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An overview of the EU KLEMS Growth and Productivity Accounts*

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Abstract:

The EU KLEMS project represents a unique collective effort on behalf of academics, statisticians and policy makers to provide fundamental policy insights into the changes which have occurred at the industry level in Europe, the US and Japan over recent decades. The unprecedented deepening in global trade and capital market integration since the early 1990's, allied to the cost-induced and ICT-enabled acceleration in the worldwide relocation of production processes over this period, has dramatically changed the economics of specific industries. Changes have occurred in terms of scale economies, technological spillovers (i.e. diffusion of best technologies / practices); the degree of import competition; and the productivity effects from the reallocation of resources amongst the different market players. Many of these globalisation related transmission mechanisms are having direct knock-on effects in terms of the specialisation patterns of individual countries, with the result that the post-1995 period has been marked by significant, industry-driven, divergences in the productivity and GDP per capita growth trends of specific countries and regions around the world. Against this background, the present paper has focussed on providing firstly, an overview of the contents and policy significance of the EU KLEMS project and secondly, a series of analyses which illustrate the usefulness of the project's datasets and its conceptual framework.

Keywords: GDP growth, productivity, growth accounting.

JEL Classification: O33, O47, D24, E22

***** EU KLEMS stands for EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs. EU KLEMS is a research project funded by the European Commission as part of the 6th Framework Programme, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs".

*** ***The authors are economists in the Directorate-General for Economic and Financial Affairs (ECFIN) of the European Commission.

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[1] EU15ex5 = EU15 excluding Greece, Ireland, Luxembourg, Portugal and Sweden.

1 : Introductory Remarks

With the pace of economic change accelerating and with the degree of complexity in decision making rising in tandem, policy makers need more extensive sources of information in order to respond in an effective manner. This is particularly true in the case of industry level statistics where official, national accounts sourced, datasets are presently only available for a relatively small number of countries, industries and variables. The unprecedented deepening in global trade and capital market integration since the early 1990's, allied to the cost-induced and ICT-enabled acceleration in the worldwide relocation of production processes over this period, has dramatically changed the economics of specific industries. Changes have occurred in terms of scale economies, technological spillovers (i.e. diffusion of best technologies / practices); the degree of import competition; and the productivity effects from the reallocation of resources amongst the different market players. Many of these globalisation related transmission mechanisms are having direct knock-on effects in terms of the specialisation patterns of individual countries, with the result that the post-1995 period has been marked by significant, industry-driven, divergences in the productivity and GDP per capita growth trends of specific countries and regions around the world.

It is against this backdrop that the EU KLEMS project has emerged as an attempt by the Commission services to better understand the global and EU specific phenomena driving EU growth and productivity trends in the post-1995 period. It is generally accepted that it is not possible to provide a meaningful interpretation of developments over this time period without examining manufacturing and service industry trends. The key objective of the EU KLEMS project was therefore to build a system of analysis at the industry level for the EU's Member States (as well as for the US, Japan and a number of other countries) which encompasses internationally harmonised, national accounts based, statistics and indicators, as well as an analytical framework for interpreting this information based on input-output analysis and growth accounting. The project is in effect an attempt to overcome current deficiencies in official industry level statistics[2], especially with regard to the provision of data for service industries. It is conceived as a coherent, policy driven, framework for the further development of official statistics in this domain and consequently has the potential to ensure a more informed EU structural policy debate over the coming years.

The present paper provides an overview of the EU KLEMS project, including an analysis of the inaugural version of the EU KLEMS databank which was launched in March 2007. Section 2 gives a short description of the project's main objectives and of its policy significance. Sections 3 to 5 then examine the March 2007 databank to see what the datasets are telling us about the industry level underpinnings of macroeconomic trends in output, employment and productivity, both in the EU and the US :

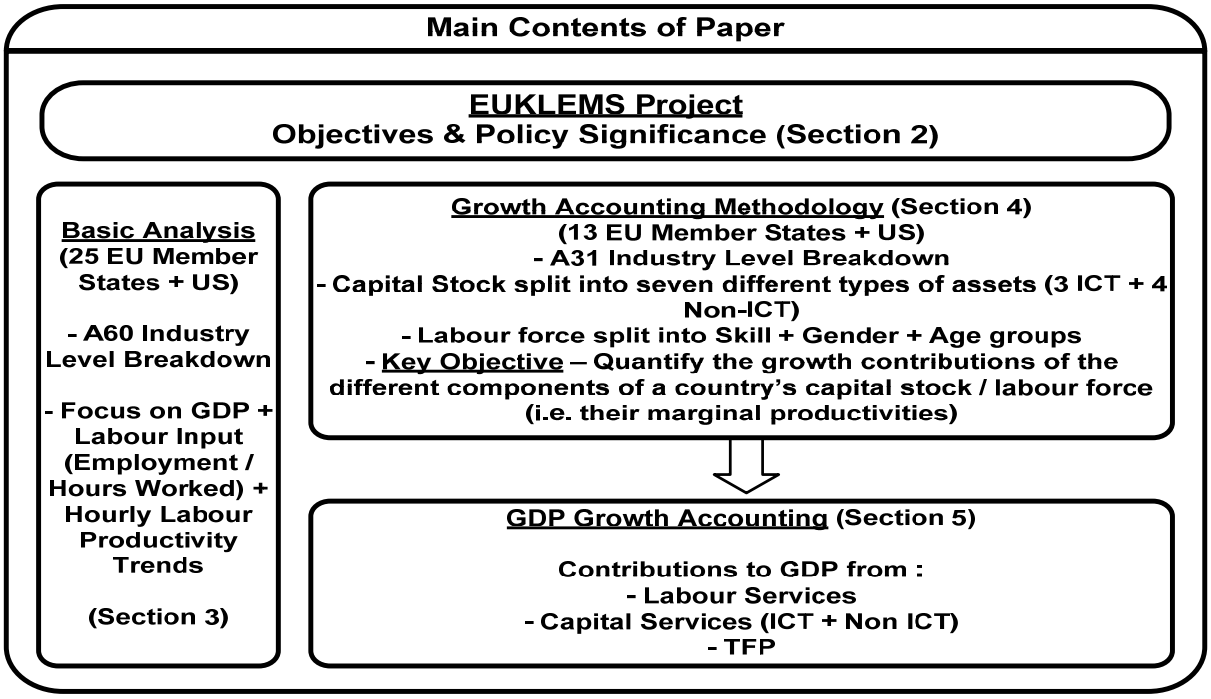
- An analysis is provided in section 3 of the "basic", national accounts sourced, variables in EU KLEMS, namely value added, labour input (employment and hours worked) and labour productivity. The important industries needed to explain EU-US productivity growth differentials are also isolated.

- Section 4 gives a summary of the KLEMS growth accounting framework which constitutes the central core of the EU KLEMS project.

[2] While the work of Eurostat and the National Statistical Institutes (NSIs) offers hope for the future provision of pertinent data, the present situation is particularly problematic, with long runs of official industry level data only available for a relatively small number of countries, industries and variables and with these short sample lengths precluding any serious degree of analysis.

- Section 5 then goes on to examine EU and US GDP growth trends in more detail, using the KLEMS growth accounting methodology. Value added is broken down into the contributions from labour services, capital services and total factor productivity (TFP). The focus of the analysis is on the small group of industries which are pivotal in understanding ongoing EU-US productivity differentials.

The final section provides a summary of the key results from the analysis of the EU KLEMS datasets; highlights a number of questions which need to be addressed before the datasets can be used for meaningful policy evaluation purposes; and stresses the importance which the ECOFIN Council places on ensuring the long run survival of EU KLEMS given its potentially pivotal role in ensuring a more informed structural policy debate in the EU over the coming years.



2 : Main objectives and policy significance of the EU KLEMS research project

The Commission services have been actively involved in the initiation and negotiation of the FP6[3] funded project EU KLEMS. The project has the ultimate objective of creating a comprehensive industry level, national accounts based, statistical system for the EU[4]. The first complete version of the EU KLEMS databank was publicly released in March 2007, with Annex 1 giving a detailed description of its coverage, including variables, industries and countries. The present section provides an overview of the project's main objectives (2.1) and of its policy significance (2.2).

2.1 : Main Project Objectives : EU KLEMS has 4 main objectives :

1. To create a sustainable growth, employment and productivity database at the industry level for 25 of the 27 EU Member States[5] as well as for non-EU countries such as the US, Japan and Canada (and later on perhaps Korea, China and India) **:** The primary focus of this project is the construction of an internationally comparable database[6], with the key variables anchored in official statistics. The database will facilitate the sustainable production of high quality statistics on economic growth, productivity, employment creation, capital formation and technological change in the European Union at the industry level (manufacturing and services). The database consists of two separate modules :

- ***A: Analytical Module***[7] : This module aims to include the greatest amount of data possible given its essential role in driving analytical research work both in the consortium[8] itself as well as in the wider research community. In addition to filling

[3] 6th Framework Programme for Research.

[4] The term "industry level" is used here to signify the A60 total economy breakdown into service industries (26 individual service industries) and manufacturing, construction and basic materials (34 industries).

[5] It is hoped that the work can be extended to Romania and Bulgaria in the near future.

[6] Regarding the actual construction of the research database, the consortium has made good progress in terms of developing a statistical system where "meta-data" describing the underlying data sources and the relationships between the various classification systems (industries, labour input categories, asset types) and between the economic concepts (output, intermediate inputs, factor inputs, PPP's) are separated from the statistical routines and growth accounting algorithms used to manipulate the data.

[7] The EU KLEMS analytical module, released in March 2007, has been constructed using the concepts and methodologies laid out in a series of "best practice" manuals on the measurement of output and productivity at the industry level both from Eurostat (i.e. the "Handbook on Price and Volume Measures in National Accounts" + "The ESA 95 Input-Output Manual – Compilation and Analysis") and from the OECD (i.e. "Measuring Capital - Measurement of Capital Stocks, Consumption of Fixed Capital and Capital Services" + "Measuring Productivity : Measurement of Aggregate and Industry Level Productivity Growth)". In addition, substantial efforts have been made by the consortium to ensure harmonisation of the basic datasets. Harmonisation has been focussed in a number of key areas such as industrial classifications; aggregation levels; reference year for volume measures; price concepts; methods for solving breaks; more detailed asset classifications; development of harmonised measures of labour input (employees, self-employed, hours worked); measurement of labour services and capital services inputs in a standardised way; and the generation of total factor productivity measures using harmonised methodologies. Due to the consortium's extensive collection and harmonisation work, researchers and policy analysts will be able to carry out much more refined growth accounting analyses at the industry level (between 30 and 72 industries in total, depending on the country, the variables included and the sub-period).

[8] "Consortium" refers to the group of research institutes which were awarded the EU KLEMS contract. In addition to a number of important advisors to the project including Prof. D. Jorgenson, the main participant organisations are 1. Rijksuniversiteit Groningen (RUG – Netherlands); 2. National Institute of Economic and Social Research (NIESR - UK); 3. Centre d'études prospectives et d'informations internationales (CEPII - France); 4. Centre for Economic and Business Research (CEBR - Denmark); 5. Netherlands Institute for Economic Policy Analysis (CPB - Netherlands); 6. Deutsches Institut für Wirtschaftsforschung (DIW - Germany); 7. Federaal Planbureau (FPB - Belgium); 8. Istituto di Studi e Analisi Economica (ISAE - Italy); 9. Instituto Valenciano de Investigaciones Económicas (IVIE - Spain); 10. Helsinki School of Economics (HSE - Finland); 11. Österreichisches Institut für Wirtschaftsforschung (WIFO - Austria); 12. Vienna Institute for International Economic Studies (WIIW - Austria); 13. Economic and Social Institute, Free University Amsterdam (ESI - Netherlands); 14. The Conference Board Europe, Brussels (TCBE - Belgium).

gaps in the data through transparent estimation procedures, the analytical module uses a range of techniques (mainly derived from growth accounting) and considers alternative or pioneering assumptions regarding certain statistical conventions on, for example, the output and price measurement of ICT goods and non-market services, the comparison of skill levels, the construction of the capital stock and measurement of capital services, or on the capitalization of intangible assets. Such efforts will contribute to the improvement in the international comparability of productivity measures and will provide the necessary (more refined) information that is vital for academic and statistical research on the sources of growth. The series in the analytical module are not official statistics and the module will be treated solely as a research database[9].

- ***B : Statistical Module*** (the first version of which should be released early in 2008)[10] : The ESA95-compliant data is being developed as a statistical module which is intended to be validated and adopted in official statistical practice, subject to the agreement of the NSIs. This module aims to collect data following the rules and conventions as established in the present System of National Accounts (1993) and in the European System of Accounts (1995). For the statistical module, the support of the NSIs is needed in order to fill this module with the largest possible number of official, industry level, data series. The consortium is working closely with the NSIs and with Eurostat in the context of the contractually agreed Statistical Implementation Plan to ensure that the largest proportion possible of the "Analytical Module" is included in the "Statistical Module".

- ***Convergence of "analytical" and "statistical" modules over time*** : An explicit aim of the project is to outline the relationship between the *statistical and analytical modules* of the database. The dynamics of a convergence between both datasets is determined by the "Statistical Implementation Plan". With regard to the scope of the convergence process, the focus should not be in terms of the growth accounting methodology itself but on the basic official (industry level – value and volume) series used as inputs (both in terms of growth rates and levels), such as those for gross output, intermediate inputs (energy, materials and services), gross value added, labour compensation; employment and hours worked by skill groups, gross fixed capital formation, capital stock by asset type and depreciation rates.

[9] The first version of the analytical module was released on 15 March 2007. It constitutes a unique resource for policy makers and researchers to exploit :
- It is extremely rich in terms of its coverage of over 60 industries, with 25-30 countries, up to 35 years of data and between 60-70 variables / indicators included.
- These industries cover the whole economy, including a detailed breakdown of service industries.
- Labour input is disaggregated by age, gender as well as by distinct skill categories (i.e. high, medium and low skilled workers). This breakdown is based on data from the Labour Force Survey (LFS).
- A breakdown of capital distinguishing its ICT and non-ICT components is also included.
- The databank also allows for an analysis of gross output as well as value added, with intermediate inputs (energy, materials and services) being considered as additional factors of production.
- In the December 2007 version of the analytical module, knowledge creation datasets (technology indicators such as R&D and patents; measures of intangible capital accumulation from innovation surveys such as the CIS etc) will be added. It is planned that the consortium will make progress on the development of new conventions on measures of non-tangible assets and on issues related to the measurement of educational qualifications using labour force statistics. The consortium is also willing to consider providing additional breakdowns for a number of the variables in the databank into their domestic and foreign components, with priority to be given to a further breakdown of the capital stock and of the intermediate inputs series.

[10] Whilst the analytical module contains all available data sources (including estimations), the statistical module will contain that part of the analytical module which, as a rule, can be regarded as official statistics –i.e. statistics produced and validated by the NSIs.

2. To make methodological breakthroughs in the field of productivity measurement : The project is addressing a wide range of methodological issues which top the agenda of statistical agencies and institutions involved in empirical economic research. Substantial methodological research has been carried out on the measurement of output, inputs, prices, knowledge indicators and productivity levels (most notably in terms of the production of industry specific purchasing power parities), especially in terms of improving the international comparability of these indicators[11].

3. To carry out a large amount of policy – oriented research using the assembled datasets **:** The overall objective of the analytical research work to be carried out by the consortium is to use the assembled EU KLEMS datasets to inform policy makers on the EU's structural performance at the aggregate EU level, within the EU, and also compared with the US, Canada and Japan. In particular, this research will help (along with the research emanating from the wider research community following the release of the analytical module) to unravel the extent to which total economy productivity growth differentials can be traced to industry specific factors and how much of these differentials are related to ICT investment; to the accompanying changes in the skill composition of employment / organisational changes; to R&D developments and finally, the extent to which measurement problems (most notably in terms of service industries) also play a role[12].

4. To use EU KLEMS as a stepping stone towards the creation of a comprehensive, industry level (manufacturing + services), set of statistics : The ultimate objective of the EU KLEMS project is to use the assembled datasets as the essential building block for providing EU and national policy makers and researchers with a national accounts based, industry level, statistical system with a breadth and quality equivalent to that presently available to US policy makers.

2.2 Policy Significance of EU KLEMS : Given the progress which has been made in terms of the building-up of the databank itself; the provision of an analytical framework based on input-output analysis and growth accounting; as well as the important methodological and

[11] In terms of the methodological breakthroughs to be made by the project, one of the most important is the issue of industry level purchasing power parities (PPP's). Regarding the current state of progress on PPP's in EU KLEMS, while the gross output industry level PPP's presently produced by the consortium are robust enough for growth rate aggregation purposes, this unfortunately is not the case for levels comparisons. This in part reflects the fact that inconsistencies between the output and input (labour, capital) series by industry in the national accounts is producing unusual levels comparisons for some Member States for a number of specific years and industries. It is absolutely essential to have PPP indicators of sufficient quality to ensure meaningful, cross country, productivity level comparisons for furthering the policy debate in a number of industries, most notably in the services arena. In this context the consortium is committed to providing robust measurements of productivity levels at the A31 level so as to ensure that policy relevant analyses can be carried out in terms of the levels of both labour productivity and of TFP.

[12] More specifically, the policy oriented research work to be carried out by the consortium will focus on the following four broad thematic areas, each of which will have multiple individual research projects :

- **A) Analysis of Productivity, Prices, Structures and Technology and Innovation Indicators :** Productivity (labour productivity and TFP) measures can be directly obtained from the EU KLEMS database. Several measures of skills, physical capital accumulation, technological change and innovation as well as industry price structures can also be directly derived from the database and can be used for policy analysis in the light of the evaluation of the Lisbon strategy.
- **B) Research on labour markets and skill creation :** Examples include : the determinants of the demand for different types of labour, in particular in relation to skill-biased technological change and the substitution between different age and gender groups in the labour force. The effects of international outsourcing on the skills composition of the labour force can be examined by using industry level taxonomies of technology, skill and innovation propensities.
- **C) Research on technological progress and innovation :** The focus here will be on investigating the consequences of integrating technology indicators (R&D, patents measures), measures of intangible capital accumulation (indicators from innovation surveys) and foreign direct investment into various types of productivity analyses. The impact of public innovation support on R&D expenditure and on the productivity effects of private R&D will also be examined.
- **D) Comparative analyses based on linking the industry level productivity results with firm level databases :** With these firm level datasets, the EU KLEMS analysis can be extended to investigate the relationship between R&D accumulation and productivity growth on the one hand and firm demographics (entry, exit and incumbents shares) at the industry level on the other. Analyses are also possible on the effects of firm-level dynamics on productivity growth within industries.

policy oriented research work which has been initiated; EU KLEMS has the potential to be directly beneficial to EU policy makers in the following areas :

1. EU KLEMS is essential for understanding recent EU productivity trends : Productivity growth is the lifeblood of our economies and is the ultimate driver of sustained increases in living standards. The Commission services submitted the EU KLEMS project for funding under FP6 since it felt that satisfactory explanations for the growing EU-US per capita income differentials in the post-1995 period (and also for the widening intra-EU growth gaps) could not be explained solely on the basis of highly aggregated macroeconomic indicators. An industry level perspective was deemed essential to explain these trends and more specifically to understand the reasons behind the large cross-country differences in terms of productivity experiences both within the EU and relative to other developed economies around the world, most notably the US. As stressed in many seminal papers in the literature, and confirmed in the EU KLEMS datasets, aggregate EU-US productivity growth differentials can indeed be traced to industry specific developments. Much of the gap is linked with either the production of ICT or with the intensive use of ICT products and services. Understanding these developments will be made easier given the improvements made by the consortium in terms of the growth accounting capacity of the databank, with the provision of capital stock, labour composition and intermediates (energy, materials and services) datasets particularly noteworthy[13].

2. EU KLEMS is fundamental in assessing progress with the Lisbon Strategy : On the assumption that a significant part of the analytical module will eventually be regarded as official statistics, EU KLEMS has the capacity to substantially improve the measurement of the effectiveness of Lisbon related structural reforms[14].

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[13] Specific insights are expected from EU KLEMS in the following three, productivity-related domains :

- The project will deepen the understanding of policy makers concerning the drivers / barriers to higher investment and faster technological change. Restrictions concerning labour and product markets, lack of openness to trade and/or foreign direct investment, as well as barriers in terms of access to new technologies and in relation to the diffusion of innovations are the key determinants of EU productivity growth. International comparisons reveal sizeable disparities in investments with regard to physical capital, human capital and in research and development. EU KLEMS will examine those sectors of economic activity where the differences are most acute and which have shown the greatest narrowing in growth differentials over time.
- EU KLEMS will deliver insights relating to the changing nature of the demand for skilled labour arising from the implementation of, and adaptation to, new technology. Factor demand studies could reveal country specific adjustment rigidities. The data will allow policy makers to monitor more closely these shifts in the skill composition of employment in specific sectors of the economy and to link these shifts to the structure of investment. In other words it will help to identify patterns of substitutability and complementarity between specific types of labour and capital.
- EU KLEMS will assist in assessing the relative competitive position of individual countries / industries, between major groups of countries such as the European Union and the US or Japan, and between the 'old' and 'new' Member States of the EU. By making closer links between production data and trade statistics, the project will also provide new insights into the outsourcing phenomenon by studying how intermediate imports interact with domestic factors of production. In addition, the EU KLEMS data will permit the calculation of sector and country specific indicators of the degree of competition on goods and service markets which can then be linked to total economy competitiveness measures. As a consequence of EU economic integration, of the emergence of global production structures and the harmonisation of institutions that govern product and factor markets, relative productivity levels will increasingly serve as an important indicator / benchmark of the technological performance of economies.

[14] EU KLEMS allows us to learn from past reforms and to alert us to what works and does not work. The datasets can, for example, be used to analyse the effects of reform efforts in labour and product markets and for assessing the importance of knowledge investments in meeting the Lisbon goals :

- A diverse range of labour market reforms have been introduced in many European countries since the mid-1990's. Collectively the reforms have contributed to a decline in structural unemployment rates in recent years. Here, EU KLEMS offers the possibility to see how specific reforms have affected employment at the sectoral level both via capital labour substitution, the change in the skill composition of employment but also via an expansion of specific industries.
- Many product market reforms have an explicit industry specific dimension. One can think, for example, about the successful liberalisation of a range of important network industries which took place since the early 1990's. Here EU KLEMS will be especially useful in tracing how the observed price declines can be explained by changes in technology and market structure.
- In addition, we know from productivity developments in industrialised countries since the mid 1990s that knowledge investments are important growth drivers. It comes as no surprise that countries with well educated labour forces and with a sectoral structure geared towards ICT production that they have done well over this period. The Lisbon strategy puts a lot of emphasis on the creation of knowledge capital via its focus on education and R&D investments. EU KLEMS will certainly help in identifying specific strengths and weaknesses in industrial structures across EU countries which, in turn, will help in devising targeted reform efforts in this area of the "knowledge economy".

It will provide high-quality, internationally harmonised, datasets using a detailed industry breakdown (40% of whose headings are services) for the EU's member states since 1970 (1995 for 10 of the new EU Member States - EU10) as well as providing comparable datasets for the US, Japan and Canada.

3. EU KLEMS can complement the "Structural Indicators" Programme : EU KLEMS has been devised to act as a complement to the "Structural Indicators" programme, with the objective of strengthening its overall coherence. This complementarity aspect reflects the fact that whilst the "Structural Indicators" is a collection of very diverse individual indicators, EU KLEMS is more of an economically intuitive analytical tool for policy-orientated analysis. It provides a conceptual framework (i.e. the production function) for interpreting and understanding the relationships / links between the different indicators included in the databank.

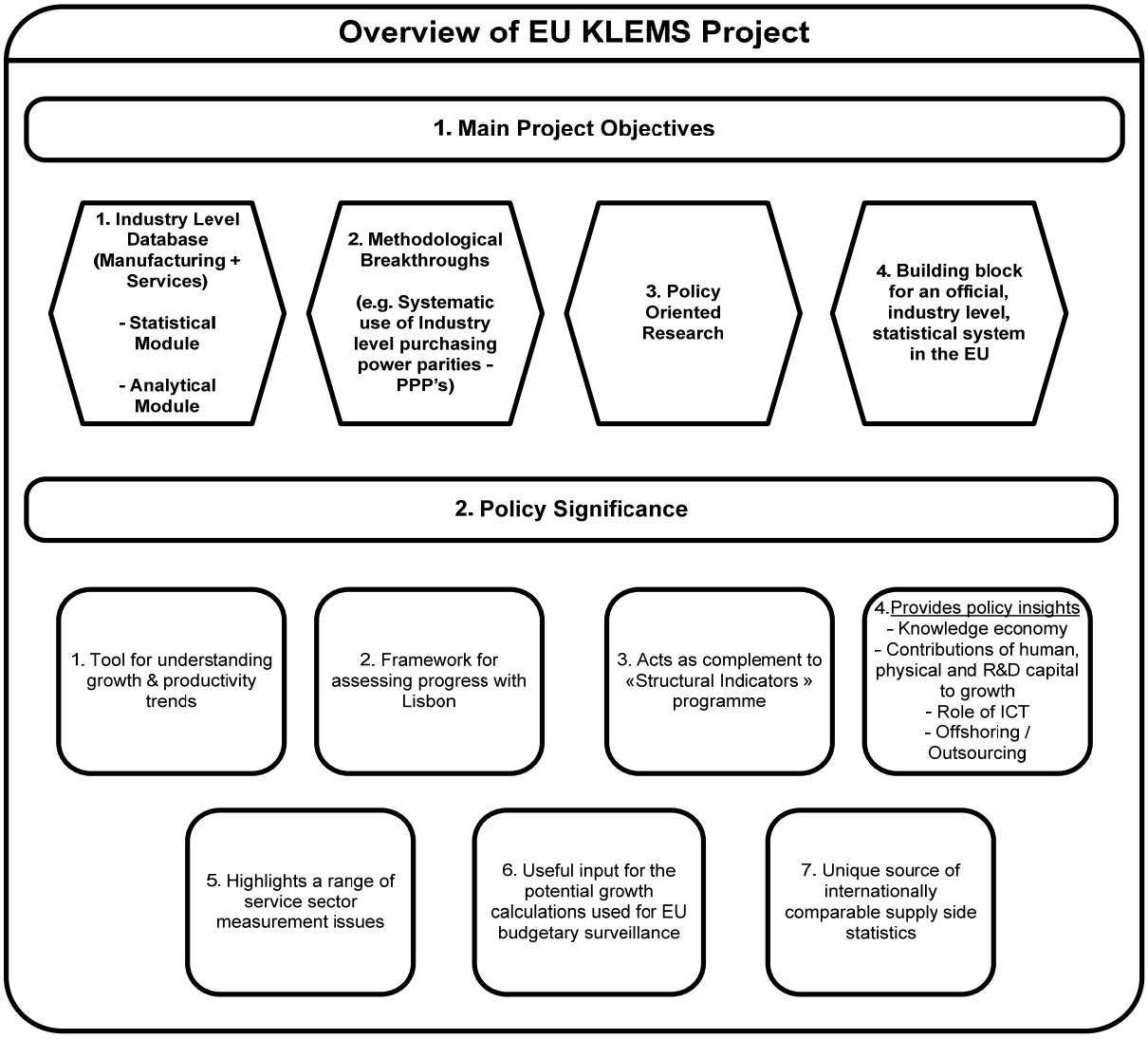
4. EU KLEMS will explore a large number of policy relevant issues : The project will provide important insights into a range of pressing policy issues (e.g. the knowledge economy; the contributions of human, physical and R&D capital to growth; the role played by different types of skilled labour; the role of ICT in explaining growth differentials; the long run economic impact of offshoring and outsourcing and the additional insights provided by linking trade and production data). The challenge for policy makers is to propose and implement reform initiatives in all of these policy areas aimed at enhancing the efficiency of resource allocation in the EU and ultimately stimulating higher, sustainable, rates of economic growth and standards of living for EU citizens. In this context, EU KLEMS is central to the efforts of policy makers to gain deeper insights into the changes which have occurred at the industry level from both the creation of the Euro area and from the enlargement / globalisation processes.

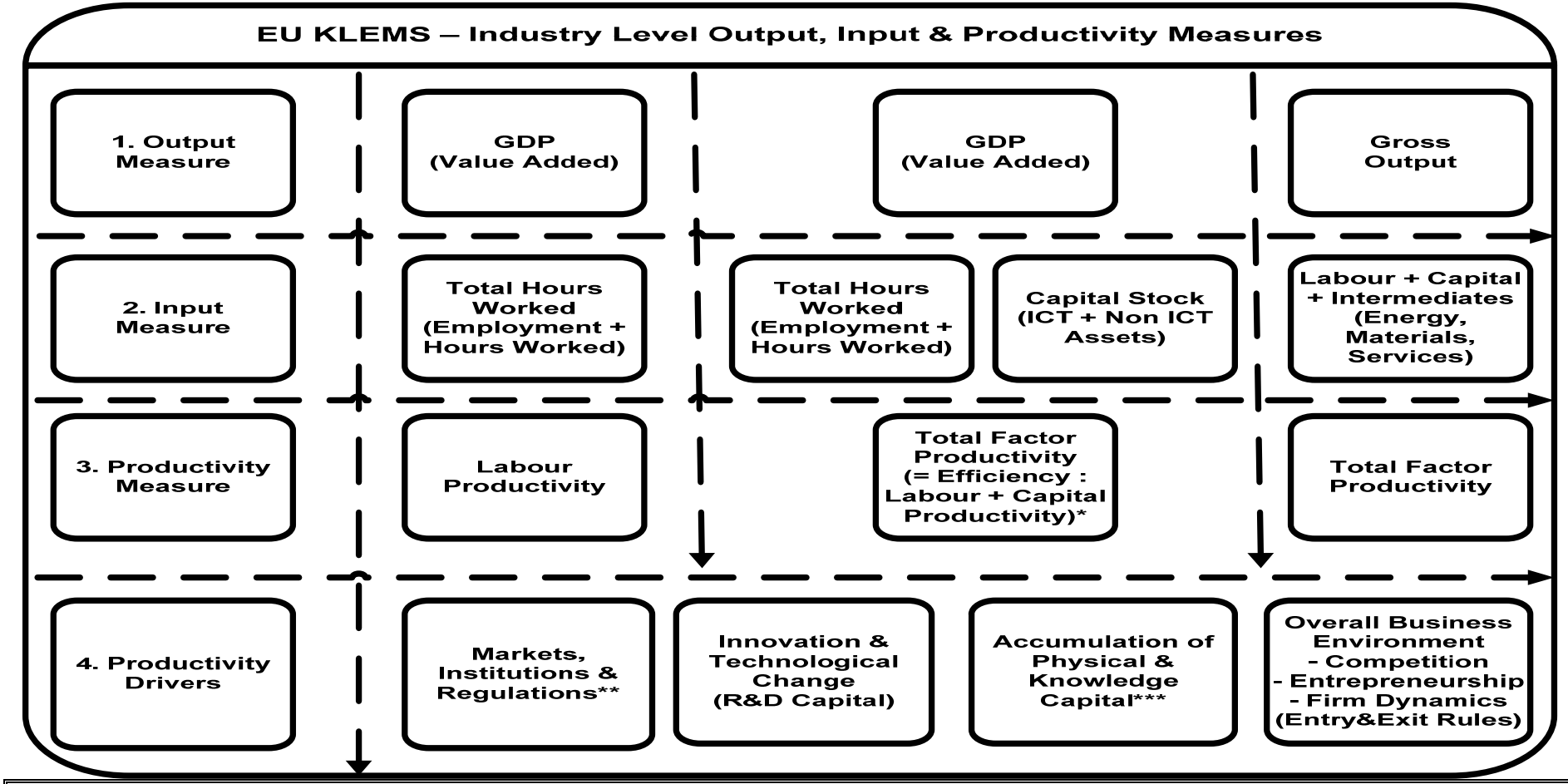
5. EU KLEMS has already initiated an EU-wide debate on the measurement of specific service industries : With the release of the analytical module in March 2007, EU KLEMS "kick-started" a fundamental debate in the EU on the measurement of a number of service industries such as wholesale and retail trade and financial services. Given the important role which these latter industries appear to be playing in explaining EU-US productivity differentials, there is now a widespread acceptance of the need for policy makers to get more involved in addressing these issues and to take views on a range of conceptual questions relating to the services sector e.g. an evaluation of the available methods used to measure value added in the services sector; how quality changes in specific service industries are catered for; and the degree of robustness of the deflators used to produce the volume measures for specific service industries.

6. EU KLEMS provides an additional data source for refining the potential growth rate estimates used in the EU's budgetary surveillance process : EU KLEMS will allow the Commission services to carry out a more refined growth accounting analysis at the industry level. This in turn will help to strengthen the ECOFIN Council approved, production function, methodology which is presently used to produce the potential growth and output gap estimates needed for the EU's budgetary surveillance exercise. In this context, a key issue which is presently concentrating the minds of economists and policy makers is the nature of the recent recovery in productivity : is it mainly a cyclical phenomenon or does it signal a structural improvement in the growth potential of European economies ? A detailed analysis of industry level productivity trends using EU KLEMS would be very useful in coming to an informed judgement on such issues but only if the timeliness of the present datasets is

improved. At the moment, the databank only goes up to 2004 but it is hoped that as the policy relevance of EU KLEMS becomes more apparent that more frequent updates will be possible as the project develops. This will be important in ensuring that policy makers can effectively integrate the datasets into their regular structural policy surveillance exercises.

