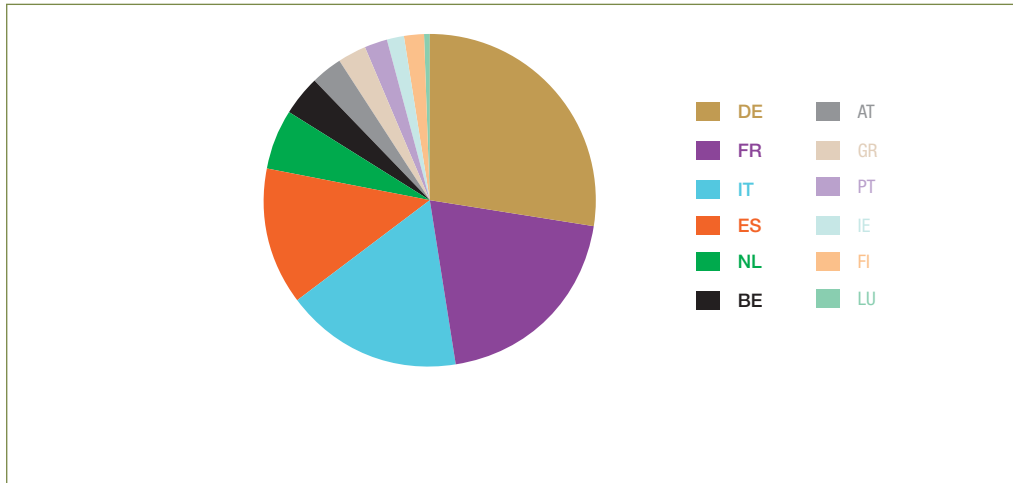


Figure 6: Country Shares of Euro Area Investment 2001-2007



In contrast, the gap between the investment and GDP performances during the 2002-2005 period seems to be as much attributable to a fall-off in investment growth in the Euro Area as to acceleration in the US. This deterioration in investment growth rates is of particular interest in the following examination of country contributions. Certainly, the decomposition analysis suggested that investment contributed a fairly diverse range of values to national GDP growth rates: a disaggregated view of Euro Area investment growth rates could be expected to indicate similar disparity.

Clearly, where a Euro Area aggregate is given by the sum of the individual member states, its percentage change will be given by the weighted sum of each member states percentage change, where the weight is the country's share in the total level. So of course, each country's contribution to the aggregate depends not only on its own investment growth rate, but also its relative size.

$$ITR^{ea} = \sum_i ITR^i$$

$$\frac{dITR^{ea}}{ITR^{ea}} = \sum_i \frac{ITR^i}{ITR^{ea}} * \frac{dITR^i}{ITR^i}$$

Turning to relative size first, it appears that there has not been a significant degree of

variation across the Euro Area countries over the full sample under consideration. Most countries have maintained approximately the same percentage share over the 1980-2007 period. The average shares in the Euro Area total for the 2001-2007 interval are depicted in Figure 6. It can be clearly seen that four countries account for some 80 per cent of the Euro Area total investment, namely Germany (28 per cent), France (20 per cent), Italy (17 per cent) and Spain (13 per cent). The next largest share in the total is The Netherlands at 6 per cent, followed by Belgium and Austria at around 3.5 per cent each, Greece at 2.7 per cent and remaining countries at 2 per cent or less. The only variations in share worth noting is that Spain's share in the total has risen from 9 per cent in the first period, while that of Germany and Italy has fallen off a little from 32 per cent and 19 per cent respectively. It is also worth remarking that Ireland's share in the total investment rose from 1 per cent to 2 per cent on the back of strong investment throughout the middle and later part of the sample, but that at these low weights, the impact of such strong investment on the Euro Area total is muted.

Clearly, given the weights indicated here, the investment growth rates in Germany, France, Italy and Spain will have the most notable

impact on the Euro Area total. The following review of country growth rates will necessarily focus particularly on these four countries.

