

EU Productivity and Competitiveness: An Industry Perspective Can Europe Resume the Catching-up Process?

Mary O'Mahony* and Bart van Ark**
Editors

*National Institute of Economic and Social Research, London

**Groningen Growth and Development Centre, University of Groningen
and The Conference Board

Acknowledgments: The authors thank Colin Webb (OECD) for his advice on the use of the OECD STAN database, which has been an important input for the databases used for this study. We also received data series and advice on their use from employees at various national statistical offices, in particular Statistics Denmark, the Federal Statistical Office in Germany, Statistics Finland, the Central Statistics Office in Ireland, Statistics Netherlands, the Office for National Statistics, UK, the Bureau of Economic Analysis, US, and the Bureau of Labor Statistics, US. We also received useful advice from Lourens Broersma (Netherlands), Harald Edquist (Sweden), Martin Falk (Austria), Lawrence Nayman and Johanna Melka (France), and Nicholas Oulton and Sylaja Srinivasan (UK). The editors of this study and the authors of the individual chapters are solely responsible for the results provided in this study.

Table of Contents

| | |
|--|-----------|
| Executive Summary | 4 |
| Report Overview | 12 |
| Chapter I: Productivity Performance Overview..... | 13 |
| <i>Mary O’Mahony* and Bart van Ark**</i> | |
| I.1 Introduction..... | 13 |
| I.2 An overview of EU-US productivity differentials..... | 14 |
| I.3 Performance measures and measurement issues..... | 18 |
| <i>I.3.1 Why adopt an industry perspective?.....</i> | <i>18</i> |
| <i>I.3.2 The industry databases</i> | <i>19</i> |
| I.4 A summary of the results | 24 |
| <i>I.4.1 Sector Results.....</i> | <i>24</i> |
| <i>I.4.2 Decomposition of EU-15 labour productivity growth by country</i> | <i>25</i> |
| <i>I.4.3 Results using industry taxonomies.....</i> | <i>26</i> |
| <i>I.4.4 Growth accounting results</i> | <i>28</i> |
| <i>I.4.5 Productivity and competitiveness in manufacturing.....</i> | <i>30</i> |
| <i>I.4.6 Cyclical influences on productivity growth</i> | <i>30</i> |
| <i>I.4.7 Results at the firm level.....</i> | <i>30</i> |
| I.5 Implications for policy..... | 32 |
| Chapter II: Industry Structure and Taxonomies..... | 34 |
| <i>Catherine Robinson*, Lucy Stokes*, Edwin Stuivenwold** and Bart van Ark**</i> | |
| II.1 Introduction | 34 |
| II.2 Data description..... | 34 |
| II.3 Industry structure..... | 35 |
| <i>II.3.1 Industry shares of aggregate economic activity.....</i> | <i>35</i> |
| <i>II.3.2 The size distribution of industries.....</i> | <i>36</i> |
| <i>II.3.3 Capital intensity</i> | <i>41</i> |
| II.4 Industry taxonomies | 42 |
| <i>II.4.1 ICT taxonomy</i> | <i>43</i> |
| <i>II.4.2 IT occupational taxonomy.....</i> | <i>46</i> |
| <i>II.4.3 General skills taxonomy</i> | <i>48</i> |
| <i>II.4.3.1 Using the detailed skills data for the UK and US</i> | <i>48</i> |
| <i>II.4.3.2 Using Eurostat Skills database to develop a taxonomy.....</i> | <i>49</i> |
| <i>II.4.4 Innovation taxonomy based on the Pavitt taxonomy.....</i> | <i>57</i> |
| <i>II.4.5 The taxonomies combined</i> | <i>62</i> |
| II.5 Conclusions | 66 |
| II.A Appendix Tables..... | 67 |