7. EU KLEMS will improve the availability of policy relevant, supply side, statistics : Since the early 1990's, the EU-related statistical priorities of Eurostat and the NSIs have been, understandably, focussed on the provision of a wide range of short-term EMU related statistics. With a functioning EMU now in place and with the growing acceptance that existing Euro area growth rate differentials are linked to differences in the production structures of Euro area countries, there is now a case for giving consideration to a re-evaluation of the EU's statistical priorities. This has already in fact started with the proposed extension of the ESA95 transmission programme towards the provision of statistics which have a more medium to long term, structural policy, focus.





*	TFP is affected by factors such as labour quality/skill mix improvements; capital quality (vintage and asset composition); pure technological progress; sectoral reallocation effects; changes in capacity utilisation rates and measurement errors with respect to the contributions from physical capital, labour or, in the case of industry gross output, intermediate inputs.
**	Markets, institutions and regulations: This refers to both the macro fundamentals (i.e. low + stable inflation; moderate tax burdens on labour + capital; trade openness) and the micro environment (i.e. adequate incentive structures + well functioning product, labour + financial markets).
***	Knowledge capital includes "soft" / intangible investments in education, skills and organisational / managerial best practices.

3 : "Basic" sectoral and industry level analysis : Output, employment and labour productivity trends for 25 EU Member States and the US

The present section provides an analysis of the "basic" variables in EU KLEMS, namely value added, labour input (employment and hours worked) and labour productivity per hour worked. Most of these series form part of the present European System of National Accounts (ESA 1995) and many of them can be found in the national accounts of the individual countries, at least for the most recent period. The main adjustments made by the consortium to these series relate to filling gaps in industry level detail and in linking series over time.

The March 2007 release of the database includes the basic variables broken down by detailed manufacturing and service industries for 25 of the 27 EU member states (the exceptions being Bulgaria and Romania) as well as for Japan and the US. In general, data is available for 1970-2004 for the "old" EU-15 countries and for the US, with series from 1995 onwards available for ten of the new EU member states. Specific data gaps have the effect, however, that coverage in the databank does differ across countries, industries and variables, with an overview of the country-by-country situation given in Annex 1 (section 1.4).

In terms of structure, sub-section 3.1, using period averages, gives an overview for the main EU aggregates (i.e. Euro area, EU15, EU10 and EU25) and for the US of developments in value added, labour input and labour productivity over the period 1981-2004. A breakdown of "total industries" into the 3 broad sectors of manufacturing, private services and "rest of economy" is provided. Sub-section 3.2 then goes on to give a, HP-filtered, trend comparison[15] between one of the EU aggregates (i.e. the EU15) and the US. The final sub-section (3.3) focuses in on differences in the industry-level contributions to labour productivity growth for the EU15, EU10 and the US, using the most detailed industry breakdown available in EU KLEMS (i.e. the A60 level).

3.1 : Sectoral Overview (Manufacturing, Private Services, "Rest of Economy") : Table 1 gives period average growth rates for value added, labour input and hourly labour productivity for a number of EU aggregates and for the US. The figures for "total industries" can be directly compared with the "total economy" figures for the equivalent aggregates. As the analysis in annex 2 stresses, the EU KLEMS trends for value added, labour input and labour productivity are broadly comparable with the Eurostat validated, "total economy", figures from Ameco, with only minor deviations evident for the series chosen. In the specific case of labour productivity, table 1 shows that the EU KLEMS datasets mirror the well-documented downward movement in EU labour productivity trends, with EU15 and Euro area annual average labour productivity per hour growth rates falling from over 2% over the 1981-1995 period to 1 1/2% (1996-2000) and to 1% (2001-2004). These EU trends are in marked contrast to those experienced in the US which witnessed a sharp acceleration in its productivity performance over the same time periods, with annual average growth rates doubling from 1 1/4% over the period 1981-1995 to 2 1/2% for 2001-2004. The apparent out-performance of the US relative to the EU has been widespread at the industry level, with both the manufacturing and private services sectors both highlighting the relatively poor EU outturn. From an EU perspective, productivity per hour trends in the EU10 grouping (i.e. the new Member States) have been much more encouraging, with rates of growth of 3 1/4% for 1996-2000 accelerating to close to 4% over the most recently available years.

[15] Filtering the data allows one to identify the underlying trends by removing the cyclical effects.

Table 1: EU Aggregates + US[16]
GDP, Labour Input in Hours and Labour Productivity per Hour
(Annual Average Volume Growth Rates in %)

	GDP			Labour input in hours			Labour productivity per Hour		
	1981-1995	1996-2000	2001-2004	1981-1995	1996-2000	2001-2004	1981-1995	1996-2000	2001-2004
	Total Industries								
Euro Area	1.9	2.5	1.4	-0.2	1.1	0.4	2.1	1.5	1.0
EU15	2.0	2.7	1.5	-0.2	1.1	0.4	2.2	1.6	1.1
EU10		3.4	2.7		0.2	-1.2		3.2	3.9
EU25		2.7	1.6		0.9	0.1		1.8	1.5
US	2.8	4.1	2.1	1.4	2.0	-0.4	1.3	2.1	2.6
	Manufacturing								
Euro Area	1.5	2.5	0.5	-1.8	-0.2	-1.3	3.3	2.7	1.9
EU15	1.5	2.4	0.4	-2.0	-0.3	-1.9	3.5	2.6	2.3
EU10		6.2	4.5		-1.0	-2.1		7.2	6.5
EU25		2.6	0.7		-0.4	-1.9		3.0	2.6
US	3.0	4.9	0.8	-0.3	0.4	-5.0	3.3	4.4	5.7
	Private Services								
Euro Area	2.7	3.0	1.8	0.7	2.1	1.0	1.9	1.0	0.8
EU15	2.8	3.4	2.0	0.7	2.0	1.1	2.1	1.4	0.9
EU10		3.4	2.4		1.4	-0.9		2.0	3.2
EU25		3.4	2.0		1.9	0.8		1.5	1.2
US	3.2	5.1	2.6	2.1	2.8	-0.4	1.2	2.2	3.0
	Rest of Economy								
Euro Area	1.0	1.6	1.4	-0.3	0.4	0.4	1.3	1.2	0.9
EU15	1.1	1.5	1.4	-0.2	0.4	0.7	1.3	1.0	0.7
EU10		2.3	2.4		-0.2	-1.2		2.6	3.5
EU25		1.6	1.5		0.3	0.3		1.3	1.2
US	1.8	1.7	2.0	1.5	1.6	1.4	0.3	0.0	0.6

Source: EU KLEMS and own calculations

[16] ***Two data sources for US*** : The EU KLEMS consortium was forced to provide two alternative datasets for the US because the main national accounts based building block for the US KLEMS productivity database (i.e. the NAICS – North American Industry Classification System - annual industry accounts from the Bureau of Economic Analysis – BEA) is presently only available for the period 1998-2005, with a full series going back to 1970 only being made available by the BEA in 2008. Consequently, the consortium has had to use the SIC (Standard Industrial Classification) industry accounts from the Bureau of Labor Statistics (BLS) for the period 1970-2000 and has extrapolated forward this dataset to 2004 using the NAICS data. Since the NAICS classification system, compared with the SIC, is based on a more detailed correspondence table with the ISIC (International Standard Industrial Classification), the NAICS datasets are more internationally comparable. Due to these short-term problems with the US datasets, we have decided, as an interim solution, to use the US NAICS data for international comparisons of value added, labour input and labour productivity per hour (i.e. for the tables and graphs in the present section 3) and to use a "hybrid" solution for the growth accounting analyses (essentially sections 4 and 5 of the paper where the NAICS is used for all of the main US variables, with the exception of "labour composition" since this latter data is only available from the SIC database). Annex 2 has a graph showing the main differences, in quantitative terms, between both data sources, using TFP as an example.

3.2 : EU15 vs. US : Trend Comparisons : In order to bring out the essential longer term (non-cyclical) patterns more clearly, graphs 1a-1c show trends for the EU15 and the US for value added, labour input and hourly labour productivity. EU15 is chosen since, as shown in table 1, its overall performance for the three variables in question is roughly equivalent to that of the Euro area and the EU25 aggregates. Since the datasets for the new Member States (EU10) only start in 1995, the short series length unfortunately excludes a meaningful trend analysis. The graphs for EU15 and the US show the contributions to the total economy change in the three variables from the manufacturing, private services and "rest of economy" sectors (i.e. the combined effect of growth for the variable / sector and their respective output / employment shares). The trends have been calculated using a Hodrick-Prescott (HP) filter which is effectively equivalent to applying a centred moving average[17]. The set of graphs have all the same scale and are additive (i.e. manufacturing + services + rest of economy = "total industries"). The main points to be retained are as follows :

- In terms of output growth, the US has consistently outperformed the EU over the period 1980-2004, with the trend performance gap averaging around 1% point over recent years. This "total industries" gap is essentially driven by differences in the performance of the private services sector, although manufacturing has also played a role.

- Of the overall 1% point growth gap, roughly 80% is due to differences in labour productivity per hour, with 20% due to a slower growth in the contribution of labour. There has been a relatively strong convergence between the EU and the US over the last decade or so with regard to the contribution of labour to value added growth, with the contribution falling in the US and rising in the EU. The strong EU recovery in its trend utilisation of labour was unfortunately accompanied by a correspondingly negative trend for labour productivity. The EU15 has now a trend productivity growth rate which is substantially lower than that of the US and the gap is relatively wide and persistent.

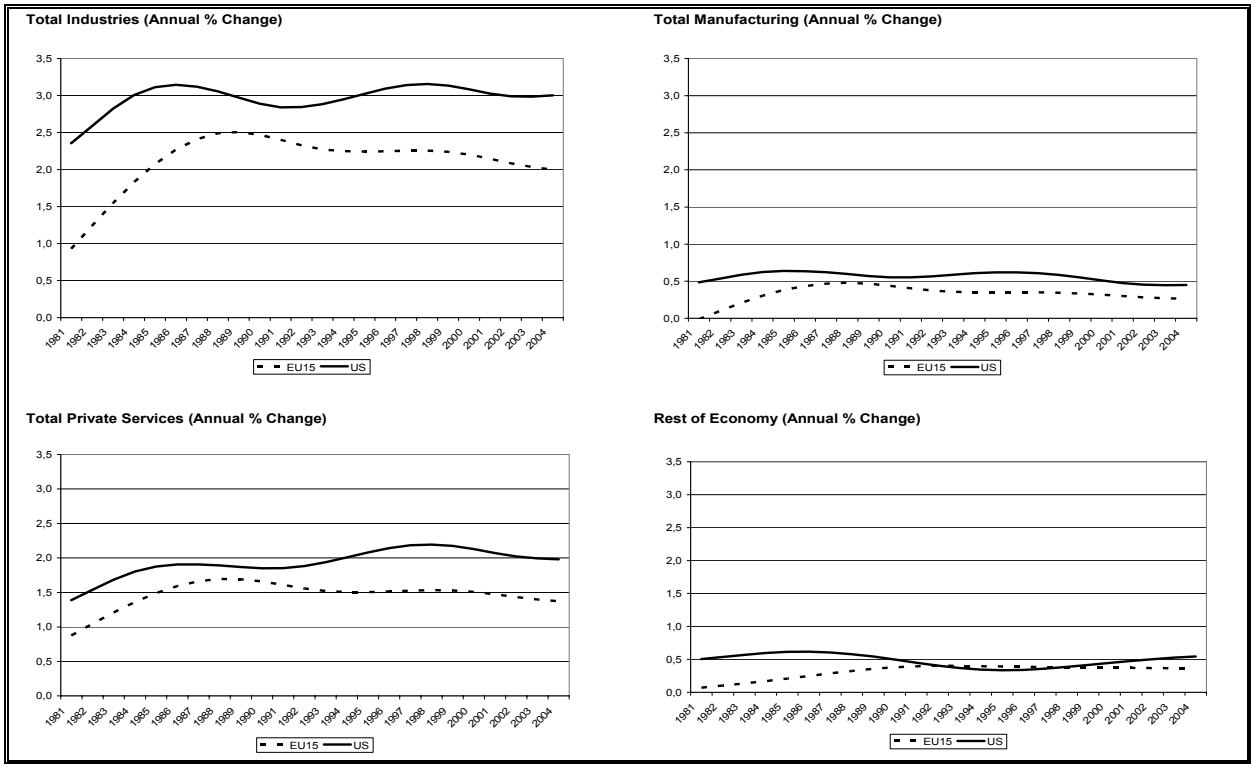
- In terms of the sectoral composition of differences in the contribution from labour, it is interesting to note from the graphs that divergences are not a feature of the manufacturing and private services sectors but are due to differences in the "rest of the economy" sector which is made up of primary industries plus public services.

- With regard to the labour productivity differences at the sectoral level, of the total productivity gap of around 0.8 percentage points in favour of the US, roughly 25% of the gap for the most recent years is emanating from manufacturing and 75% from private services. The EU has however retained its traditional productivity advantage for the "rest of the economy" sector.

- The graphs showing the total change in hours worked in the different sectors appear to imply that labour productivity trends in the manufacturing and private services sectors have little to do with the broad labour input trends in these respective sectors. This trade-off conclusion is confirmed in the analysis described in Annex 4.

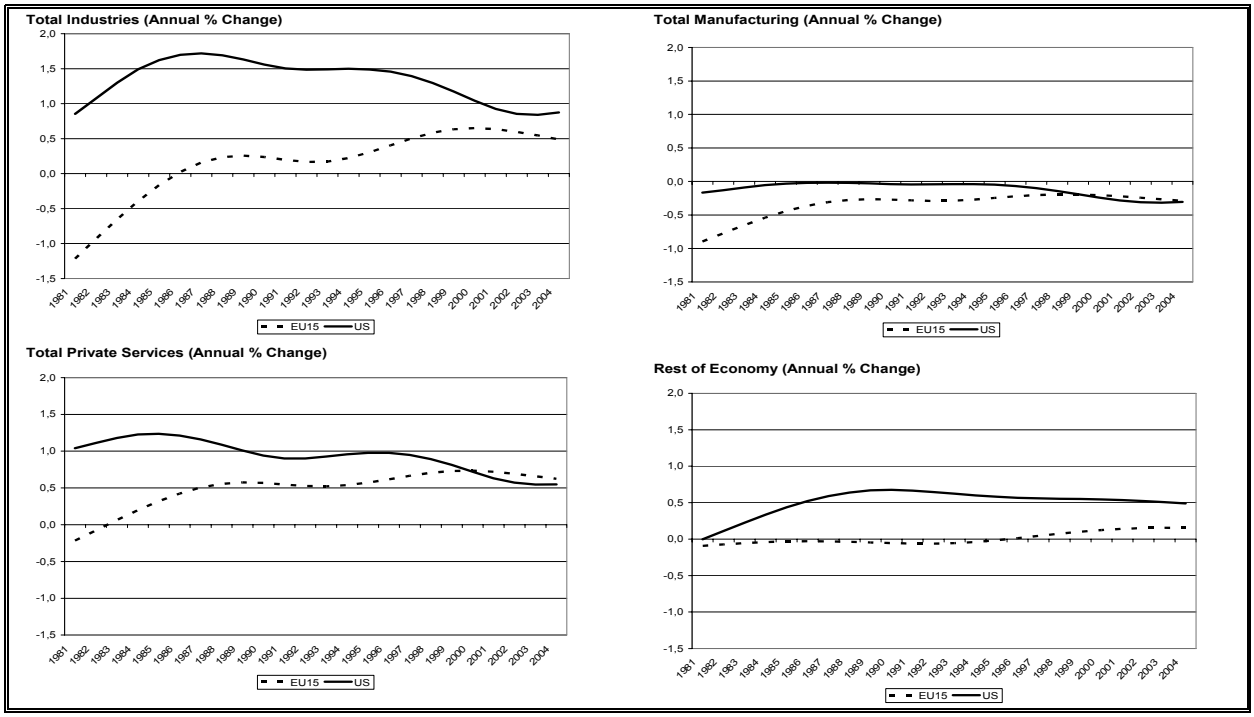
[17] A further 3 years are added at the end of the series to limit the influence of the well-known "end point bias" problem associated with the fact that the HP filter becomes asymmetric towards the end of the series.

Graph 1A : EU15+ US – Trend Contributions to Total Change in Output (Value Added) - Breakdown into Manufacturing, Private Services and Rest of Economy



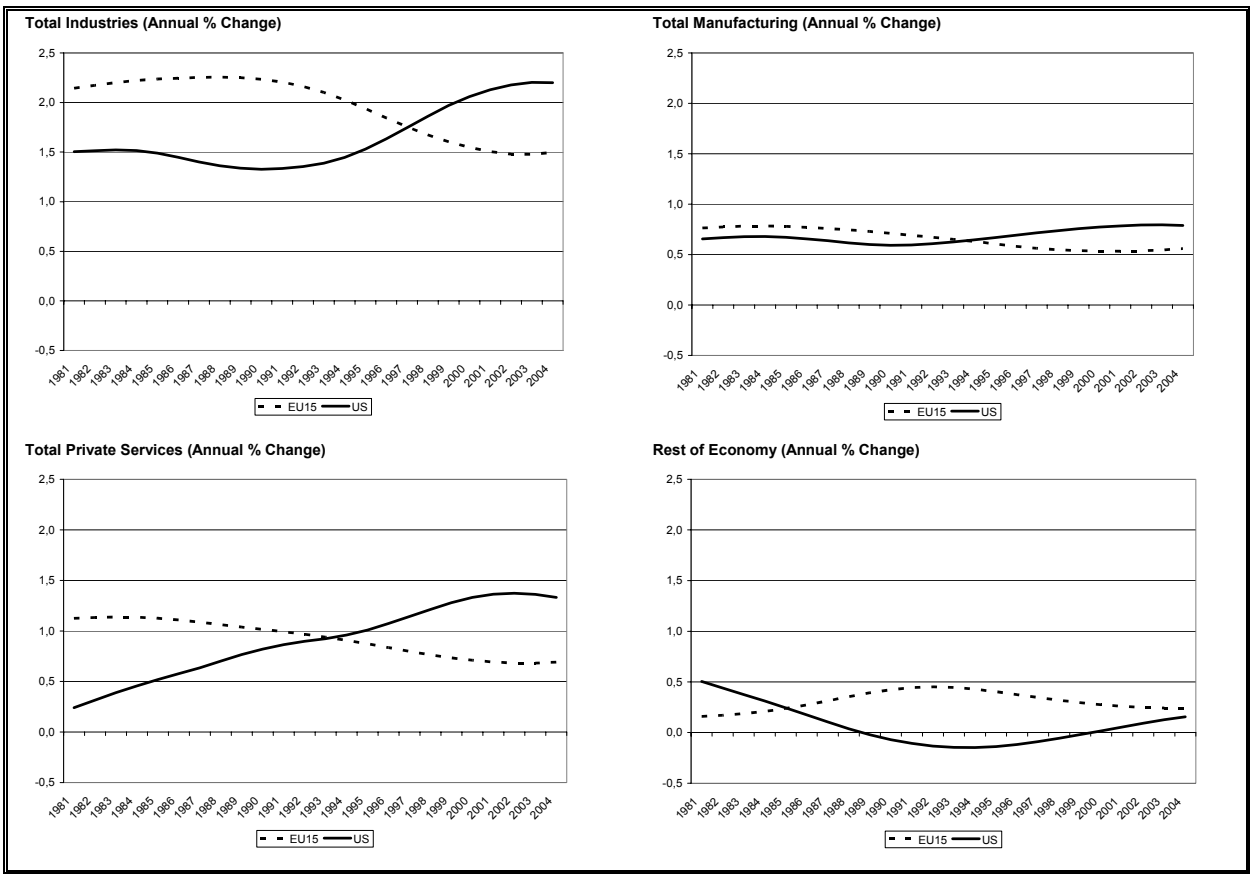
Source: EU KLEMS and own calculations

Graph 1B : EU15 + US – Trend Contributions to Total Change in Employment (Hours Worked) - Breakdown into Manufacturing, Private Services and Rest of Economy



Source: EU KLEMS and own calculations

Graph 1C : EU15 + US – Trend Contributions to the Total Change in Labour Productivity per Hour - Breakdown into Manufacturing, Private Services and Rest of Economy



Source: EU KLEMS and own calculations

3.3 Detailed industry breakdown (A60 level) – Focus on contributions to labour productivity growth in the EU15, EU10 and US : Given that section 3.2 showed that the bulk of the EU-US GDP growth differences reflect divergences in terms of hourly labour productivity, and given that it is unprecedented in the post-war period for the EU to have a lower trend productivity growth rate to that of the US, the present sub-section will take a closer look at productivity developments. Following on from the earlier sectoral analysis, it digs deeper at the sub-sectoral level and provides an A60 industry (a total of 58 individual industries)[18] breakdown for the EU (EU15 + EU10) and US economies. This is the most detailed, comparable, industry level breakdown which is available in EU KLEMS for these EU aggregates and the US. Given their similar levels of development, graph 2 directly compares the US and the EU15 for the 1996-2004 period, with graph 3 giving more details for those specific industries where EU-US productivity differences are greatest. The emphasis in both graphs is on the labour productivity contribution of each industry to the overall total. For the EU10 grouping, since there is a large catch-up element in the productivity trends, graph 4 does not compare the new Member States with the EU15 or with the US but instead splits the 1996-2004 time period into two separate periods, 1996-2000 and 2001-2004 to see the evolution of the EU10 productivity changes over time.

For the EU15 and the US, graph 2 provides a snapshot of the 58 industries and their importance for the productivity performance of both economies over the period 1996-2004.

[18] While we are using the NACE A60 industry breakdown, data is only available for a total of 58 industries since some of the smaller headings such as "extra-territorial organisations and bodies" have been merged with other NACE codes.

This breakdown visualises the productivity dilemma facing the EU15 by giving a panoramic overview of the contribution of the different industries[19]. For ease of exposition, the industries are shown as part of the manufacturing, private services and rest of economy sectors which have already been discussed in 3.2.

Graph 2 shows that the EU has been doing reasonably well compared with the US in a wide range of manufacturing and service industries over the period as a whole. However, the problem is that most of these industries are not making big contributions to overall productivity growth, with the graph indicating a contribution of much less than 0.1% for most of the industries concerned. In those, mainly traditional and medium tech, industries where the EU has equalled or outperformed the US over the second half of the 1990's, most are either low productivity growth industries or do not have a large enough share of EU output to alter the EU's overall productivity performance (see annex 8 for details on growth rates and value added / employment shares).

This is particularly the case in the manufacturing sector, where the EU has no industry which contributes in excess of 0.08 to overall labour productivity growth. The US, on the other hand, has a number of industries which individually contribute strongly to the overall US performance, with high technology industries such as radio, television and communications (which includes semiconductors); and computer equipment being good examples. These 2 industries, in fact, collectively contributed over 17% of all US labour productivity growth over the 1996-2004 period. With respect to private services, the EU has done reasonably well in a number of the "network" industries (i.e. post and telecommunications; electricity, gas and water supply) and in parts of the financial services industry (i.e. financial intermediation, excluding insurance and pension funding). However, despite these individual success stories, the total EU15-US gap for private services productivity is much larger than for manufacturing, reflecting the strong out-performance of the US in service industries such as wholesale and retail trade, the financial services industry as a whole, and "other" business services.

Graph 3 splits the 1996-2004 period into two sub-periods (1996-2000 and 2001-2004) to see the changes over time for those 10 industries which graph 2 has isolated as being important in explaining overall EU-US labour productivity differences. Of the 10 industries, 3 are in the manufacturing sector, with all three closely linked to the ICT revolution (communications equipment; semiconductors[20]; and computer related products). The remaining 7 industries are all in the private services sector, two of them form part of the overall wholesale and retail trade industry; two are in the financial services industry; two are associated with the

[19] Note : The contribution of the different industries to overall, economy-wide, labour productivity growth does not allow one to separate out the productivity effect from the reallocation of hours worked across industries. For example, if labour is shifting from a low productivity level industry to a high productivity level one, the aggregated labour productivity growth rate will be faster than the weighted sum of the growth of the individual industries. This difference is known as the reallocation effect. The effect has been excluded since it is generally of only a very small order of magnitude. However, if one wishes to allow for the reallocation effect, it is possible to do so by calculating the respective contributions using a shift-share approach. Following Stiroh (2002) aggregate labour productivity growth can be written as:

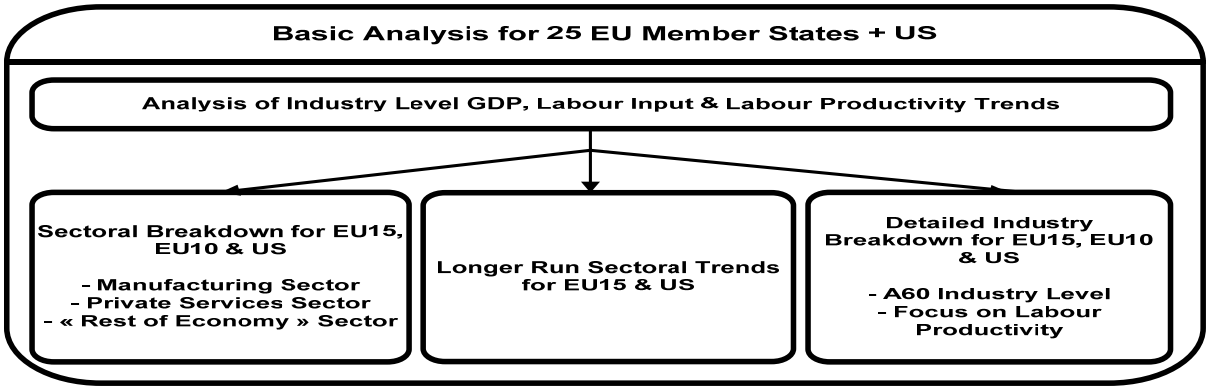
$$\ln \frac{VA_t / H_t}{VA_{t-1} / H_{t-1}} = \sum_i \overline{v}_i^{VA} \ln \frac{VA_{i,t} / H_{i,t}}{VA_{i,t-1} / H_{i,t-1}} + \left(\sum_i \overline{v}_i^{VA} \ln \frac{H_{i,t}}{H_{i,-1}} - \ln \frac{H_t}{H_{t-1}} \right) \quad (1)$$

where VA and H denote gross value added and hours worked respectively, and $\overline{v}_i^{VA}$ is the two-period average share of industry *i* in aggregate value added. The contribution of an industry to aggregate productivity growth is measured by weighting its labour productivity growth rate by its share in aggregate value added. The term in brackets in equation (1) is the reallocation of hours. It reflects differences in the share of an industry in aggregate value added and its share in aggregate hours worked. The reallocation term is positive if employment shifts from low productivity industries towards high productivity industries.

[20] Semiconductors form part of the "communications equipment" industry but has been isolated here for illustrative purposes.

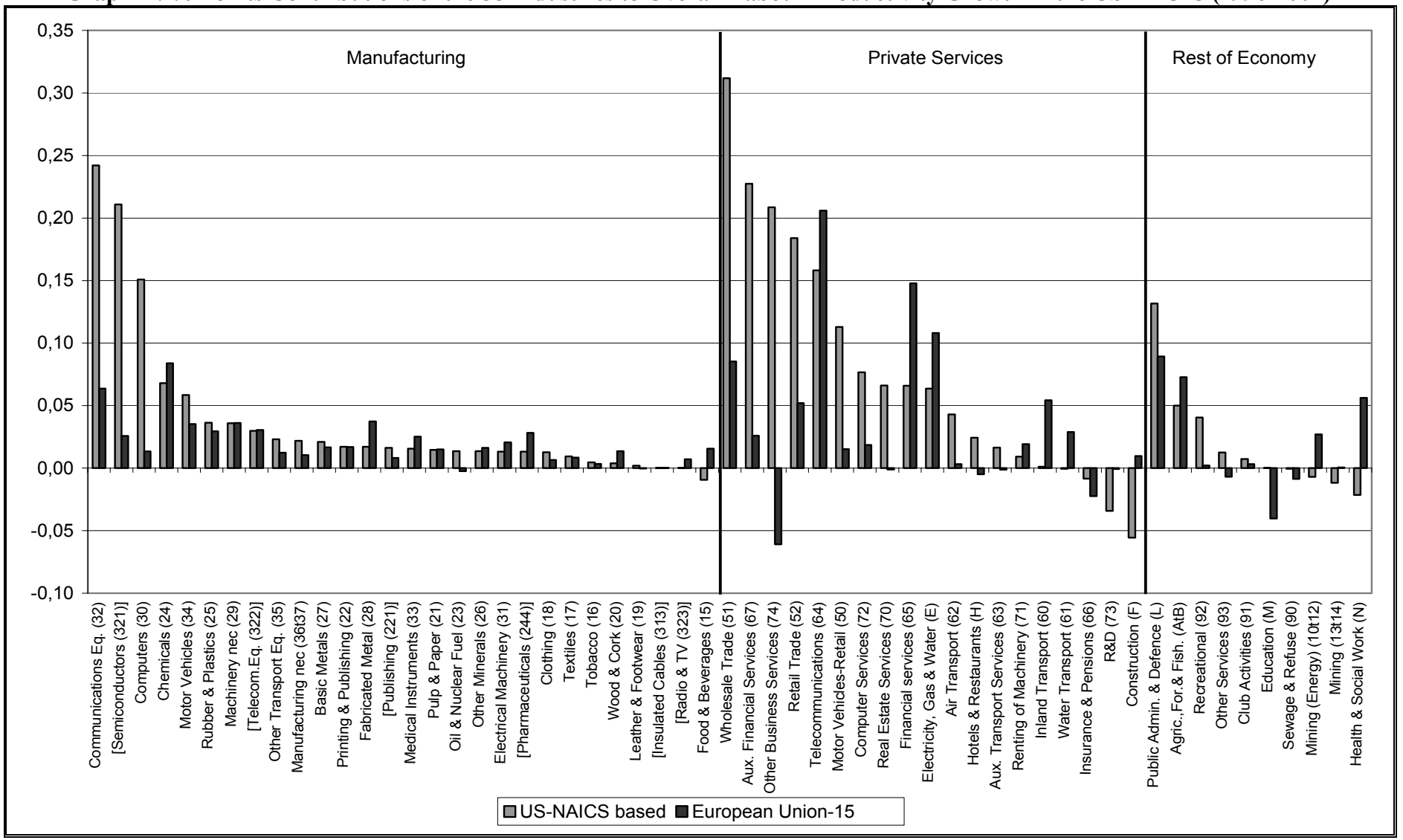
"network" industries; and the seventh one is a residual industry made up of "other business services". Regarding financial services, the overall sector is divided into 3 different industries, two of which are amongst the best performing industries and one (insurance and pensions) which is contributing negatively to labour productivity growth in both the US and the EU. With regard to the 3 industries where the EU outperformed the US over the period as a whole (i.e. telecommunications; financial intermediation services; and utilities), we can see that the 1996-2004 outturn was in fact driven by developments up to the year 2000, with the US catching up with, or outpacing, the EU in these industries over the most recent 2001-2004 period. The US, on the other hand, continued to outperform the EU in the remaining 7 industries over both time periods.

For the new Member States, graph 4 shows the industry level contributions to overall labour productivity growth in the 1996-2000 and 2001-2004 time periods. What is striking from the graph is the extent to which the catching-up process in these countries appears to be driven by the services sector, both public and private, rather than by manufacturing. The conventional view in the literature would suggest that the early stages of the convergence process is more likely to be driven by high rates of productivity growth in the more exposed manufacturing sector, with a lagged response from the relatively less tradeable services sector. On a closer examination of the data, however, one sees that the conventional view is supported by the emerging trends, with much higher productivity gains in a range of manufacturing industries, such as motor vehicles and computers, compared with service industries such as wholesale and retail trade. However, while manufacturing industries such as motor vehicles may have much higher productivity growth rates (for example, hourly labour productivity growth rates for motor vehicles averaged nearly 16% annually over the period 1996-2000 compared with a little over 3% for retail trade)[21], industries such as retail trade have a much higher share of value added (its share is, in fact, over 8 times greater than that of motor vehicles), with the result that graph 4 shows that retail trade makes a contribution to total economy labour productivity growth which is nearly double that of motor vehicles.