### Investment in individual Euro Area countries

Investment growth rates for the individual Euro Area countries are summarised in Table 6, listing average annual growth per interval shown. The countries are listed in order of relative weight in the Euro Area total, grouping the four highest investing countries first in order to clearly identify the growth rates which principally drive the Euro Area growth rates. In general, there is to some degree a shared pattern over the full time period under review, with many countries sharing similar experiences in keeping with a priori expectations. Periods of relative uncertainty, namely the early 1980s (oil price shock), early 1990s (currency crisis) and 2001-02 (difficulties in the information technology sector and the events of 11 September 2001), are marked by muted or negative investment growth. Conversely, periods of stability, including steady or declining interest rates, are associated with improved investment performance. There are of course many exceptions to these generalizations and in addition the scale of country reactions varies significantly. As was evident in the decomposition analysis, there is thus a rather mixed batch of rates underlying the headline Euro Area rate, with a clear diversity between countries in each time period and across time.

Looking at the four largest contributors first, the most notable investment growth rates are those of Spain. Consistently lying above the Euro Area average, they reflect the strong results noted in the decomposition analysis whereby investment and capital contributions were on the upper end of the spectrum. Uniquely amongst these four, investment growth rates remained strong during the two periods of muted Euro Area investment performance, relative to the US, in particular in 2002-2005. It is the only country of these four not to experience negative growth rates at some point over this period. It is also worth noting that all four countries experienced negative rates during 1992-1993, and while Spain and Italy

recorded the lowest rates, the former showed the strongest rebound in the following years. France and Italy shared experiences to some degree, both countries recording dips in investment in 1992 and 1993, although in the case of France it was less pronounced. Also, in France, the pace of recovery was more sluggish, only picking up substantially at the close of the decade. Both countries had one further year of negative growth in investment, 2002 in France and 2003 in Italy, but thereafter while in France the rates of growth picked up and continued to improve up to most recent data, the rates of investment growth in Italy have remained somewhat subdued. These two countries, together with Germany and Austria, record the lowest levels of volatility around their average growth rates, although it is Germany which has the lowest average value for the full sample, standing at just 1.5 per cent per annum. Although recording some of the strongest growth rates in the Euro Area for the early 1990s, investment growth in Germany dipped substantially in the following years, lagging behind the Euro Area average in each year during 1995-2005. In nine of those eleven years, investment growth in Germany was one of the three lowest rates of the Euro Area countries. Thereafter, growth picked up significantly, particularly in 2006 with a growth rate of 7.7 per cent, the second largest annual investment growth rate for Germany over the full sample.

Turning to the wider set of countries, it is apparent from Table 6 that different growth experiences occurred across countries over time. That said, there were a number of common factors shared by many countries: as noted above, all countries experienced negative growth rates in investment at some point during the early 80s, most countries for a number of consecutive years: investment rates in Finland were least affected, with only one year negative growth (1984). Conversely, Finland was the country most affected during the investment dip of the early 90s, recording five consecutive years of reduced investment (1990-1994). All Euro Area countries experienced dips in investment throughout this period, with 1993 being a particularly difficult

**Table 6: Average growth rates in investment for individual Euro Area countries**

	1980-1991	1992-1999	2000-2001	2002-2005	2006-2007
Germany	2.0	1.7	-0.3	-1.4	6.0
France	2.1	1.4	4.8	2.1	4.8
Italy	2.1	0.8	4.5	1.4	1.9
Spain	5.1	3.2	5.7	5.3	6.2
The Netherlands	2.4	5.1	0.4	-1.2	6.1
Belgium	2.0	2.3	2.4	2.8	5.1
Austria	2.5	2.4	1.9	0.8	3.6
Greece	0.0	4.0	6.0	8.2	9.6
Portugal	3.5	6.3	2.2	-2.9	1.0
Ireland	0.2	10.7	3.5	6.9	1.6
Finland	1.9	1.5	5.1	2.0	6.6
Luxembourg	5.8	6.6	2.1	3.0	9.1
Euro Area	2.3	2.1	2.7	1.3	4.9