| | |
|--|------------|
| Chapter III: Productivity and Competitiveness in the EU and the US..... | 69 |
| <i>Robert Inklaar** , Mary O'Mahony* , Catherine Robinson* and Marcel Timmer**</i> | |
| III.1 Introduction..... | 69 |
| III.2 Labour productivity in the EU-15 and US: an overview | 69 |
| III.3 Productivity growth grouped by industry taxonomies | 73 |
| <i>III.3.1 ICT taxonomy.....</i> | <i>73</i> |
| <i>III.3.2 IT occupational, general skills and innovation taxonomies.....</i> | <i>80</i> |
| <i>III.3.3 Conclusions from the taxonomy approach.....</i> | <i>85</i> |
| III.4 Decomposition of EU-15 labour productivity growth by country | 86 |
| III.5 Growth accounting | 89 |
| <i>III.5.1 Data and methods</i> | <i>89</i> |
| <i>III.5.2 Growth accounting results.....</i> | <i>90</i> |
| <i>III.5.3 Further analysis of input contributions.....</i> | <i>96</i> |
| III.6 Competitiveness in manufacturing: productivity levels and unit labour costs..... | 100 |
| <i>III.6.1 Relative labour productivity levels.....</i> | <i>101</i> |
| <i>III.6.2 Unit labour costs.....</i> | <i>103</i> |
| III.7 Conclusions..... | 106 |
| III.A Appendix Tables | 108 |
| Chapter IV: Structural and Cyclical Performance..... | 127 |
| <i>Robert Inklaar** and Robert McGuckin***</i> | |
| IV.1 Introduction..... | 127 |
| IV.2 Decomposing productivity growth rates into cycle and trend | 128 |
| <i>IV.2.1 Data.....</i> | <i>130</i> |
| <i>IV.2.2 Structural and cyclical effects in the productivity series.....</i> | <i>131</i> |
| <i>IV.2.3 A note on the sensitivity of the results to choice of lambda.....</i> | <i>133</i> |
| IV.3 Structural trends in productivity growth..... | 134 |
| <i>IV.3.1 Structural and cyclical decomposition by sector.....</i> | <i>136</i> |
| IV.4 Inventories and ICT | 138 |
| <i>IV.4.1 Inventories / sales ratios</i> | <i>139</i> |
| <i>IV.4.2 Inventories and volatility.....</i> | <i>140</i> |
| <i>IV.4.3 Data.....</i> | <i>140</i> |
| <i>IV.4.4 Empirical findings.....</i> | <i>141</i> |
| IV.5 Conclusions..... | 144 |
| IV.A Appendix Table..... | 146 |
| Chapter V: Productivity Performance at the company level..... | 147 |
| <i>Ana Rincon* and Michela Vecchi*</i> | |
| V.1 Introduction..... | 147 |

| | |
|--|------------|
| V.2 Description of the data set..... | 148 |
| V.2.1 Data sources and transformations..... | 148 |
| V.2.2 Descriptive statistics..... | 149 |
| V.2.3 Merging company and industry information..... | 151 |
| V.3 Trends in labour productivity growth..... | 152 |
| V.3.1 General trends..... | 152 |
| V.3.2 R&D, firm size and productivity performance..... | 154 |
| V.4 Econometric analysis..... | 157 |
| V.4.1 Modelling the impact of R&D on productivity growth..... | 157 |
| V.4.2 Basic production function results..... | 158 |
| V.4.3 Results for the sample split at 1995 and firm size..... | 161 |
| V.4.4 Introducing the taxonomy dummies..... | 166 |
| V.5 Firm dynamics..... | 169 |
| V.6 Conclusions..... | 176 |
| V.A Appendix: Methods and Tables..... | 178 |
| V.B Appendix: Generalised Methods of Moments (GMM) estimates..... | 181 |
| Chapter VI: The Policy Framework: Does the EU need a Productivity Agenda..... | 184 |
| <i>Geoff Mason*, Mary O'Mahony* and Bart van Ark**</i> | |
| VI.1 Background..... | 184 |
| VI.2 Theoretical perspectives on productivity-enhancing policies..... | 186 |
| VI.3 Scope for improving productivity growth rates..... | 188 |
| VI.3.1 Improvements through better use of ICT..... | 188 |
| VI.3.2 Non-ICT impacts on growth..... | 190 |
| VI.4 The regulatory and institutional environment..... | 194 |
| VI.5 Policy implications..... | 197 |
| VI.6 Conclusions..... | 200 |
| Chapter VII: Data Sources and Methodology..... | 203 |
| <i>Robert Inklaar**, Lucy Stokes*, Edwin Stuivenwold**, Marcel Timmer** & Gerard Ypma**</i> | |
| VII.1 General Introduction on Performance Measurement Issues..... | 203 |
| VII.2 Databases for this project..... | 206 |
| A. The 56-industry database for the European Union and the US..... | 207 |
| B. Industry growth accounting database for the European Union and the US..... | 215 |
| C. Manufacturing Productivity and Unit Labour Cost database for the European Union and the US..... | 227 |
| References..... | 236 |