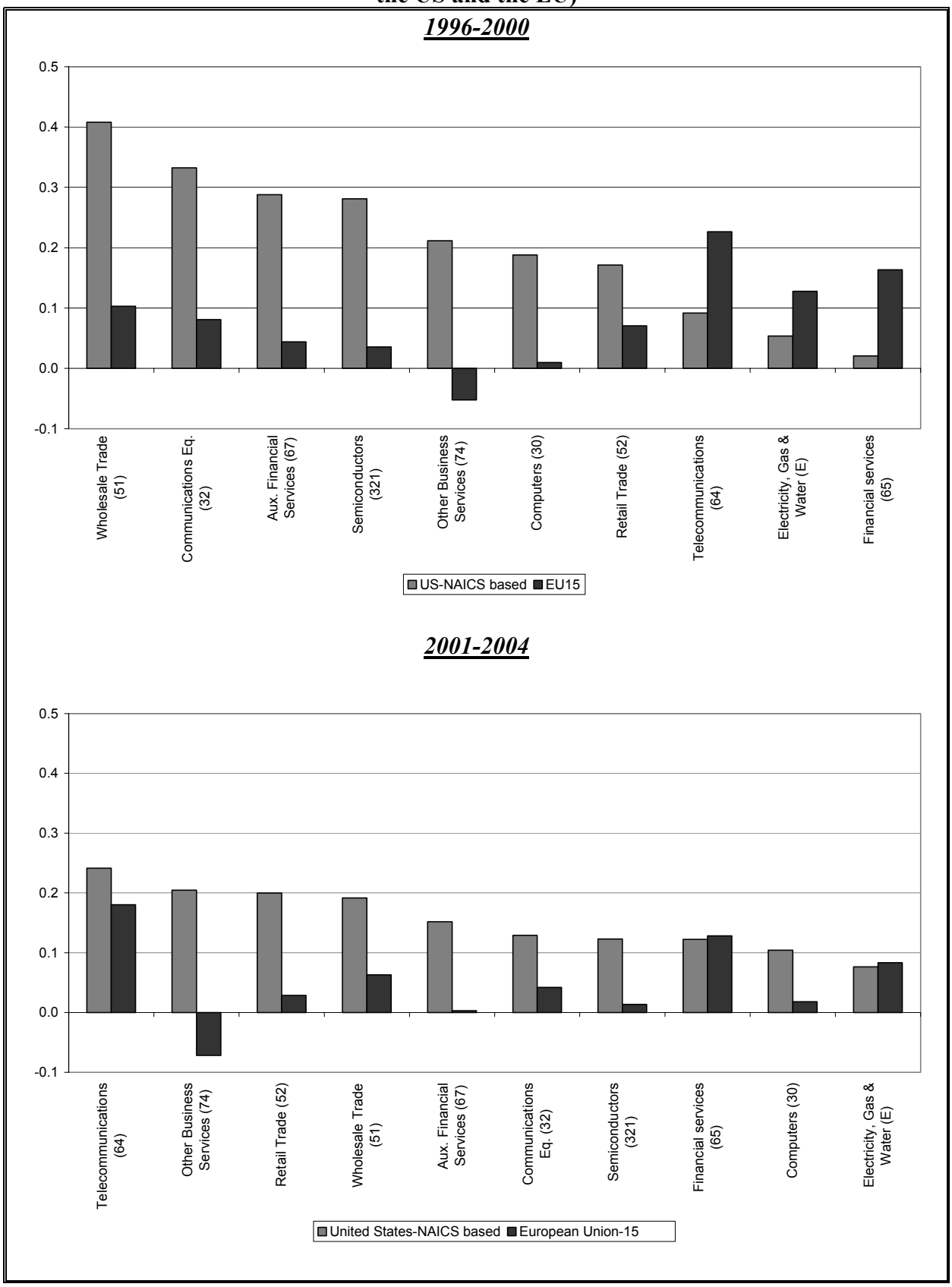
[21] The high rates of productivity growth in specific manufacturing industries are undoubtedly being supported by FDI inflows (although the domestic value added contribution is often not as significant due to the relatively high import propensity of many of the firms involved). The available FDI data shows that a large majority of the foreign investments into these countries over the last 10 years have been concentrated in the manufacturing sector, although there have been high levels of foreign penetration in a number of important private services sectors such as financial services and the distribution sector.

Graph 2 : % Points Contributions of the 58 Industries to Overall Labour Productivity Growth in the US + EU15 (1996-2004)



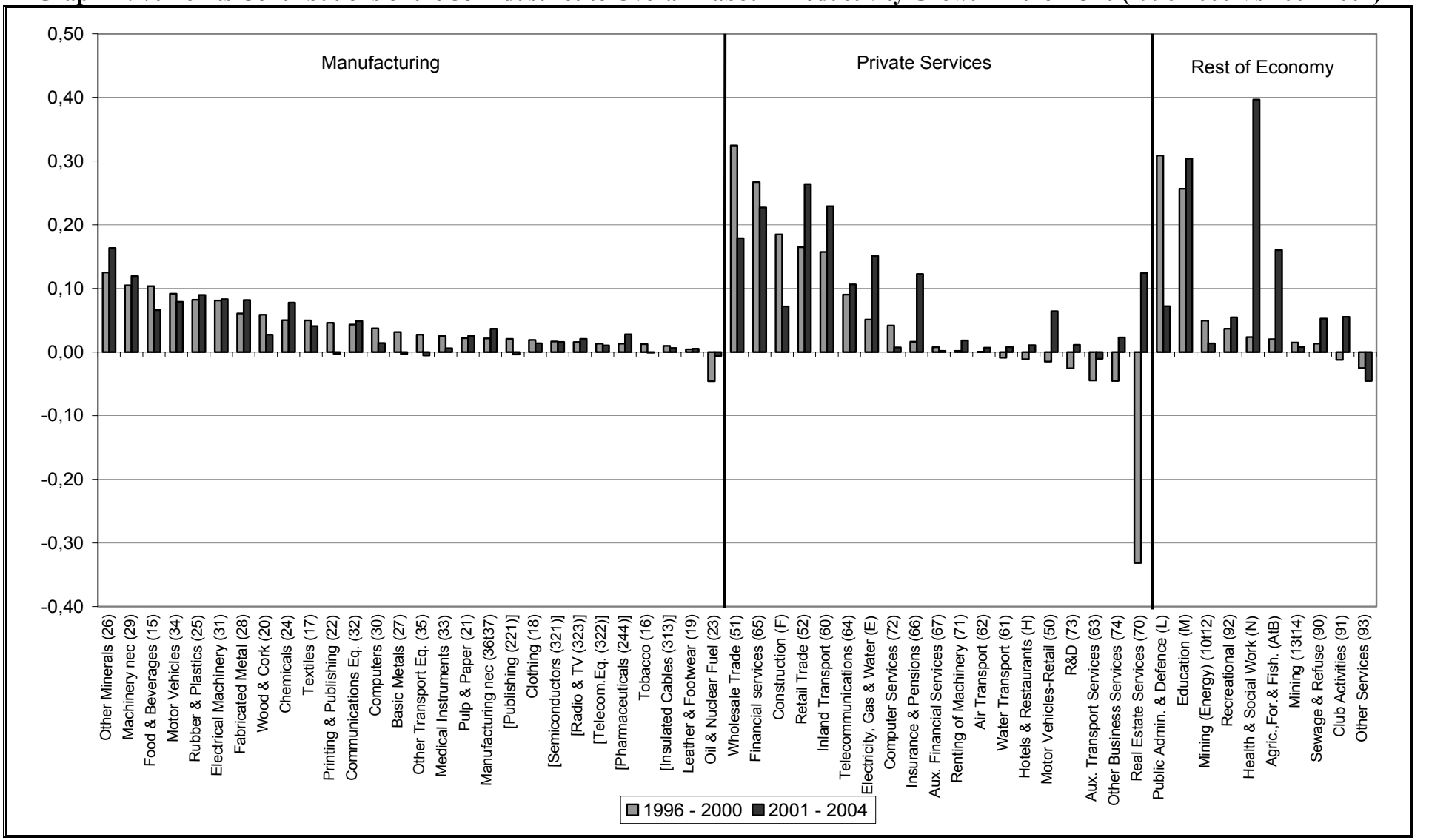
Source: EU KLEMS and own calculations

Graph 3 : Comparison of the 1996-2000 and 2001-2004 periods for 10 of the top performing industries (% points contributions to overall labour productivity growth in the US and the EU)



Source: EU KLEMS and own calculations

Graph 4 : % Points Contributions of the 58 Industries to Overall Labour Productivity Growth in the EU10 (1996-2000 Vs 2001-2004)



Source: EU KLEMS and own calculations

4 : "Growth Accounting" Analysis - Key Features of the EU KLEMS Approach[22]

As mentioned at the outset, EU KLEMS stands for EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs. In section 5 of the paper the KLEMS growth accounting methodology is applied to explain the determinants of GDP growth in the EU and the US. Unlike section 3 which focussed only on measuring the contribution of labour to growth, section 5 allows one to quantify the proportion of the growth rate which can be attributed to the accumulation of both factors of production (i.e. capital and labour) and the part which can be attributed to independent technical progress or total factor productivity (TFP). The analysis also differs from other growth decomposition exercises in that it focuses on the concepts of labour and capital service flows which allow for a more accurate measurement of the contribution to growth of different groups of workers and of each unit of capital (see Box 1). While the KLEMS method is also distinguished from earlier growth accounting studies in that it provides a breakdown for both gross output (i.e. including intermediates) as well as for value added growth, the present paper only focuses on the latter since the gross output part of the databank is still very much in the research phase[23].

The present section provides an overview of the KLEMS methodology, with the latter rooted in the tradition of national accounting, input-output analysis and growth accounting as pioneered by the seminal contributions of economists such as Kuznets, Leontief, Solow, Griliches and Jorgenson. Decomposing value added growth into its main determinants can be done using a wide variety of growth accounting methods, one variant of which is applied by the EU KLEMS team. This variant essentially uses a production function which includes productive capital (a volume index of capital services[24]); human capital (a skills based indicator of the average qualifications of the labour force)[25]; employment levels adjusted for hours worked; and a residual

[22] What makes the EU variant of KLEMS unique is the interaction between database construction and methodological / analytical research which ensures that the datasets can be correctly interpreted in the light of economic theory and policy-orientated research. In particular it allows for a meaningful interpretation of the relationships between the different indicators in the databank, most notably regarding the drivers and barriers to productivity growth.

[23] Another unique feature of EU KLEMS is the availability of gross output and intermediate (energy, materials and services) input variables for a large number of industries. Unfortunately, however, it is not yet possible to do gross output aggregations for the different countries since the industry level gross output measures include intra-industry deliveries of intermediates. As a result of this problem, measures of gross output can be highly misleading, especially at higher levels of aggregation, unless one has a very detailed knowledge of the specific industries in the various countries. What one needs are measures of sectoral output, net of intra-industry deliveries of intermediates. These sectoral output measures, covering the period from 1995 onwards are presently being assembled by the consortium but will only be made available in the next EU KLEMS release.

[24] According to the OECD's manual on "Measuring Capital", the capital services approach (i.e. calculating the flow of services produced by capital assets) has a number of advantages in measuring the contribution of capital to value added growth compared with approaches which use the capital stock (i.e. changes in the stocks of capital assets). The manual highlights the following problems in using capital stocks : "The first problem in using stocks, whether net or gross, is that the other variables in the growth accounting model are all flows ….. A second problem with using the net or gross capital stock is that neither measure reflects the productive efficiency of capital assets …. Finally, in calculating the net or gross capital stock, each asset in the stock is weighted by its market value. This implies that two assets with the same market value are assumed to make an equal contribution to production. Suppose, however, that one of the assets is a truck with a life of seven years and the other is a structure with a fifty-year service life. It is clear that in order for the owners to recoup their investment, the shorter-lived asset must generate its contribution to production at a faster rate than the asset with the longer life. Weighting them both by their (identical) market values will understate the annual contribution of the truck into the production process and overstate that of the structure".

[25] See EU KLEMS manual for a detailed commentary (www.euklems.net).

term which, amongst other things, includes an estimate of the level of efficiency associated with the use of the various factors of production[26].

The practical application of the KLEMS methodology is made possible by the provision of detailed industry level labour and capital accounts (and intermediates in the case of gross output) which have been assembled at the national level by the EU KLEMS consortium partners :

- Firstly, industry level investment series have been collected for 7 different types of capital and for 31 industries (A31 level breakdown). These national accounts sourced series are aggregated on the basis of the user cost of capital (i.e. the rental price of employing each asset type for a particular period of time) to produce capital service flows which take into account the widely different marginal productivities of the different components of a country's capital stock.

- Secondly, unlike standard measures of labour input, such as numbers employed or hours worked, the database provides, industry level, measures which take account of the wide differences in the productivity of various types of labour over time (i.e. labour services). Labour force heterogeneity is an integral part of these labour services calculations, with the overall growth contribution of labour being calculated on the basis of the services provided by different groups of employed workers.

In order to appreciate the extent of the advances made by the consortium with regard to the measurement of the main factors of production, the rest of this section provides an overview of the capital (4.1) and labour (4.2) flow accounts which form the core of the whole project. These accounts are crucial in making a more accurate assessment of the contribution of capital and labour to productivity and value added growth in the different economies.

4.1 Capital Accounts for Calculating Industry Level Capital Services : Providing a measure of capital services requires two essential inputs, firstly industry level capital stock estimates for detailed asset types and secondly estimates of industry level capital shares (i.e. the shares of capital remuneration in the total value added of a particular industry). As is standard in the literature, the construction of capital stock estimates for all asset types is done in EU KLEMS using the Perpetual Inventory Method (PIM), with aggregation across asset types allowing for the widely different marginal productivities inherent in such a heterogeneous stock of assets. The capital service flows are then derived by weighting the growth of the capital stocks by the share of each asset in total capital compensation, with these shares linked with the rental price of each asset. The rental prices (or user-cost of capital[27]) for the different asset types are determined by

[26] With the addition of intermediate inputs in the case of industry gross output. Measuring the proportion of the growth rate of value added or gross output which can be attributed to the accumulation of the factors of production (i.e. the growth of employment, fixed capital and intermediates) and the part which can be attributed to independent technical progress or total factor productivity is still the subject of heated debate amongst academics and policy makers.

[27] The user cost approach is based on the assumption that marginal costs reflect marginal productivity (in a world with perfect capital markets, a firm will set the marginal product of capital equal to its user cost of capital). Consequently user costs are fundamental to any meaningful analysis of the contribution of capital to output growth. If, for example, it is less costly to rent one euro of residential assets compared with one euro of computer equipment, this is reflected in the user cost. The higher rental cost of computers compared with buildings reflects the former's faster obsolescence rates and the fact that the price of building assets tends to rise over time whereas those for computer assets tend to decline rapidly.

their real rates of return (i.e. the nominal rate of return[28] adjusted for asset-specific capital gains, with the latter derived from investment price indices) and the rate of depreciation :

- ***Rate of return estimation methods*** : The nominal rate of return can be estimated using two different methods, the "ex ante" and the "ex post" approaches. The ex-ante capital services method is based on an exogenous value for the rate of return (e.g. interest rates on government bonds). The Jorgenson inspired, ex-post (endogenous), approach is used for the calculations given in the EU KLEMS databank. It estimates the internal rate of return as a residual given the value of capital compensation from the national accounts (e.g. the gross operating surplus), depreciation and capital gains[29].

- ***Asset types and depreciation rates*** : EU KLEMS gives a breakdown of the industry level capital stock into 7 different asset types. 3 of the latter are ICT assets (namely computing equipment; communications equipment; and software) and 4 of them are non-ICT assets (transport equipment; other machinery and equipment; residential structures; and non-residential structures). EU KLEMS uses the asset depreciation rates which have been calculated by the US Bureau of Economic Analysis (BEA) and applies these in a harmonised way across countries. Whilst there is no country variation, depreciation rates do differ by asset type and by industry, with rates ranging from .011 for residential structures up to .315 for computing equipment (implying that whilst computer equipment is technologically obsolete after only a few years, residential structures can continue to provide annual capital service flows for many decades). (See Annex 8 – table 1 - for the depreciation rate ranges used for the different asset types).

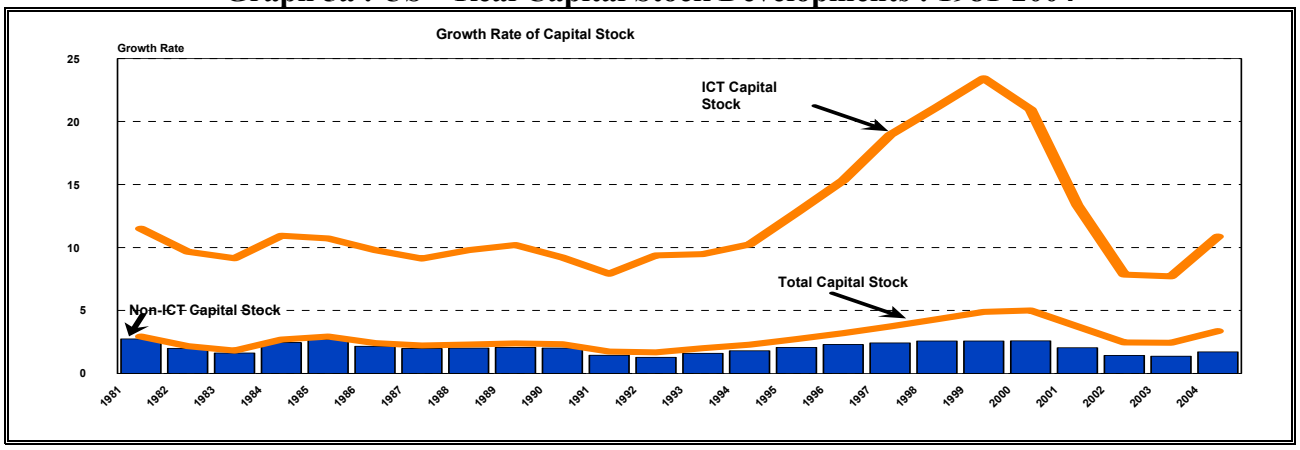
Illustration of EU KLEMS (Ex Post) Capital Services Estimation Approach for the US : Graphs 5a-5c provide a visual overview of what is needed to compute a set of capital services estimates, using data for the US as an example. The graphs refer to "total industries", with 5a showing the growth rates of the total capital stock and of its ICT and non-ICT components. Graph 5b then displays trends for the two crucial variables used in moving from the capital stock to the capital services estimates, namely a breakdown of capital compensation and of the user

[28] EU KLEMS assumes that the total value of capital services for a particular industry is equal to the capital compensation (i.e. the gross operating surplus) accruing to all assets in that industry. The capital compensation of a specific industry is equal to the value added of the industry in question minus the wage share (i.e. labour compensation). This method of calculating rates of return results in the capital income being fully exhausted, thereby ensuring complete consistency between the income and production accounts. It is also consistent with an assumption of constant returns to scale. Finally, whilst the nominal rates of return are the same for all the asset types employed in an individual industry, they do vary across industries.

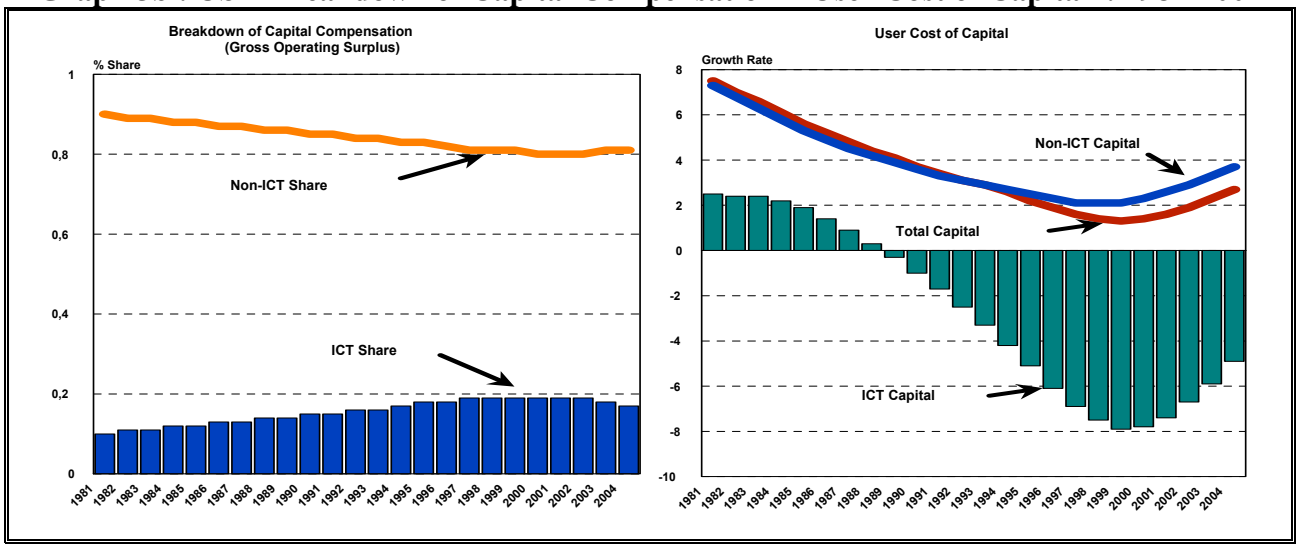
[29] While it is generally agreed in the literature that the ex-post measure is in principle the preferred measure of marginal productivity and that the gross operating surplus from the national accounts is a rough proxy of the true measure, unfortunately there are a lot of problems in the practical application of the ex-post method (which is the one presently used in the EU KLEMS database). For example, it is widely accepted that ex post rates of return tend to overestimate the "true" rate of return since not all asset classes are covered (e.g. user costs of asset classes such as land and inventories are excluded from the calculations); that the ex post method is based on very strong assumptions such as perfect competition and constant returns to scale; and very importantly that it leads to endogenous rates of return which are volatile and can lead to negative rental prices. Consequently, for all these reasons, whilst the ex post approach may be theoretically superior, in practical empirical work its use is less clearcut. Given the above, and conscious of the uncertainties involved, it is important that some stress testing work is carried out to assess the sensitivity of the results to the method adopted, especially in terms of the estimated contribution to growth from capital. It is already clear that this choice of assumption has potentially significant implications for the growth accounting estimates produced, with the ex post method in general giving contributions from capital which are much higher than those of the ex ante method, with the knock-on effect of producing TFP estimates which are substantially lower. One way out of the present problem, suggested in the literature, is to use a "hybrid" method since the choice of ex post / ex ante does not appear to matter greatly when calculating the growth rate of capital services but it does matter when calculating the contribution of capital to output growth. A "hybrid" approach could help by using an ex ante method to calculate the growth rate of capital services and an ex post method to calculate the contribution of capital to output (i.e. by weighting the growth rate of the capital services from the different asset classes with their actual observed share of capital compensation / profits in output).

cost of capital into their respective shares for ICT (aggregation of 3 different types of assets) and non-ICT (aggregation of 4 different types of assets). While the graph shows that the growth rate of ICT user costs has been declining since the early 1990's, nevertheless the absolute cost of renting ICT equipment is still, according to EU KLEMS, generally 50-60% of its investment price compared with less than 10% in the case of buildings (i.e. the marginal costs of leasing one euro of computer assets is therefore much higher than the equivalent rate for buildings). The final graph (5c) shows the growth rate of ICT and non-ICT capital services and emphasises the growing importance of ICT in determining overall economy-wide capital services trends. In terms of contributions to total capital services (measured by weighting the growth rate of capital services with the ICT / non ICT capital compensation shares), graph 5c shows that 60-70% of the growth rate of total capital services over recent years has been driven by ICT capital. This growth in the importance of ICT assets reflects not only substantially increased investment spending on ICT goods but also the fact that the "user cost" weights needed to calculate the flow of capital services take into account the higher marginal costs / marginal productivity of these assets relative to non-ICT assets[30].

Graph 5a : US – Real Capital Stock Developments : 1981-2004

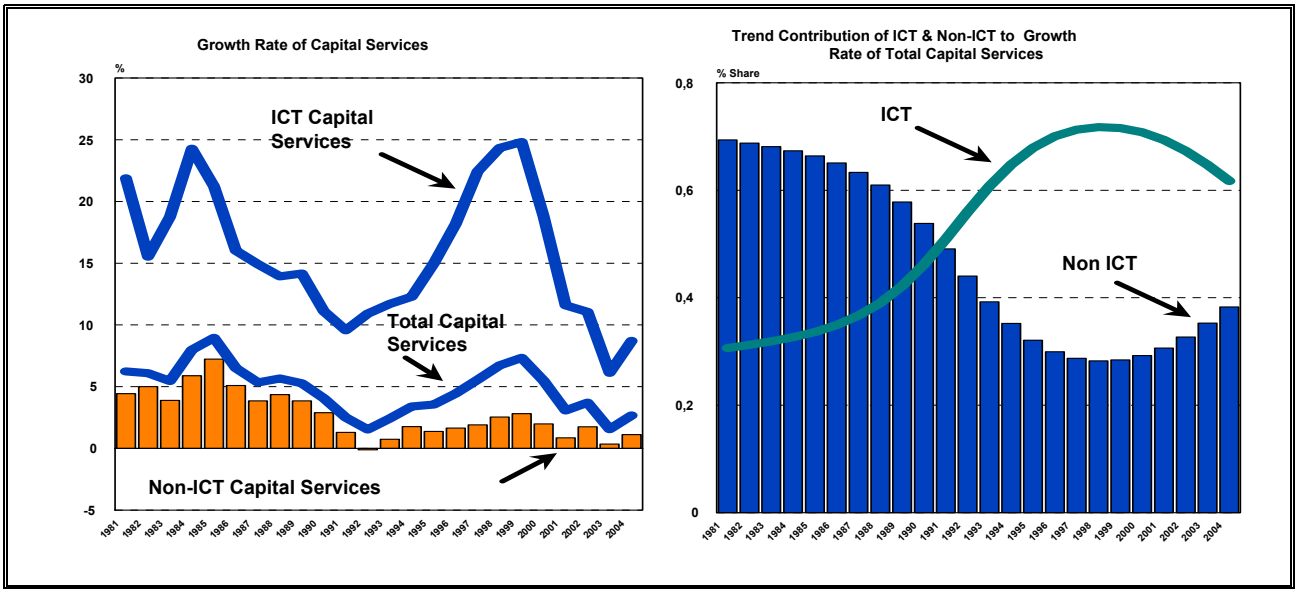


Graph 5b : US – Breakdown of Capital Compensation + User Cost of Capital : 1981-2004



[30] i.e. ICT assets have larger user-cost weights.

Graph 5c : US - Capital Services Developments + Contribution of ICT / Non-ICT : 1981-2004



Source: EU KLEMS and own calculations

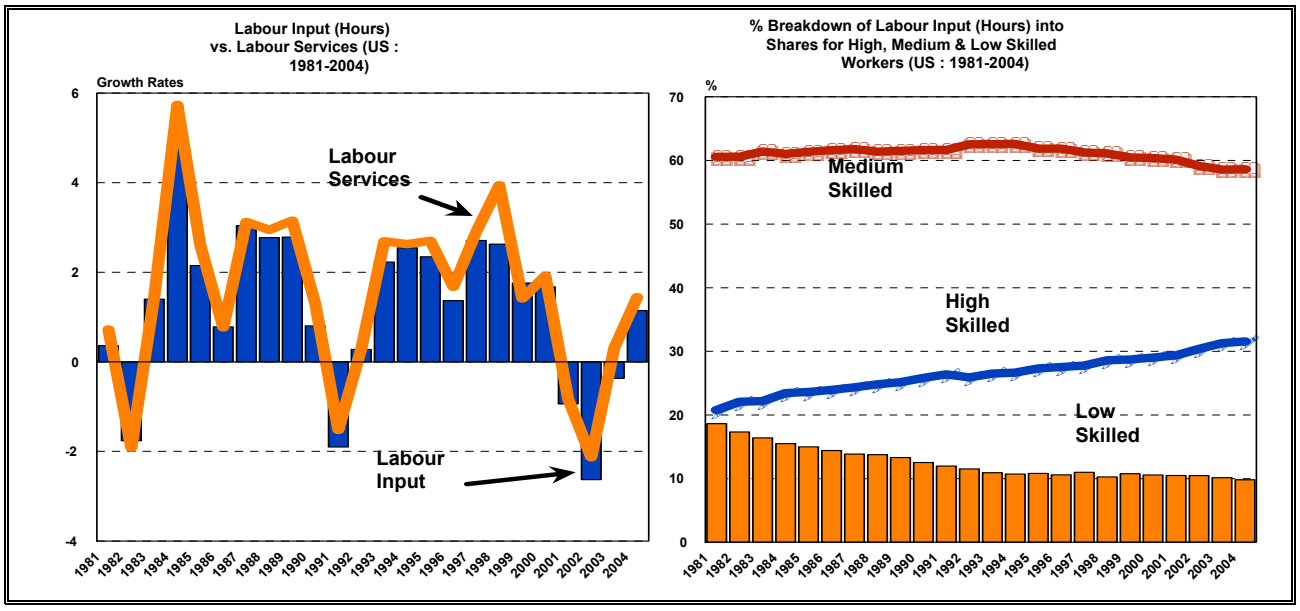
4.2 : Labour Accounts for Calculating Industry Level Labour Services[31] : Data on hours worked and compensation by labour type are needed to calculate series on labour services. These labour services estimates attempt to reflect changes in both the quantity (hours worked) and quality (skill levels etc) of labour. Allowance is made for compositional changes by splitting the labour force on the basis of specific characteristics such as age, gender and skill level (proxied by educational attainment). The productivity of the different types of labour will of course differ, with workers (e.g. low vs. high skilled) being paid according to their marginal productivities. Total labour services is calculated as a quantity index of the different labour types, where the weights used in the aggregation process reflect the average share of each type of worker in total labour compensation. This aggregation approach ensures that the changing composition of the labour force over time is being reflected in the labour services estimates. A positive labour composition / labour quality effect could occur, for example, if the share of high-skilled workers in the labour force increases over time or if there is a shift in hours worked towards older, more experienced, workers[32]. This would have the effect of producing a growth in labour services which is greater than the growth in total hours worked. This labour composition effect reflects the normal ongoing improvements in economies with respect to the quality of labour employed.

Illustration of EU KLEMS Labour Accounts for the US :To illustrate the quantity and quality features of the labour accounts in EU KLEMS, graphs 6a-6c provide an overview of the essential features of the US accounts. Graph 6a shows the difference between the growth rates of labour input and labour services over the period 1981-2004. The graph clearly illustrates the ongoing improvement in the quality of the US labour force, with growth rates of labour services being marginally, but persistently, higher than those of the quantity of labour input (i.e. employment measured in hours worked). This point is brought out more forcefully in the second graph which

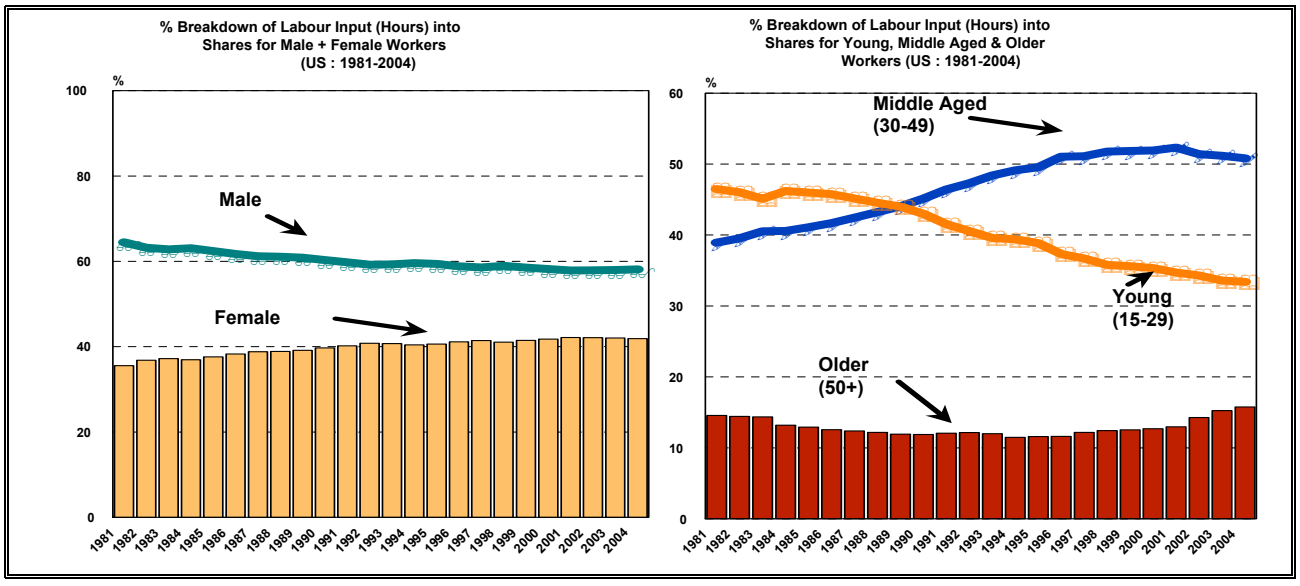
[32] A shift of hours worked away from young, inexperienced, workers towards more experienced older workers will be reflected in a positive contribution of labour services to growth as long as the wages of the younger workers are lower in relative terms.

shows a strong rise in the share of high skilled workers over the period, mainly at the expense of the low skilled. Graph 6b provides a gender and age cohort breakdown of the total quantity of labour input. The US has experienced a steady rise in the share of female and middle-aged workers, with corresponding falls in male and young workers. As regards older workers (i.e. those aged 50 and over), whilst the 1980's saw a downward trend in the share of such workers, this pattern has been reversed since the second half of the 1990's. The final set of graphs (6c) show the shares of the different skill groups in total economy labour compensation, with this breakdown of the wage share being used to calculate the labour services contribution of the different skill groups to overall value added growth in the US.

