The impact of EMU on growth in Europe

March 2008

Ray Barrell, Dawn Holland, Iana Liadze and Olga Pomerantz

Abstract Output growth in the Euro Area has been disappointing since the formation of EMU. This may be the consequence of the new monetary and exchange rate arrangements, but it is necessary to remove the effects of other factors such as the growth of labour input, skills, knowledge and risk premia. This paper undertakes a growth accounting exercises and an econometric investigation of the determinants of output in Europe and the US. It concludes that EMU has probably had a small positive effect whilst differences in the accumulation of skills and labour input growth explain much of the difference in performance across countries.

National Institute of Economic and Social Research

2 Dean Trench Street

Smith Square

London SW1P 3HE

Report prepared for the European Commission

I. Introduction

This study addresses and evaluates the impacts of the introduction of the euro on both actual and potential output in the Euro Area. There are several channels through which the euro may have affected growth: greater transparency and its impact on competitiveness and the effectiveness of the single market; integration of financial markets, which may raise productivity; and a more stable macroeconomic environment, which affects risk and investment decisions. We analyse the impact of each of these channels on the drivers of growth, after controlling for factors such as workforce skills, research base, openness, demographic developments and structural reform on the evolution of output.

The central result of our study is that EMU affects output growth directly and the many potential concerns preceding the launch of the euro seem to have been unfounded, and our work suggests that the effects of EMU that we observe have been beneficial for economic growth and employment overall. Our analysis suggests that the direct positive effects of EMU are likely to be larger in the core countries, despite their recent slow growth, and that EMU may lead to agglomeration of activities.

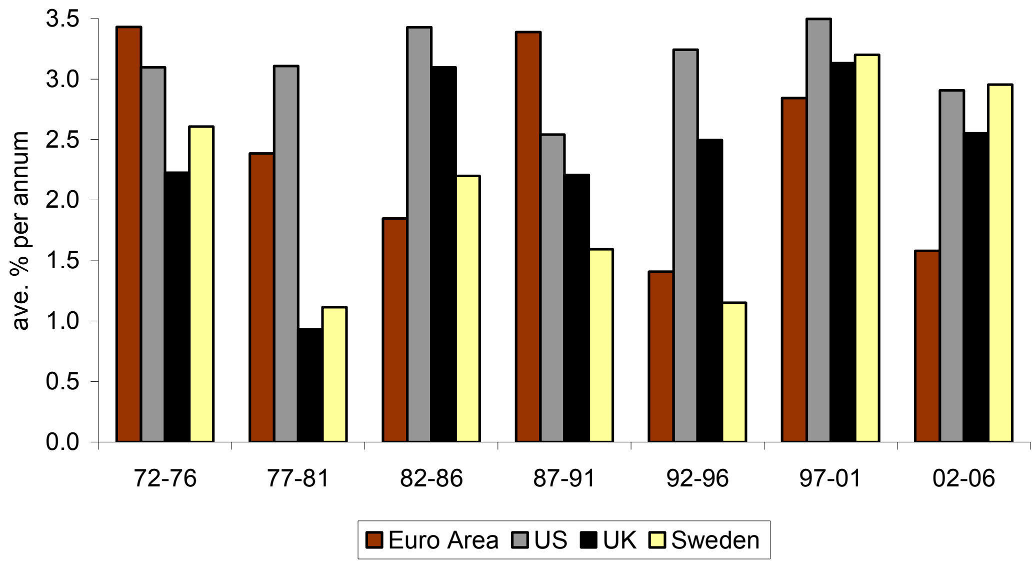
The effects of EMU on output can come through a number of channels. Economists find it useful to describe output as being the result of inputs such as capital and labour organised for output through a production function and influenced by efficiency and technology. EMU might influence the stock of capital or the supply of labour. It might also affect the efficiency with which factors are used as it may reduce barriers to competition. The time frame over which these effects may come through will vary, and it may be particularly long for capital, and hence it may not be possible to uncover the effects directly. However, the effects on labour markets and on efficiency may be more visible after eight years of EMU.

The structure of the paper is as follows. Section 2 sets out the issues to be discussed, with a comparison of output, factor input and productivity growth, and the factors behind recent slow productivity growth in the Euro Area. Section 3 presents a simple approach to modelling productivity and output, within a framework that allows us to test the impact of EMU on growth after allowing for other systemic factors and structural reforms. We then report the results of econometric estimation of this model and discuss the multiple channels through which EMU may impact output and productivity growth.

II. Factors behind the recent slow Euro Area growth

Since the introduction of the common currency, growth in the Euro Area has been weak relative to that in the US and the EU countries outside the Euro Area, the UK, Denmark and Sweden[1]. Figure II.1 highlights the average annual growth rate differentials among the US, Euro Area, the UK and Sweden[2]. In the US and the Euro Area growth was similar in the two decades to 1991 whilst Swedish and UK growth rates were generally lower than those in the US and the Euro Area over the same period. Since the mid 1990s growth in the Euro Area has lagged behind that of other economies, with the gap widening from 2002. The UK and Sweden, both of whom were in the European Union for (much of) the period from 1992, have been performing significantly better than the other members of the European Union whilst they have stayed outside EMU.

Figure II.1 Output growth in the Euro Area, the US, the UK and Sweden
Average annual growth rates



A closer look at the output growth in individual Euro Area members reveals a significant degree of variation in rates. Output growth rates, presented in Table II.1 suggest that the weak performance in the Euro Area in the early half of the current decade was driven primarily by slow output growth in Germany and Italy, each of which expanded at an average rate of less than 1 per cent per annum over the 5-year period from 2002 to 2006. Growth in the Netherlands was also less than the Euro Area average over the same period. By contrast, GDP growth in Finland and in Spain

[1] We exclude the new member states that joined the EU after the formation of EMU.
[2] We use the most commonly quoted measure of output growth, real GDP at market prices, in order that we can compare growth across these countries and construct a consistent Euro Area aggregate. It also allows comparisons with other studies. Over five year periods this should grow at a similar rate to GDP at basic prices, which removes indirect taxes and subsidies.

outpaced that recorded in the US and the non-EMU EU members. Growth picked up noticeably in 2006 and 2007 in much of the Area, and differentials narrowed. The slowdown in growth in the Euro Area after the adoption of the common currency has led many to look for the causes as coming from the monetary arrangements.

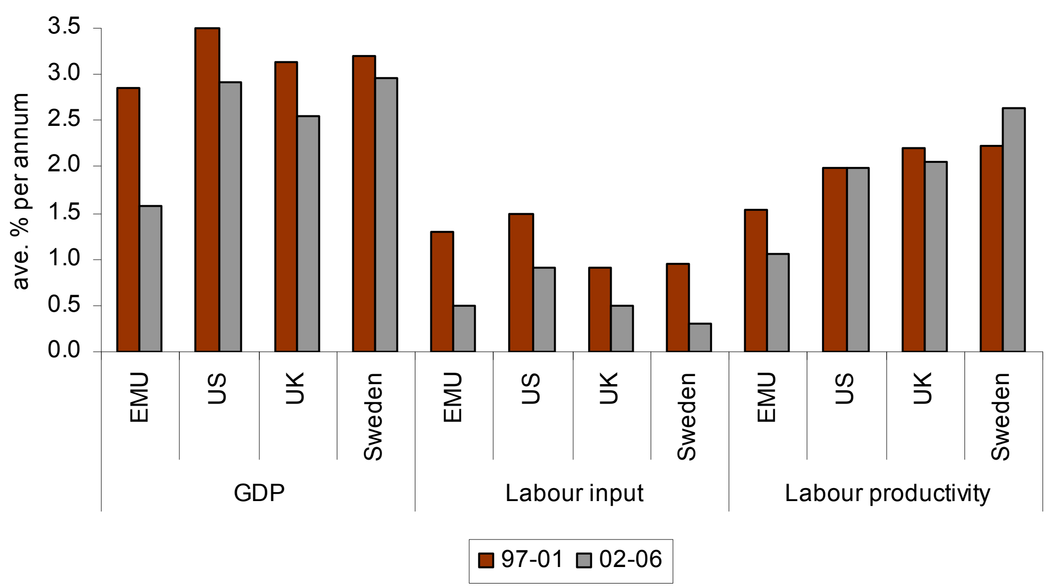
Table II.1 Output growth – country details
Average annual growth rates

period	BG	DK	FN	FR	GE	IT	NL	OE	SD	SP	UK	US	EMU
72-76	3.8	2.7	2.4	3.4	2.6	3.8	3.4	4.1	2.6	5.0	2.2	3.1	3.4
77-81	1.5	1.0	3.2	2.7	2.3	2.8	1.7	2.4	1.1	1.1	0.9	3.1	2.4
82-86	1.4	3.6	3.0	2.0	1.6	2.1	1.9	1.9	2.2	2.1	3.1	3.4	1.8
87-91	3.1	0.8	1.5	3.1	4.0	2.8	3.2	3.5	1.6	4.4	2.2	2.5	3.4
92-96	1.9	2.6	1.2	1.2	1.3	1.1	2.3	2.0	1.2	1.2	2.5	3.2	1.4
97-01	2.6	2.4	4.6	3.0	2.1	2.1	3.7	2.6	3.2	4.4	3.1	3.5	2.8
02-06	1.9	1.8	3.1	1.7	0.9	0.7	1.3	1.9	3.0	3.3	2.6	2.9	1.6

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.