year: all countries bar Luxembourg recorded negative growth. Thereafter, most countries recorded positive growth rates for the balance of the 1990s, with Portugal, Luxembourg, Greece and the Netherlands and — most notably — Ireland recording strong investment figures to the latter part of the decade. Finland also had strong investment growth during the second half of the 1990s, but the weak first half performance yielded a comparatively low average for the 1992-1999 interval as noted in Table 6. The turn of the decade then brought a further period of relative uncertainty, associated with difficulties in the information technology sector and the events of 11 September 2001. Most countries experienced either diminished investment growth rates or negative rates at some point over 2001-2004. Greece alone withstood the general trend of reduced investment, presumably reflecting the capital spending programme associated with the Athens Olympics (2004). In fact, Greece is the only country with consistent improvement over the intervals chosen. Ireland is also notable in Table 6 as having a relatively strong investment performance in the 2002-2005 interval: while experiencing significantly lower investment in 2001-2002 than previous years, investment growth rates recovered well up to 2005.

Finally, nearly all Euro Area countries experienced a return to strong investment in 2006-2007, with all member states bar Ireland and Portugal recording higher growth rates than the full sample average. Germany, Finland and Greece, in particular, have growth rates

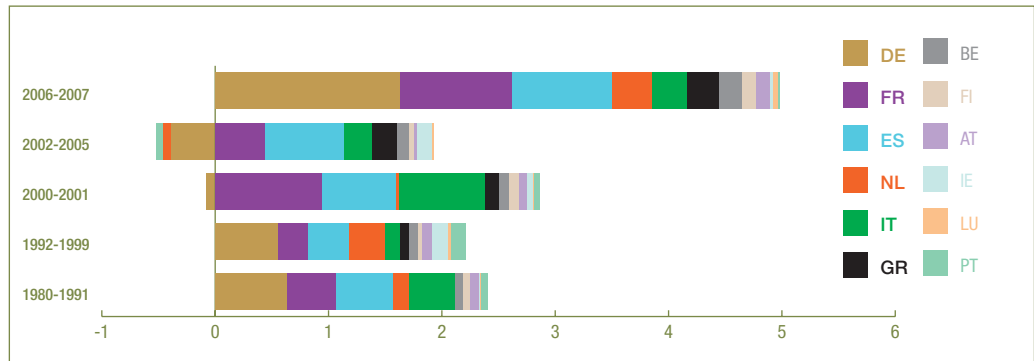
around three times the sample average, while France, Belgium and The Netherlands all around twice their average.

### Country contributions

What is interesting to note is the diversity of investment performance throughout the Euro Area: in particular, during the two intervals of low investment relative to the US, many countries actually had quite strong growth rates. This is especially evident during 2002-2005, where only four countries (Germany, The Netherlands, Austria and Portugal) had growth rates below the Euro Area average of 1.3 per cent, while Spain, Greece and Ireland had rates well in excess. The spread of values ranging from -1.4 per cent (Germany) to +8.2 per cent (Greece) is quite wide. It is also evident from Table 6 that, with the exception of Spain, the strongest growth rates during these two intervals are coming from countries with comparatively low weights in the Euro Area total, while those of the higher weighted countries are disappointing. In particular, the -1.4 per cent drop in investment recorded in Germany during 2002-2005 when combined with the average weight of 28 per cent for the same period can be seen to have quite a reducing effect on the Euro Area average.

Figure 7 summarises the country contributions, taking both weight and percentage growth into account, to each of the average growth rates recorded in the intervals under consideration. Taking most recent data first, it is apparent that many countries enjoyed relatively strong growth

Figure 7: Country Contributions to Euro Area Investment Growth Rates



rates in investment, relative to historical rates, as noted in the previous section. This translated into strong gains in the Euro Area average relative to all preceding periods. Clearly, the strong investment performance in Germany, combined with a high weight in the total, has heavily influenced the growth rate, adding 1.63 percentage points to the total. France and Spain add a further 1 and 0.90 percentage points respectively. The Netherlands is the next largest contributor in this period, adding a further 0.35 percentage points and bringing the combination of the four largest contributors to 77 per cent of the total. Interestingly, both Italy and The Netherlands contributed the same amount in this period, around 0.3 percentage points, the former through a combination of relatively high weight but low investment growth, and vice versa in the case of the latter. All remaining countries contributed 0.2 percentage points or less.