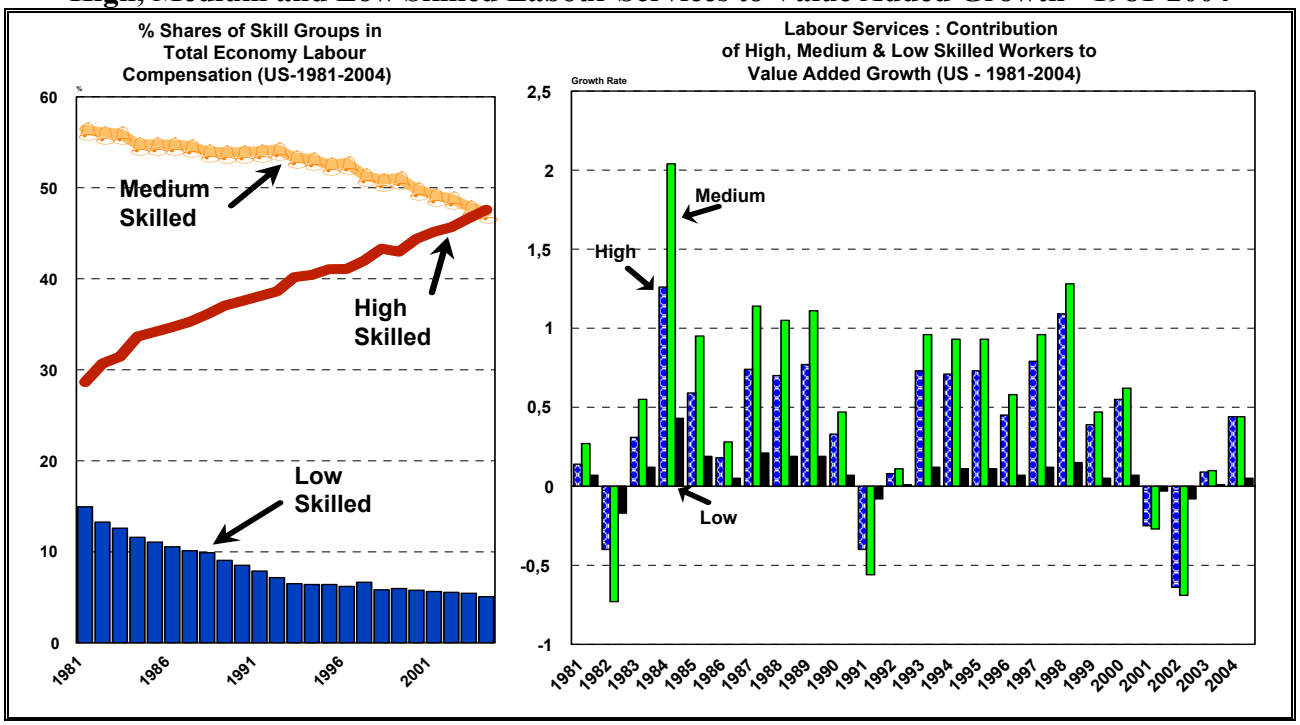
Graph 6a : US – Labour Input Vs Labour Services + Skills Based Breakdown 1981-2004



Graph 6b : US – Gender + Age Breakdown 1981-2004



Graph 6c : US – Breakdown of Labour Compensation (Wage Share) + Contribution of High, Medium and Low Skilled Labour Services to Value Added Growth - 1981-2004



Source: EU KLEMS and own calculations

Data Quality Issues : Whilst the labour composition data adds enormously to the overall usefulness of the EU KLEMS databank, there are nevertheless a number of outstanding issues on the quality side which need to be addressed. Many of these issues are linked with the fact that although the basic employment and hours worked series are taken from the national accounts, the labour composition data is mainly taken from the labour force survey (LFS). Three issues in particular need to be looked at :

- **Small sample size** : The LFS runs into problems at the detailed industry level due to sample size restrictions[33]. In order to minimise the potential problems associated with this issue, the consortium has had to aggregate the labour composition data into 15 industries for all countries instead of the A31 level detail which is available for the capital accounts. This is broadly justifiable, however, since the labour composition data does not differ much at the lower industry levels and consequently applying the results for 15 industries to the A31 industry level represents a pragmatic, interim, solution.

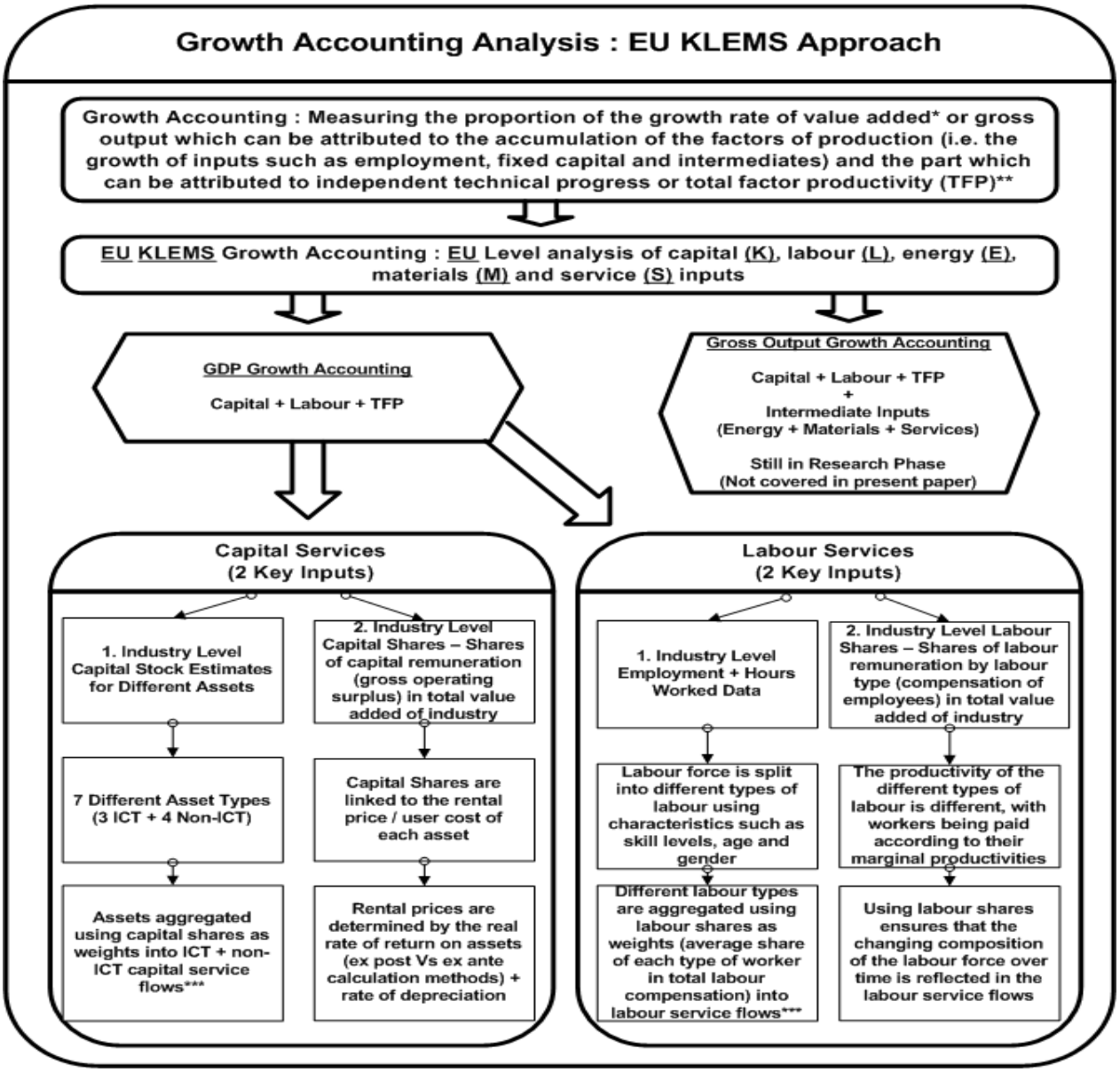
- **Changes in the LFS sample over time** : Periodic changes in the composition of the LFS sample have raised questions as to whether the survey is really designed to capture changes over time. The consortium would argue that the LFS is employed extensively in a wide range of time series analyses and is generally considered to be relatively reliable. This is particularly the case from the mid-1980s onwards when large efforts were made to

[33] An additional concern is that survey respondents are often not very familiar with the relevant industry classification systems, with this problem solved only in countries that can do micro data linking.

make the survey methodology consistent across time and countries. Despite these efforts, a careful assessment of any remaining breaks in the series is still warranted.

- **Outstanding issues in terms of skills** : Despite the progress made by the consortium, comparisons of skill levels across countries remain problematic due to definitional issues and quality differences in the respective education systems. The consortium accepts that additional research into the skills data is needed, including for example the cross-checking of the datasets with other surveys (e.g. those collected in the Luxembourg Income Studies project) and by working to improve the international comparability of the data. At the moment, there are still differences in the definition of high-skilled workers for specific countries (reflecting fundamental differences in the quality of schooling) and consequently international comparisons must be done with caution. However, no such comparability problems exist for comparing skill trends within individual countries (on the assumption of course that educational attainment is considered to be a good proxy for actual skill / qualification levels in the country in question).

Whilst the above labour quality concerns must be addressed, particularly on the skills side, this should not be seen as a criticism of the enormous progress already achieved by the consortium partners. The latter are well aware of the inherent weaknesses in using the LFS and have tried to cross check their results with other available information sources to ensure that the trends in the published EU KLEMS datasets are plausible. Many of the problems encountered by the consortium reflect the fact that the LFS is not a fully integrated part of the National Accounts and consequently quality concerns will continue to persist until this situation is addressed at an official level. In addition, the issues raised on the quality side refer mainly to comparisons of levels of labour services rather than to growth rates over time. It can be argued therefore that the labour composition data is of sufficient quality to be used, in a responsible manner, for the growth accounting analysis to be conducted in the next section. Regarding the levels issue, improvements are clearly needed, with any robust comparison of skill levels across countries needing to correct for the previously mentioned quality differences inherent in their respective education systems.



* Value added refers to the contribution of the factors of production to raising the value of a good or service. Value added corresponds to the incomes received by the owners of the factors of production for the "services" provided. Gross value added is measured as the value of gross output produced in an economy minus the costs of intermediate inputs, with the result essentially equalling the sum of compensation of employees (wages) and the gross operating surplus (profits). The sum of wages and profits is called total factor income and it measures the value of GDP at factor (basic) prices. Adding taxes less subsidies converts GDP at basic prices to GDP at final / market prices, with the result that the expenditure and income methods of measuring GDP are in principle the same.

** Growth accounting is more of an art than a science. Small differences in assumptions or poor quality for some of the many inputs to the process can seriously affect the outcome of any growth accounting exercise.

*** These capital and labour service flows reflect the widely different marginal productivities of various types of capital assets / workers.

Box 1 : EU KLEMS Growth Accounting Methodology*

The EU KLEMS growth accounts are based on the growth accounting methodology as laid out in the seminal contribution of Jorgenson and Griliches (1967) and put in a more general input-output framework by Jorgenson, Gollop and Fraumeni (1987) and Jorgenson, Ho and Stiroh (2005). Growth accounting allows one to assess the relative importance of labour, capital and intermediate inputs to growth, and to derive measures of total factor productivity (TFP) growth. TFP indicates the efficiency with which inputs are being used in the production process and is an important indicator of technological change**. Under the assumptions of competitive factor markets, full input utilization and constant returns to scale, the growth of output of an industry is equal to the (compensation share) weighted growth of inputs and TFP. In this way one can establish the proportion of output growth which is accounted for by the growth in intermediate inputs, capital services, labour services and TFP, respectively.

Accurate measures of labour and capital input are based on a breakdown of aggregate hours worked and of the aggregate capital stock into various components. Hours worked are cross-classified by various categories to account for differences in the productivity of various labour types, such as high- versus low-skilled labour. Similarly, capital stock measures are broken down into stocks of different asset types. Short-lived assets like computers have a much higher productivity than long-lived assets such as buildings, and this should be reflected in the capital input measures. The contribution of intermediate inputs is broken down into the contribution of energy goods, intermediate materials and services.

Measurement of capital services : The availability of investment series by asset type and by industry is one of the unique characteristics of the EU KLEMS database. They are based on series obtained from national statistical institutes, allowing for a detailed industry-by-asset analysis. Importantly, EU KLEMS makes a distinction between three ICT assets (office and computing equipment, communication equipment and software) and four non-ICT assets (transport equipment, other machinery and equipment, residential buildings and non-residential structures). ICT assets are deflated using a quality-adjusted investment deflator, except for those countries which have not yet implemented adequate quality adjustment where the harmonisation procedure suggested by Schreyer (2002) is used. The real investment series are used to derive capital stocks through the accumulation of investment into stock estimates using the Perpetual Inventory Method (PIM) and the application of geometric depreciation rates. Then capital service flows are derived by weighting the growth of stocks by the share of each asset's compensation in total capital compensation. In this way, aggregation takes into account the widely different marginal products from the heterogeneous stock of assets. The weights are related to the user cost of each asset.

The user cost approach is crucial for the analysis of the contribution of capital to output growth. This approach is based on the assumption that marginal costs reflect marginal productivity. For example, if the costs of leasing one euro of computer assets is higher than the leasing of one euro of buildings, computers have a higher marginal productivity, and this should be taken into account. There are various reasons why the costs of computers is higher than that for buildings. While computers may typically be scrapped after five or six years, buildings may provide services for several decades. In addition, the prices of new computers are rapidly declining and those of buildings are normally not. Hence the user cost of IT-machinery is typically 50 to 60 percent of the investment price, whilst that of buildings is less than 10 percent. Therefore one euro of computer capital stock should get a heavier weight in the growth of capital services than one euro of building stock. This is ensured by using the rental price of capital services as weights.

Measurement of labour services : The productivity of various types of labour input, such as low- versus high-skilled, will also differ. Standard measures of labour input, such as numbers employed or hours worked, will not account for such differences. Hence one needs measures of labour input which take the heterogeneity of the labour force into account in analysing productivity and the contribution of labour to output growth. These measures are called labour services, as they allow for differences in the amount of services delivered per unit of labour in the growth accounting approach. It is assumed that the flow of labour services for each labour type is proportional to hours worked, and workers are paid their marginal productivities. Weights are given by the average shares of each type of labour in the value of labour compensation. In this way, aggregation takes into account the changing composition of the labour force. EU KLEMS cross-classifies labour input by educational attainment, gender and age with the aim of providing a proxy for differences in work experience, which gives an overall total of 18 labour categories. Typically, a shift in the share of hours worked by low-skilled workers to high-skilled workers will lead to a growth of labour services which is larger than the growth in total hours worked. This difference is referred to as the labour composition effect.

Series on hours worked by labour types are not part of the standard statistics reported by the NSIs, not even at the aggregate economy level. Also, there is no single international database on skills which can be used for this purpose. For each country covered in EU KLEMS, a choice has been made to use survey data which provide the best sources for consistent wage and employment data at the industry level. In most cases this was the labour force survey (LFS), sometimes together with an earnings survey when wages were not included in the LFS. In other cases, use has been made of establishment surveys or a social-security database, or a mixture of sources. Care has been taken to arrive at series which are consistent over time, which was important as most employment surveys are not designed to track developments over time, since breaks in methodology or coverage occur frequently.

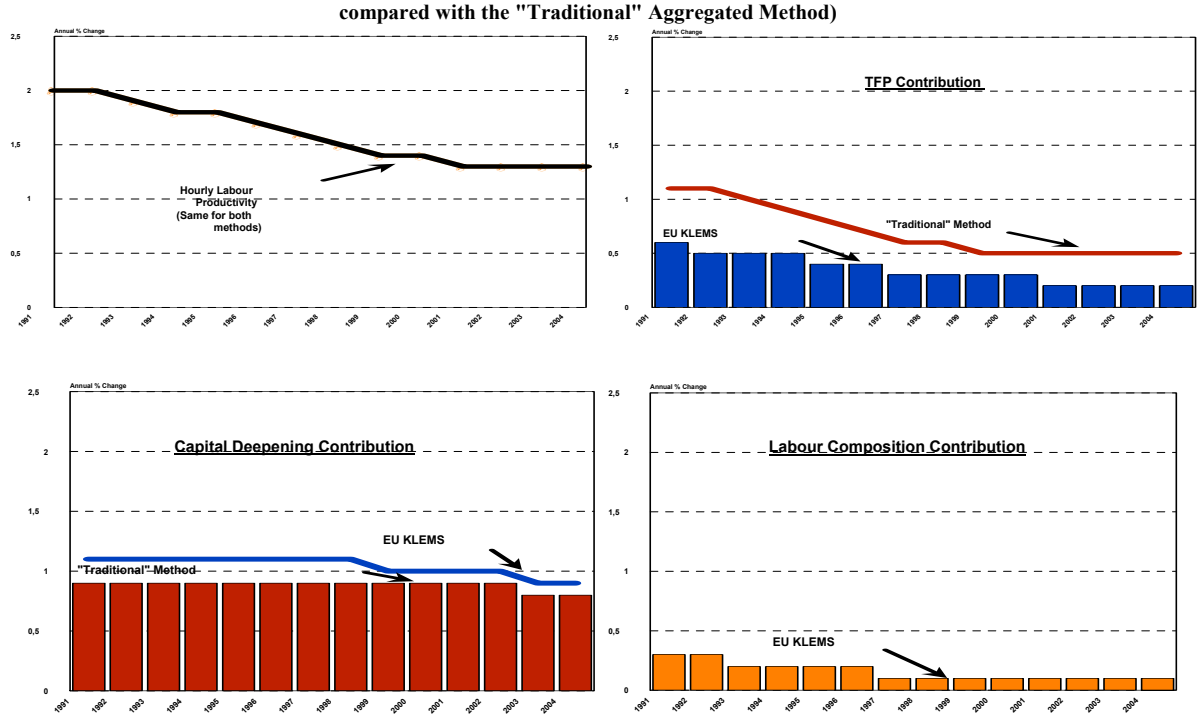
* The contents of this box are taken from Timmer, M,, O'Mahony, M. and B. van Ark (2007), "EU KLEMS Growth and Productivity Accounts : An Overview", International Productivity Monitor, Number 14, Spring 2007.

** Under strict neo-classical assumptions, TFP growth measures disembodied technological change. In practice, TFP is derived as a residual and includes a host of effects such as improvements in allocative and technical efficiency, changes in returns to scale and mark-ups and technological change proper. All these effects can be broadly summarised as "improvements in efficiency", as they improve the productivity with which inputs are being used in the production process. In addition, being a residual measure, TFP growth also includes measurement errors and the effects from unmeasured output and inputs.

Box 2 : "EU KLEMS" vs. "Traditional" Approaches to Growth Accounting

This box attempts to demonstrate the most significant differences, both quantitative and qualitative, between the EU KLEMS growth accounting approach and a more "traditional" growth accounting method. Essentially, the latter method assumes that the marginal productivity of all types of labour and capital are the same and are equal to the aggregate wage and capital shares (note : the capital share is often calculated as one minus the wage share, as implied by constant returns to scale and perfect competition[34], with the aggregated capital and labour shares being roughly 0.35 / 0.65 of value added). A serious drawback with the "traditional" approach is that measured TFP overstates "true" TFP if the composition of factor inputs (i.e. labour and capital) is shifting over time towards types of higher quality (i.e. composition effects). To obtain a more accurate TFP estimate, it is essential therefore to allow for such shifts in quality i.e. to a workforce with a higher share of high skilled workers or to the purchase of specific capital asset classes – such as ICT – which potentially have higher marginal productivities. This is what EU KLEMS is essentially trying to achieve, with a more accurate measurement of the contributions to growth of labour and capital leading, in turn, to the possibility of achieving less biased estimates of the crucial TFP variable. Accurate measurements of TFP are of importance to policy makers since TFP is the structural component of labour productivity and is essentially the sole determinant of labour productivity trends over the longer run. As the graphs below for the Euro Area indicate, the overall effect of adopting the EU KLEMS approach is to significantly reduce the contribution of TFP to the Euro Area's labour productivity growth rate. Since the overall rate of labour productivity growth does not differ between both methods, the smaller TFP contribution estimated by EU KLEMS is offset by higher contributions from capital (estimated on the basis of a disaggregated capital stock) [35]and from labour (estimated on the basis of a disaggregated labour force)[36]. With respect to labour, as the set of graphs make clear, the contribution of "labour composition" effects to labour productivity growth are taken into account in the EU KLEMS approach but not in the "traditional" method. Finally, while the TFP growth rates calculated using both methods are clearly very different (e.g. the EU KLEMS TFP rates in 2004 are less than half those calculated using the traditional approach), the overall downward trend for Euro Area TFP over the period 1991-2004 is confirmed on the basis of both approaches.

Contributions to Hourly Labour Productivity - Growth Accounting for the Euro Area (1991-2004)
(EU KLEMS –"Disaggregated Labour and Capital Method")
compared with the "Traditional" Aggregated Method)



[34] Constant returns to scale and perfect competition in product and factor markets are two important assumptions of the growth accounting model.

[35] Using a measure of capital services rather than simply a measure of the quantity of the capital stock essentially means that the efficiency gains from using the capital (i.e. the quality improvements) are included as part of the contribution of capital to growth, rather than being part of the residual TFP component. For example, using this approach ensures that a distinction is made between the marginal productivity of different types of capital i.e. ICT vs. non-ICT capital assets. This has the effect that the role of ICT capital in boosting GDP and labour productivity growth since the mid-1990's is greatly enhanced using the capital services vs. the capital stock approaches. This is particularly important in understanding the growing EU-US growth differentials over the last decade. The increasing penetration of these ICT technologies in a range of private service sector industries has been stressed as a key factor in understanding the EU-US growth differentials. For example, over the 1996-2000 period, ICT capital services is estimated by EU KLEMS to have contributed 1.4% points to US GDP growth, compared with 0.4% points in the EU. What is equally striking is that the contribution to growth of ICT capital was substantially larger than non-ICT capital in the US (in fact 2 ½ times larger) whereas the opposite is the case for the EU, with ICT capital contributing less than non-ICT capital.

[36] Capital services and labour services growth rates are higher than the capital stock and labour input growth rates.

5 : GDP Growth Accounting Analysis for the EU15ex5 Aggregate[37] and the US

Using the EU KLEMS growth accounting methodology described in section 4 and drawing in particular on the capital and labour accounts in the databank, the present section provides a GDP decomposition into labour services, capital services and TFP for the EU15ex5 and the US. Unlike the variables used in section 3 which were drawn from official sources, the variables used in the present and subsequent sections are taken from the growth accounting part of the EU KLEMS databank and are more of an analytical nature. This means that whilst based on published national accounts and input-output datasets, these variables (e.g. labour services; capital services; and TFP) cannot be directly derived from published data sources without additional economic assumptions. Unfortunately, unlike the analysis for the "basic" datasets provided in section 3 which is possible for 25 of the EU's Member States, the growth accounting analysis in the present section can only be carried out for a subset of the Member States due to the absence of capital stock and labour composition data series for some countries. The full set of growth accounting results are only available for roughly half of the EU's Member States, 10 of the "old" EU15 countries and 3 of the "new" Member States, although more limited analyses are possible for a number of other countries.

The objective of the present section is to provide a flavour of what is available in the growth accounting part of the databank rather than to give an exhaustive economic analysis of differences in the performances of the EU and US economies. The emphasis is on moving from an analysis of broad sectors to a more detailed industry overview which will allow us to isolate the small number of specific industries which are driving the bulk of the EU-US productivity differences. Section 5.1 looks at period averages and trend developments for the EU and the US for "total industries" and for the manufacturing, private services and "rest of economy" sectors. Sections 5.2 and 5.3 then go on to look at an A31 level breakdown of industries[38] where the labour quality and capital stock data in EU KLEMS can be used to do a detailed growth accounting analysis for those five industries where EU-US productivity differentials are greatest.

5.1 : Sectoral Breakdown (Manufacturing, Private Services, "Rest of Economy") : Table 2 is based on a partial KLEMS growth accounting methodology (i.e. excluding intermediates), with value added being decomposed into labour services, capital services and TFP[39]. This overview table only contains data for the EU aggregates and the US, with broadly similar analyses for the individual Member States being included in Annex 3. For all of the graphs in this section, the

[37] EU15ex5 = EU15 excluding Greece, Ireland, Luxembourg, Portugal and Sweden.

[38] While we are using the NACE A31 industry breakdown, data is only available for a total of 28 industries since some of the smaller headings have been merged with other NACE codes.

[39] The contributions of capital, labour and TFP to value added (GDP) growth are calculated using the respective shares of capital and labour in value added (which in the growth accounting model always equals 1 - all of value added is allocated to either labour or capital). TFP is the residual component of GDP growth, once the contributions of labour and capital have been removed. Getting from the volumes of labour and capital services to contributions to value added growth works as follows. With regard to labour, the change in the volume index of labour services equals the change in total hours worked for different labour types weighted by the share of each labour type in total labour compensation. The contribution of labour to value added growth is then calculated as the change in the volume index of labour services weighted by total labour compensation in nominal value added. With respect to capital, the productive capital stock of each asset type is calculated using the perpetual inventory method and an assumed geometric rate of depreciation. The change in the volume index of capital services is then calculated as the change in the real capital stock of 7 different asset types, weighted by the share of each asset in total capital compensation (these shares are linked to the rental price / user cost of assets). The contribution of capital to value added growth is then calculated as the change in the volume index of capital services weighted by total capital compensation in value added.

EU15ex5 aggregate[40] is used for the EU in comparisons with the US. The key points from Table 2 are as follows :

- The table shows firstly that GDP growth in the US has consistently outperformed the EU15ex5 aggregate over the period as a whole at the level of the total economy (i.e. "total industries"), with the extent of the out-performance tending to rise over time[41].

- In terms of the components of growth, in the past the higher contribution of labour services to growth in the US has been the driving factor, with the US outperforming the EU15ex5 grouping by 0.7 and 0.5 % points respectively over the 1981-1995 and 1996-2000 periods. This situation has been completely reversed over the most recent 2001-2004 period, with the US experiencing a strongly negative contribution from labour services due to a particularly heavy shakeout in its manufacturing sector. The EUex5 aggregate, on the other hand, has enjoyed very buoyant labour market conditions in recent years, driven by a relatively strong performance in the private services sector and much more limited losses in the manufacturing sector compared with the US.

- Table 2 also shows that despite its strong labour market performance, the EU15ex5 grouping has continued to trail the US in terms of GDP growth rates, with the EU's previously strong labour productivity performance giving way to a relatively pronounced deterioration in the post 1995 period. More worryingly, the table shows that the big labour productivity gap between the EU and the US over the most recent period, 2001-2004, is due to TFP and not to capital services. At the level of total industries, the average TFP growth rate differential for 2001-2004 is 1 ¾ percentage points, compared with a gap of only ½ a percentage point for the period 1996-2000. Again, as with the overall labour productivity trends, the gap in TFP growth rates is widespread at the sectoral level, with very large EU-US TFP growth rate differentials for both the manufacturing and private services sectors.

- With respect to the new Member States, it is encouraging to note the acceleration in the contribution of TFP to overall value added growth in the period 2001-2004 for the CHS[42] grouping. Some concerns on the sustainability of these trends can be expressed, however, given the fact that this "total industries" acceleration is due to a sharp acceleration in the TFP trend for the "rest of the economy" sector and to an improving, but still negative, outturn for private services. In addition, the relatively sharp decline in the growth rates of TFP in the manufacturing sector is a further source of concern.

[40] This EU aggregate covers roughly 92% of EU15 GDP.

[41] With respect to the EU15ex5 aggregate, the contribution of labour services to GDP growth over the period 2001-2004 was 0.5 of a percentage point, of which 60% came from faster growth in total hours worked and 40% from an improved labour force composition effect (i.e. a higher share of more skilled workers). In the US, the contribution of capital services to GDP growth at the aggregate level rose only slightly in the 1996-2000 period compared with 1981-1995. Despite this relative stability at the aggregate level, there have been big shifts in terms of the relative contributions of ICT and non-ICT capital, with ICT doubling its contribution from 0.7 to 1.4% points and with an almost halving in the contribution of non-ICT capital from 1.0 to 0.6% points. The changes in the ICT / non-ICT distribution in the EU over the same period have been much less dramatic, with ICT growing slightly in importance and with non-ICT capital making an equivalent contribution over both periods.

[42] CHS = Czech Republic, Hungary and Slovenia.

- In order to bring out the points from Table 2 more clearly, graphs 7a-7c provide a growth accounting trend analysis based on a HP filter approach. The graphs show the trend contributions (i.e. the combined effect of each of the different components of growth and their respective output shares) of labour services, capital services and TFP to GDP growth. This analysis is done for "total industries" (7a) and for the manufacturing (7b) and private services (7c) sectors. The graphs have all the same scale and are additive (i.e. labour services + capital services + TFP = total GDP). This type of trend analysis is only possible for the US and the EU15ex5 grouping due to sample length problems for the CHS aggregate.

- If one looks at the total economy (i.e. "total industries"), the graphs confirm the story given in table 2 that TFP is the biggest contributor to the productivity gap and that this EU15ex5-US TFP gap is rising over time[43]. While there is also a gap in favour of the US with regard to capital services, the latter has stayed broadly constant over time. One interesting feature of the capital services gap is that it is totally due to ICT capital, with the EU consistently having a higher contribution from non-ICT capital services since the early 1990's. Similar breakdowns are available in graphs 7b and 7c for the manufacturing and private services industries, with exactly the same pattern emerging, namely that TFP explains the sectoral productivity differences, with these efficiency gaps for the manufacturing and private services sectors tending to rise over time in favour of the US.

[43] Whilst the growth accounting approach allows one to isolate the key role for TFP in explaining EU-US labour productivity differences, such an analytical approach has little to say concerning the underlying driving factors behind the divergences which emerged. Other analyses, including panel regressions, must be used to isolate those factors such as R&D, human capital, the regulatory environment etc which are critical in explaining differences in the evolution of TFP.