A decomposition of GDP growth into changes in labour input and labour productivity gives some insight into the source of growth differentials between the Euro Area members and other OECD countries observed in recent years. Figure II.2 shows this breakdown, with labour input measured as total hours worked and labour productivity measured as real GDP per hour worked. This latter measure reflects the impacts of changes in capital per person employed as well as improvements in the efficiency of the use of factors. From 2002 to 2006, labour input in the Euro Area grew at a similar rate to that in the EU countries outside EMU, but somewhat more slowly than it did in the US. However, labour productivity grew noticeably more slowly in the Euro Area over this period, and is largely responsible for the weaker output growth recorded.

Figure II.2 GDP, labour input and labour productivity growth
Average annual per cent change



Tables II.2 and II.3 present labour input and labour productivity growth for individual EU member states and the US. Over all of the period labour input growth has been more rapid in the US than in the Euro Area, in part because average hours worked per person employed have declined less, but also because the population of working age has been growing more rapidly in the US, in part because of migration. The labour input growth differential has been much lower in the last ten years than previously, and it has contributed less to the recent growth differential than it had in previous periods. Participation and employment rates in Europe have been rising, whilst they have fallen marginally in the US. Labour input growth in the UK and Sweden has been marginally lower than in the Euro Area in the last decade, and hence this cannot be a major factor behind the relative slowdown in Euro Area growth.

Table II.2 Average annual growth of labour input

period	BG	DK	FN	FR	GE	IT	NL	OE	SD	SP	UK	US	EMU
72-76	-0.9	-1.5	0.9	-0.3	-1.7	-0.3	-1.9	-0.6	0.1	0.1	0.0	1.8	-0.7
77-81	-1.4	0.1	0.2	-0.9	-0.1	0.1	0.0	-0.9	-0.6	-3.2	-0.9	2.0	-0.6
82-86	-0.8	1.9	-0.1	-1.1	-0.4	-0.4	-0.8	-0.8	0.9	-1.9	0.2	1.9	-0.8
87-91	0.7	-1.4	-1.3	0.5	0.9	0.5	1.2	0.4	0.7	2.9	0.9	1.2	0.9
92-96	-0.6	0.0	-1.9	-0.5	-1.0	-1.5	0.8	0.4	-1.0	-0.5	-0.1	1.7	-0.8
97-01	1.3	1.6	2.0	0.9	0.2	1.0	2.3	0.6	0.9	4.6	0.9	1.5	1.3
02-06	0.3	0.5	0.3	0.0	-0.5	0.6	0.0	0.5	0.3	3.1	0.5	0.9	0.5

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.

The breakdown of labour productivity growth by country reveals significant variation. During the early years of the current decade, overall productivity growth in the Euro Area was reduced noticeably by remarkably low productivity growth in Italy and in Spain. This may partly reflect the responses of these economies to unanticipated increases in the labour force[3]. Over the same period, labour productivity growth in Finland and Ireland – two Euro Area members – was higher than in the US and in the EU member states outside EMU.

Table II.3 Average annual growth of labour productivity

period	BG	DK	FN	FR	GE	IT	NL	OE	SD	SP	UK	US	EMU
72-76	4.7	4.2	1.5	3.7	4.3	4.1	5.4	4.8	2.5	4.9	2.3	1.3	4.2
77-81	2.9	1.0	3.0	3.6	2.4	2.7	1.7	3.3	1.7	4.4	1.9	1.1	3.0
82-86	2.2	1.6	3.1	3.1	2.1	2.6	2.7	2.7	1.3	4.1	2.9	1.5	2.6
87-91	2.4	2.3	2.8	2.6	3.1	2.4	1.9	3.1	0.9	1.4	1.3	1.3	2.5
92-96	2.4	2.6	3.1	1.7	2.4	2.6	1.4	1.7	2.1	1.7	2.6	1.5	2.2
97-01	1.3	0.8	2.5	2.0	1.9	1.1	1.5	2.0	2.2	-0.2	2.2	2.0	1.5
02-06	1.6	1.4	2.8	1.7	1.4	0.2	1.3	1.4	2.6	0.2	2.1	2.0	1.1

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.

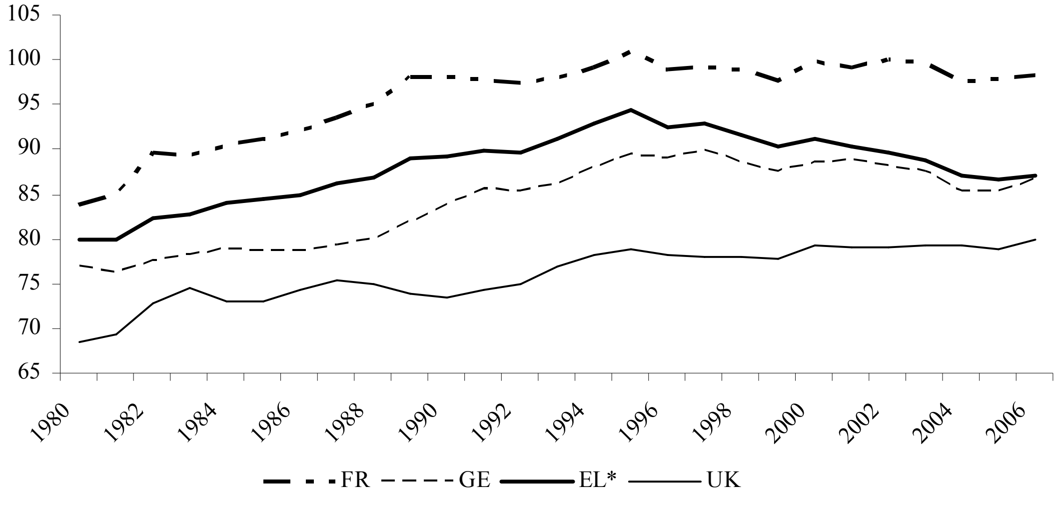
3 If the labour force increase is anticipated well in advance then capital can be in place to match the labour force. This balanced growth path has been common in countries with high natural population growth rates or sustained and anticipated inflows of migrants. Both of these assumptions describe the US from 1840 to 1920

Spain has seen significant increases in employment, which rose by around 30 percentage points more than the Euro Area average between 1997 and 2006. This was largely due to an increase in the labour force because of inward migration but about a third also came from reductions in unemployment. Both of these will push the supply of labour down an existing labour demand curve, and hence wages and productivity growth will be lower than they otherwise would have been. Once investment takes place to provide capital for productive use, productivity rises again as the labour demand curve shifts out. However, it is possible that much of the initial capita accumulation after large scale migration might be in the stock of housing, as in Spain, and hence labour productivity growth might take some time to return to trend.

While productivity growth in the Euro Area lagged the same measure in the US and in the non-EMU members, levels of productivity present a more nuanced story. Figure II.3 highlights the evolution of productivity levels in Europe relative to the US. Measured in constant US dollars at 2000 purchasing power parities, productivity per person hour in France has been at or at times slightly higher than in the US since the mid-1990s. While productivity levels in the Euro Area as a whole have been declining relative to the US since the mid-1990s, the overall figure is influenced largely by the developments in Spain. Those outside the Euro Area have not experienced a significant catch-up in productivity levels relative to the US. Notably, productivity levels in the UK have been remarkably constant relative to the US for much of the past decade. These differences in the level of productivity reflect different levels of skills, knowledge and capital endowments, and catching up to the higher levels can take place through the accumulation of any one of these three factors.

Figure II.3 Productivity levels relative to the US

US productivity = 100 in each year

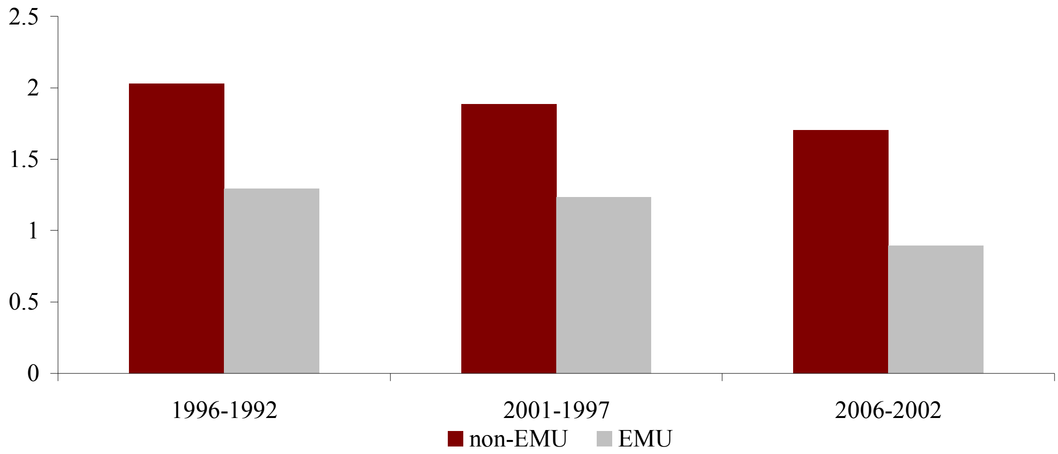


* Euro Area

The comparison of productivity levels is inevitably broad brush, as levels of data may not be comparable across countries, but comparisons of productivity growth rates are less subject to this problem. Using standard growth accounting techniques, labour productivity can be disaggregated into capital deepening and total factor productivity (TFP) (See for example Barrell, Guillemineau and Holland, 2007), allowing us to determine if the differences in labour productivity growth across countries stem from the factors that drive capital accumulation or factors that drive the efficiency of use of factor inputs. We can compare whole economy TFP in all European Union countries using output at constant basic prices. This output measure removes indirect taxes and subsidies from the volume data, and is available up until the end of 2006 for all countries except Greece[4]. We take estimates of the whole economy capital stock along with employment and hours data and use equation (1) for TFP growth (tfp) where Y_t is constant price output in basic prices, K_t is the constant price value of the whole economy capital stock, E_t is total employment in the economy, and H_t are hours per person in employment. The parameters b_t are the average of the capital share in output for the two most recent years.[5]