Turning to the most disappointing interval of all, 2002-2005, where Euro Area investment growth was at its lowest, it is clear from Table 6 and Figure 7 that three countries experienced reductions in investment. This is particularly notable in the case of Germany: when coupled with the high weight results in 0.4 percentage points being shaved off the Euro Area growth rate. The Netherlands and Portugal account for a further -0.15 percentage points between them. Many countries have lower contributions during 2002-2005 than preceding periods, although Belgium, Spain, Greece and Ireland

managed to nudge theirs upwards. Most usually, Belgium, Greece and Ireland account for a third of the Euro Area growth rate during 2002-2005, although this is as much attributable to poor investment performance in Germany and France as it is to strong growth rates in these three countries.

The other comparatively poor interval of investment growth relative to the US was 1992-1999, although as previously noted, this gap was more attributable to pronounced investment growth in the US than especially low rates in the Euro Area. That said, this period was marked by low growth rates in many countries, particularly high weight countries — most notably France. Ireland, Portugal and The Netherlands account for an unusually high proportion of Euro Area growth, contributing 27 per cent of the total, due to strong growth rates in these countries.

### Concluding remarks

Reviewing economic performance over the past three decades, it is apparent that GDP growth in the US is faring better than that in the Euro Area. Year-on-year growth rates regularly exceed those of the Euro Area: the 1992-1999 interval shows particularly that US GDP growth rose significantly in comparison to that of the Euro Area, as is the case during 2002-2005. Given that capital is a significant driver of output, as noted in the decomposition analysis, an examination of relative investment performance is warranted. Clearly, from



national accounting identities, strong investment boosts national income in arithmetic terms, but it is its role in maintaining and augmenting the stock of productive capital as a means of producing GDP which has most concerned us here.

Gaps in investment growth rates mirror those of GDP, with 1992-1999 and 2002-2005 being strong periods of investment growth in the US relative to the Euro Area. The former is particularly notable with the US experiencing a sustained period of investment growth and increasing the investment share in national income considerably over the period.

Although the Euro Area growth rates are sometimes capturing a fairly diverse range of experiences in Member States, with some countries at times recording far higher rates of investment than others, there is more common ground in periods of cutting back, with intervals of negative rates applying across a broad range of countries. The early 1980s, early 1990s and also the early years of the current decade all showed consistent patterns of falling investment across most, if not all, Euro Area Member States. The uncertainties associated with each period of lowered investment applied — albeit unequally — across Member States. This is most notable in the early 1980s, a period of oil price hikes combined with a strong dollar and high interest rates, where all Euro Area countries experienced falls in investment at some point, Ireland more so than most. The early 1990s were marked by currency instability and rising interest rates, with all Member States experiencing at least one year of negative growth in investment: clearly, this was more pronounced in countries most affected by the currency crisis. The turn of the decade then brought a further period of relative uncertainty, associated with difficulties in the information technology sector and the events of 11 September 2001. Most countries experienced either diminished investment growth rates or negative rates at some point over 2001-2004. Greece alone withstood the general trend of reduced investment.

In examining the gaps which emerged between investment performance in the US and the Euro

Area, perhaps the most interesting period is 1992-1999. This is the period of marked acceleration in the investment rate of the US already noted, due at least in part to pronounced ICT investment. Recording an average rate of in excess of 7 per cent per annum relative to that in the Euro Area of just over 2 per cent, rapid gains in the capital stock were accordingly accumulated in the US. The start of this expansion, however, occurred at a time where currency instability and high interest rates across many countries were having the opposite effect in the Euro Area, dampening the investment rates, thereby exacerbating the wedge opening between the two economic areas. Conversely, the period 2002-2005 began with falling investment in both the US and the Euro Area. Nearly all Member States experienced significantly lower investment growth in 2002 than preceding years, with seven countries recording negative growth figures, most notably Germany at -6 per cent. Thereafter, the contrast in experiences between the US and the Euro Area is apparent, with the former rapidly recovering investment performance, while the latter records very muted investment performance for longer. That said, the Euro Area data does amalgamate some rather disparate rates from different countries: some very solid growth rates are recorded in Ireland, Belgium and Spain, while disappointing investment rates still feature in Germany, The Netherlands and Portugal. It is, however, the relative weight applied to data for Germany in the aggregate which has a pronounced dampening effect on the Euro Area investment growth rate.