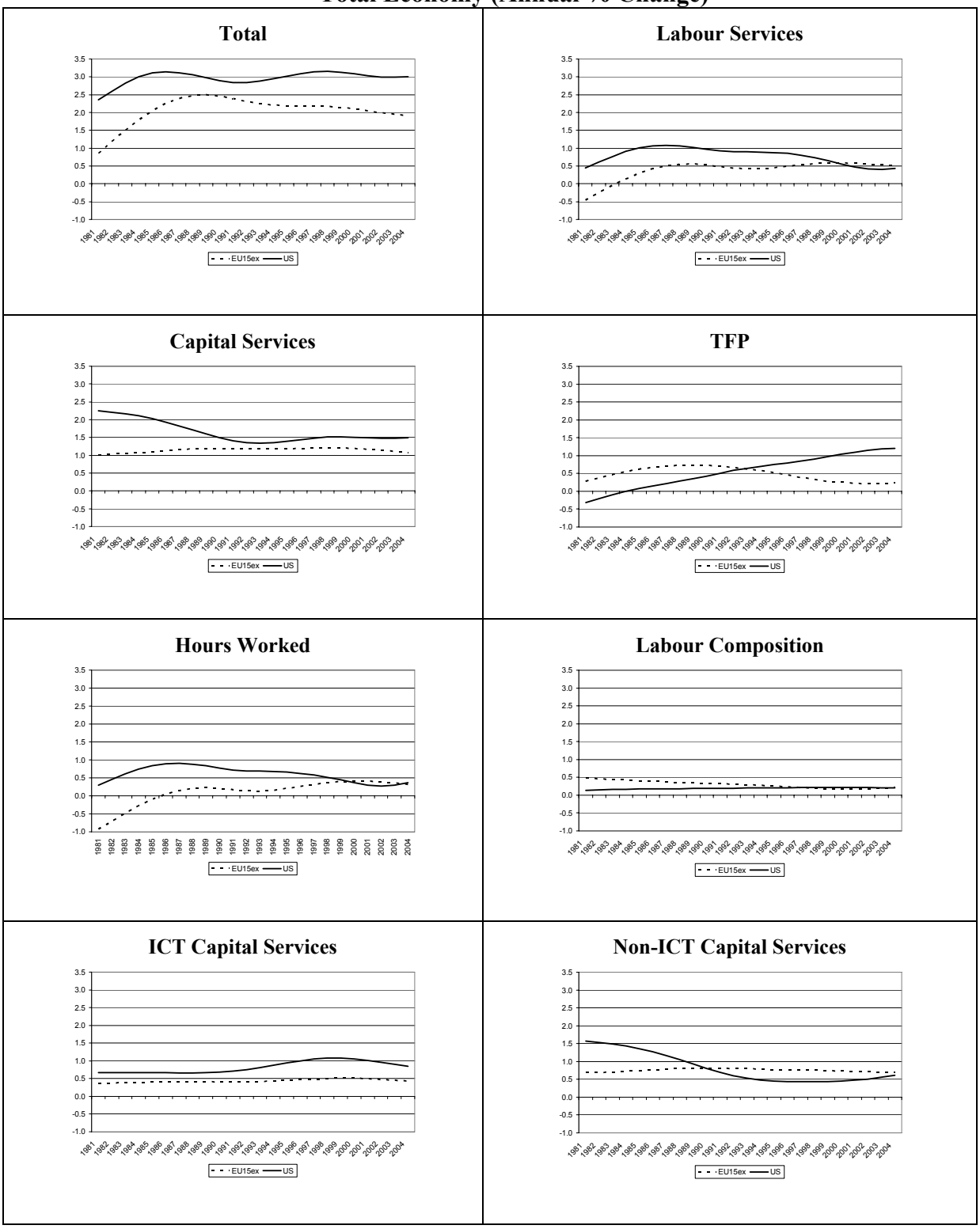
Table 2 : US, EU15ex5 and CHS* – Results of Growth Accounting Analysis – Gross Value Added Growth and Contributions (Annual Average Volume Growth Rates in %)

	US			EU15ex5			CHS*	
	1981-1995	1996-2000	2001-2004	1981-1995	1996-2000	2001-2004	1996-2000	2001-2004
Total Industries								
1. Labour Services	0.9	1.3	-0.5	0.2	0.8	0.5	0.6	0.2
Of which								
Hours	0.7	1.1	-0.8	-0.1	0.7	0.3	0.2	-0.5
Composition	0.2	0.2	0.3	0.4	0.1	0.2	0.4	0.8
2. Capital Services	1.7	2.0	0.9	1.1	1.4	1.0	1.4	1.6
Of which								
ICT	0.7	1.4	0.6	0.4	0.6	0.4	0.5	0.4
Non-ICT	1.0	0.6	0.3	0.8	0.8	0.6	0.9	1.1
3. TFP	0.3	0.8	1.7	0.7	0.3	-0.1	0.2	0.8
Total Industries GDP	2.8	4.1	2.1	2.0	2.6	1.4	2.1	2.6
Manufacturing								
1. Labour Services	-0.2	0.3	-3.4	-1.2	0.1	-0.9	0.3	-0.4
Of which								
Hours	-0.6	-0.1	-3.9	-1.5	-0.2	-1.3	0.3	-1.0
Composition	0.3	0.5	0.5	0.3	0.2	0.5	0.0	0.5
2. Capital Services	1.0	1.8	0.2	0.8	0.9	0.4	1.9	2.3
Of which								
ICT	0.5	1.1	0.3	0.3	0.4	0.2	0.4	0.4
Non-ICT	0.4	0.7	-0.1	0.6	0.5	0.2	1.5	2.0
3. TFP	2.2	2.8	4.0	1.9	1.1	0.7	3.7	1.9
Total Manufacturing GDP	3.0	4.9	0.8	1.5	2.0	0.3	5.9	3.8
Private Services								
1. Labour Services	1.4	2.1	-0.1	0.7	1.2	0.7	0.8	0.5
Of which								
Hours	1.2	1.7	-0.3	0.5	1.1	0.6	0.6	0.1
Composition	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.4
2. Capital Services	2.4	2.5	1.2	1.4	1.9	1.4	2.4	2.0
Of which								
ICT	0.9	1.9	0.9	0.5	0.9	0.5	0.7	0.6
Non-ICT	1.5	0.6	0.3	1.0	1.1	0.9	1.7	1.5
3. TFP	-0.5	0.5	1.6	0.7	0.2	-0.2	-1.6	-0.2
Total Private Services GDP	3.2	5.1	2.6	2.8	3.3	1.9	1.6	2.3
Rest of Economy								
1. Labour Services	1.5	1.3	1.4	0.5	0.8	0.9	0.4	0.3
Of which								
Hours	1.2	1.3	1.2	0.3	0.6	0.8	0.0	-0.3
Composition	0.3	0.0	0.2	0.2	0.2	0.1	0.4	0.5
2. Capital Services	0.7	1.1	0.8	0.7	0.6	0.5	-0.3	0.6
Of which								
ICT	0.3	0.7	0.3	0.2	0.3	0.2	0.3	0.3
Non-ICT	0.4	0.5	0.5	0.5	0.3	0.3	-0.5	0.3
3. TFP	-0.4	-0.7	-0.2	-0.2	0.1	-0.2	0.9	1.6
Total Rest of Economy GDP	1.8	1.7	2.0	1.0	1.5	1.3	1.1	2.5

***CHS = Czech Republic, Hungary and Slovenia (Note : "Total Industries" GDP for this grouping of countries does not track very closely the equivalent figures for "Total Economy" in AMECO).**
Source: EU KLEMS and own calculations

Graph 7A : EU + US – Growth Accounting Analysis – Trend Contributions to the Total Change in GDP from Labour Services, Capital Services and TFP

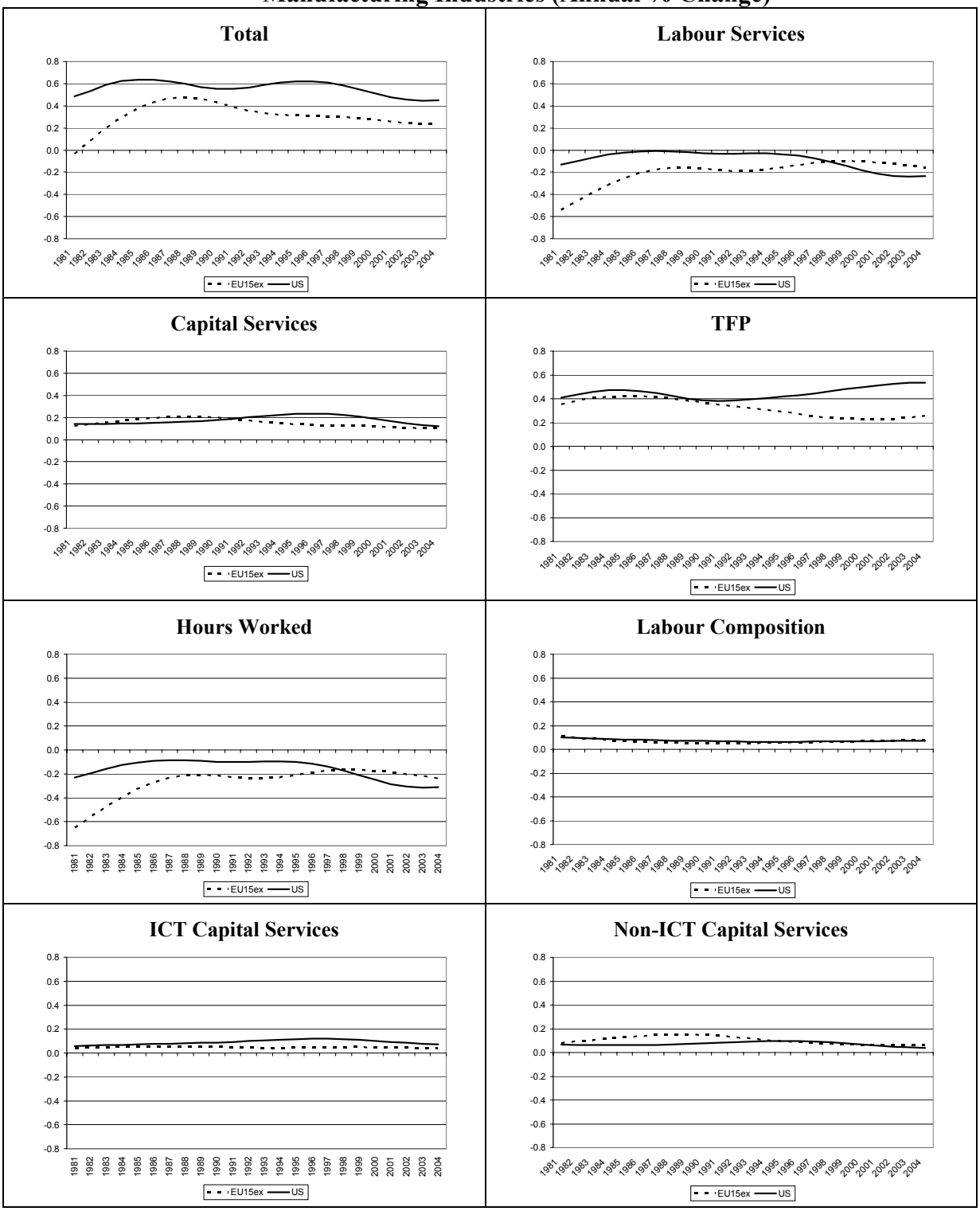
- Total Economy (Annual % Change)-



Source: EU KLEMS and own calculations

Graph 7B : EU + US – Growth Accounting Analysis – Trend Contributions to the Total Change in GDP from Labour Services, Capital Services and TFP

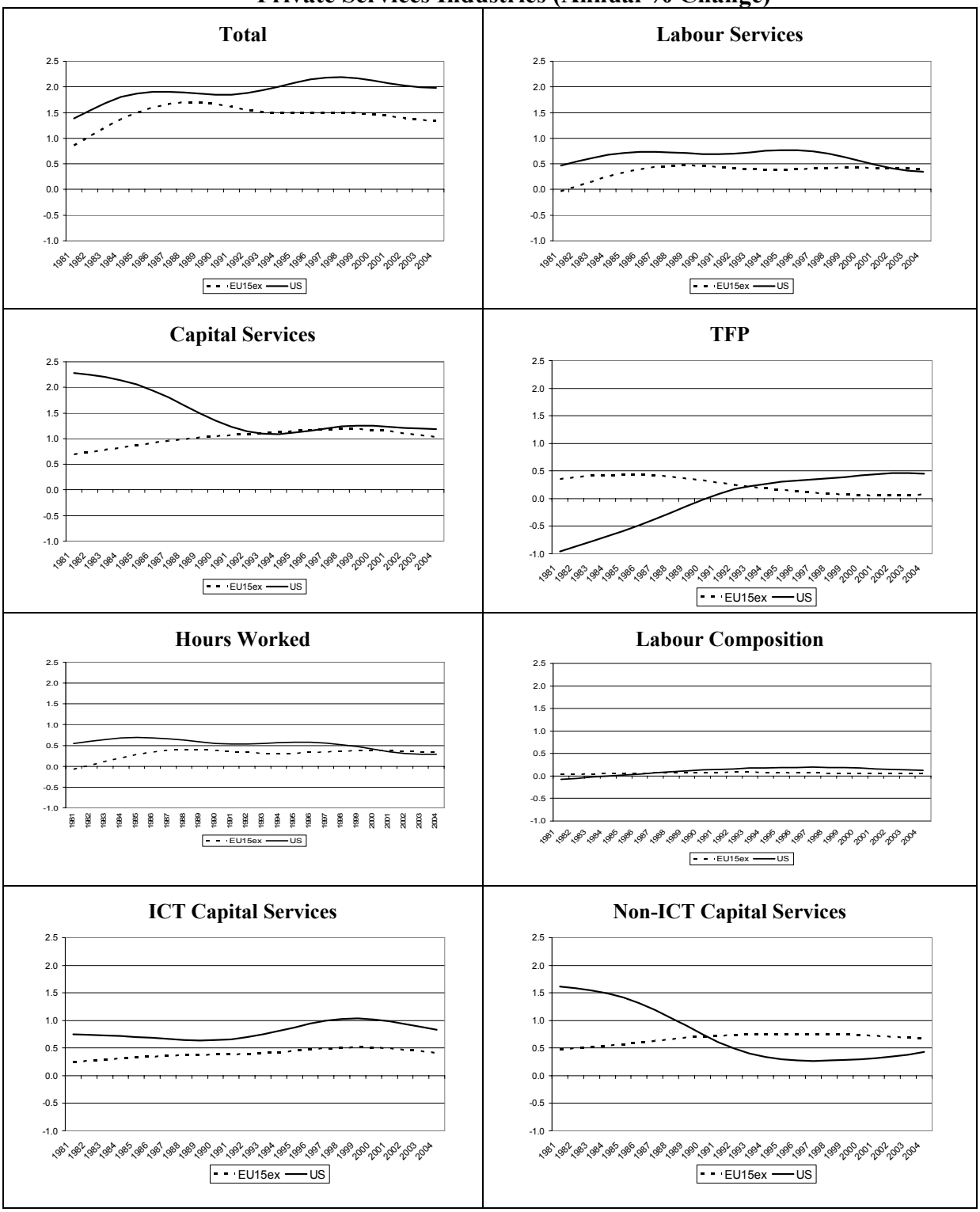
- Manufacturing Industries (Annual % Change)-



Source: EU KLEMS and own calculations

Graph 7C : EU + US – Growth Accounting Analysis – Trend Contributions to the Total Change in GDP from Labour Services, Capital Services and TFP

- Private Services Industries (Annual % Change)-



Source: EU KLEMS and own calculations

5.2 : Industry Breakdown (A31 Level) : The present sub-section goes on to provide a more detailed breakdown for the EU15ex5 aggregate and the US for the manufacturing, private services and "rest of economy" sectors by examining those industries in the databank (28 in total – 14 manufacturing, 7 private services and 7 "other industries")[44] where labour quality and capital stock data exists and which are therefore amenable to the type of growth accounting analysis discussed earlier.

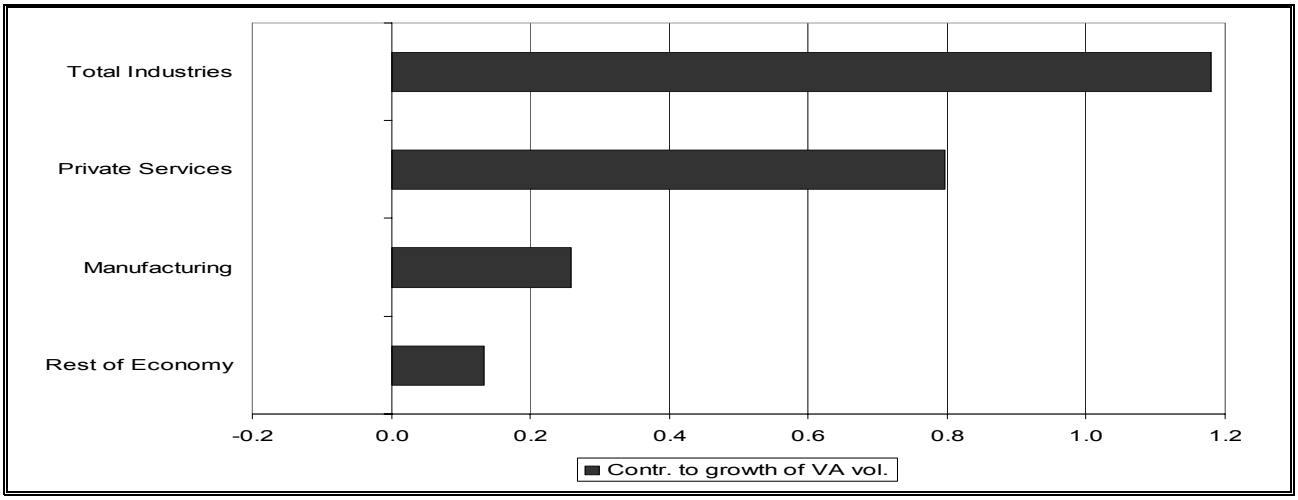
Given that a detailed, growth accounting, analysis for 28 industries would be excessive for the purposes of the present exercise, only summary indicators are provided for the 28 industries. This is done in graphs 8a-8c which show the contributions to value added, labour input and hourly labour productivity for the 28 industries in the EU and the US. The relative performance of both areas is established by taking the US contributions and subtracting the equivalent EU contributions for the various industries and sectors. For each target variable (i.e. value added, labour input and labour productivity) a graph is provided for the sectoral (i.e. manufacturing, private services and "rest of economy") differences as well as for the 28 industries, with each of the latter in turn attributed to their respective sectors (i.e. M = manufacturing; P.S. = private services and O = "other industries"). The three sets of graphs all use the ranking provided by the contributions to EU-US labour productivity differences. These summary indicators allow one to focus in on the small group of industries which are the main drivers of EU-US differences for all three variables, although the primary objective is to isolate those industries which are the key drivers of EU-US productivity differentials since this is the main objective of the analysis in sub-section 5.3.

As shown in graph 8a, over the 1996-2004 period, there was a 1.2 % points GDP growth gap in favour of the US. Graph 8b shows that only a small part of this growth difference was due to industry level labour input divergences, with nearly 85% of the gap due to productivity (graph 8c). In addition, with regard to the argument that labour input differences could potentially shed light on some of the productivity differences, there is little evidence to support the view that labour input / labour productivity trade-off's are playing a large role, at least for those industries where the productivity differences are greatest.[45]. One interesting feature of the graphs on labour input is the extent to which the US has got a higher contribution than the EU from the "rest of economy" sector. As one can see from the graph, this is evident for both the education and health and social work industries, although US trends in these industries are possibly influenced by their relatively large private sector components. Regarding productivity, graph 8c shows that all of the 1 percentage point (annual average) gap in EU-US labour productivity growth rates can be explained by just 4 industries, other business services (including real estate); wholesale and retail trade; electrical and optical equipment; and financial intermediation[46]. On a more encouraging note, the graph also indicates that the EU has done relatively well in "utility" industries such as electricity, gas and water as well as transport and communications.

[44] The analysis is only possible for 28 industries since 3 of the A31 level industries have been merged with other industries.
[45] This conclusion is supported by the analysis in annex 4.
[46] As can be seen from the more detailed industry breakdown in section 3, financial intermediation is made up of three different industries, financial services, auxiliary financial services and insurance and pensions.

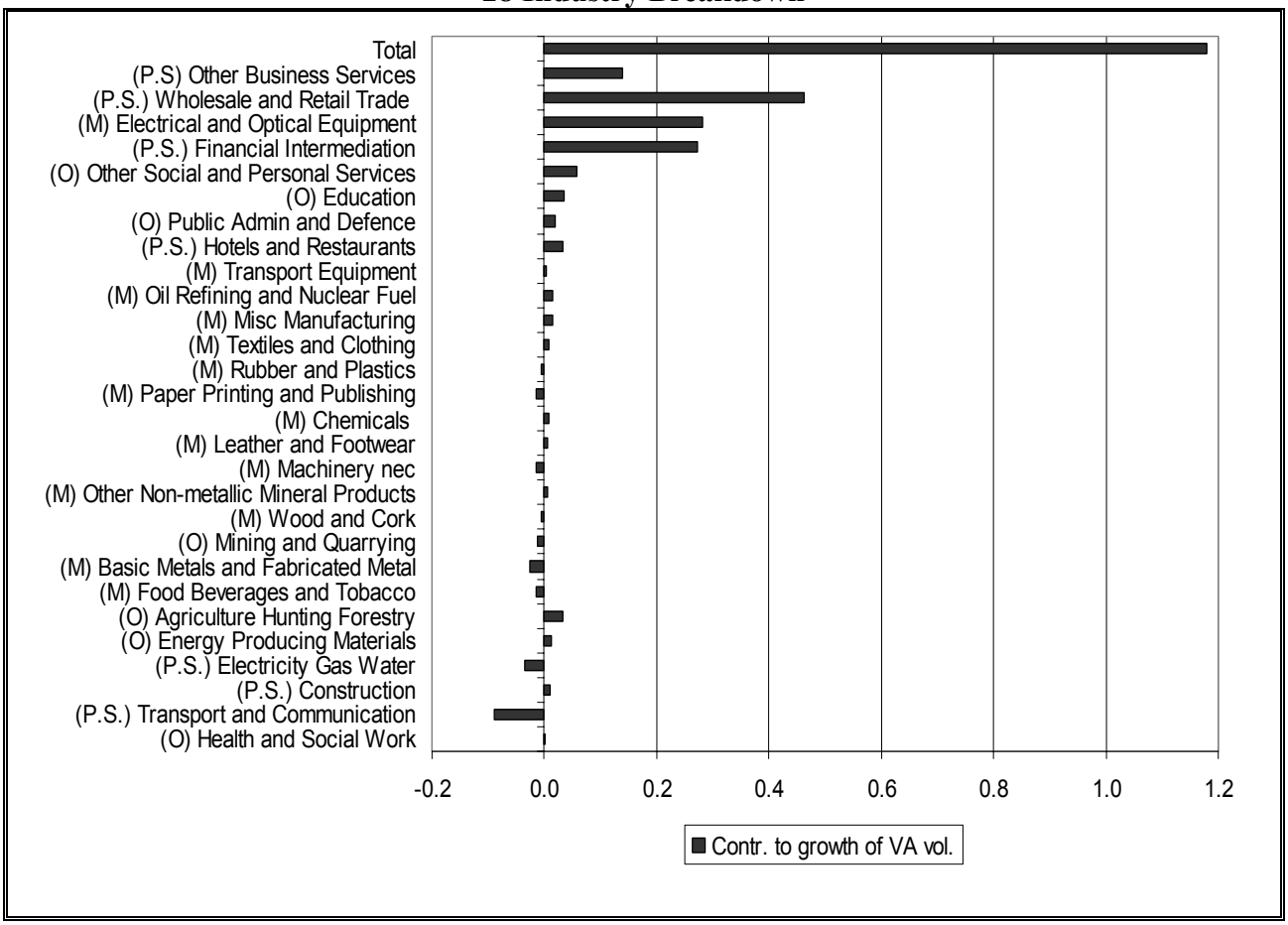
Graph 8a : 3 Sector + 28 Industry Breakdown (1996-2004)
Contribution to Total Economy Change in GDP – Value Added (US Less EU)

3 Sector Breakdown



Source: EU KLEMS and own calculations

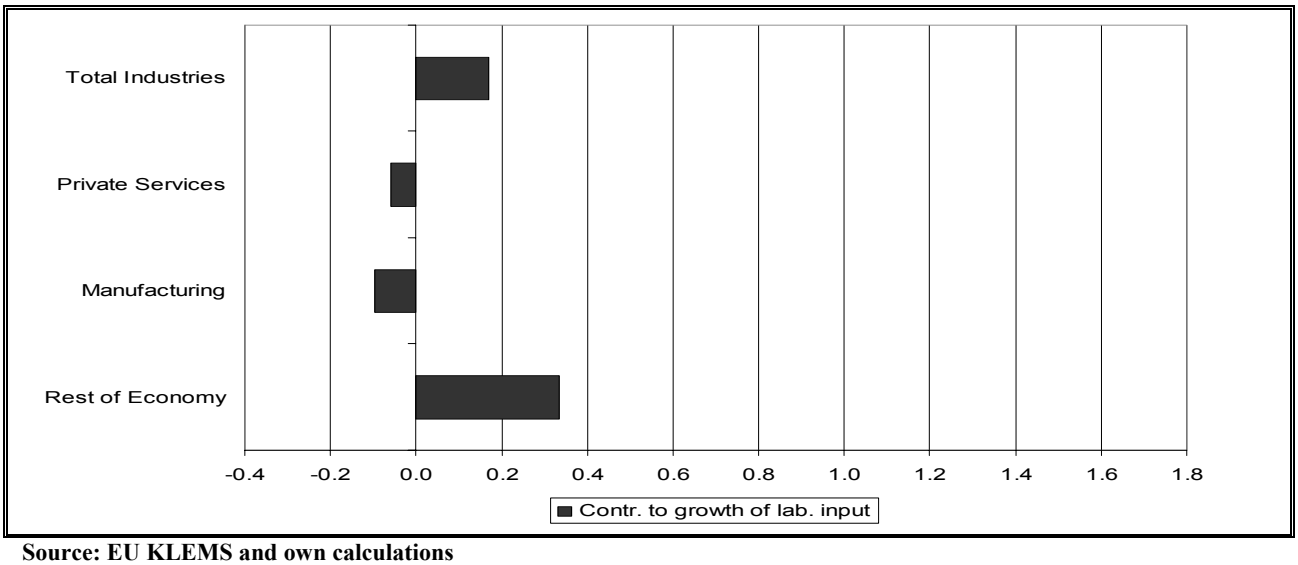
28 Industry Breakdown



Source: EU KLEMS and own calculations

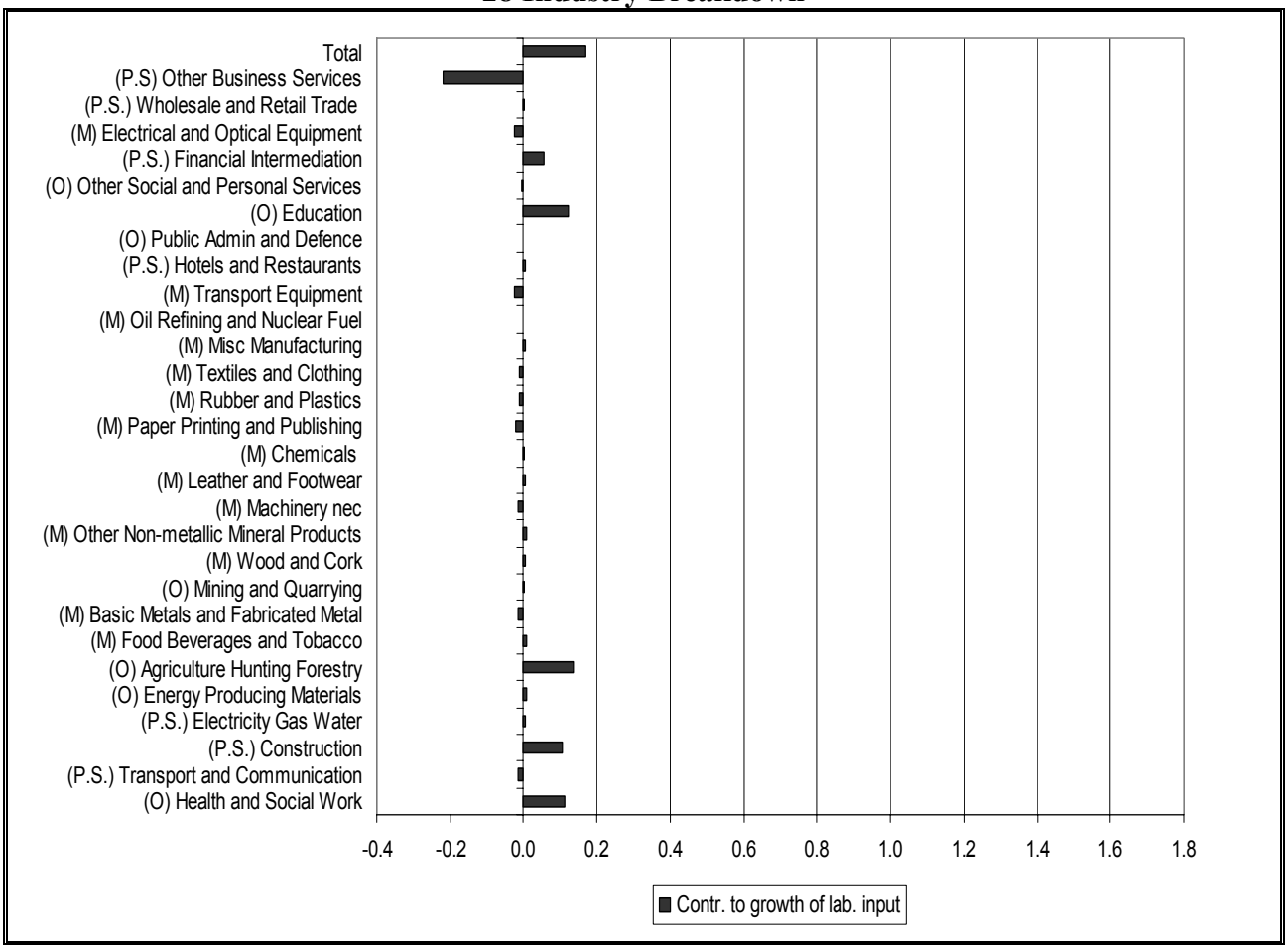
Graph 8b : 3 Sector + 28 Industry Breakdown (1996-2004)
Contribution to Total Economy Change in Labour Input (US Less EU)

3 Sector Breakdown



Source: EU KLEMS and own calculations

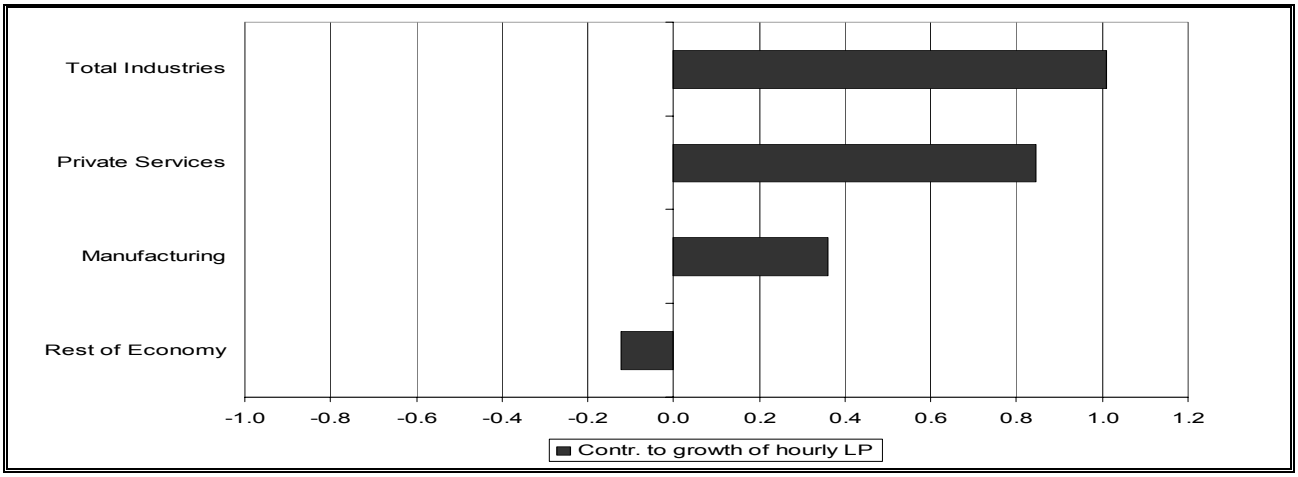
28 Industry Breakdown



Source: EU KLEMS and own calculations

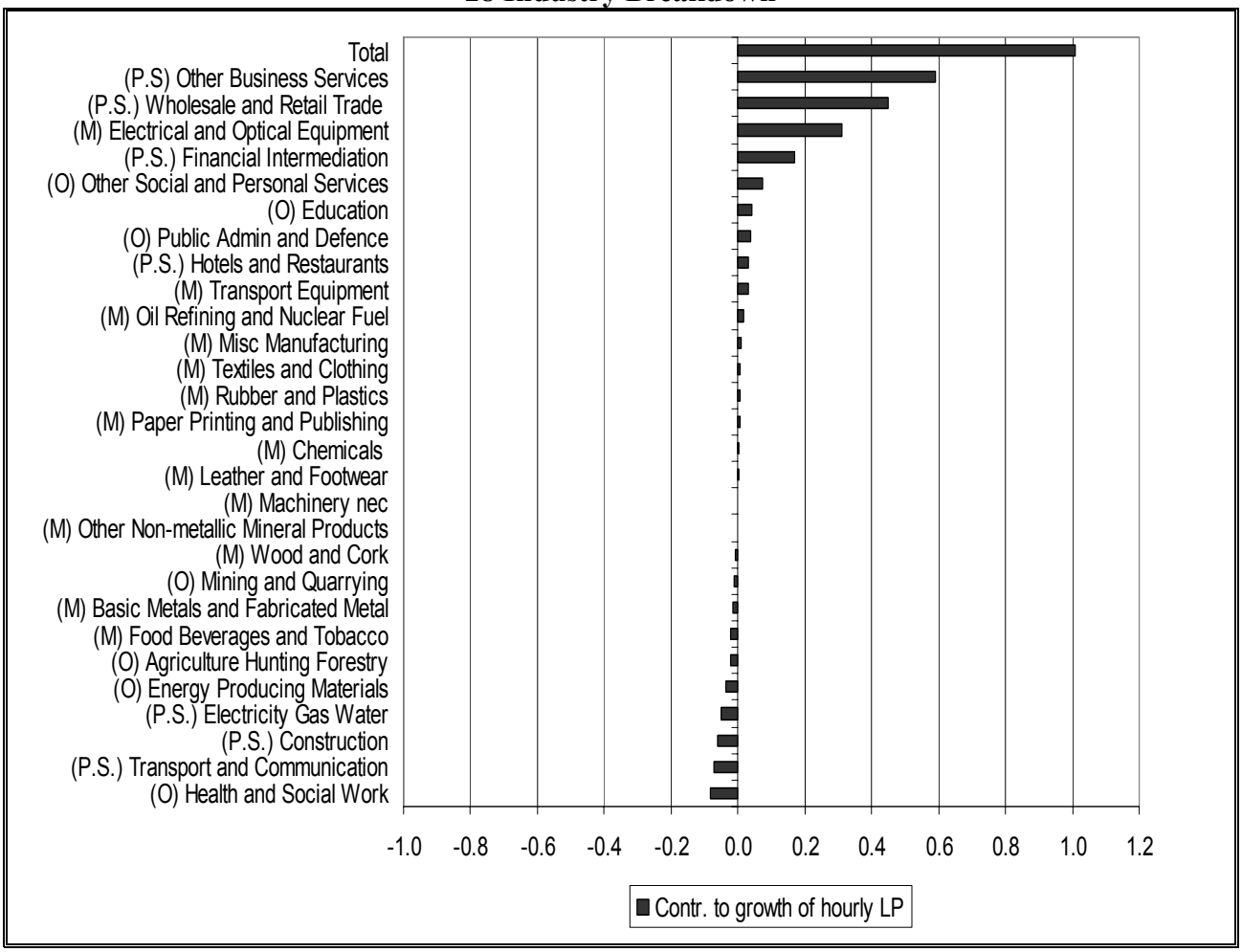
Graph 8c : 3 Sector + 28 Industry Breakdown (1996-2004)
Contribution to Total Economy Change in Hourly Labour Productivity (US Less EU)

3 Sector Breakdown



Source: EU KLEMS and own calculations

28 Industry Breakdown



Source: EU KLEMS and own calculations

5.3 : Focus on Five Key Industries : "Other Business Services"; Wholesale and Retail Trade; Electrical and Optical Equipment; Financial Intermediation; and "Network" industries

The present section follows up on the analysis in 5.2 by doing a detailed growth accounting breakdown for those five industries which have been shown to be the key drivers of EU-US productivity differentials. With the exception of electrical and optical equipment, all of the industries are in the private services sector. The set of 8 graphs per industry (i.e. 9a-9e) provide insights into the principal, industry-by-industry, growth determinants. The following points should be borne in mind in drawing conclusions from the graphs :

"Other Business Services"

- The "other business services" industry includes real estate and as a result displays quite volatile trends, at least in terms of the breakdown of labour productivity into capital services and TFP. It is accepted that due to the large measurement issues associated with this industry that great care is needed in drawing inferences from the patterns presented.