$$tfp = dlnY_t - [b_t dlnK_t + (1-b_t)\, dln(E_t H_t)] \quad (1)$$

Figure II.4 Growth of total factor productivity
Average per cent per annum



* The non-EMU aggregate covers the UK, Sweden and Denmark

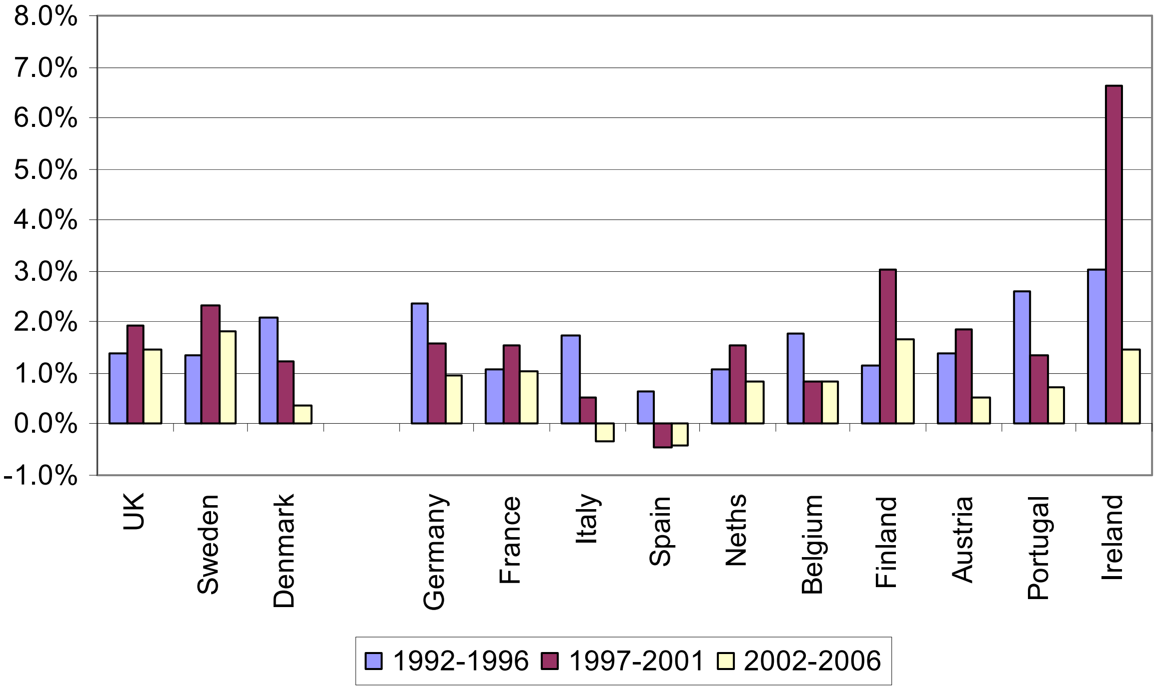
Figure II.4 presents a comparison of TFP growth in the Euro Area and the non-EMU EU members. The EU countries outside the Euro Area experienced faster TFP growth as compared to the Euro Area members well in advance of the introduction of the common currency. TFP growth in EMU slowed after the introduction of the euro

[4] We do not include the US in this comparison as it only produces basic price whole economy numbers in current prices. The OECD recalculate these numbers to produce volume figures, but with a delay and hence are not as up to date, or at the same stage of revision, as other countries. We use data on all other countries up until 2006 when data for the US stopped in 2005

[5] We have assumed that the self employed receive the same wage per hour as the employed.

Figure II.5 illustrates the calculations for TFP growth on a country-by-country basis[6]. TFP growth slowed between 1997-2001 and 2002-2006 in almost all EU countries, both inside and outside of EMU. TFP growth was particularly robust in Finland and Ireland[7] between 1997 and 2001. Productivity growth in the UK and in Sweden was higher in this period than in any of the other Euro Area countries, and it remained so between 2002 and 2006. However, TFP growth was only noticeably lower than in the UK in Italy, Spain and Belgium between 1997 and 2001, and in the same countries along with the Netherlands, Austria and Portugal between 2002 and 2006. In both these periods productivity growth in France and Germany was marginally lower than in the UK. Productivity levels actually declined in Spain in the second two sub periods and in Italy in the last period.

Figure II.5 TFP growth (basic prices)



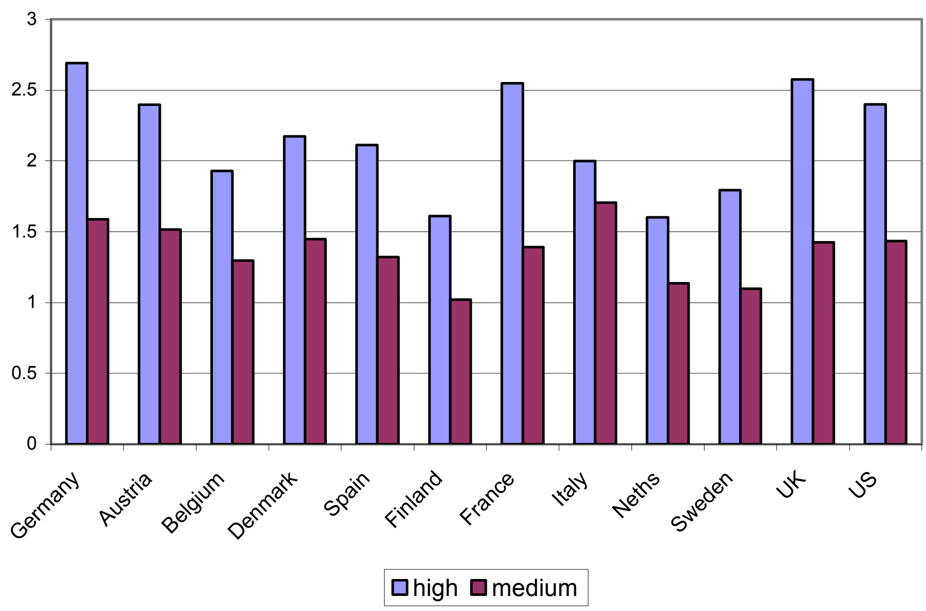
Some of the factors affecting TFP growth are discussed in Barrell (2007), Crafts (2007) and McMorrow and Röger (2007). We can decompose them into the skills of

[6] Basic price data are not available for Greece, and we do not present that country separately. In Figure II.4 we have made the appropriate but approximate adjustment to the Greek market price data in order to calculate the aggregate for the Euro Area.

[7] The strong growth in Ireland may in part reflect transfer pricing from elsewhere in Europe. In most countries GDP is a good indicator of production and incomes received by domestic residents. Incomes of residents can be scaled by GNP, and as a rule GDP and GNP move together. However, Ireland has been chosen by non-EU firms as a location for declaring profits to ensure that they are remitted at low tax rates. The ratio between GDP and GNP in Ireland was around 1.1 in 1986, and stayed at that level for a decade. When it became clear that Ireland would be in monetary union there was a sharp increase in profits oriented transfer pricing through that country and between 1996 and 1998 the ratio rose by six percentage points. The allocation of profits to Ireland on this scale will have raised measured output and productivity growth in a spurious way. Over this period the equivalent ratios in the UK, the US and Belgium fluctuated around or just below one despite their differing net foreign asset positions.

the workforce, the level of scientific knowledge and the efficiency with which factors of production are used. Any production function may be written as Y_t=f(capital$_t$, labour$_t$, tech$_t$) where the labour input is in efficiency units and tech$_t$ picks up other forms of technical progress. If we cannot measure labour in efficiency units then the tech term will be a combination of labour skills effects and other technology and productivity effects. If we were able to measure labour in efficiency units (rather than in person hours) then the resulting tfp calculated from equation (1) above would reflect only the impacts of scientific knowledge and the efficiency of factor use. It is possible to construct an index of efficiency units of labour for each country based on the assumption that wage differentials reflect underlying productivity differentials. A higher value of the index implies a higher level of knowledge embodied in workers, which raises productivity of labour. The efficiency index uses indicators of relative wages for each of three skill groups to weight together the numbers employed in each skill group to give a weighted average skill indicator. We assume that the wage of unskilled workers in a base year 1992 is 1.0, and the skill premium for the other two groups means that medium skilled workers receive a weight in excess of 1 and skilled workers an even higher weight. These weights are based on the average wage of the higher skill groups relative to that of unskilled workers, and are plotted in Figure II.6. When the number of skilled workers increases then the stock of skills rises in the economy, and we assume that a one per cent increase in skills raises effective labour input by one percent.

Figure II.6 Relative wages by skill category (1992 unskilled =1)



The skills and wages data come from the EUKLEMS[8] database which contains information on the skill mix of the members of the EU and the US, with proportions of the workforce in low, medium and high skill occupations. There are also data on the relative compensation of these groups over time and therefore it is possible to produce a compound skill indicator if we assume that the skill level of the unskilled is constant and that relative wages reflect relative marginal product[9]. Table II.4 reports average annual growth of a skills index with fixed weights based on 1992 for each of the countries where we have data. Care has to be taken in the interpretation of these data when making cross country comparisons at a single point in time, as definitions of skill categories differ between countries, especially amongst the high skilled groups. Educational systems also differ, with average graduates representing a larger and different group in the US than in moist European counties. However, these differences matter less when we make comparisons over time within a country as definitions and education systems change much less in this dimension.