*National Institute of Economic and Social Research, London.

**Groningen Growth and Development Centre, University of Groningen.

***The Conference Board.

Executive Summary

Background

- Since the mid 1990s the average growth rates of real GDP, labour productivity and total factor productivity in the European Union have fallen behind those in the United States. What makes this remarkable is that this is the first time since World War II that these performance measures have shown lower growth rates for the EU for several years in a row.
- This represented a reduction in labour productivity levels in the EU relative to the US in recent years, down from a position of near parity in the mid 1990s. Estimates of the average GDP per hour worked gap range from EU levels between 87% and 92% of US levels in 2002 and early indications are that the gap has widened further in 2003.
- There is a wide variation across European Union in productivity performance, both in terms of growth rates as well as levels. A limited number of countries show productivity levels near to that of the US (Germany, Netherlands) or even above it (Belgium, France), whereas others are substantially behind. However, nearly all countries show a recent erosion of their average productivity levels relative to the US.
- Weighting growth rates by each country's shares of EU employment highlights the importance of two countries (Germany and Italy) in accounting for the EU slowdown in the second half of the 1990s. Thus of the countries that experienced a slowdown, about 75% of the total decline was due to these two, with Germany about twice as important as Italy.
- The contrasting experience of the US and the EU in the 1990s could in theory be due to cyclical influences. A range of tests in this report show no significant effect on the productivity growth measures due to different timings of the business cycle.
- This report argues that these findings can be better understood by employing an industry perspective. This approach can answer the following questions, which aggregate economy wide estimates cannot deal with.

To what extent are the aggregate trends in output and productivity common across industries?

Are there differences in industry specialisations across the two regions?

How are industry output and productivity affected by investment in physical and human capital?

How is productivity related to competitiveness in manufacturing?

Is productivity affected by the market environment in which firms operate?

- In addition an industry perspective can help to inform industrial policy in the EU.

Industry databases

- For the purpose of this study, a unique database, the *Industry Labour Productivity Database*, has been developed for this report.
- The database provides industry detail for 1979 to 2001 on output, hours worked and labour productivity for all 15 EU countries and the US.
- The database covers 56 individual industries covering the total aggregate economy.
- In addition, data series for capital inputs and labour force skills were constructed for the US and four of the larger EU countries, namely France, Germany, the Netherlands and the UK, for 26 individual industries.
- To achieve international consistency, US deflators were employed to obtain real output series in manufacturing sectors producing information and communications technology (ICT) equipment. A common (Törnqvist) weighting system was employed to obtain more consistent aggregate series across countries.
- Finally, to study relative competitiveness, the database includes estimates of relative productivity levels and unit labour costs in manufacturing. These again cover all EU countries.