Wholesale / Retail Trade + Financial Intermediation

- The need for caution also applies in interpreting the results for the wholesale and retail trade and financial services industries, but possibly to a lesser extent than for "other business services".

- Whilst conscious of the measurement issues involved (see annex 2), and whilst accepting that a lot more detailed analysis would be needed to draw firm conclusions, nevertheless the graphs for both wholesale and retail trade and financial services do provide a lot of "food for thought" for EU policy makers. If the trends in the graphs are corroborated by subsequent analyses, they could raise important policy issues in at least some of the EU's member states where productivity growth in these specific industries has been relatively poor in recent years.

- This is particularly the case for wholesale and retail trade since if one looks at the graphs for this industry grouping, one sees that virtually none of the labour productivity differences relate to differences in terms of capital services (nor indeed is it due to any differences in terms of the ICT / non-ICT breakdown of capital services). It is totally a TFP effect[47]. At this stage, no adequate explanation can be given to decipher such "efficiency" differences although a range of hypotheses have been postulated as to what the key drivers are. Detailed industry specific studies are clearly needed to cross-check the plausibility of the labour productivity / TFP trends emerging from the EU KLEMS datasets.

[47] In fact, the key difference between the EU and the US in the retail and wholesale trade industry is not so much in terms of their use of any of the production inputs (e.g. factors of production such as skilled labour and ICT capital) where both areas have enjoyed similar trend growth rates. The big difference is in terms of the efficiency with which those inputs are being deployed (i.e. TFP growth rates). This is an issue which equally applies at the level of the total economy.

- As regards financial intermediation, the graphs suggest that differences between the EU and the US in terms of their labour productivity performances, to a large extent, reflect differences in the contribution to growth of ICT capital services. The much higher level of ICT investments in the US financial services industry resulted in ICT making a contribution to US value added growth which was double that of the equivalent ICT effect for the EU. EU-US TFP differences are, on the other hand, of a relatively minor order of magnitude although a small gap in favour of the US does appear to be emerging since the mid-1990's.

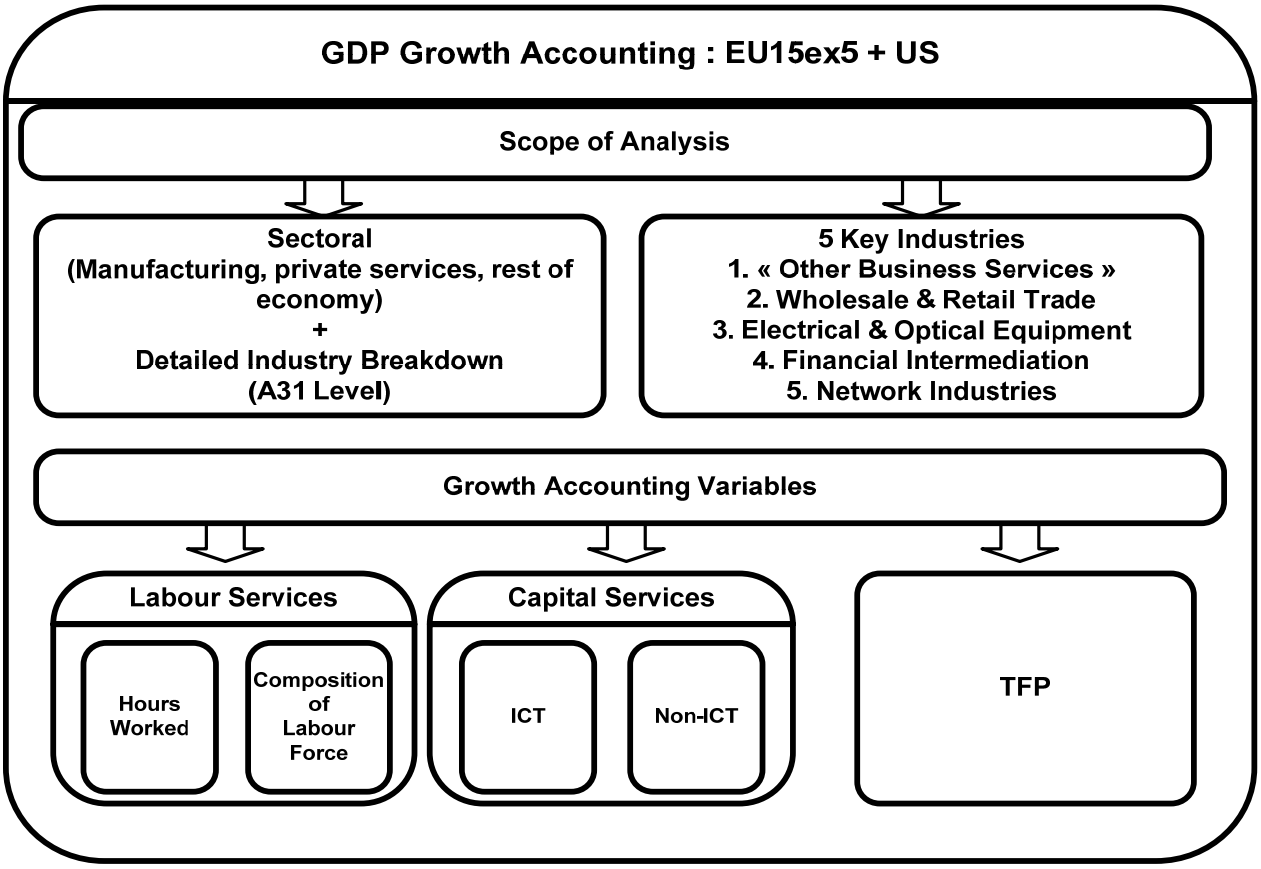
Electrical and Optical Equipment

- Electrical and optical equipment is the only one of the five industries which is in the manufacturing sector and consequently is probably unique in that measurement issues do not pose fundamental concerns. The graphs show that the large difference in the contribution of this industry to overall productivity growth in the US relative to the EU is totally a TFP phenomenon. This is not that surprising since the key driver in this industry is semiconductors which has benefited enormously from the TFP enhancing effect of "Moore's Law"[48]. The better performance of the US in this industry essentially reflects the US's superior innovation capacity, with its knowledge economy geared not only to the production of new ideas but to the commercialisation of a flow of innovative technologies over the longer term. Up to 30% of the total EU-US TFP differences emanate from this single industry, underlining yet again the importance of the EU moving towards an innovation-based economic model as laid out in "Lisbon".

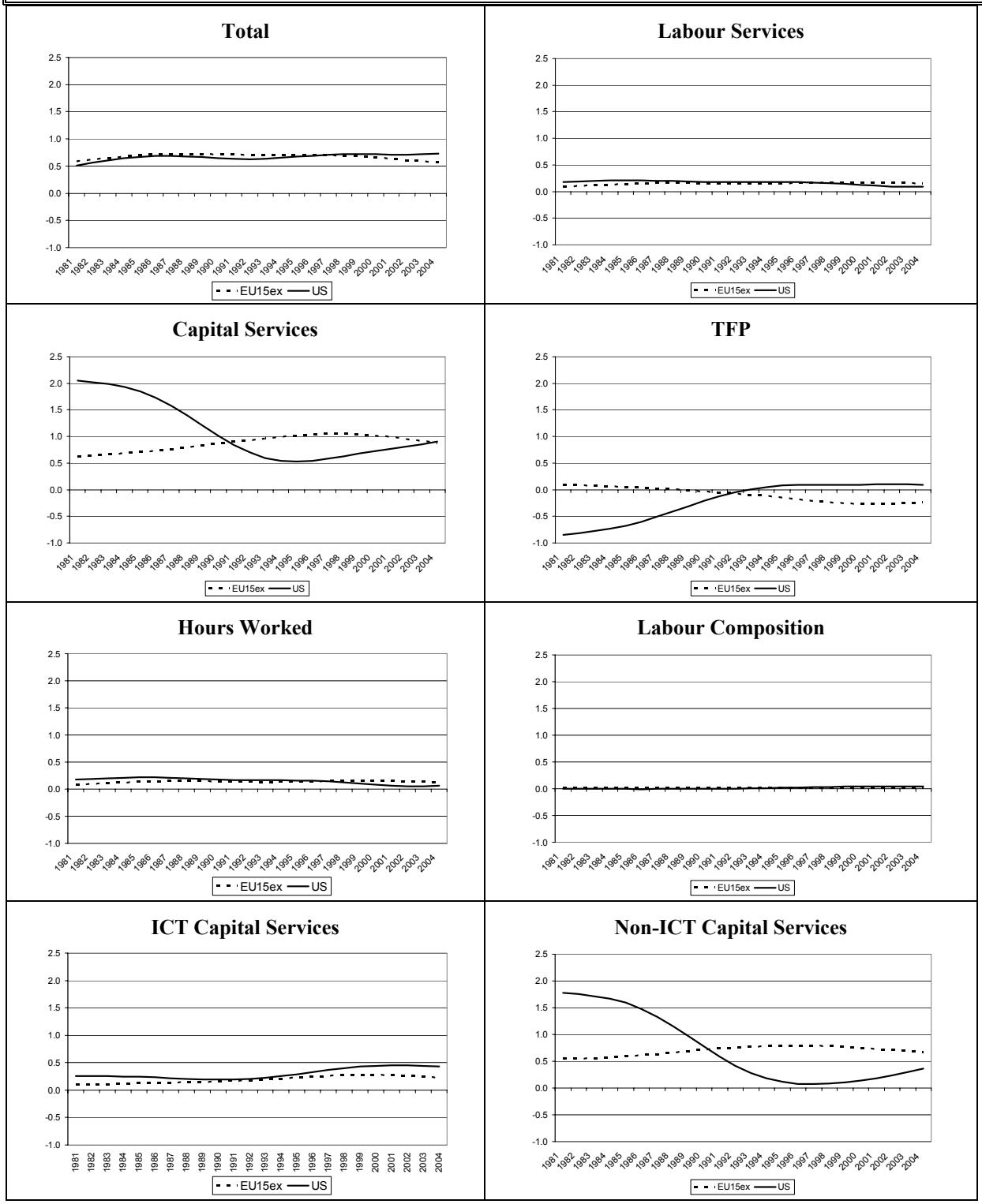
"Network Industries"

- The "network industries" are the only industry grouping where the EU has consistently outperformed the US over recent decades. For the purposes of the present exercise, a number of individual industries (i.e. electricity, gas and water supply; transport, storage and communications; and post and telecommunications) have been aggregated to form the "network" grouping. For this set of industries, the graphs show that the EU has had a consistent advantage over the US over the whole period since 1981 and that the key driver of this advantage has been TFP trends and not differences in the contribution of capital services or labour services. The favourable TFP gap relative to the US does however appear to be narrowing in recent years, and the closing of the value added gap is also being helped by the fact that the network industries in the US have been investing substantially more in the area of ICT capital compared with the EU since the early 1990's.

[48] Moore's Law is the empirical observation that the number of transistors on an integrated circuit doubles approximately every two years.

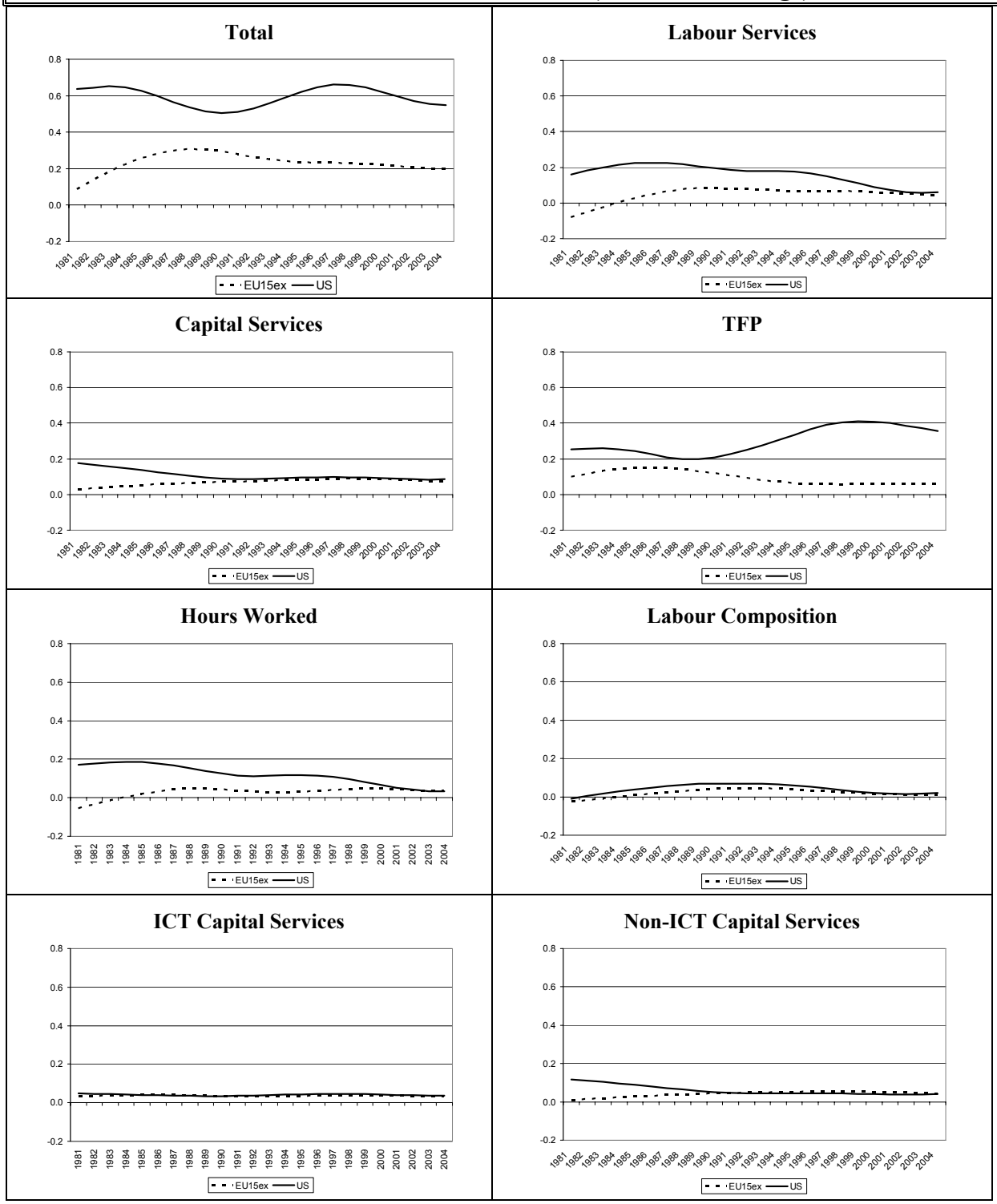

GDP Growth Accounting : EU15ex5 + US
Scope of Analysis
Sectoral
(Manufacturing, private services, rest of economy)
+
Detailed Industry Breakdown
(A31 Level)
5 Key Industries
1. « Other Business Services »
2. Wholesale & Retail Trade
3. Electrical & Optical Equipment
4. Financial Intermediation
5. Network Industries
Growth Accounting Variables
Labour Services
Hours Worked
Composition of Labour Force
Capital Services
ICT
Non-ICT
TFP

Graph 9a : EU + US – Growth Accounting Analysis
Trend Contributions from Labour Services, Capital Services and TFP to the Value Added of "Other Business Services (including Real Estate)" (Annual % Change)



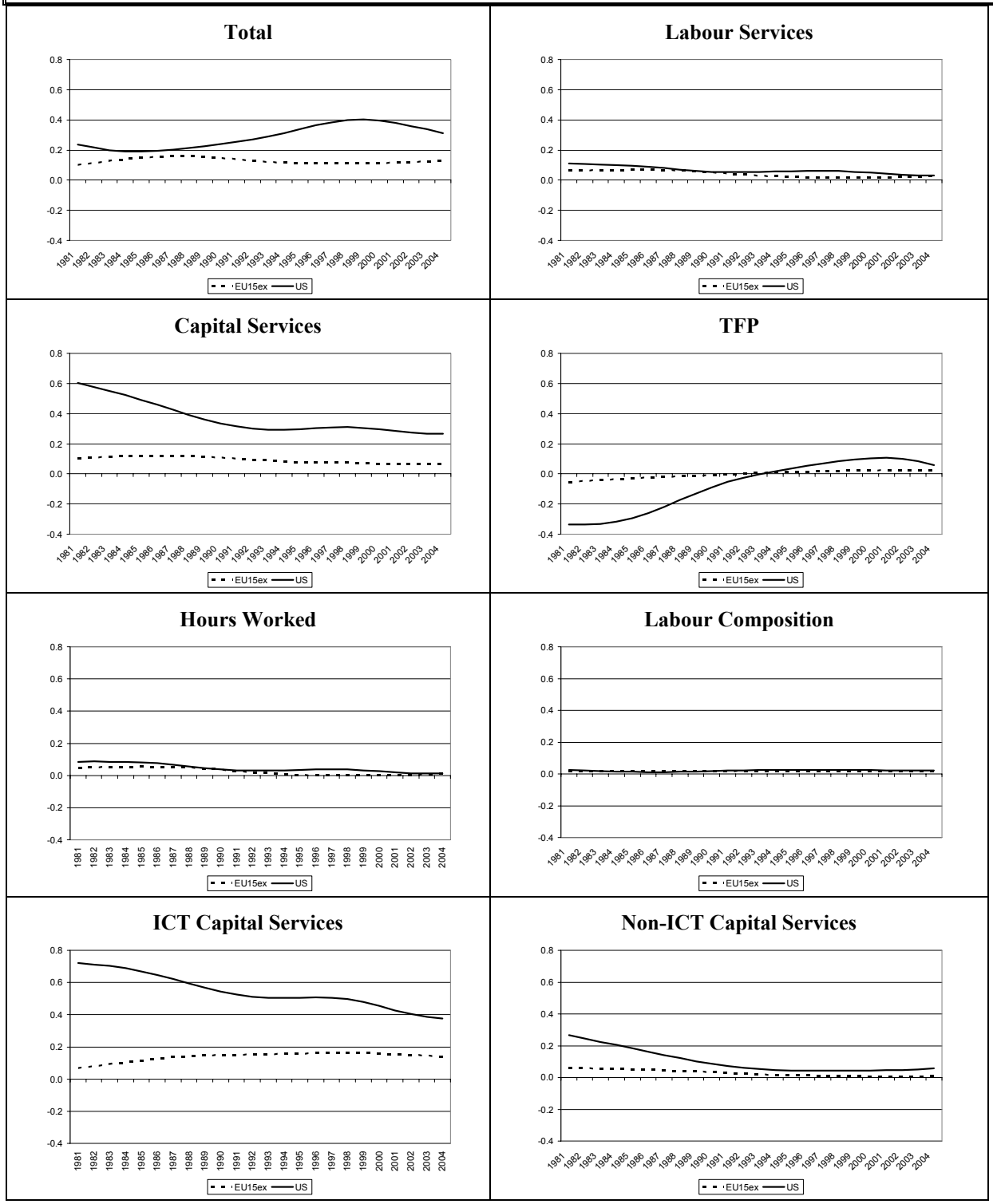
Source: EU KLEMS and own calculations

Graph 9b : EU + US – Growth Accounting Analysis
Trend Contributions from Labour Services, Capital Services and TFP to the Value Added of "Wholesale and Retail Trade"(Annual % Change)



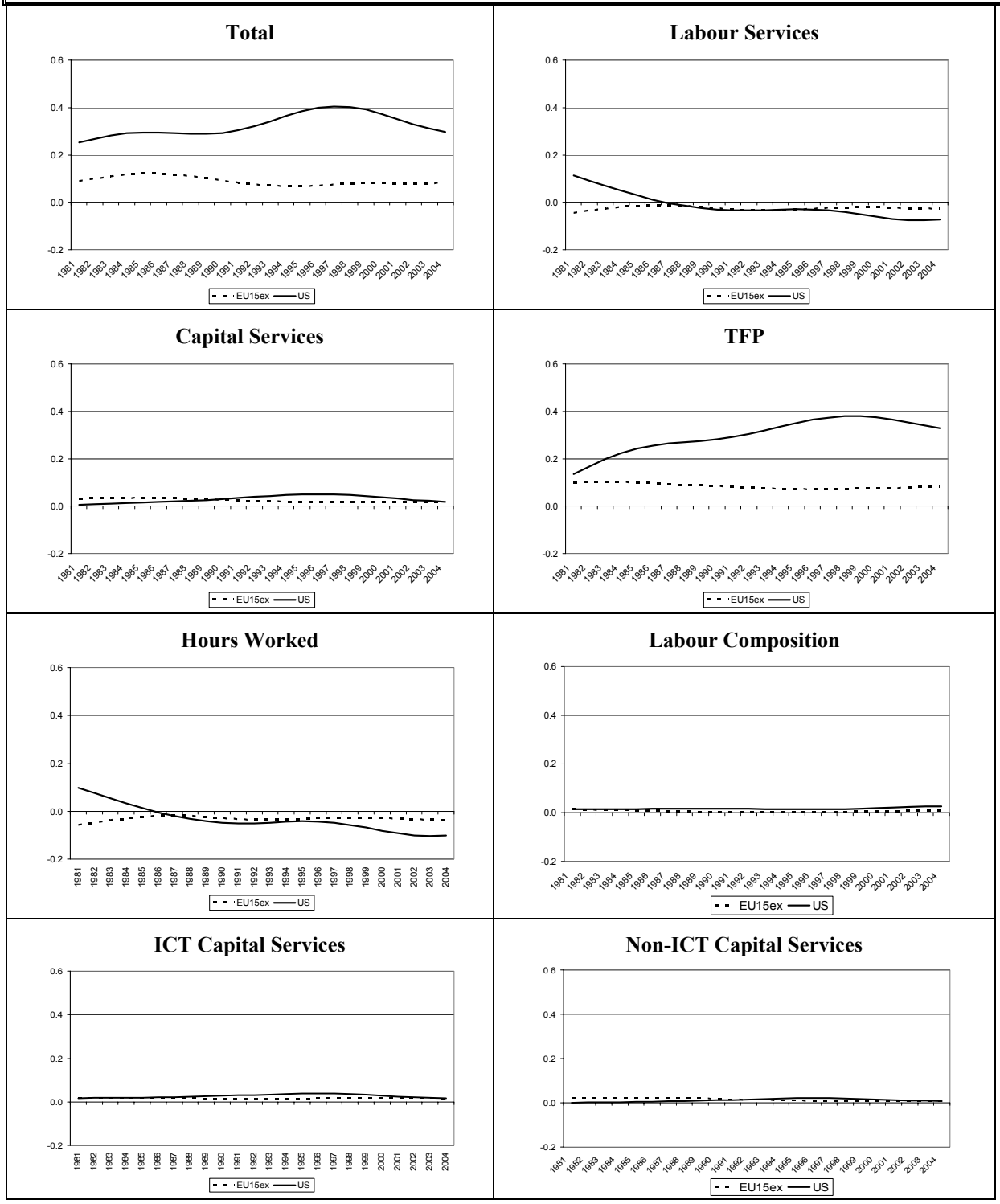
Source: EU KLEMS and own calculations

Graph 9c : EU + US – Growth Accounting Analysis
Trend Contributions from Labour Services, Capital Services and TFP to the Value Added of "Financial Intermediation"(Annual % Change)



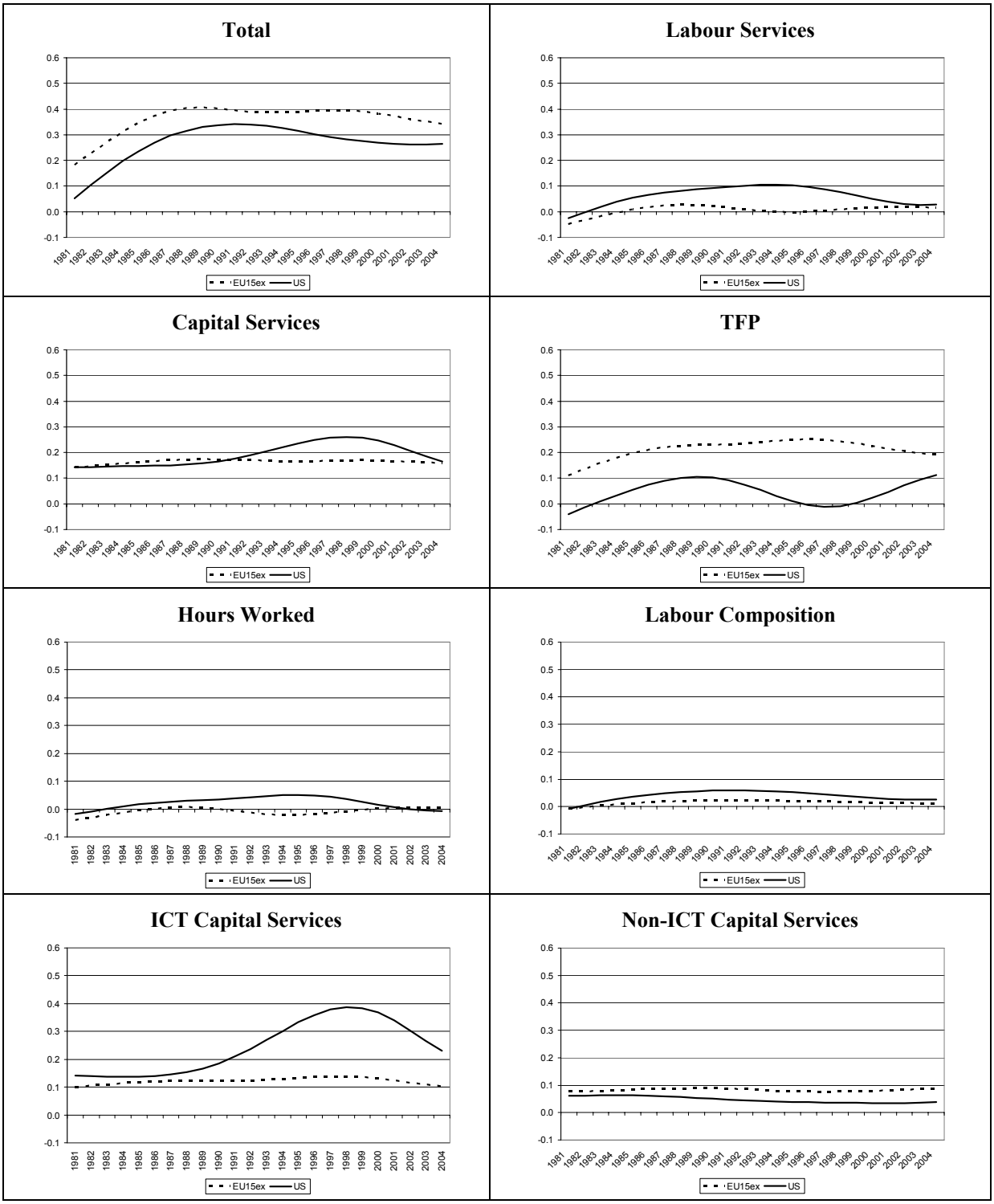
Source: EU KLEMS and own calculations

Graph 9d : EU + US – Growth Accounting Analysis
Trend Contributions from Labour Services, Capital Services and TFP to the Value Added of "Electrical and Optical Equipment" (Annual % Change)



Source: EU KLEMS and own calculations

Graph 9e : EU + US – Growth Accounting Analysis
Trend Contributions from Labour Services, Capital Services and TFP to the Value Added of the "Network Industries" (Annual % Change)



Source: EU KLEMS and own calculations

6 : Summary and Concluding Remarks

The EU is, and wants to remain, an important part of an increasingly integrated world economy. The dramatic intensification of the globalisation process over the last 15-20 years is transforming the economic structures of the developed and developing worlds, with India emerging as a global power in services, China consolidating its position in manufacturing and with the developed world as a whole searching for an appropriate response. The combination of these global trends allied to important domestic EU developments, such as the internal market, single currency and enlargement processes, have the potential to generate the largest structural upheaval in EU economies since the industrial revolution. As in the past, these internal and external processes are being underpinned by both technological change (most notably the ICT revolution) and by a shift in policies in many countries around the world towards a more open, market based, system of economic governance. These policies reflect the realities of a new world order where knowledge creation and absorption and the flexibility of the regulatory and institutional frameworks will increasingly be the key determinants of the economic fortunes of economies.

Within this rapidly evolving economic environment, the EU KLEMS project represents a unique collective effort on behalf of academics, statisticians and policy makers to provide fundamental policy insights into the changes which have occurred at the industry level over recent decades. In this context, the present paper has focussed on two broad objectives, firstly to provide an overview of the contents and policy significance of the EU KLEMS project and secondly, to provide a series of analyses which illustrate the usefulness of the project's datasets and its conceptual framework. Regarding the latter, a clear distinction has been made in the paper between the more "basic" labour productivity analysis which is described in section 3[49] and the more detailed (labour + capital + TFP) growth accounting analysis (restricted to a subset of the countries) which is contained in the subsequent two sections (i.e. 4 to 5). Section 4 provides an introduction to the KLEMS methodology and section 5 illustrates the overall approach by carrying out a GDP growth decomposition[50] for the US and the EU using the detailed capital and labour accounts included in the databank.

In terms of the economic insights provided by the datasets, in addition to confirming the well known trends for GDP, labour input and labour productivity at the total economy level, EU KLEMS provides an extremely rich breakdown of the key drivers of growth at the industry level. At the level of "total industries", the datasets confirm that, despite the strong growth performances of a number of individual EU countries, including the EU's new Member States,

[49] The basic analysis is a "single factor input" productivity approach, where the growth contribution of the factor of production labour is analysed for 25 of the EU's Member States as well as for the US and Japan.

[50] See also annex 5 for a labour productivity growth accounting analysis for the Euro Area and the US. Annex 5 gives a decomposition of labour productivity growth (GDP per hour worked) into the contributions from ICT capital deepening (i.e. ICT capital services per hour worked); non-ICT capital deepening (i.e. non-ICT capital services per hour worked); labour composition (labour services per hour worked) and TFP. The contributions are calculated by multiplying the growth rates of the different factor inputs by their respective shares in value added. In terms of explaining differences in the labour productivity performances of the different countries, the annex shows that the big driver has not been labour market skill levels nor rates of investment (ICT and non ICT investments – especially the former) but differences in the degree of efficiency with which skilled labour and new investments are being deployed within economies. The annex shows that some countries clearly make more productive use of these scarce factors of production than others. For example, it shows that whilst differences in the contribution to labour productivity growth from capital deepening and labour composition effects is not that different between the Euro Area and the US, the contribution of TFP to growth is more than 10 times greater in the US (1.1% points contribution to total hourly labour productivity growth vs. 0.1% points for the Euro Area).

the EU's overall growth performance since the mid-1990's has been relatively disappointing. Whilst many EU countries managed to improve their labour market positions over this period, this unfortunately was accompanied by a relatively aggressive slowdown on the productivity side. According to EU KLEMS, labour productivity per hour growth rates in the "old" EU Member States fell from over 2% over the 1981-1995 period to 1 1/2% for 1996-2000 and then to 1% (2001-2004)[51]. These trends were in marked contrast to those experienced in the US which witnessed a strong acceleration in its productivity performance over the same time periods. The out-performance of the US relative to the EU has been widespread at the sectoral level, with both the manufacturing and private services sectors as a whole both displaying positive gains in favour of the US.

What is particularly worrying about the EU KLEMS based analysis is that the big labour productivity gap between the EU and the US over the period since 1995 has been mainly driven by TFP developments (i.e. the structural component of productivity)[52], although differences in the value added contribution of ICT capital services was a significant additional explanatory factor over the second half of the 1990's. Over the most recent period, 2001-2004, it is clearly TFP which is the key driver. At the level of total industries, the TFP growth rate differential since 2000 is an alarming 1 ¾ percentage points, compared with a gap of only ½ a percentage point over the earlier 1996-2000 period. This message is also corroborated in annex 5 which shows that virtually all of the Euro Area's labour productivity growth over the period 1996-2004 is being driven by human and physical capital investments rather than by efficiency gains in the form of TFP (i.e. the Euro Area is displaying a more extensive pattern of growth compared with the more TFP driven, intensive, growth pattern in the US).