Table II.4 The growth rate of skills

period	BG	DK	FN	FR	GE	IT	NL	OE	SD	SP	UK	US
85-89	0.4	0.5	0.4	0.7	0.4	0.2	0.4	0.5	0.3	0.8	0.7	0.3
90-94	0.8	0.6	0.7	0.8	0.3	0.2	0.3	0.5	0.3	0.8	1.0	0.3
95-99	0.5	0.4	0.2	0.6	0.0	0.2	0.3	0.5	0.2	0.7	0.8	0.3
00-04	0.4	0.3	0.2	0.4	0.2	0.1	0.2	0.3	0.6	0.7	0.6	0.4

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.
Source: Own calculations using EUKLEMS data

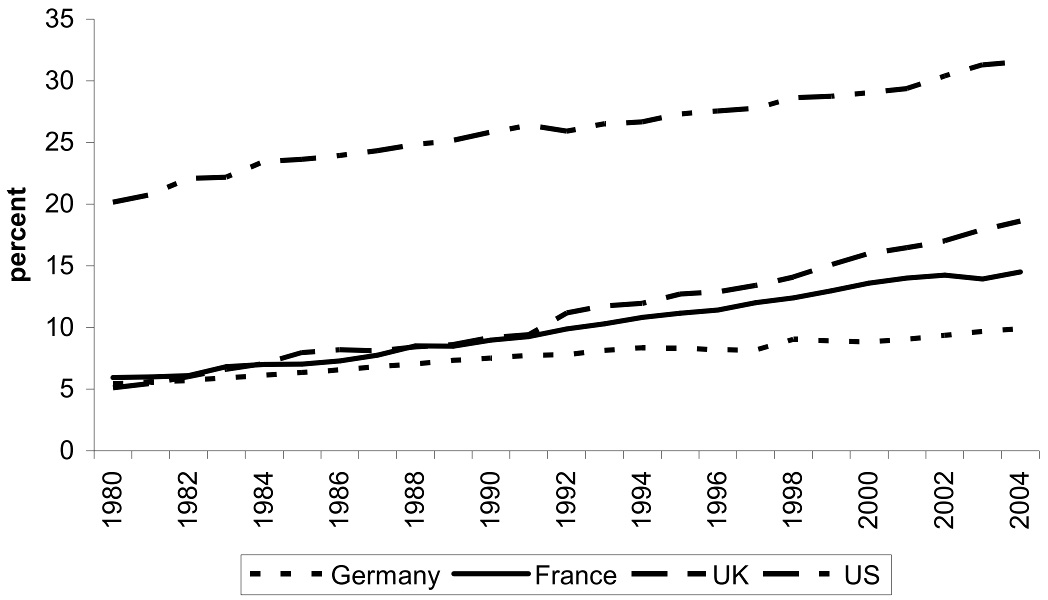
The existence of the skills data constrains both the time frame and the country coverage of this study. The data are available from 1980 for most countries, but EUKLEMS data starts later for Sweden and the other excluded EU countries. We have extended the Swedish data back using national sources. In other countries, such as Spain, the growth of skilled and semi skilled occupations has been rapid because of urbanisation and industrialisation catching up process that country has undergone, and the meaning of the unskilled group may change over time in such situations, and caution has to be used when utilising these data. While it is difficult to make cross-country comparisons as definitions of skills vary greatly across countries, the relatively slow accumulation of skills in Germany over the past two decades as compared to the UK and France may be one reason for relatively low productivity

[8] The EU KLEMS Database was the result of a large scale collaborative project between European researchers on productivity financed by the European Commission. It was published in March 2007, and is available at **http://www.euklems.net**.

[9] A skills index can be constructed either by using a Tornquist discrete time version of a Divisia index, or it can be constructed with fixed weights. We have experimented with both, and marginally prefer the fixed weight index shown in Table II.4. The chain weighted index induces a cycle into the quality index that is related to the business cycle, as wage differentials become compressed or expand over the business cycle. If we could choose either similar points on the cycle or calculate cycle average relative wages then we could construct an approximate Tornquist index.

growth in the Euro Area's largest economy. Figure II.7 shows the share of university graduates in total employment. It suggests that the proportion of employees with university education has grown faster in the UK and France as compared to Germany over the past several decades. This difference may be one of the main sources of slower skills accumulation in Germany.

Figure II.7 Percent of university graduates in total employment



We can repeat our growth accounting exercise, but take into account the quality of labour. If we call the stock of skills $S_{t,}$ we can calculate a skills adjusted tfp indicator, denoted tfps, as:

$$tfps = dlnY_t - [b_t dlnK_t + (1-b_t)\, dln(E_t H_t S_t)] \qquad (2)$$

For growth accounting purposes we can use the time period from 1991 for comparison, and if we do that we only lose Greece, Portugal and Ireland from our calculations, as the former has neither the basic price GDP data and skills information we need, whilst the latter two do not have enough information on skills and relative wages to be included in the comparison.

Figure II.8 plots the skills adjusted TFP growth for the Europeans where we have a sufficiently reliable data set, and compares the period before the formation of EMU with that afterwards. After skills adjustment, TFP growth was similar in the UK, Germany and the US over the period 1999-2004. However, in the Euro Area as a whole TFP growth on a skills adjusted basis averaged less than 1 per cent per annum, or about half a percentage point lower than in Germany, the UK and the US[10].

[10] In order to calculate this figure we have used our out factor price adjustment for Greece and we have assumed that skills in Ireland, Portugal and Greece grew at the same rate as in France, a country that