Results: Labour productivity

Industry variation

- The data show a wide variation in performance across industries, countries and time periods. Double-digit annual average growth rates in labour productivity are common in ICT producing sectors such as office machinery and electronic components. Strongly negative rates occur frequently in services such as transport or business services industries. About half the industries show higher growth in the EU, but the locus of these industries has changed through time.
- Comparing the period since 1995 to the early 1990s, the acceleration in US growth is by no means ubiquitous, occurring in about half of the 56 individual industries. But in contrast less than 20% of industries in the total EU show accelerating growth across these two periods.
- Weighting each industry's performance by employment shares gives an indication of their contribution to aggregate economy labour productivity growth. In the US, the post 1995 acceleration is dominated by a few industries, namely ICT producing sectors, wholesale and retail trade and banking and auxiliary financial services. This confirms findings elsewhere in the literature, stressing the importance of services in explaining the US

growth advantage over the EU. In the EU, the aggregate deceleration in the same period is spread more widely across industries.

Industry taxonomies

- In order to make sense of this wide variation in performance, industries were grouped according to common features. Thus taxonomies were created based on whether industries are producers or users of ICT (and within the latter their intensity of use), whether industries mainly employ skilled or unskilled labour, and on the channels through which innovation occurs.
- In both the US and the EU, the ICT producing group experienced very high and accelerating productivity growth rates, although double-digit rates are confined to manufacturing. ICT producing services (communications, computer software, etc.) is the only group that shows the reverse pattern of accelerating growth in the EU and decelerating in the US, but this group has a small employment share.
- In intensive ICT using sectors, productivity growth in the EU is relatively stable across time in contrast to a very large acceleration in the US, mostly in the services part. This is a clear indication that the US is ahead of Europe in terms of productive application of ICT outside the ICT producing sector itself.
- Non-ICT industries (those neither producing nor intensively using the new technology), show decelerating growth in both regions. The rate of decline in the final period is greater in the EU but from higher growth rates in the 1980s and early 1990s. Non-ICT service industries show a marginal improvement in the US post 1995 which is not matched in the EU.
- Dividing industries according to their use of skilled labour shows accelerating US growth in industries which are intensive in their use of university graduates. In this group no productivity change across time occurs in the EU.
- Productivity growth rates in sectors characterised by higher intermediate skills (higher level but below degree) were relatively high and increasing across time in the EU. This group includes most of the non-ICT producing engineering industries, which are traditionally seen as areas of EU strength, relying on the large endowments of skilled craft workers in many EU countries.
- Of more concern for the EU is declining productivity growth in sectors that intensively use lower intermediate skills, particularly since this group shows pronounced acceleration in the US from the mid 1990s. This group includes some of the larger ICT using sectors in services, notably wholesale and retail distribution. This raises the possibility that

traditional lower intermediate skills in the EU may not be appropriate for the needs of the information economy.

- Finally in both the EU and the US productivity growth has been declining in low skill intensive industries. These include many mature manufacturing sectors subject to product cycle influences arising from strong competition with low wage economies in the developing world and Central and Eastern Europe.
- The innovation taxonomy considered the source of innovations, distinguishing between those where innovations were external (supplier based) or internal to the industry (scale intensive, science based, based on organisational innovations or instigated through the demands of clients).
- The US outperformed the EU in specialised suppliers manufacturing (which are mainly ICT producing industries). In services both supplier based services (dominated by retail trade) and client led groups (dominated by wholesale trade) showed the familiar pattern of accelerating US labour productivity growth simultaneously with unchanged or declining EU growth. Innovation in these service industries will become an increasingly important source of productivity growth in future.
- The EU outperformed the US in all periods in all (manufacturing) goods industry groups, except in specialised suppliers manufacturing. This indicates Europe's relative strength in traditional manufacturing and in industries where (mainly process) innovations arose from in-house R&D. The latter is strongly tied to the EU advantage in industries characteristics of higher intermediate skills. However, the productivity growth rates in all these manufacturing industry groups are slowing down, which – in combination with the declining shares of these industries – raises the question whether manufacturing will remain the “power house” of the European economy as it used to be before.
- In summary the taxonomies point to industry features that can explain some of the varying performance when industries are grouped on the basis of key characteristics that matter for growth differentials. More importantly, they also provide explanations for the diverging EU-US productivity performance which are not apparent from examination of the aggregate economy figures. Thus industries can be loosely divided into the following groups, based on their labour productivity performance, sharing one or more of the listed features:

US productivity growth acceleration, EU unchanged or declining. Industries that are ICT producing manufacturers or intensive users of ICT, employ graduates or lower intermediate skilled labour, and where innovations arise through specialised suppliers, supplier based innovation and are provided through demands of clients.