In the last years of the sample period, 2006-2007, the Euro Area enjoyed a recovery in investment growth rates, with nearly all Euro Area countries experiencing a return to strong investment. All member states bar Ireland and Portugal recorded higher growth rates than the full sample average. The recovery in the Euro Area aggregate reflects this across-the-board resurgence, but can be seen to be principally driven in arithmetic terms by a distinct improvement in rates of investment growth in Germany. It is likely that this recovery, however, will be short-lived in view of the present global downturn.

## References

- Bart van Ark, Mary O'Mahony, and Marcel P. Timmer (2008). "The Productivity Gap between Europe and the United States: Trends and Causes", *Journal of Economic Perspectives*, Volume 22, Number 1, Winter 2008, pps 25-44.
- Stéphane Déés and Arthur Saint-Guilhem (2009). "The Role of the United States in the Global Economy and its Evolution over Time", ECB Working Paper Series No. 1034.
- Domenico Giannone, Michele Lenza and Lucrezia Reichlin (2009). "Business Cycles in the Euro Area", ECB Working Paper Series No. 1010.
- Domenico Giannone and Lucrezia Reichlin (2006). "Trends and Cycles in the Euro Area: How Much Heterogeneity and Should We Worry About It?", ECB Working Paper Series No. 595.
- International Monetary Fund (2007). "Decoupling the Train? Spillovers and Cycles in the Global Economy", *World Economic Outlook*, Chapter 4, 121-160.
- McQuinn, Kieran and Karl Whelan (2006). "Prospects for Growth in the Euro Area", CBFSAI Research Technical Paper Series 12/RT/06.
- McQuinn, Kieran and Karl Whelan (2008). "Prospects for Growth in the Euro Area", *CESifo Economic Studies*, 54(4) pps 642-680.
- Linehan, Suzanne and Kieran McQuinn (2008). "A Sectoral Analysis of the Average Work Week in Euro Area countries", *Quarterly Bulletin*, Central Bank and Financial Services Authority of Ireland, no. 3, pps 68-79.
- McCarthy, Yvonne and Kieran McQuinn (2008). "Changing Participation Rates in the Euro Area: The Case of the Celtic Tiger", *Quarterly Bulletin*, Central Bank and Financial Services Authority of Ireland, no. 2, pps 68-88.

Solow, Robert (1956). "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, pps 65-94.

## Data Appendix

### Euro Area data

Unless otherwise stated, all data for Euro Area countries are drawn from Eurostat's New Cronos database. Data are annual and cover the period 1980 to 2007.

GDP and investment data are chainlinked (2000). As the chainlinked data is not available for all countries with sufficient backdata, some series were extended backwards using older constant price series.

Some country-specific observations:

- Data for Germany are generally available from 1991. Prior to that, the databases generally refer to West Germany. Real investment and GDP data for Germany was extended back using growth rates of the West Germany series.
- Real data are only available for Cyprus from 1995 and for Malta from 2000 and so were not used in this analysis.
- Real data for Slovenia are available from 1990 onwards. This series was considered sufficiently long for inclusion in the growth accounting exercise. However, where the analysis refers to Euro Area aggregates over the full sample period, these are usually defined excluding Slovenia.

Numbers employed were also drawn from New Cronos, using LFS definitions. As with national accounts, data was not available for all countries covering the full period, so Euro Area data were backcast using growth rates of the best available aggregate.

### US data

US national accounts data are drawn from the Department of Commerce's Bureau of Economic Analysis (BEA). The method for generating real investment data is adopted from McQuinn and Whelan, applying a Fisher



chain aggregation to private and government investment.

Although official capital stock series are available from the BEA, it was decided to generate a capital stock for the US using the same assumptions as for the Euro Area. Therefore, the same fixed depreciation rate was applied to the capital stock when rolling each series forward and the relationship between

investment and capital is clear-cut. Specifically, for the purposes of the present analysis, differences in the evolution of the capital stock arise from differences in investment patterns rather than different assumptions in relation to the depreciation rates.

Numbers employed data are drawn from the Department of Labor's Bureau of Labor Statistics.