Figure II.8 Skills adjusted TFP growth

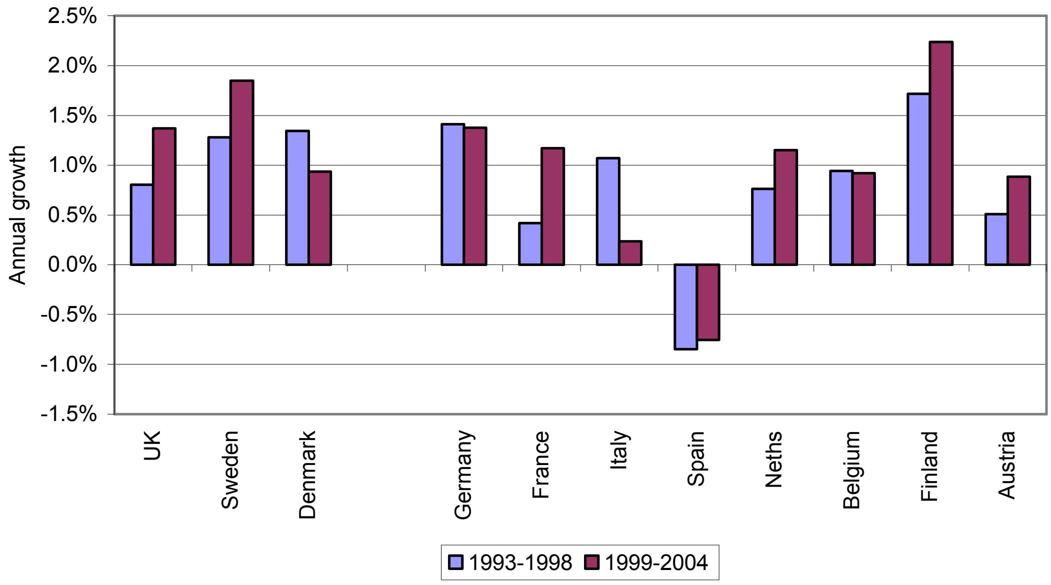


Figure II.9 Unadjusted TFP growth

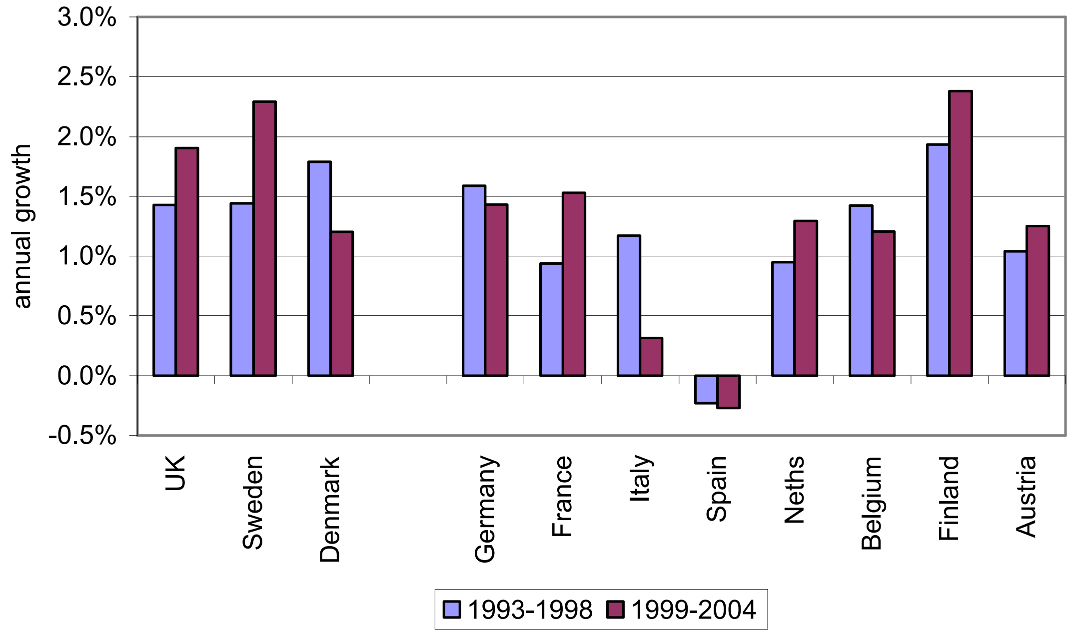


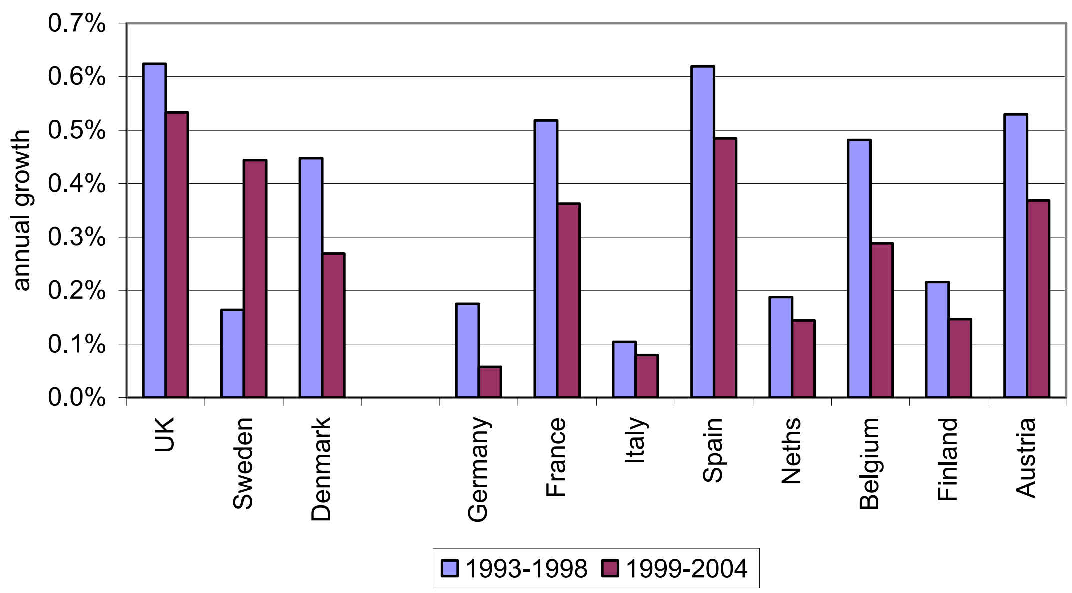
Figure II.9 reports TFP growth before skills adjustment for the same period and countries. It is clear that TFP growth was particularly low in Spain and Italy, especially during the EMU period, but skills adjusted or not, TFP growth rates, especially in Spain, were also weak before the formation of EMU. TFP growth was positive and accelerated in the EMU period in France, Netherlands, Finland and Austria, and only Italy experienced a marked slowdown of skills adjusted TFP growth into the EMU period.

---

performed well. Changes in these assumptions would only marginally change the results as these three countries represent a small share of Euro Area output

As with the previous analysis we also lose the US because it lacks data for constant price output at basic prices, although we can approximate this data for the US over the same period. These estimates suggest that TFP growth was around 1.7 per cent per annum between 1993 and 2004, and that skills contributed about 0.2 percentage points per annum of this, leaving underlying TFP growth (tfps above) at around 1.5 per cent a year on average over this period. These figures for TFP growth may \appear to be lower than those commonly referred to for the US as they reflect whole economy output and whole economy capital stocks as well as whole economy labour input. Most work on the US, including that published by the Bureau of Economic Analysis, reports figures for TFP growth in the non-farm business sector, and hence misses out the more slowly developing government sector and the agricultural sector.

Figure II.10 Skills component of TFP growth



We can also plot the contribution of skills to the growth rate of these countries, and we do so in Figure II.10. The contribution of skills growth in the UK is noticeably greater than that in Germany or Italy, as we might expect from Table II.4, but the contribution of skills growth was also quite noticeable in France, Spain, Belgium and Austria. It would not be surprising if it were also rapid in Ireland over this period. It would appear that most of the poor productivity performance of the German economy in the EMU period has been due to slow skills growth, and to a lesser extent the same is true of France. A low contribution from skills has also been important in Italy, but there are also other factors holding back productivity growth there, as there are in Spain. Productivity growth after factoring out skills has been particularly strong in Sweden and Finland. It would appear that differences in skills growth have contributed about a quarter of a point to the Euro Area growth deficit against the UK since 1999, and around a fifth of a percentage point in the period in the run up to the formation of EMU. Skills growth rates were similar in aggregate to the US[11].

Our skills adjusted TFP growth can result from either increases in the stock of knowledge or changes in the competitive environment that make factor use more efficient. All of the European countries were members of the European Union, and hence all will have been influenced by the Single Market Programme, and the only major market efficiency related initiative that separates them is the EMU process. Knowledge comes from many sources, and that part not embodied in the skills of the workforce depends on access to the knowledge base associated with scientific activity. In practice, the stock of knowledge in an economy is often proxied by the levels of Research and Development (R&D) activity and access to technology from abroad through imports and Foreign Direct Investment (FDI).

The role of FDI in the growth process has been emphasised by Barrell and Pain (1997) and others. Table II.5 reports the stock of inward FDI as a share of GDP for many of the countries in this study in select years. In 2006, the stock of inward FDI in France and the UK was marginally larger relative to GDP than in Germany, but this ratio has not risen very rapidly in any of these countries since 1991. The stock of FDI rose much more rapidly relative to GDP in Finland, Sweden and Denmark over this period, and this may help explain the strong TFP growth recorded in these countries. The growth of FDI stocks between 1991 and 2006, reported in the last row of the table, has a correlation of 0.68 with the growth of skills adjusted TFP reported in Figure II.8, and this suggests that there has been some impact from the development of the FDI stocks.

Table II.5 Stock of FDI as a per cent of GDP

period	BG	DK	FN	FR	GE	IR	IT	NL	OE	SD	SP	UK	US
1991	11.2	11.6	8.3	11.4	11.7	10.8	11.1	11.2	9.3	11.8	11.4	12.0	12.9
1996	11.6	11.8	8.9	12.0	11.7	10.8	11.0	11.6	9.7	12.4	11.5	12.1	13.3
2001	12.4	13.3	10.2	12.7	12.6	12.0	11.7	12.6	10.5	13.7	12.2	12.8	14.1
2006	13.0	13.5	10.8	13.2	12.8	11.8	12.2	12.6	10.9	14.2	12.5	13.3	14.4
2006-1991	1.8	1.9	2.5	1.8	1.1	1.0	1.1	1.4	1.6	2.4	1.1	1.3	1.5

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IR=Ireland, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.
Source: UNCTAD and NIESR calculations

A number of endogenous growth models have been developed where R&D expenditures or the number of researchers drive the growth process with Aghion and Howitt (1998) and Griffith *et al* (2004) being amongst the most significant for our

[11] The same basic price adjustment and skills assumptions have been made about Greece, Portugal and Ireland, and hence the same caveats hold. Skills growth was probably higher in Ireland and lower in Greece and Portugal than in France and hence our number may be a lower bound.

purposes. Not only does R&D increase the innovation rate in the technology frontier country, but it also raises the absorptive capacity of an economy to new ideas. Hence we use an estimate of the stock of R&D at t as an indicator of usable knowledge, based on the accumulation of flows of R&D onto a depreciating stock[12].

Table II.6 Stock of R&D – annual average growth rate

period	BG	DK	FN	FR	GE	IT	NL	OE	SD	SP	UK	US
90-94	4.6	5.0	6.9	3.7	3.8	4.0	2.5	6.2	4.9	9.3	1.5	2.8
95-99	4.5	5.6	7.6	2.6	2.9	2.3	2.7	6.1	5.2	6.1	1.3	3.0
00-05	4.0	5.8	7.7	2.4	3.0	2.6	2.1	6.3	5.2	6.8	1.6	3.2

Note: BG=Belgium, DK=Denmark, FN=Finland, FR=France, GE=Germany, IT=Italy, NL=Netherlands, OE=Austria, SD=Sweden, SP=Spain.
GERD stock, million national currencies, constant prices, 5% depreciation rate

Table II.6 shows the average growth rates of the R&D stock for all the countries in this study. The stock of R&D grew most rapidly in Finland, Spain and Austria over this sample period. Over the last 10 years, the stock of R&D in Germany has risen at about the same rate as in the US, after growing more rapidly in the previous 10-year period. The stock of R&D in France has risen somewhat more slowly than it has in Germany, while the growth of R&D has been particularly slow in the UK. There seems to be no strong pattern from a simple investigation of the table, unlike with FDI, but more careful investigation, and allowance for other factors should help us uncover any possible role for R&D in explaining differences in productivity growth.

Both R&D and FDI are potential variables that might explain differences in growth rates. However, a number of other factors have been affecting productivity growth in these countries. Increased openness is often regarded as a factor driving growth, and all have become more open over time, at least as measured by the ratio of the volumes of exports and imports of goods and services to output. Openness increases in part because the nature of goods changes, and they become lighter and more mobile, and import penetration rises. However, it is not clear that such changes increase competition and the efficiency of factor use. Openness can also increase because barriers to trade are removed, as with the European Single Market, the North American Free Trade Agreements and other measures that are designed to increase trade and competition. We include indicators of these agreements in our work.

[12] We benchmark the stock in 1974, before the beginning of our data period, as the flow divided by the average growth rate and the depreciation rate, and we cumulate flows onto this stock with a depreciation rate of 5 per cent per annum in line with Coe and Helpman (1995). The data comes from the OECD Science and Technology database.