EU KLEMS is also able to show the highly industry specific nature of the TFP differences, with only a small handful of industries explaining the diverging EU-US trends, namely wholesale and retail trade; other business services; electrical and optical equipment (which includes semiconductors, the main ICT-producing industry); and to a lesser extent financial intermediation. On a more positive note, there are a small number of industries where the EU has done better, with the so-called "network" industries doing particularly well.

While it is comforting to note that the industry level GDP, labour input and productivity trends which have emerged from the analysis in the paper are in keeping with the consensus view regarding economy-wide developments for these particular variables, it is still somewhat premature to consider using the datasets for policy analysis purposes. For this to occur, a number of issues need to be addressed, including :

[51] These EU KLEMS trends are in keeping with official "total economy" statistics.

[52] A reduction in TFP growth rates may be pointing to a structural decline in the EU's overall innovation capacity as well as in the efficiency with which capital and labour are employed in its production systems. Many commentators suggest that the problems could reflect an inflexible and outdated EU industrial structure which is excessively concentrated in low to medium technology industries and which has failed to fully exploit the direct and indirect productivity benefits from relatively new, leading edge, technologies such as ICT. Differences in the overall structure of production could reflect failures not only to reallocate resources towards high growth industries but also to achieve "soft" efficiency gains in a range of private market services. These structural challenges ultimately reflect the EU's difficulties in transforming its industrial structure from one based on imitation of US technological advances to one founded on a more innovation-based economic model. Access to high quality industry level statistics is essential in facilitating an examination of the role played by these contributory factors to the EU's recent productivity performance.

- Firstly, and most importantly, the overall quality of the datasets needs to be thoroughly evaluated by the relevant statistical agencies, with this process now in fact already underway[53]. Particular attention needs to be focussed on the basic variables included in the databank (such as the gross output, intermediates, value added, labour input and capital stock series at the industry level) and on the methodologies employed to ensure accurate, cross-country, comparisons of growth rates and levels. In addition, strong consideration should be given to the potential for a deeper integration of certain, economically relevant, labour force attributes such as skill levels (from surveys such as the Labour Force Survey (LFS)) into the national accounts framework.

- Secondly, further analyses are needed to corroborate the trends for those specific industries which have been highlighted in the paper as being important in understanding EU-US productivity trends. This is particularly the case since EU-US productivity differences appear to be heavily concentrated in the market services sector where the conceptual and empirical problems in accurately measuring output and price developments have been well documented[54]. Whilst important, these measurement problems must not however be exaggerated, with annex 2 pointing out that many of the problems reflect a failure to apply "best practice" rather than being linked to insurmountable conceptual issues. In this respect, an assessment needs to be made of whether the NSIs are currently implementing the agreed "best practices" (as laid out in manuals such as Eurostat's 2001 "Handbook on price and volume measures in national accounts") for the measurement of prices and volumes in those specific industries which appear to explain the EU-US productivity gap. The current use of different measurement practices seriously undermines the credibility of international comparisons of productivity trends in these, mainly service sector, industries.

- Thirdly, the database as yet does not include productivity level (labour productivity and TFP) estimates for the respective industries. It is only when these level estimates are released in the coming months that one will be in a position to make a more accurate evaluation of the policy significance of the productivity growth rate analyses included in the present paper. Accurate productivity level estimates are crucial, for example, in assessing whether the higher US productivity growth rates in a range of market services over the period since 1995 simply reflect a US catching-up phenomenon (relative to the higher productivity levels pertaining in these industries in many European countries) or whether they are pointing to issues such as the increasingly important role which "intangibles" (including those linked with organisational and managerial "best practices") may be playing in the technology transfer process in some private service industries.

[53] Eurostat has set up a high level "Task Force of National Accounts Experts on EU KLEMS", with its mandate focussed on agreeing the subset of the analytical module (i.e. variables, time periods, classification systems) that will constitute the statistical module to be maintained and updated by the NSIs and Eurostat. In addition the task force will analyse how the EU KLEMS statistical module could be integrated into the existing EU national accounts system (ESA95). An interim report on the scope and role of the NSIs in ensuring the future sustainability of EU KLEMS will be delivered by January 2008, with a final report and implementation plan by June 2008.

[54] An example of the type of industry level studies which would be helpful in this regard include the 2005 study by M. Timmer and R.Inklaar on "Productivity Differentials in the US and EU Distributive Trade Sector : Statistical Myth or Reality".

- Finally, given that the measurement of TFP growth is surrounded by considerable uncertainty, a normal degree of caution is warranted when interpreting the results obtained from all growth accounting exercises, including EU KLEMS[55]. Due to the well known limitations of growth accounting[56], additional research work is needed to corroborate the results from this approach, especially in considering situations where the growth accounting assumptions may not hold. For example, econometric estimation should be used to complement the growth accounting work by describing the dynamic evolution of variables; by testing different hypotheses; by controlling for extraneous factors; and by helping to indicate causality. This, in fact, is one of the key research areas for the EU KLEMS consortium over the remaining months of the contract.

While the above remarks underline the point that EU KLEMS is still "work in progress", nevertheless it is already clear, on the basis of the March 2007 release of the EU KLEMS datasets, that industry level statistics, allied with an economically intuitive analytical framework, can provide important insights into many growth and productivity related domains. These insights, if acted upon by policy makers, could have a direct bearing on medium to long run GDP per capita trends in the EU. Thanks to the work of the EU KLEMS consortium, EU and national policy makers are already more informed regarding the global and EU-specific phenomena which are at present radically reshaping our economic environment and which will undoubtedly continue to do so over the coming years and decades.

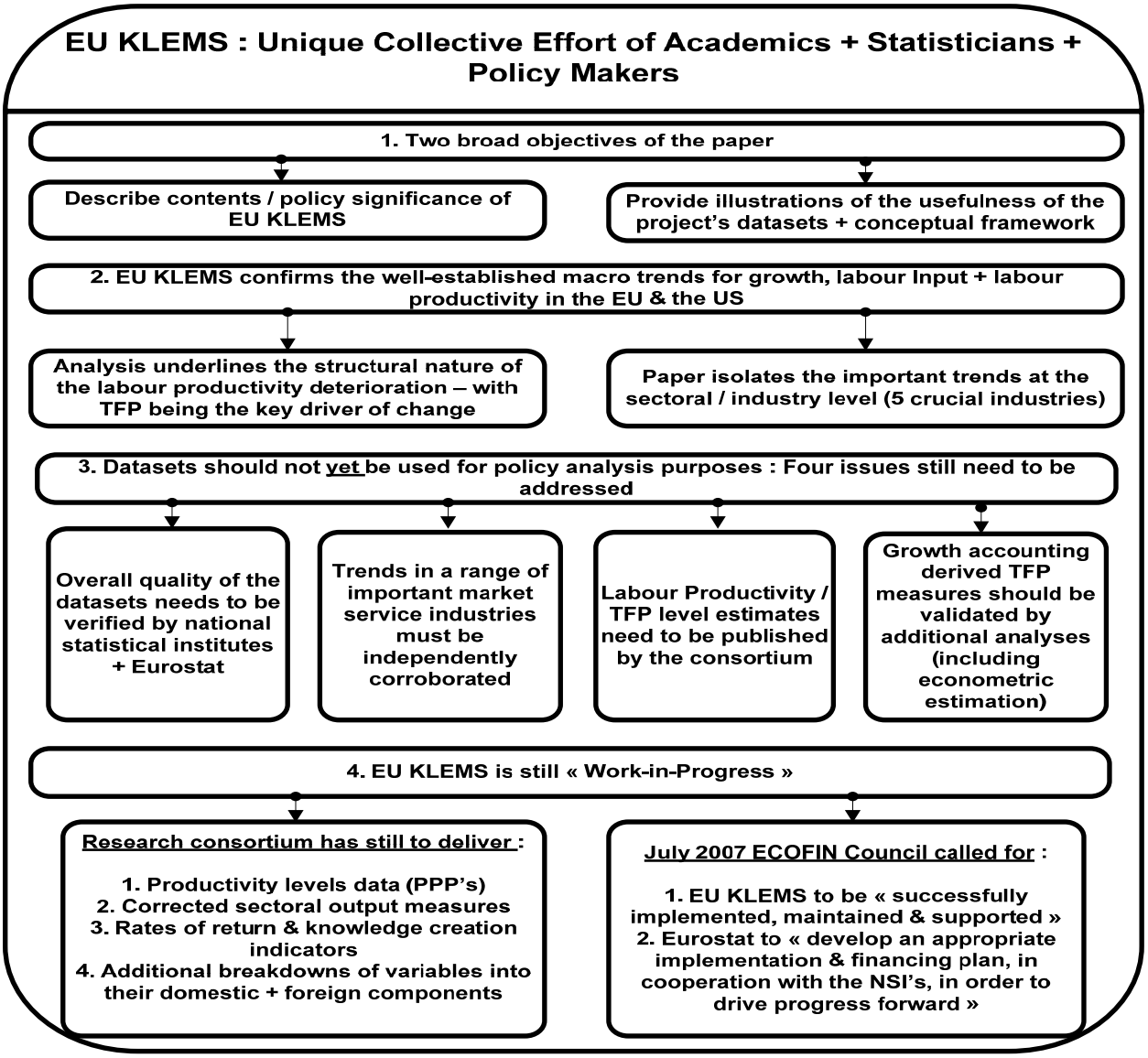
In addition, the consortium is committed to building on the progress already made. For the next update of the EU KLEMS databank (in addition to revisions to the March 2007 datasets and the inclusion of data for the year 2005) labour productivity and TFP levels data will be provided (including the underlying purchasing power parities - PPP's - by industry); as well as sectoral output measures net of intra-industry deliveries of intermediate inputs; rates of return and knowledge creation indicators; and additional breakdowns for the capital stock and intermediate input variables into their domestic and foreign components.

To conclude, the ultimate objective of the EU KLEMS project is to provide EU and national policy makers with datasets and an analytical framework for structural policy analysis which is equivalent in scope and quality to that presently available to US policy makers. The importance of this work has long been recognised and supported by the EU's Economic Policy Committee (EPC), with the EPC's support leading to the project being endorsed by the ECOFIN Council in July 2007. As stressed by ECOFIN ministers at their July meeting, EU KLEMS is directly relevant in "ensuring a sustainable path of productivity growth in Europe, in facilitating the evaluation of policies, the definition of best practices and the measurement of the impact of

[55] Even for the EU KLEMS methodology itself, there is ongoing discussions regarding the merits of the ex post versus the ex ante capital services approaches which need to be resolved. In addition, the consortium recognises that future refinements of the EU KLEMS TFP measure are possible, including adjustments to allow for both changes in rates of capacity utilisation (to remove any cyclical components) and for the effects of intangible forms of capital such as R&D and organisational capital. Consequently, while EU KLEMS does represent a breakthrough in that shifts in the quality of factor inputs are stripped out of the "cruder" TFP measures, one must remain conscious of the fact that the methodologies / statistical sources (e.g. Labour Force Survey - LFS) must be properly stress tested before one can be comfortable in using the more "sophisticated" TFP measures which have been produced. In addition, one must accept that TFP is still a residual measure which includes all of the remaining measurement errors with respect to the contributions from the various factors of production.

[56] Growth accounting limitations include its sensitivity to underlying assumptions (i.e. constant returns to scale and perfect competition in product and factor markets); the size of the residual which is left to be explained; and its inability to distinguish between the different sources of TFP growth.

structural reforms that have been implemented in the spirit of the Lisbon agenda". Ministers also recognised the fact that although the project has the capacity to become an important analytical component of the Lisbon Strategy, with significant policy implications, that the overall project still represents "work-in-progress". They have consequently asked that all the necessary efforts be made to ensure that EU KLEMS is now "successfully implemented, maintained and supported". As a first step, Eurostat has been requested to "develop an appropriate implementation and financing plan in cooperation with the National Statistical Institutes, in order to drive progress forward … with the plan then being presented to the ECOFIN Council for further endorsement". On the assumption that this momentum behind the project is maintained over the coming months, it is not unrealistic to predict that EU KLEMS can quickly form the basis of a common EU methodology for evaluating progress with, and for assessing the effects of, Lisbon-related structural policies to promote growth and competitiveness in the enlarged European Union.



Annexes

Annex 1 : Variable, Industry and Country Coverage of EU KLEMS Databank

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Annex 1 : Variable, Industry and Country Coverage of EU KLEMS Databank

1.1 Variable Coverage

1. Basic Variables

Values

GO	Gross output at current basic prices (in millions of local currency)
II	Intermediate inputs at current purchasers' prices (in millions of local currency)
IIE	Intermediate energy inputs at current purchasers' prices (in millions of local currency)
IIM	Intermediate material inputs at current purchasers' prices (in millions of local currency)
IIS	Intermediate service inputs at current purchasers' prices (in millions of local currency)
VA	Gross value added at current basic prices (in millions of local currency)
COMP	Compensation of employees (in millions of local currency)
GOS	Gross operating surplus (in millions of local currency)
TXSP	Taxes minus subsidies on production (in millions of local currency)
EMP	Number of persons engaged (thousands)
EMPE	Number of employees (thousands)
H_EMP	Total hours worked by persons engaged (millions)
H_EMPE	Total hours worked by employees (millions)

Prices

GO_P	Gross output, price indices, 1995 = 100
II_P	Intermediate inputs, price indices, 1995 = 100
VA_P	Gross value added, price indices, 1995 = 100

Volumes

GO_QI	Gross output, volume indices, 1995 = 100
II_QI	Intermediate inputs, volume indices, 1995 = 100
IIE_QI	Intermediate energy inputs, volume indices, 1995 = 100
IIM_QI	Intermediate material inputs, volume indices, 1995 = 100
IIS_QI	Intermediate service inputs, volume indices, 1995 = 100
VA_QI	Gross value added, volume indices, 1995 = 100
LP_I	Gross value added per hour worked, volume indices, 1995=100

2. Growth accounting Variables

LAB	Labour compensation (in millions of local currency)
CAP	Capital compensation (in millions of local currency)
LAB_QI	Labour services, volume indices, 1995 = 100
CAP_QI	Capital services, volume indices, 1995 = 100
VA_Q	Growth rate of value added volume (% per year)
VAConL	Contribution of labour services to value added growth (percentage points)
VAConH	Contribution of hours worked to value added growth (percentage points)
VAConLC	Contribution of labour composition change to value added growth (percentage points)

VAConKIT	Contribution of ICT capital services to output growth (percentage points)
VAConKNIT	Contribution of non-ICT capital services to output growth (percentage points)
VAConTFP	Contribution of TFP to value added growth (percentage points)
TFPva_I	TFP (value added based) growth, 1995=100
GO_Q	Growth rate of gross output volume (% per year)
GOConII	Contribution of intermediate inputs to output growth (percentage points)
GOConIIM	Contribution of intermediate material inputs to output growth (percentage points)
GOConIIE	Contribution of intermediate energy inputs to output growth (percentage points)
GOConIIS	Contribution of intermediate services inputs to output growth (percentage points)
GOConL	Contribution of labour services to output growth (percentage points)
GOConK	Contribution of capital services to output growth (percentage points)
GOConTFP	Contribution of TFP to output growth (percentage points)
TFPgo_I	TFP (gross output based) growth, 1995=100

3. Additional variables

CAPIT_ICT	ICT Capital compensation (share in total capital compensation)
CAPNIT	Non-ICT capital compensation (share in total capital compensation)
CAPIT_QI	ICT capital services, volume indices, 1995 = 100
CAPNIT_QI	Non-ICT capital services, volume indices, 1995 = 100
CAPIT_QPH	ICT capital services per hour worked, 1995 reference
CAPNIT_QPH	Non-ICT capital services per hour worked, 1995 reference
LABHS	High-skilled labour compensation (share in total labour compensation)
LABMS	Medium-skilled labour compensation (share in total labour compensation)
LABLS	Low-skilled labour compensation (share in total labour compensation)
LAB_QPH	Labour services per hour worked, 1995 reference
H_HS	Hours worked by high-skilled persons engaged (share in total hours)
H_MS	Hours worked by medium-skilled persons engaged (share in total hours)
H_LS	Hours worked by low-skilled persons engaged (share in total hours)
H_M	Hours worked by male persons engaged (share in total hours)
H_F	Hours worked by female persons engaged (share in total hours)
H_29	Hours worked by persons engaged aged 15-29 (share in total hours)
H_49	Hours worked by persons engaged aged 30-49 (share in total hours)
H_50+	Hours worked by persons engaged aged 50 and over (share in total hours)

Source : EU KLEMS

1.2 Industry Coverage
(International Standard Industrial Classification – ISIC)

TOT TOTAL ECONOMY

AtB AGRICULTURE, HUNTING, FORESTRY AND FISHING

A …AGRICULTURE, HUNTING AND FORESTRY

1 ……Agriculture
2 ……Forestry

B …FISHING

C MINING AND QUARRYING

10t12 …MINING AND QUARRYING OF ENERGY PRODUCING MATERIALS
10 ……Mining of coal and lignite; extraction of peat
11 ……Extraction of crude petroleum and natural gas and services
12 ……Mining of uranium and thorium ores

13t14 …MINING AND QUARRYING EXCEPT ENERGY PRODUCING MATERIALS
13 ……Mining of metal ores
14 ……Other mining and quarrying

D TOTAL MANUFACTURING

15t16 …FOOD PRODUCTS, BEVERAGES AND TOBACCO
15 ……Food products and beverages
16 ……Tobacco products

17t19 …TEXTILES, TEXTILE PRODUCTS, LEATHER AND FOOTWEAR
17t18 Textiles and textile products
17 ……Textiles
18 ……Wearing Apparel, Dressing and Dying Of Fur
19 ……Leather, leather products and footwear

20 …WOOD AND PRODUCTS OF WOOD AND CORK

21t22 …PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING
21 ……Pulp, paper and paper products
22 ……Printing, publishing and reproduction
221 … Publishing
22x … Printing and reproduction

23t25 …CHEMICAL, RUBBER, PLASTICS AND FUEL PRODUCTS

23 ……Coke, refined petroleum products and nuclear fuel
24 ……Chemicals and chemical products
244 … Pharmaceuticals
24x … Chemicals excluding pharmaceuticals
25 ……Rubber and plastics products

26 …OTHER NON-METALLIC MINERAL PRODUCTS

27t28 …BASIC METALS AND FABRICATED METAL PRODUCTS

27 ……Basic metals
28 ……Fabricated metal products

29 …MACHINERY, NEC

30t33 …ELECTRICAL AND OPTICAL EQUIPMENT

30 ……Office, accounting and computing machinery
31t32 Electrical engineering
31 ……Electrical machinery and apparatus, nec
313 … Insulated wire
31x … Other electrical machinery and apparatus nec
32 ……Radio, television and communication equipment
321 … Electronic valves and tubes
322 … Telecommunication equipment
323 … Radio and television receivers
33 ……Medical, precision and optical instruments
331t3 Scientific instruments
334t5 Other instruments

34t35 …TRANSPORT EQUIPMENT

34 ……Motor vehicles, trailers and semi-trailers
35 ……Other transport equipment
351 … Building and repairing of ships and boats
353 … Aircraft and spacecraft
35x … Railroad equipment and transport equipment nec

36t37 …MANUFACTURING NEC; RECYCLING

36 ……Manufacturing nec
37 ……Recycling

E ELECTRICITY, GAS AND WATER SUPPLY

40 …ELECTRICITY AND GAS

40x ……Electricity supply
402 ……Gas supply

41 …WATER SUPPLY

F CONSTRUCTION

G WHOLESALE AND RETAIL TRADE

50 ……Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of
51 ……Wholesale trade and commission trade, except of motor vehicles and motorcycles
52 ……Retail trade, except of motor vehicles and motorcycles; repair of household goods

H HOTELS AND RESTAURANTS

I TRANSPORT AND STORAGE AND COMMUNICATION

60t63 …TRANSPORT AND STORAGE

60 ……Inland transport
61 ……Water transport
62 ……Air transport
63 ……Supporting and auxiliary transport activities; activities of travel agencies

64 …POST AND TELECOMMUNICATIONS

JtK FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES

J …FINANCIAL INTERMEDIATION

65 ……Financial intermediation, except insurance and pension funding
66 ……Insurance and pension funding, except compulsory social security
67 ……Activities related to financial intermediation

K …REAL ESTATE, RENTING AND BUSINESS ACTIVITIES

70 …… Real estate activities
71t74 … Renting of machinery and equipment and other business activities
71 ……Renting of machinery and equipment
72 ……Computer and related activities
73 ……Research and development
74 ……Other business activities
741t4 … Legal, technical and advertising
745t8 … Other business activities, nec

LtQ COMMUNITY SOCIAL AND PERSONAL SERVICES

L …PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY

M …EDUCATION

N …HEALTH AND SOCIAL WORK

O …OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES

90 ……Sewage and refuse disposal, sanitation and similar activities
91 ……Activities of membership organizations nec
92 ……Recreational, cultural and sporting activities
921t2 Media activities
923t7 Other recreational activities
93 ……Other service activities

P …PRIVATE HOUSEHOLDS WITH EMPLOYED PERSONS

Q …EXTRA-TERRITORIAL ORGANIZATIONS AND BODIES

Source : EU KLEMS

1.3 Country Coverage		
Country Code	**Country**	**Period Covered**
EU Member States		
AT	**Austria**	**1970- 2004**
BE	**Belgium**	**1970- 2004**
CY	**Cyprus**	**1995-2004**
CZ	**Czech Republic**	**1995-2004**
DE	**Germany**	**1970-2004**
DK	**Denmark**	**1970-2004**
EE	**Estonia**	**1995-2004**
ES	**Spain**	**1970-2004**
FI	**Finland**	**1970-2004**
FR	**France**	**1970-2004**
GR	**Greece**	**1970-2004**
HU	**Hungary**	**1995-2004**
IE	**Ireland**	**1970-2004**
IT	**Italy**	**1970-2004**
LT	**Lithuania**	**1995-2004**
LV	**Latvia**	**1995-2004**
LU	**Luxembourg**	**1970-2004**
MT	**Malta**	**1995-2004**
NL	**Netherlands**	**1970-2004**
PL	**Poland**	**1995-2004**
PT	**Portugal**	**1970-2004**
SE	**Sweden**	**1970-2004**
SI	**Slovenia**	**1995-2004**
SK	**Slovakia**	**1995-2004**
UK	**United Kingdom**	**1970-2004**
Non-EU Countries		
JP	**Japan**	**1970-2004**
US1	**United States (NAICS) ***	**1977-2004**
US2	**United States (SIC)****	**1970-2004**

Source : EU KLEMS

* NAICS – North American Industry Classification System - industry accounts from the Bureau of Economic Analysis – BEA

** SIC (Standard Industrial Classification) industry accounts from the Bureau of Labour Statistics - BLS

1.4 : Data Availability per Country

Country	Labour Productivity (Number of Industries)		Growth Accounting	Intermediate Inputs (Energy, Materials and Services Inputs)	Labour Composition (Breakdown by age, gender and skills)
	1970-1995	1995-2004	Period Covered	Period Covered	Period Covered
EU Member States					
Austria	56	63	1980- 2004	1988- 2004	1980- 2003
Belgium	64	72	1986- 2004	1995- 2002	1986- 2004
Cyprus	n.a.	59	n.a.	n.a.	n.a.
Czech Republic	n.a.	63	1995-2004	1995-2004	1995-2004
Germany	52	66	1970-2004	1978-2004	1970-2004
Denmark	60	64	1980-2004	1970-2005	1980-2003
Estonia	n.a.	61	n.a.	2000-2002	n.a.
Spain	71	71	1980-2004	1980-2004	1980-2004
Finland	60	67	1970-2004	1970-2004	1970-2003
France	65	67	1982-2004	1978-2004	1982-2004
Greece	48	67	n.a.	1995-1999	n.a.
Hungary	n.a.	64	1995-2004	1995-2004	1995-2005
Ireland	59	62	n.a.	n.a.	n.a.
Italy	48	62	1970-2004	1970-2004	1970-2004
Lithuania	n.a.	60	n.a.	n.a.	n.a.
Latvia	n.a.	60	n.a.	n.a.	n.a.
Luxembourg	40	63	1970-2004	1995-2004	n.a.
Malta	n.a.	57	n.a.	2000-2001	n.a.
Netherlands	48	63	1979-2004	1981-2004	1979-2003
Poland*	n.a.	62	1995-2004	1995-2004	1995-2004
Portugal	48	65	n.a.	n.a.	n.a.
Sweden	48	62	1993-2004	1993-2003	1993-2004
Slovenia	n.a.	63	1995-2004	1995-2004	1995-2004
Slovakia	n.a.	64	n.a.	1995-2005	1995-2005
United Kingdom	69	69	1970-2004	1970-2004	1970-2004
Non-EU Countries					
Japan	55	61	1973-2004	1973-2004	1970-2004
United States (NAICS)	71	71	1977-2004	n.a.	n.a.
United States (SIC)	65	65	1970-2004	1970-2004	1970-2004

Source : EU KLEMS

* The growth accounting breakdown for Poland excludes the ICT / non-ICT split for capital services since the national statistical office does not collect the necessary capital stock datasets for these groupings of assets.

Annex 2 : Data Quality Concerns : Comparison of EU KLEMS datasets with official statistics (AMECO) + More fundamental measurement issues

Data quality concerns essentially come in two forms :

- Firstly, how do the EU KLEMS datasets compare with officially validated statistics (section 1 below); and

- Secondly, the more serious issue of conceptual and empirical difficulties in measuring price and volume changes in a range of service industries (section 2 below).

1. Comparison of EU KLEMS Datasets with Official Statistics (Ameco) : The comparison of EU KLEMS with official statistics only refers to the basic series - value added and labour input (employment and hours worked) - since most of these series are found in the national accounts of the individual countries. Since this is not the case with the growth accounting results, it is not possible to carry out an equivalent comparative exercise for the growth accounting part of the databank. This section looks firstly at the "old" EU15 Member States and the US and then looks at the "new" EU10 Member States.

EU15 and US : Graphs 1 and 2, for the EU15 aggregate and the US, cover the period 1981-2004. The graphs compare the growth rates for the value added and labour input (i.e. employment and hours worked) series taken from EU KLEMS ("total industries") with the equivalent official series as contained in DG ECFIN's Ameco database. The graphs show clearly that the trends from both datasets are broadly comparable, with only minor deviations evident for the series chosen.

A more extensive comparison of the EU KLEMS and Ameco databases was carried out for an evaluation report on EU KLEMS. For this report, comparisons were made for 29 countries, 6 industries and 9 variables[57]. In general, the two sets of series compared well with 87% of the approximately 1100 checks which were made appearing to match very closely. Some countries had a much higher number of mismatches than others, with for example one third of the series for Portugal and Greece emerging as concerns. Amongst industries, "Agriculture and Fishing" stood out as being particularly problematic, with 32% of series deemed mismatches. In terms of the problematic variables, "TFP (value added based) growth", showed an above average proportion of mismatches but this is undoubtedly linked to the specific growth accounting methodology used for the EU KLEMS calculations[58]. In fact, it is highly likely that a lot of the concerns raised by different commentators over recent months regarding the overall quality of the EU KLEMS datasets have more to do with inappropriate comparisons of the EU KLEMS growth accounting results with other sources, than with the basic national accounts sourced variables in the databank such as value added and employment. Whilst it is accepted that there are undoubtedly problems for specific countries,

[57] The **industries** were 1.Agriculture, forestry and fishing; 2.Manufacturing; 3.Construction; 4.Mining; electricity, gas and water supply; 5.Wholesale and retail trade, hotels and restaurants; transport; financial intermediation; and public services; 6. Total of all industries.

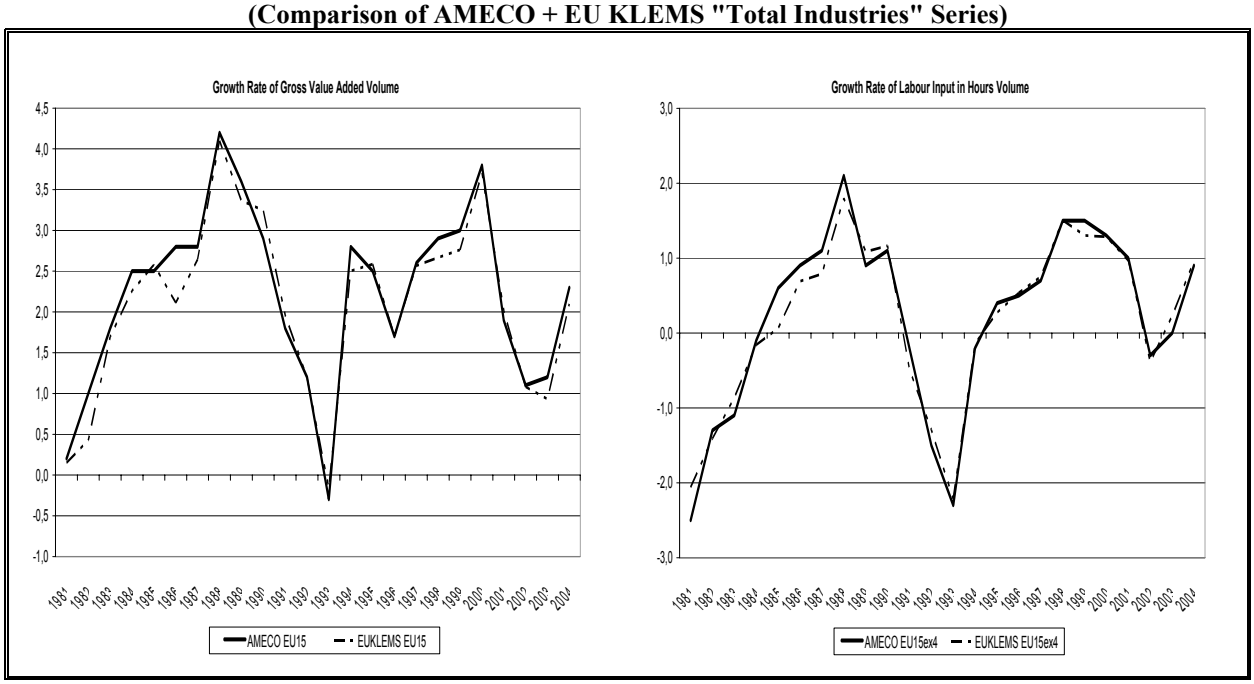
The **variables** were 1. Labour compensation; 2. Number of employees; 3. Gross value added (current prices); 4. Gross value added (1995=100); 5. Compensation of employees; 6. Number of persons engaged; 7. Total hours worked by persons engaged; 8. Total factor productivity; 9. Gross value added per hour worked.

[58] For example, one key driver of the differences in TFP is the choice of estimation method made by the consortium in terms of the measurement of capital services by industry i.e. the ex post approach.

industries and variables, there is little evidence to suggest widespread quality concerns with the EU KLEMS datasets for the EU15 Member States and the US.