EU productivity growth relatively high, little or no US acceleration. Industries that are ICT producing services, employ highly skilled craftsmen (higher intermediate skilled labour) and/or where innovations are largely process changes arising from in-house R&D.

Relatively low and declining productivity growth in both the US and EU. Industries that neither produce nor intensively use ICT and employ mostly unskilled labour.

Results: Input use and Total Factor Productivity

- This section of the report compares performance in the US with an EU-4 aggregate employing data for France, Germany, the Netherlands and the UK.

Physical capital and labour quality

- Investment in ICT equipment has been proceeding rapidly in both the EU-4 and the US. The contribution of ICT capital per hour worked (capital deepening) to labour productivity growth has been increasing across time and this is widespread across industries. Its impact is proportionally greater in ICT producing and ICT using industries than in more traditional sectors but nevertheless remains significant in the latter.
- Whereas the contribution of non-ICT capital deepening has been relatively stable in the US, in the EU-4 the importance of non-ICT capital has been declining through time in most sectors. There is a clear reduction in the rate of substitution of capital for labour in most industry groups in Europe. Although this report cannot unambiguously relate this to the moderation in wage growth in Europe during the second half of the 1990s, it is very likely that this traditional explanation has a role to play but is very dependent on country-specific institutional arrangements in their labour markets.
- Industries in both the EU and US have increased their skill base, and hence the quality of their labour force. However, the rate of increase has slowed in the US in the ICT producing sectors, that are the most intensive users of university graduates. In the EU-4, the slowdown in labour quality growth has occurred primarily in non-ICT industries. This may be influenced by active labour market policies to reduce unemployment and increase the employment rate, inducing relatively low skilled workers back into the labour force.

Total Factor Productivity

- Total factor productivity is defined as the change in output after taking account of growth in physical capital and changes in the quantity and quality of labour inputs. In many respects the TFP estimates mirror the results for labour productivity with accelerated growth in recent years confined to the US.
- The estimates confirm the now widely accepted proposition that the US TFP growth acceleration occurred in ICT using as well as ICT producing sectors. But the results also suggest an acceleration in TFP growth in ICT using sectors in the EU-4 although at much lower rates than in the US. Thus the labour productivity slowdown among ICT users in these four EU countries combined was largely due to a reduction in ICT capital deepening.
- These observations raise the possibility that, at least in the US, ICT has an impact on TFP above that due to ICT capital deepening.

Firm Level Analysis

- In addition to presenting results by industry, one chapter of this report is devoted to an analysis of productivity change at the company level providing complementary evidence to the industry results discussed above.
- An econometric analysis suggests that returns to R&D are positive and significant in the US, and in the three largest EU countries combined (France, Germany and the UK) but not in the EU as a whole.
- The analysis also suggests positive returns to R&D in firms located in service industries post 1995 in both the US and the EU.
- The results indicate that small and intermediate size companies, employing less than 250 and between 250-1000 employees, respectively, enjoyed higher productivity growth than the larger ones. However, returns to R&D investment in both the EU and the US were highest in the largest companies, especially in the manufacturing sector.
- This chapter in addition reviews the literature on firm dynamics and concludes that, compared to the EU, entry of new firms is easier in the US and there is stronger growth of surviving firms after entry.

Results: Manufacturing productivity levels and unit labour costs

- The report also compares labour productivity levels in manufacturing in the EU relative to the US. This shows considerably lower EU levels in ICT producing sectors. Similarly

calculations of unit labour costs show the EU at a competitive disadvantage relative to the US in these sectors.