III. EMU and productivity

Economists generally agree that we may describe output (Y_t) as being produced by capital and labour inputs being mediated by a production function that embeds the current state of technology and efficiency in factor use. Many things change the supply of factors and the efficiency with which they are used. Technology also changes over time. A constant returns to scale production function can be written as

$$\ln Y_t = b \ln(labour_t) + (1\text{-}b) \ln(K_t) + Tech_t \qquad (3)$$

Where $labour_t$ is person hours input in efficiency terms at time t, K_t is the capital stock (or rather input) at time t, and $Tech_t$ is an indicator of the level of technical efficiency at time t. The labour input may be decomposed into units of labour, E_t, average hours per unit, H_t and the average skills of the workforce, S_t.

$$Labour_t = E_t\, H_t\, S_t \qquad (4)$$

Employment and hours data are relatively easily available, but skills per unit of labour are harder to derive. It is important to separate out the impacts of skills and we have estimates available for our sample. In order to avoid using low quality capital stock data, and to focus on the role of volatility directly we substitute out for the capital demand equation, which can be written as

$$\ln(K_t) = a + \ln(Y_t) - c \ln(user_t + risk_t) \qquad (5)$$

Where $user_t$ is the user cost of capital at t and $risk_t$ is the risk premium at t. We calculate the user cost of capital according to a standard Hall-Jorgensen formula:

$$user_t = \frac{pdk_t}{py_t}\left[c + kdep_t - \Delta \ln\left(\frac{pdk_t}{py_t}\right)^e\right] \Big/ (1 - ctaxr_t) \qquad (6)$$

where *pdk* is an investment deflator, *py* is the GDP deflator, *c* is the real cost of finance, *kdep* is the depreciation rate, *e* denotes expectations and *ctaxr* is the corporate tax rate. The real cost of finance, *c*, is weighted average cost of capital, as defined by Brealey and Myers (2000). This weights together the cost of debt finance (r_D) and the cost of equity finance (r_E). The weights are given by the share of capital in the economy that is listed on the stock market. The cost of debt finance is adjusted by the corporate tax rate, reflecting the tax deductibility of borrowing, and is calculated as the risk-free long real interest rate, plus a measure of corporate spreads. Corporate spreads are calculated as the absolute difference between average corporate bond yields and yields on 10-year government bonds[13]. The cost of equity finance is calculated as the return on equity, which is estimated using price-earnings ratios for a national stock index. While this measure embeds a risk premium into it, our framework allows us to test for the impact of additional risk factors that are not priced into corporate spreads or the return on equity, which do not fully capture expectations.

Substituting our capital equation into our output equation and collecting terms we get

$$\ln Y_t = \gamma 1 + \ln(labour_t) - \gamma_2 \ln(user_t + risk_t) + \gamma_3\ Techt \qquad (7)$$

where $\gamma_3 = 1/b$, $\gamma_2 = \gamma_3 *c*(1\text{-}b)$ and $\gamma_1 = a*(1\text{-}b)*\gamma_3$. We are interested in explaining output per person hour after factoring out skills, which we assume has a unit elasticity with respect to labour productivity. This is consistent with the construction of the skills data, where relative wages and relative productivity of the skill groups are assumed to remain constant over time. We may rewrite the equation again by taking E_t H_t and S_t to the left hand side as

$$\ln(Y_t / (Et\ H_t\ S_t)) = \gamma_1 - \gamma_2 \ln(user_t + risk_t) + \gamma_3\ Tech_t \quad (8)$$

Output per person hour, after adjusting for skills should in the long run be driven by the user cost of capital, the risk associated with investment and a remaining element we describe as technology, but which covers both the general stock of knowledge, the ability to utilise this stock and the efficiency with which factors of production are organised in utilising this stock of knowledge. The factors that impact on the efficiency of factor use may include the openness of the economy, the competitive environment that is constructed through institutions such as laws, regulations and monetary structures and also social institutions. It is possible that EMU would affect this relationship directly through the competitiveness channel, as it may increase transparency and reduce transactions costs even as compared to having a fixed exchange rate with major trading partners. If we are find the effects of EMU on output growth we must factor out all the other dimension of knowledge and efficiency effects that have been at work in the last decade or so.

There are a number of indicators of knowledge and of the competitive environment that we can utilise. The most obvious are the stocks of Research and Development (R&D) and Foreign Direct Investment (FDI) that we have discussed above, as these either reflect the creation of knowledge or are channels through which it is absorbed. Openness to trade and investment are also thought to have important effects on

[13] These data are available for the Euro Area, US, UK, and Denmark. Sweden is assumed to follow the corporate spreads for Denmark. Prior to 1984, the UK spread is assumed to move in line with the US, prior to 1994 the spread for Denmark is assumed to move in line with the US and UK average, and prior to 1999 Euro Area spreads is assumed to move in line with a proxy measure for Germany.

productivity growth both through knowledge transfers and their efficiency effects. The ability to trade enables a country to specialise in more efficient production processes raising the aggregate growth rate temporarily. Endogenous growth models have also pointed to the possibility that contacts with the outside world may potentially raise the growth rate permanently (see, for instance, Coe and Helpman, 1995; and Proudman ands Redding, 1998). There is also evidence that increases in competition brought about by the intentional removal of barriers to trade and investment raise output, and there is a significant literature, discussed in Badinger (2007), on the impacts of the European Single Market Programme (SMP) on productivity. Membership of the European Union may also have increased productivity by widening the span of competition. The has also been a significant amount of research on the effect of North American Free Trade Agreements (NAFTAs), much of which is summarised in the symposium edited by Lederman and Serven (2005)

We look at these factors in our countries, following Barrell, Liadze and Pomerantz (2007) in the construction of our openness and globalisation indicators. The single market programme (SMP) is a variable that starts in the third quarter of 1986 at 0 and rises to 1.0 in 1992[14]. Not all countries were members at the time, and we index the impact of integration using a dummy that increases over the three years until they become full members, and we denote it as EU. In a similar way we also separately distinguish the impacts of the Canada US Free Trade Agreement in the 1980s and the subsequent wider NAFTA agreement. In order to pick up other trade and competitiveness related factors we have also experimented with openness indicators and have included a measure based on exports plus imports of goods and services divided by GDP (OPEN) in our work. This is the variable that would change if EMU had an impact on trade, as the work surveyed by Baldwin (2006) suggests it does, but we factor it out separately as well.

---

[14] For a detailed description of the Single Market Programme see European Parliament (2008). The Single European Act (which was signed in February 1986 and came into force on 1 July 1987) was a revision of the Treaty of Rome. Its first objective was the incorporation of the specific concept of the internal market in the Treaty defining it as 'an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured' and setting a precise deadline for its completion: 31 December 1992. It also wanted to give the completed internal market effective decision-making machinery, by introducing qualified majority voting for most subjects concerned, instead of the unanimity that had hitherto been required. By the deadline, most of the 1992 targets had been met. Over 90 % of the legislative projects listed in the 1985 White Paper had been adopted, largely by using the majority rule. They included full liberalisation of capital movements and total abolition of checks on goods at internal frontiers.

If we wish to investigate the impact of Monetary Union after factoring our other influences on productivity we must include countries who are not members. To that end we include members of the Euro Area along with UK, Sweden, Denmark, and the US in order to compare effects between the two groups. Our country choice and timeframe depend on data, and we are in particular constrained by the availability of skills data over long periods, and in the EUKLEMS database skills stop at 2004. Our end date allows us to use simple volatility indicators for risk, based on the work of Blanchard and Simon (2001).

In our work below we look for the effects of two possible sources of uncertainty for exchange rate volatility and output volatility. In this section we look for a role for the conditional volatility of output, which can be taken as an imperfect indicator or expected volatility. The volatility of output is gauged by the Root Mean Squared Deviations (RMSD) of output around a centred 17 moving average trend. The centred average on which volatility is conditioned uses output data up until the first quarter of 2007 to produce a centred estimate of trend output for the last quarter of 2004, which is the end of our sample period. In the next section we use GARCH techniques to condition the volatility of real exchange rates, which we would expect to influence the equilibrium capital stock. We also test for the effect of real exchange rate volatility in this section by construction a conditional measure that is equivalent to our output volatility measure. We use a 13 period centred moving average of real exchange rates as the conditional trend and create the RMSD series for this variable[15]. In both cases these are constructed regressors that give an indication of the variable of interest and as such they are generated regressors that need to be instrumented, as is stressed in Pagan (1984). As these are variables measured with error that we expect to be closely correlated to the true variable of interest we use Durbin's (1954) method of dealing with errors in variables problems.

We need to find a cointegrating set of variables for each country and then use them to undertake dynamic panel analysis on our dependent variable, output per person hour adjusted for skills (SY). We search across a range of possible sets of driving factors after testing their order of integration, and we look for the smallest cointegrating set in each country whilst making sure that the contents remain as similar as possible in order that we may undertake panel analysis. If a variable is included in a cointegrating set when it is not needed that set is not irreducible in the terms of Davidson (1998) and hence we may gain spurious information output the determinants of long run behaviour.

[15] The centered window length was chosen in relation to the cyclical properties of the data.