- In contrast EU unit labour costs, averaged across the years 1999 to 2001, were lower than in the US across a wide range of traditional manufacturing industries.
- But comparisons with the US are less relevant here, since both the EU and US are likely to have high unit labour costs relative to their main competitors in developing countries and Central and Eastern Europe.

Policy Implications

- Chapter VI of the report outlines the main forces driving EU productivity growth and their policy implications. In general it stresses that public policy interventions are likely to involve costs as well as benefits in productivity terms, and that there is no easy cure to correct the EU's productivity problem.
- On balance the report suggests that policies to strengthen product market competition may be worthwhile in some industries, in particular in services. While recognising that intensification of product market competition may sometimes also have a negative impact on incentives to innovate, the weight of empirical evidence appears to favour a continued emphasis on continued deregulation.
- In contrast to product markets, there is less consensus on the productivity growth impacts of deregulating labour markets. Here the trade off is between static gains in efficiency and the more dynamic implications for investment in human capital. If labour market deregulation undermines incentives for individuals to accumulate human capital or for firms to engage in on the job training, then this could have a negative impact on long run growth.
- Raising employment has long been on the agenda of EU policy. But increased employment of low-skilled labour may have negative consequences for labour productivity growth at least in the short run. The potential conflict between employment and productivity objectives can be ameliorated if simultaneous efforts are made to upgrade the skills of new entrants and re-entrants to the labour force, in particular in the light of new opportunities for innovation in technology using industries.
- Finally there are strong arguments in favour of providing general support to build up the EU knowledge base, for example, through programmes which promote two-way knowledge transfer between enterprises and academic 'science base' institutions and encourage enterprises to build up collaborative R&D networks in conjunction with supply-chain partners and with universities and research institutes. There should also be

stronger emphasis on activities that support innovation in service industries. But the high degree of institutional variation among EU member-states suggests that policies aimed at promoting knowledge transfer and fostering innovation should also try to build on accumulated institutional strengths within individual EU countries.

REPORT OVERVIEW

This report consists of a summary chapter, five chapters making up the main body of the analysis and a chapter describing sources and methods for the underlying the industry results. *Chapter I, Productivity Performance Overview*, begins with a discussion of the overall productivity picture comparing the EU with the US. Following a brief overview of the important features of the databases and a discussion of some additional measurement issues, the chapter summarises the main findings from the study and the policy implications.

Detailed analyses are presented in chapters II-V, which together form the main analytical part of this report. *Chapter II, Industry Structure and Taxonomies*, describes industry structure in the EU and US. Industry structure is first described in terms of the size distribution of firms and levels of capital per hour worked, followed by industry clustering procedures. Industry taxonomies are created based on common structural features of industries, such as their intensity of use of information technology inputs or skilled workers and on the channels through which innovations occur. *Chapter III, Productivity and Competitiveness in the EU and the US*, presents the main results on industry productivity performance. It starts with estimates of output per hour worked, extends to measures that additionally take account of capital inputs and labour quality and finally to an examination of relative productivity levels and unit labour costs in manufacturing. *Chapter IV, Structural and Cyclical Performance*, examines the argument that cyclical developments affect the comparability of EU-US comparisons, by decomposing labour productivity growth into trend and cyclical components in order to separate the short run impacts from long run trends in productivity growth rates. This chapter also considers the link between inventories and information technology. The industry analyses in chapters II-VI are supplemented by additional analysis at a more micro level in *Chapter V, Productivity Performance at the Company Level*. This chapter employs company accounts data which allows estimation of the direct effect of R&D on performance at the firm level. For completeness, Chapter V also includes a summary of the literature on firm dynamics, i.e. the process by which entry, exit and growth increases productivity growth.

Chapter VI, The Policy Framework: Does the EU need a Productivity Agenda, begins with a discussion of theoretical perspectives that can be employed to understand the policy implications of the results in the analytical chapters. This is followed by a discussion of the main policy recommendations that are frequently put forward to cure the EU's productivity problem. Finally, *Chapter VII: Data Sources and Methodology*, describes in greater detail the construction of the industry databases.