As increased competition may improve factor efficiency and raise output for given inputs indicators of its must be included in our cointegrating set. However, they are not stochastic regressors, but rather intercept shifts, and hence do not need to be included in the choice of significance levels. Removal of trade barriers and increases in the scope of markets such as the Single Market Programme, EU entry and North American. Trade Agreements are therefore included in cointegrating sets. As a common currency may increase transparency and the effective scope of competition we include an EMU dummy in these sets

As we wish to look for direct effects from volatility we separate out the effects of user and volatility we separate out the effects of ln(user+risk) by noting that ln(a+b) = ln(a*(1+b/a)) = ln(a) +ln(1+b/a). Our basic cointegrating regression is of the form

$$\begin{aligned} \ln(SY_{it}) &= c_{i1}\ln(R\,\&\,D_{it}) + c_{i2}\ln(user_{it}) + c_{i3}\ln(1 + volY_{it}/user_{it}) \\ &\quad + c_{i4}\ln(FDI_{it}) + d_{i1}ESM_{it} + d_{i2}EMU_{it} + d_{i3}EU_{it} + d_{i4}NAFTA_{it} \end{aligned} \tag{7}$$

but other variables will have been investigated, as we discuss below.

Table II1.1 Unit root test results

	log(dependent variable)		log(user cost)		log(R&D)		log(1+(risk/user cost))	
	level	difference	level	difference	level	level (including trend)	level	difference
	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.
Austria	0.513	0.003	0.604	0.002	0.140	0.001	0.067	0.000
Belgium	0.494	0.000	0.553	0.000	0.000	-	0.465	0.007
Denmark	0.797	0.000	0.107	0.000	0.417	0.051	0.080	0.000
Finland	0.815	0.000	0.788	0.000	0.094	0.002	0.355	0.000
France	0.498	0.000	0.659	0.000	0.005	-	0.373	0.001
Germany	0.577	0.001	0.284	0.006	0.001	-	0.225	0.003
Italy	0.121	0.008	0.675	0.001	0.000	-	0.260	0.002
Netherlands	0.423	0.000	0.425	0.000	0.022	-	0.021	-
Sweden	1.000	0.000	0.277	0.000	0.024	-	0.220	0.001
UK	0.883	0.000	0.095	0.009	0.552	0.001	0.239	0.003
US	0.997	0.000	0.594	0.001	0.334	0.030	0.095	0.011

Data period 1980q1 2004q4

We check data for stationarity by testing for the presence of a unit root. Augmented Dickey-Fuller (ADF) tests are computed with an intercept and a lag length of 4 with quarterly data. Test results are reported in table III 1. Unit root tests indicate that at 5 percent significance level the null hypothesis for the presence of a unit root cannot be rejected for three out of four variables reported. The stock of R&D data has a clear trend over the sample period and it is checked for the trend stationarity. It can be seen from the table that we cannot reject the hypothesis of trend stationarity in R&D series. A hypothesis of unit root is rejected when ADF tests are applied to the first differences of logarithms of remaining three variables. We conclude that the dependent variable, the user cost of capital and one plus volatility of output (from now on referred to as risk) over user cost of capital variables are I (1).

Not all variables are needed in the cointegrating set and in particular we find that openness does not need to be in it, despite the popular debate on the role of EMU in increasing trade. Hence we do not report its order of integration, but find that the logged first difference is I(0) Both stocks of Research and Development (R&D) and Foreign Direct Investment (FDI) may drive the efficiency of factor use, but we report only on R&D as it is the preferred variable in all countries except the UK.

It is necessary to check under what conditions can there be a cointegrating set of variables in the long run. We augment the long run equation with dummies for trade such as ESM, NAFTA and EMU and check for the presence of a long run structure. The residuals from the estimated equations are tested for the existence of a unit root, using t-statistics of Augmented Dickey-Fuller tests by including intercept and 4 lags. The results of the cointegration test for the final set of long run equations are presented in Table III.2. All countries pass the cointegration test.

Table III.2. Cointegration of the long run

t-statistics from the ADF tests for the long run equation

Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Sweden	UK	US
-4.27	-3.83	-3.98	-4.45	-4.86	-4.04	-4.61	-4.31	-3.93	-4.25	-6.20

Data period 1980q1 2004q4 The appropriate critical values are -3.452, -3.743, -4.298 at the 10%, 5% and 1% level, respectively. The exception is the UK where critical values are -3.811, -4.100, -4.649 at the 10%, 5% and 1% level.

In our final cointegrating set we have tested for the effects of openness (defined as a sum of exports and imports as a share of GDP) and stock of FDI separately for each country. Adding either openness or FDI raises the critical value for the test but does not raise the test value and as a result not all of the countries pass long run cointegration tests at 5% critical value if they are present. We did not find a systematic role for the openness or FDI in the long run specification for our list of countries with the exception of the UK where FDI was necessary for the existence of the long run relationship. If we include R&D in the UK equation, but do not include FDI, we do not find cointegration. If we remove R&D from the set including FDI we still find that it cointegrates, and hence the irreducible set for the UK include FDI but excludes R&D. Openness was not required for cointegration, but the trade and competition related variables SMP and NAFTA variables were and they may have driven openness. We return to this issue later.

The level of output responds slowly to its determinants, and hence we specify the equation in equilibrium correction form. This allows the effects of all the driving factors such as the SMP, EMU and volatility effects to come through gradually. The dynamic equation can be described by:

$$
\begin{aligned}
\mathrm{dln}(Y_{it} / (E_{it} H_{it} S_{it})) = \alpha_i + \lambda_i [&\ln(Y_{it-1} / (E_{it-1} H_{it-1} S_{it-1})) - \beta_{i1} \ln(R\&D_{it-1}) \\
&- \beta_{i2} \ln(user_{it-1}) - \beta_{i3} \ln(1+(vol(Y_{it-1})/user_{it-1}) \qquad (8) \\
&- \beta_{i4} \ln(FDI_{it-1}) - \beta_{i5} ESM_{t-1} - \beta_{i6} EMU_{t-1} - \beta_{i7} EU_{t-1} \\
&- \beta_{i8} NAFTA_{t-1})] \\
&+ \gamma_{i1} \mathrm{dln}(Y_{it-1} / (E_{it-1} H_{it-1} S_{it-1})) + \varepsilon_{it}
\end{aligned}
$$

A panel of 11 countries was constructed and estimated by three stage least squares. . Three stage least squares was used because the volatility of output is a generated regressor measured with an error and we need to instrument it in order to get consistent estimator[16]. We apply Pooled Mean Group (PMG) estimation method as in Pesaran and Smith (1995) to test for common long run coefficients while allowing for country specific dynamics. Table III.3 reports the results from the tests on the coefficient commonality in our panel. We start by checking whether common user cost of capital and common (one plus ratio of risk over user cost of capital) can be imposed across countries. Wald tests for commonalities for both variables cannot be rejected. Common ESM effects were found in Belgium, Denmark, France, Germany, Italy and Netherlands and we can impose common EMU effect as well in the same set of countries (except for the Denmark).

Table III.3. Wald test results on commonality

	Probability
Common user cost	0.602
Common 1+(vol of output/user cost)	0.952
Common esm	0.061
Common emu	0.486

The results from the final estimates are reported in Table III.4 after common parameters are imposed and insignificant variables sequentially eliminated. The robustness of deletions and exclusions is discussed below. We consolidate the parameters on the separate US Canada and NAFTA Free trade agreements. Both are significant and we report the net effect. The user cost of capital is significant and has a negative effect on productivity whilst the impact of the ratio of risk over user cost

[16] We use rank order as an instrument as suggested by Durbin (1954)

on productivity is found to be of the same sign. An increase in either user cost of capital or the ratio of risk over user cost of capital reduces the level of productivity per person hour, as we would expect, as it will in the long run reduce the level of the capital stock available to each worker. The ESM effect is significant and positive in six out of ten European countries. Finland, Sweden and Austria were not members of the Union at the time of its implementation, and its insignificance is not surprising. Its absence in the UK may reflect the fact that we need to use FDI as an indicator for knowledge to ensure cointegration. If the SMP increased FDI to the UK, as Pain and Wakelin (1998) suggest it did, then that variable may well pick the impact of the ESM on the UK. The EU entry dummies did not have a significant impact on productivity and were removed from the estimation. The effects of R&D vary across countries, with the highest impact probably being seen in Germany and the lowest in Denmark.

Table.III.4 Final equations

	error correction	log(r&d)	log(user cost)	log(1+risk/user cost)	ESM	EMU	log(FDI)	Net trade
Austria	-0.089 (0.041)	0.235 (0.000)	-0.056 (0.000)	-0.284 (0.008)	-	-	-	-
Belgium	-0.241 (0.000)	0.190 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	0.021 (0.001)	-	-
Denmark	-0.377 (0.000)	0.150 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	-	-	-
Finland	-0.149 (0.009)	0.294 (0.000)	-0.056 (0.000)	-0.284 (0.008)	-	-	-	-
France	-0.077 (0.005)	0.267 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	0.021 (0.001)	-	-
Germany	-0.102 (0.000)	0.459 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	0.021 (0.001)	-	-
Italy	-0.092 (0.019)	0.324 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	0.021 (0.001)	-	-
Netherlands	-0.161 (0.004)	0.301 (0.000)	-0.056 (0.000)	-0.284 (0.008)	0.060 (0.000)	0.021 (0.001)	-	-
Sweden	-0.117 (0.011)	0.237 (0.000)	-0.056 (0.000)	-0.284 (0.008)	-	-	-	-
UK	-0.069 (0.029)	-	-0.056 (0.000)	-0.284 (0.008)	-	-	0.138 (0.000)	-
US	-0.147 (0.005)	0.380 (0.000)	-0.056 (0.000)	-0.284 (0.008)	-	-		0.016 (0.000)

Note: probabilities are in parenthesis. Data period 1980q1 to 2004q4. for details see appendix.

The speed of reaction varies across countries and it is highest in the small open economies, Belgium Denmark, Finland and the Netherlands. France Italy and Germany within the monetary Union, and the UK outside it have slower reactions, with the half life of adjustment probably coming after 5 years. The US adjusts more rapidly than any of the other large economies, despite its size. The EMU effects are positive and significant in the five core countries, and they indicate that over the longer term output may be raised by 2 per cent or so by membership of EMU. We did not find any significant effect of EMU either on other member countries or outsiders. To test the robustness of our conclusions we added back EMU variables into the equations of all countries in the final panel and checked for the significance of the coefficients. The results reported in Table III.5 show that EMU is insignificant in all but five core countries. There are no clear negative effects of the existence of EMU on those who were outside.

Table.III.5 Robustness check for EMU effects –adding the dummy back in

Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Sweden	UK	US
-0.013	0.019	-0.007	-0.014	0.019	0.019	0.019	0.019	0.014	0.036	0.006
(0.612)	(0.004)	(0.598)	(0.305)	(0.004)	(0.004)	(0.004)	(0.004)	(0.513)	(0.406)	(0.749)

Note: probabilities are included in parenthesis

Our result that openness and stock of FDI (except for the UK in the case of the latter variable) are not in the cointegrating set as a direct determinant of output needs to be seen to be robust, and we undertook further tests. Openness and stock of FDI separately are added back into the final panel specification as a part of the long run and checked for the significance. As it is demonstrated in Table III.6 below openness is insignificant in each country (apart from the France) and as a panel variable. The FDI effect reported in Table III.7 is found be insignificant in most countries as well – the exception is Sweden and again France. It seems that after adding EMU, ESM and NAFTA dummies to our equations there is no direct role left for the either openness or FDI stock, except for the France where the above effects still may be present.

Table. III.6 Openness effects; adding the variables back in
Openness Effects

Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Sweden	UK	US
-0.216	0.032	-0.026	-0.195	0.302	-0.030	-0.760	-0.061	-0.216	0.442	-0.520
(0.357)	(0.607)	(0.820)	(0.073)	(0.009)	(0.715)	(0.211)	(0.475)	(0.557)	(0.061)	(0.464)

Probabilities in brackets

Table III.7 FDI effects adding the variables back in

Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Sweden	UK	US
-0.052	0.027	-0.011	-0.019	0.064	-0.001	-0.021	-0.031	0.040	-	-0.010
(0.278)	(0.321)	(0.413)	(0.177)	(0.000)	(0.974)	(0.514)	(0.397)	(0.003)		(0.545)

Probabilities in brackets

In this study two different indicators of volatility are used, with the conditional volatility of output being included in the cointegrating set. We also use the conditional volatility of real exchange rates in the next section, and can test for the robustness of our results if we add this variable of substitute it for the volatility of output. Table III.8 reports tests where we firstly substitute output volatility in the risk premium term with real exchange rate volatility and secondly by including real exchange rate volatility along with output volatility in the risk premium variable in our final panel set. As real effective exchange rate volatility is a generated repressor, new instrumental variable is created and used in both cases. We estimate both panels by 3SLS. In the first, where we substitute the volatility measure the new variable is not significant. In the second set we add the new variable, and it is also not significant. In addition the coefficients for the user cost and the output volatility measure are little changed. It appears that there is no role for the real exchange rate volatility in our final panel specification.

Table III.8 Substituting and adding real exchange rate volatility effects

Austria	-0.040 (0.000)	-0.015 (0.588)
Belgium	-0.040 (0.000)	-0.015 (0.588)
Denmark	-0.040 (0.000)	-0.015 (0.588)
Finland	-0.040 (0.000)	-0.015 (0.588)
France	-0.040 (0.000)	-0.015 (0.588)
Germany	-0.040 (0.000)	-0.015 (0.588)
Italy	-0.040 (0.000)	-0.015 (0.588)
Netherlands	-0.040 (0.000)	-0.015 (0.588)
Sweden	-0.040 (0.000)	-0.015 (0.588)
UK	-0.040 (0.000)	-0.015 (0.588)
US	-0.040 (0.000)	-0.015 (0.588)

Austria	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Belgium	-0.057 (0.000)	-0.425 (0.000)	0.066 (0.123)
Denmark	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Finland	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
France	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Germany	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Italy	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Netherlands	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
Sweden	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
UK	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)
US	-0.057 (0.000)	-0.425 (0.000)	0.0656 (0.123)

Our result seem robust to these checks, and we can conclude that EMU effects do appear to be present, and that there is no statistically significant effect from real exchange rate volatility or from openness on its own in this panel of countries. Hence evidence on the role of monetary union in raising trade, however sound, may not mean that we can read an effect through to productivity. This is not to say that openness does not matter, but rather that its effects reflect the impact of conscious attempts to increase competition and the efficiency of factor use. The ESM and NAFTA clearly raise the level of output and the level of trade, but the output effects come directly and not just through their impacts on trade. The only open question remains the role of FDI in the European economies. Although it is not needed in the cointegrating set for France and Sweden, and hence should have no long run role, it does show up with a positive coefficient in our robustness checks and hence it may be having an impact in these countries.

IV. Conclusions

To date there has been little evidence on the impact of Monetary Union in Europe on output and growth. This is in part because the time period between the formation of EMU and the current date is short. It is also because there have been a number of other factors affecting growth that have to be taken into account before evaluating the impact of the Union. Most studies look either at a single driver of growth, or at one of the proximate determinants of growth, and look for EMU impacts on that proximate driver. Trade effects have been the most widely discussed, but it is not clear that even if EMU has increased trade between members that this will have a major impact on growth. We argue that only a study that takes into account other factors driving growth could uncover the potential effects on EMU on output, and we do that here.

Our analysis of the impact of EMU on output growth suggests that the introduction of the common currency has had a direct positive impact on growth in the core Euro Area countries: France, Germany, Italy, Belgium and the Netherlands. Our estimates indicate that EMU will eventually directly raise output level by around 2 per cent in these countries. This is smaller than the impact of the Single Market Programme in the late 1980s and early 1990s, and like those effects it will build up only slowly. These findings are robust to the inclusion of other variables that have been driving growth such as R&D and FDI stocks and after adjusting the labour force for differences in skills levels across countries. After accounting for EMU, the European Single Market and the North American Free Trade Agreement, NAFTA, we found that openness, as measured by a share of total trade in output, had no significant direct role in explaining output or growth in our panel of countries. We were also able to show that the EMU effects were absent from countries such as the UK, the US, Denmark and Sweden who were not members. It is not clear that there were present in small economies such as Finland and Austria which may suggest that EMU has promoted agglomeration to the core of the Union.

The positive impact of EMU on long term growth is in contrast to the widely discussed relatively slow growth in the Euro Area. Much of this slower growth is in underlying productivity per person hour, and it reflects the differences in the rate of accumulation of skills across the countries we study. Around a quarter of a percentage point of the difference in growth rates between the UK and the members of the Euro Area comes from the more rapid accumulation of skills in the UK, both in the run up to EMU and in the subsequent period. Skills growth was particularly slow in Germany and in Italy especially in the EMU period and this alone would account for half a percentage point difference in the growth rates between these countries and the UK.

References

Aghion, P. and Howitt, P. (1998). Endogenous growth theory, MIT Press.

Baldwin, R. (2006). The euro's trade effects, *ECB Working Paper Series*, No. 594

Badinger H., (2007) Has the EU's **single market programme** fostered competition? Testing for a decrease in mark-up ratios in EU industries *Oxford Bulletin of Economics and Statistics* 69 (4): 497-519 August 2007

Barrell, R., (2007) 'Economic Growth in Europe' *National Institute Economic Review* January 2007 pp 65 -68

Barrell, R, Guillemineau, C., and Holland, D., (2007) 'Decomposing Growth in France, Germany and the UK using growth accounting and production function approaches. *National Institute Economic Review* January 2007 pp 99 -113

Barrell, R., Pomerantz, O. and Liadze, I. - Import Growth and the Impact of Globalisation, Presented at Project Link CASS conference Beijing May 2007 National Institute Discussion Paper no 294

Barrell, R. and Pain, N. (1997). Foreign direct investment, technological change and economic growth within Europe, *Economic Journal*, Vol. 107, pp 1770-1786.

Barrell, R. and Pain, N. (1998), "Real exchange rates, agglomerations and irreversibilities: Macroeconomic policy and FDI in EMU", *Oxford Economic Review of Economic Policy*, Vol. 14, pp. 152-167.

Barrell, R. and Pain, N. (1999), "Domestic institutions, agglomerations and foreign direct investment in Europe", *European Economic Review*, Vol. 43, pp. 925-934.

Brealey, R.A. and Myers, S.C. (2005). Investment and uncertainty in the G7, *Review of World Economics*, Vol. 41, No. 1, pp 1-32.

Coe, D. and Helpman, E. (1995). International R-and-D spillovers, *European Economic Review*, Vol. 39, No. 5, pp 859-887.

Durbin, J. (1954). Errors in variables, *Review of International Statistics Institute*, Vol. 22, pp 23-32.

European Commission (2004). EMU after five years, *Economic and Financial Affairs Publications*, Special Report 1/2004, pp 1-260.

Griffith, R., Redding, S. and Van Reenen, J. (2004). Mapping the two faces of R&D: Productivity growth in a panel of OECD industries, *Review of Economics and Statistics*, Vol. 86, No. 54, pp 883-895.

Lederman D, Serven L (2007) Tracking NAFTA's shadow 10 years on: Introduction to the symposium *WORLD BANK ECONOMIC REVIEW* 19 (3): 335-344 2005

Pesaran, H. and Smith, R.P. (1995). Estimating long-run relationships from dynamic heterogeneous panels, *Journal of Econometrics*, Vol. 68, pp 79-113.

Proudman, J. and Redding, S. (1998). Openness and growth, Bank of England.