<u>EU10 Grouping</u> : **Graph 3 provides a similar comparison for the new Member States. Whilst the Ameco and EU KLEMS labour input series appear highly consistent, this is not the case with GDP where there still appears to be some issues which need to be resolved.**

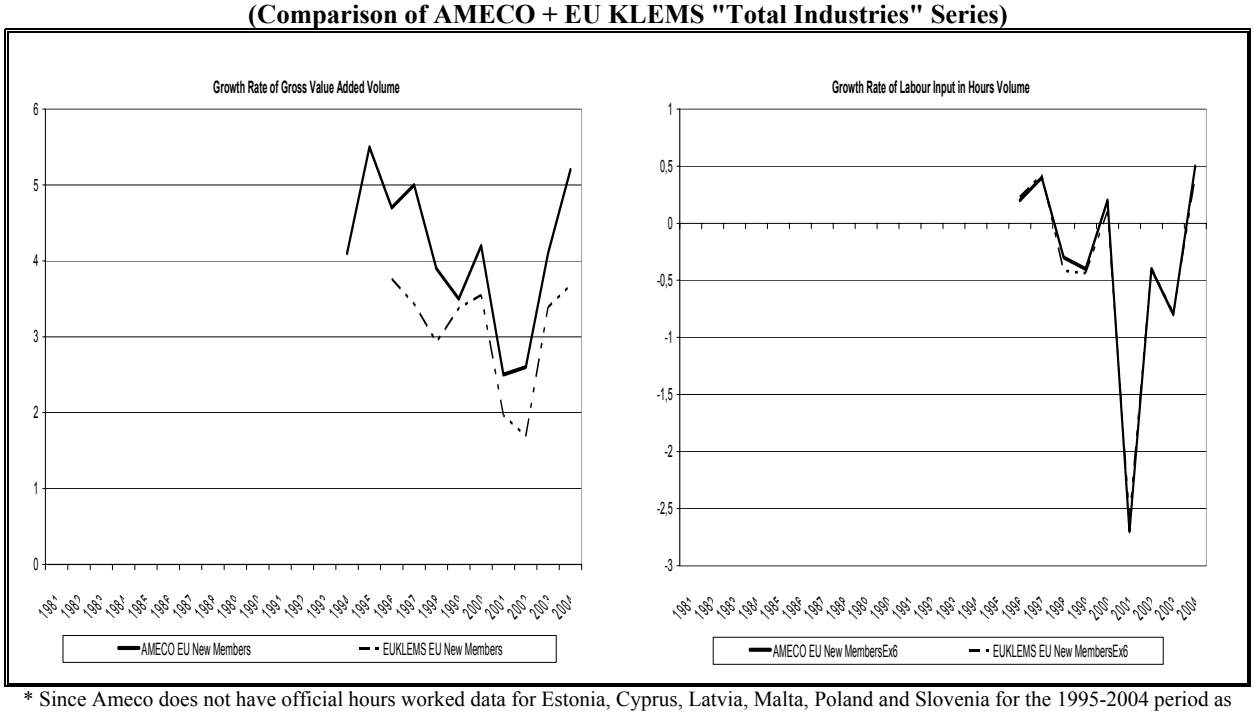
Graph 1 : EU15 GDP (Value Added) and Labour Input*
(Comparison of AMECO + EU KLEMS "Total Industries" Series)



* Since Ameco does not have official hours worked data for Greece, Luxembourg, Austria and Portugal for the 1981-2004 period as a whole, the labour input comparison is for an EU11 aggregate (with its equivalent in EU KLEMS)

Graph 2 : US GDP (Value Added) and Labour Input
(Comparison of AMECO + EU KLEMS "Total Industries" Series)

Graph 3 : EU10 GDP (Value Added) and Labour Input*
(Comparison of AMECO + EU KLEMS "Total Industries" Series)



* Since Ameco does not have official hours worked data for Estonia, Cyprus, Latvia, Malta, Poland and Slovenia for the 1995-2004 period as a whole, the labour input comparison is for an EU4 aggregate (with its equivalent in EU KLEMS)

2. Measurement of price and volume trends in service industries : Whilst the datasets appear reasonable in comparison with the existing official statistics, at least for the EU15 countries and the US, one must nevertheless remain conscious that official, industry level, statistics are still plagued by many measurement issues of a fundamental nature. These measurement issues make it extremely difficult to settle important empirical questions from the dataset, as it presently stands.

These measurement problems are mainly associated with a range of private service industries, with these problems linked to the intangible nature of the activities to be quantified. Whilst the empirical problems in accurately measuring nominal output in these private service industries can be overcome (with, for example, revenue data often being used), the real problem is getting accurate, quality adjusted, indicators of price developments in these industries, in order to produce credible output volumes.

While it is accepted that these conceptual / empirical problems may be difficult to resolve in the near future, what can be achieved is a high degree of methodological convergence regarding the "best practice" methods which should be adopted.

At the moment the international comparability of service sector productivity trends is hampered by the fact that different statistical agencies apply different methods. This is a problem in both the US and in the EU :

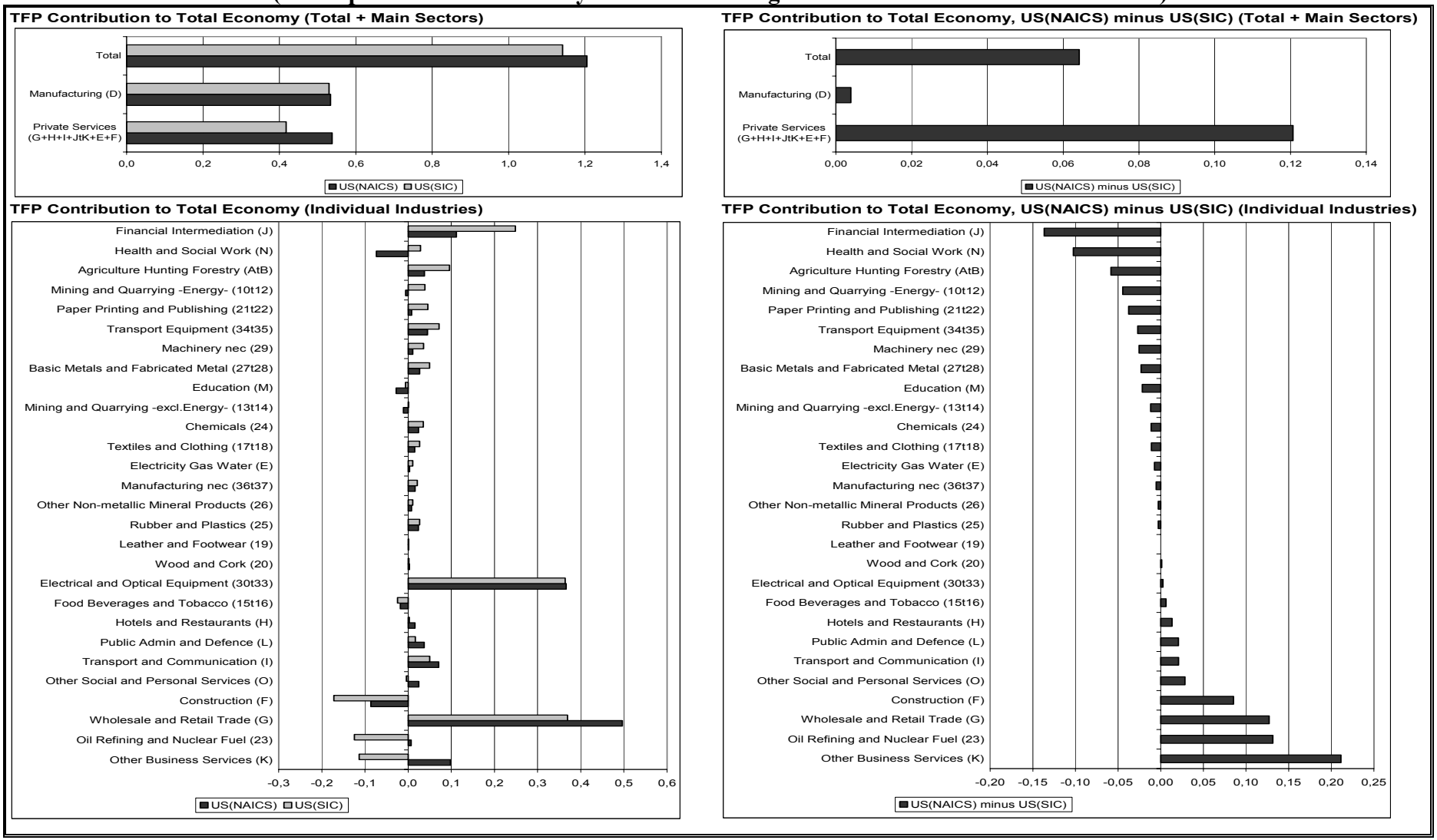
- As graph 4 shows, this is manifestly an issue within the US statistical system where the BEA (Bureau of Economic Analysis) and BLS (Bureau of Labor Statistics) take different views regarding how best to measure the real output of many industries. The graph shows the strongly divergent picture emerging for different industries (in terms of the TFP contribution to total economy GDP growth) depending on whether one

uses the BEA-NAICS or the BLS-SIC data series. This problem is often underestimated since the positive and negative differences between both datasets tend to cancel each other out, with the result that there is not much difference in terms of the NAICS and SIC estimates for "total economy" TFP (nor indeed for the TFP of relatively well measured sectors such as manufacturing). Unfortunately, this is not the case for individual industries such as, for example, financial intermediation where its contribution to total economy TFP differs greatly depending on which US data source one uses. Analysts need to be aware of these differences, especially when making EU-US comparisons.

- This is also a big issue in the EU where despite the existence of Eurostat's 2001 "Handbook on price and volume measures in national accounts"[59], there is still a large divergence in the approaches adopted by the EU's national statistical offices with regard to different industries. As made clear in the footnote below, the Eurostat "Handbook" lays out for each industry the most appropriate methods to be used for generating acceptable volume measures. Unfortunately, for specific important industries such as wholesale and retail trade and financial intermediation, the current measurement practices of many NSIs are still some distance away from what the manual would deem to be "acceptable best practice". The use of different price and volume measurement practices for these crucial service industries undermines the credibility of international comparisons of productivity trends and is an issue which must be addressed as a matter of urgency if real progress is to be made on the comparability question.

[59] The following quotation from the Eurostat manual tries to underline the point that often the problem is a failure to apply "best practice", as laid down in the manual, rather than the conceptual issues being insurmountable: "This handbook describes possible methods that can be used for the estimation of prices and volumes (for all activities including for a wide range of service sector industries)…..the methods are divided into three groups : A methods (most appropriate methods); B methods (those methods which can be used in case an A method cannot be applied) and C methods (those methods which shall not be used). The A methods are the methods that approximate the ideal as closely as possible. B methods are acceptable alternatives : they are further away from the ideal but still provide an acceptable approximation. C methods are too far away from the ideal to be acceptable. The A/B/C classification is aimed at improvement of current practice. It sets out in what direction improvements can be made. "

Graph 4 : TFP contribution of a wide range of industries to Total Economy GDP Growth in the US
(A comparison of the industry level results using BEA-NAICS and BLS-SIC datasets)



Source : EU KLEMS and own calculations

Annex 3 : EU Member States : "Basic" + Growth Accounting Analyses

Table 1a: EU15 Member States
GDP, Labour Input in Hours and Labour Productivity per Hour
(Annual Average Volume Growth Rates in %)

	GDP			Labour input in hours			Labour productivity per Hour		
	1981 - 1995	1996 - 2000	2001 - 2004	1981 - 1995	1996 - 2000	2001 - 2004	1981 - 1995	1996 - 2000	2001 - 2004
					Total Industries				
Austria	2,2	2,9	1,2	-0,2	0,8	0,2	2,4	2,0	1,0
Belgium	1,7	2,5	1,5	-0,3	1,3	0,1	2,1	1,2	1,4
Denmark	2,2	2,8	0,7	-0,4	1,7	-0,3	2,6	1,1	1,0
Finland	1,8	4,7	2,1	-1,2	1,9	0,4	3,0	2,8	1,7
France	2,0	2,6	1,5	-0,7	0,7	0,1	2,6	2,0	1,4
Germany	2,2	2,0	0,7	-0,2	0,0	-0,7	2,4	2,0	1,4
Greece	1,2	3,1	3,8	0,7	0,6	0,5	0,4	2,5	3,3
Ireland	4,0	9,2	5,3	0,5	4,0	1,9	3,5	5,2	3,4
Italy	2,0	1,8	0,8	-0,1	0,8	0,8	2,1	1,0	0,0
Luxembourg	6,1	5,4	3,0	1,9	4,3	3,0	4,2	1,1	0,0
Netherlands	2,1	3,8	0,9	0,9	2,2	-0,3	1,3	1,6	1,2
Portugal	2,6	3,6	0,8	-1,4	1,1	0,4	4,0	2,5	0,5
Spain	2,5	3,9	2,9	0,0	3,8	2,5	2,5	0,1	0,4
Sweden	1,7	3,2	1,5	0,1	0,8	-0,6	1,7	2,5	2,1
United Kingdom	2,2	3,2	2,4	-0,2	1,0	0,8	2,4	2,2	1,6
					Manufacturing				
Austria	2,0	4,3	1,3	-1,9	-1,8	-1,4	4,0	6,1	2,7
Belgium	2,2	3,0	0,4	-2,3	-0,5	-2,3	4,5	3,5	2,7
Denmark	1,6	1,8	-0,5	-0,8	-0,1	-2,8	2,4	1,9	2,3
Finland	2,7	8,0	3,8	-2,7	2,1	-1,7	5,4	6,0	5,5
France	1,4	3,6	0,9	-2,4	-1,0	-2,2	3,8	4,6	3,1
Germany	0,7	1,5	0,6	-2,0	-1,4	-1,7	2,8	2,9	2,3
Greece	-1,0	2,3	-0,6	-1,1	-0,8	-1,6	0,1	3,1	1,0
Ireland	7,6	13,0	3,7	-0,4	1,7	-1,9	8,0	11,3	5,6
Italy	1,9	0,7	-1,0	-1,4	0,2	-0,2	3,4	0,5	-0,8
Luxembourg	3,9	4,4	0,6	-0,6	-0,2	-0,6	4,5	4,6	1,2
Netherlands	2,3	3,2	-0,2	-0,9	0,0	-2,5	3,2	3,2	2,3
Portugal	0,9	3,6	0,1	-1,8	-0,6	-1,9	2,8	4,2	1,9
Spain	2,1	3,4	1,0	-1,5	3,8	-0,6	3,5	-0,4	1,6
Sweden	2,4	6,6	2,2	-1,1	0,3	-1,8	3,4	6,3	4,0
United Kingdom	1,4	0,9	-0,4	-2,9	-0,8	-4,7	4,4	1,7	4,3
					Private Services				
Austria	2,8	3,1	1,5	0,6	1,8	0,7	2,2	1,3	0,8
Belgium	1,8	2,9	2,0	0,3	2,2	0,4	1,5	0,6	1,7
Denmark	2,3	3,7	1,0	-0,3	3,4	0,1	2,6	0,3	0,9
Finland	2,0	4,6	2,2	-0,9	3,3	0,9	2,9	1,3	1,3
France	2,3	3,1	1,8	-0,1	1,4	1,0	2,4	1,7	0,8
Germany	3,1	2,3	0,7	0,8	0,6	-0,9	2,3	1,7	1,6
Greece	2,2	4,3	4,9	2,1	1,7	2,1	0,1	2,5	2,8
Ireland	2,4	10,8	6,0	1,2	7,5	2,8	1,2	3,3	3,2
Italy	2,2	2,3	1,4	1,2	1,9	1,7	1,0	0,4	-0,3
Luxembourg	7,6	6,1	3,3	3,1	6,0	3,3	4,5	0,1	0,0
Netherlands	2,7	5,3	0,7	1,7	3,2	-1,1	1,0	2,1	1,7
Portugal	3,1	4,5	0,8	-1,0	2,5	0,9	4,0	2,0	-0,1
Spain	2,9	4,4	3,5	1,2	5,0	3,8	1,7	-0,7	-0,3
Sweden	2,2	3,2	1,7	0,4	1,8	-0,5	1,8	1,4	2,2
United Kingdom	3,1	4,9	3,6	0,8	1,6	1,6	2,4	3,3	1,9
					Rest of Economy				
Austria	1,2	1,3	0,4	-0,1	0,8	0,3	1,3	0,5	0,1
Belgium	1,1	1,4	1,2	0,1	1,0	1,1	1,0	0,4	0,1
Denmark	2,5	2,0	0,7	-0,3	0,6	0,3	2,7	1,4	0,5
Finland	0,7	1,6	0,2	-0,7	0,4	0,7	1,3	1,2	-0,6
France	1,8	1,1	1,1	-0,4	0,4	-0,3	2,2	0,7	1,4
Germany	2,0	1,6	0,7	0,1	0,1	0,2	1,9	1,6	0,5
Greece	0,6	0,9	3,2	0,3	-0,2	-0,8	0,3	1,1	4,0
Ireland	3,3	1,2	5,8	0,3	0,7	2,5	3,0	0,6	3,3
Italy	1,7	1,6	1,0	-0,7	-0,4	0,1	2,4	2,1	1,0
Luxembourg	3,9	3,3	3,1	1,3	2,5	4,1	2,6	0,8	-1,0
Netherlands	1,1	1,2	2,1	0,5	1,6	1,9	0,6	-0,4	0,1
Portugal	2,8	1,8	1,4	-1,7	0,3	0,9	4,5	1,5	0,5
Spain	2,1	3,2	2,7	-0,7	1,8	1,8	2,8	1,4	0,9
Sweden	0,7	0,6	0,8	0,3	-0,1	-0,1	0,3	0,7	0,9
United Kingdom	1,4	1,1	1,6	0,4	0,8	2,1	1,0	0,4	-0,6

Source: EU KLEMS and own calculations

Table 1b: EU10 Member States
GDP, Labour Input in Hours and Labour Productivity per Hour
(Annual Average Volume Growth Rates in %)

	GDP		Labour input in hours		Labour productivity per Hour	
	1996 - 2000	2001 - 2004	1996 - 2000	2001 - 2004	1996 - 2000	2001 - 2004
		Total Industries				
Cyprus	3,4	3,7	1,0	1,8	2,5	2,0
Czech Republic	0,8	2,7	-0,4	-1,3	1,3	4,1
Estonia	5,5	7,1	-2,1	1,0	7,6	6,1
Hungary	4,7	3,5	1,4	-0,6	3,2	4,1
Latvia	6,9	3,8	0,1	0,2	6,8	3,6
Lithuania	4,6	7,5	-0,6	0,3	5,1	7,2
Malta	4,0	-1,1	1,5	-1,1	2,5	0,0
Poland	4,8	2,6	0,5	-1,8	4,3	4,4
Slovakia	3,5	3,7	-1,4	-0,9	4,9	4,6
Slovenia	4,1	3,5	-0,6	-0,2	4,8	3,7
			Manufacturing			
Cyprus	0,2	6,2	-3,5	-2,4	3,6	8,7
Czech Republic	4,4	2,7	-0,1	-1,3	4,6	4,0
Estonia	6,5	9,5	-3,9	3,0	10,4	6,6
Hungary	7,0	3,3	2,0	-2,0	5,0	5,3
Latvia	-0,7	2,5	-2,5	-0,3	1,7	2,9
Lithuania	6,5	10,3	-2,4	-0,3	8,9	10,6
Malta	4,6	-7,5	-1,1	-5,2	5,7	-2,4
Poland	7,5	4,6	-1,8	-3,4	9,2	8,0
Slovakia	4,2	7,2	-2,0	-0,6	6,2	7,9
Slovenia	5,5	4,3	-1,9	-0,9	7,4	5,2
		Private Services				
Cyprus	4,1	3,3	2,0	1,9	2,1	1,4
Czech Republic	0,1	3,2	0,0	-0,8	0,0	4,0
Estonia	5,4	8,3	0,6	-0,8	4,8	9,1
Hungary	4,6	3,5	2,7	0,3	1,9	3,2
Latvia	9,2	3,3	4,6	2,3	4,7	1,0
Lithuania	3,7	8,7	-0,8	2,8	4,6	5,9
Malta	4,1	-1,5	2,3	0,3	1,8	-1,8
Poland	5,6	2,2	1,8	-2,4	3,8	4,6
Slovakia	2,3	3,4	0,7	1,0	1,5	2,4
Slovenia	3,8	3,3	0,9	0,7	2,8	2,6
		Rest of Economy				
Cyprus	3,0	3,7	1,2	3,0	1,9	0,8
Czech Republic	-1,7	1,8	-1,6	-2,2	-0,1	4,1
Estonia	4,8	2,0	-4,4	2,1	9,2	-0,1
Hungary	2,8	3,7	-0,6	-0,8	3,5	4,4
Latvia	7,5	6,0	-3,2	-2,4	10,7	8,4
Lithuania	4,9	2,7	0,5	-1,9	4,3	4,6
Malta	3,4	4,6	2,3	-1,0	1,1	5,6
Poland	1,4	2,0	0,6	-0,9	0,8	2,9
Slovakia	5,7	0,6	-3,6	-3,9	9,3	4,5
Slovenia	3,4	3,0	-1,4	-0,9	4,8	3,9

Source: EU KLEMS and own calculations

Table 2a : EU15ex5 Member States
Results of Growth Accounting Analysis – Gross Value Added Growth and Contributions (Annual Average Volume Growth Rates in %)

	Total Industries			Manufacturing			Private Services			Rest of Economy		
	1981 - 1995	1996 - 2000	2001 - 2004	1981 - 1995	1996 - 2000	2001 - 2004	1981 - 1995	1996 - 2000	2001 - 2004	1981 - 1995	1996 - 2000	2001 - 2004
					Gross Value Added							
Austria	2,2	2,9	1,2	2,0	4,3	1,3	2,8	3,1	1,5	1,2	1,3	0,4
Belgium	1,7	2,5	1,5	2,2	3,0	0,4	1,8	2,9	2,0	1,1	1,4	1,2
Denmark	2,2	2,8	1,0	1,6	1,8	-0,2	2,3	3,7	1,6	2,5	2,0	0,7
Finland	1,8	4,7	2,1	2,7	8,0	3,8	2,0	4,6	2,2	0,7	1,6	0,2
France	2,0	2,6	1,5	1,4	3,6	0,9	2,3	3,1	1,8	1,8	1,1	1,1
Germany	2,2	2,0	0,7	0,7	1,5	0,6	3,1	2,3	0,7	2,0	1,6	0,7
Italy	2,0	1,8	0,7	1,9	0,7	-1,2	2,2	2,3	1,3	1,7	1,6	0,9
Netherlands	2,1	3,8	0,9	2,3	3,2	-0,2	2,7	5,3	0,7	1,1	1,2	2,1
Spain	2,5	3,9	2,9	2,1	3,4	1,0	2,9	4,4	3,5	2,1	3,2	2,7
United Kingdom	2,2	3,2	2,4	1,4	0,9	-0,4	3,1	4,9	3,6	1,4	1,1	1,6
					Contribution from Labour Services							
Austria	0,2	0,8	0,3	-1,2	-0,9	-0,6	0,6	1,2	0,4	0,7	1,3	0,9
Belgium	0,7	1,2	0,3	-0,7	0,0	-1,1	1,2	1,5	0,3	0,9	1,2	1,3
Denmark	0,1	1,5	0,0	-0,4	0,4	-1,5	0,1	2,2	0,3	0,5	0,9	0,4
Finland	0,0	1,5	0,5	-1,2	1,3	-0,5	0,0	1,7	0,5	0,9	1,1	1,4
France	0,2	0,9	0,3	-1,1	-0,2	-0,9	0,4	1,2	0,7	0,5	0,9	0,1
Germany	0,0	-0,1	-0,1	-1,2	-1,0	-0,6	0,6	0,2	-0,2	0,3	0,0	0,5
Italy	0,2	0,7	0,5	-1,0	0,3	0,0	1,0	1,1	1,1	0,0	0,0	-0,4
Netherlands	0,8	1,6	-0,1	-0,4	0,3	-1,2	1,2	2,3	-0,6	0,6	1,1	1,5
Spain	0,6	2,8	1,9	-0,6	2,7	0,2	1,1	3,2	2,5	0,9	1,9	1,8
United Kingdom	0,0	1,2	1,1	-2,2	0,3	-2,9	0,7	1,3	1,4	0,5	1,4	2,5
					Contribution from Capital Services							
Austria	0,9	1,1	0,8	0,6	0,5	0,5	1,4	1,6	1,3	0,3	0,4	0,0
Belgium	1,3	1,7	1,3	1,7	1,9	0,7	1,6	2,3	1,9	0,3	0,3	0,3
Denmark	1,1	1,5	1,3	1,0	1,7	1,2	1,3	1,9	1,2	0,7	0,8	1,6
Finland	1,0	1,0	0,8	1,2	2,0	0,5	1,3	0,9	1,1	0,5	0,4	0,3
France	0,9	1,0	0,8	1,1	0,8	0,6	1,1	1,3	1,1	0,4	0,4	0,4
Germany	1,0	1,4	0,7	0,6	0,5	0,2	1,4	2,2	1,1	0,5	0,6	0,3
Italy	0,9	1,0	1,0	0,9	0,9	0,6	1,3	1,3	1,3	0,1	0,6	0,5
Netherlands	1,0	1,6	0,6	0,8	0,9	0,0	1,3	2,2	0,7	0,7	0,8	0,7
Spain	1,4	1,9	1,7	1,2	1,7	0,8	1,7	2,3	2,2	1,1	1,2	1,4
United Kingdom	1,2	1,8	1,2	0,6	1,1	0,2	1,4	2,5	1,7	1,2	0,5	0,5
					Contribution from TFP							
Austria	1,0	0,9	0,0	2,5	4,6	1,4	0,8	0,2	-0,2	0,3	-0,4	-0,5
Belgium	-0,1	-0,3	0,0	0,2	1,1	0,9	-0,2	-0,9	-0,1	0,2	-0,1	-0,5
Denmark	1,0	-0,1	-0,8	1,0	-0,3	-0,2	0,9	-0,4	-0,6	1,2	0,2	-1,2
Finland	0,7	2,2	0,8	2,8	4,7	3,8	0,7	2,0	0,6	-0,8	0,2	-1,6
France	0,9	0,7	0,3	1,6	3,0	1,3	0,9	0,6	0,0	0,9	-0,2	0,6
Germany	1,2	0,6	0,1	1,3	2,0	1,0	1,1	-0,1	-0,2	1,2	1,0	-0,1
Italy	0,8	-0,1	-0,6	2,1	-0,6	-1,6	0,0	-0,1	-0,9	1,6	1,0	0,9
Netherlands	0,3	0,6	0,5	1,9	2,1	1,1	0,2	0,8	0,6	-0,3	-0,7	-0,1
Spain	0,5	-0,8	-0,8	1,5	-1,0	0,1	0,2	-1,1	-1,1	0,1	0,1	-0,5
United Kingdom	1,0	0,2	0,2	3,2	-0,3	2,4	1,0	1,1	0,5	-0,3	-0,8	-1,4

Source: EU KLEMS and own calculations

Table 2b : EU10 New Member States*

Results of Growth Accounting Analysis – Gross Value Added Growth and Contributions (Annual Average Volume Growth Rates in %)

	Total Industries		Manufacturing		Private Services		Rest of Economy	
	1996 - 2000	2001 - 2004	1996 - 2000	2001 - 2004	1996 - 2000	2001 - 2004	1996 - 2000	2001 - 2004
			Gross Value Added					
Czech Republic	0,8	2,7	4,4	2,7	0,1	3,2	-1,7	1,8
Hungary	4,7	3,5	7,0	3,3	4,6	3,5	2,8	3,7
Slovenia	4,1	3,5	5,5	4,3	3,8	3,3	3,4	3,0
			Contribution from Labour Services					
Czech Republic	-0,1	-0,4	0,1	-0,5	0,2	-0,1	-0,8	-0,9
Hungary	1,3	0,6	1,1	-0,3	2,1	1,0	0,1	0,6
Slovenia	0,1	0,1	-0,8	-0,7	0,8	0,7	-0,1	0,0
			Contribution from Capital Services					
Czech Republic	2,3	2,4	2,3	2,8	3,1	1,8	0,4	1,8
Hungary	0,4	1,2	1,5	2,0	0,7	1,5	-1,0	0,0
Slovenia	3,0	1,8	1,6	1,5	7,1	3,2	-2,8	-0,6
			Contribution from TFP					
Czech Republic	-1,4	0,7	2,1	0,4	-3,2	1,5	-1,3	1,0
Hungary	2,9	1,7	4,4	1,7	1,8	1,0	3,8	3,1
Slovenia	0,2	1,3	4,6	3,5	-4,2	-0,6	6,4	3,7

***There are some data problems in the case of Slovenia which still need to be resolved.**

Source: EU KLEMS and own calculations

Annex 4 : Labour Input[60] / Labour Productivity Trade-offs at the Industry Level

In explaining growth patterns over the second half of the 1990s, an assessment of the short and long run effects on labour productivity of a significant boost to employment (as measured in hours worked) is important in evaluating the extent to which the present downturn in EU labour productivity is a permanent or a short run phenomenon. A number of commentators have suggested that the positive trend change in EU employment growth since the mid-1990's, driven by a reform induced boost to labour supply coupled with wage restraint, could be responsible for the deterioration in productivity trends. Under this interpretation, recent productivity developments could be judged as healthy, with slower wage growth leading to a temporary decline in capital-labour substitution (i.e. capital deepening). Once full employment is reached, wage and productivity growth could accelerate again and the economy could go back to a higher growth rate of labour productivity at a higher level of employment.

An alternative view regards the labour market story as incomplete. According to this view, the data can be explained correctly only if one assumes a negative shock to productivity, either in the form of a decline in the growth rate of TFP or in the form of a positive shock to capital productivity, with the latter shock induced by higher required rates of return for investors. At the macro level a trend decline in TFP could be due to a further increase in the size of the service sector; a reduction in the quality of labour as more low skilled workers are brought into the labour force (which in EU KLEMS is separated out as a "labour composition" effect); and / or a trend decline in technological advances. Also with globalisation and increased international capital mobility, the higher returns which can be earned outside Europe may exert pressure on capital productivity. Both developments could explain why capital-labour substitution declined.

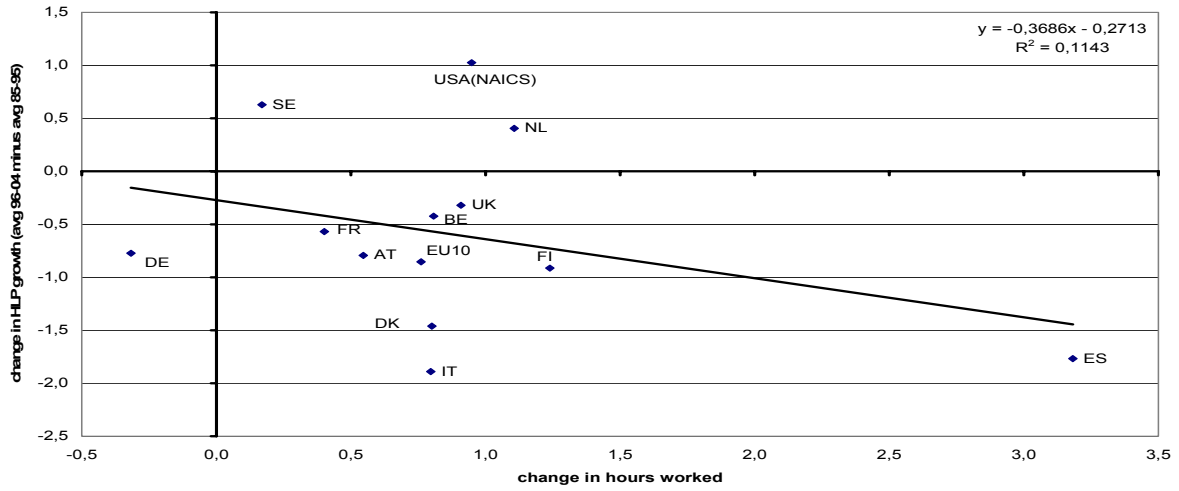
Both of the above interpretations would obviously provide a different diagnosis for Europe's productivity problems. According to the first view, recent productivity trends are a temporary phenomenon and a healthy indication that labour markets in Europe have become more flexible. The second view is more pessimistic. It regards the productivity slowdown as a continuation of the previous adverse productivity trends, with the recent increase in employment simply having an additional temporary, negative, effect on productivity. The question is which view is most supported by the empirical evidence. The following set of graphs based on the EU KLEMS datasets provide some evidence on the employment induced fall in labour productivity both at the level of total industries and for the manufacturing and private services sectors.

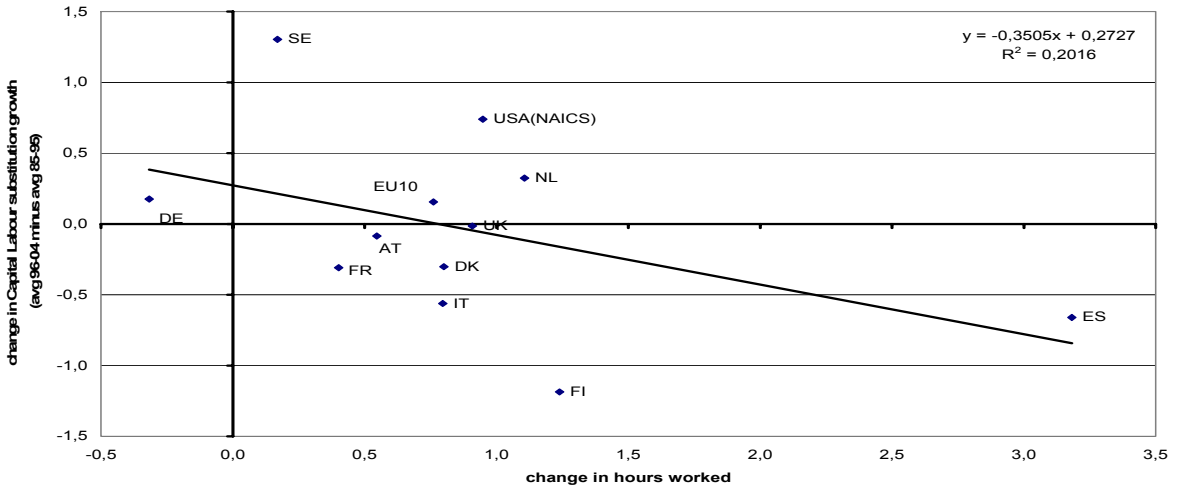
The graphs show that there is indeed a link between changes in labour input and changes in productivity growth, although the link is not very strong. However, there are interesting differences when we look at the relationship between labour input growth and TFP on the one hand and labour input and capital deepening on the other. In the case of labour market reforms we would expect the latter relationship to be stronger and this is indeed is what is shown in the graphs (at least for "total industries" and the private services sector). Regarding the hours worked / TFP relationship, apart from some evidence of a link for the manufacturing sector, the remaining graphs suggest that trends for both variables are largely unrelated. This is hardly surprising given the absence of any theoretical evidence to suggest any meaningful long run relationship, although temporary effects are possible. Whilst standard growth models do predict a temporary decline in productivity via lower capital / labour substitution over the adjustment

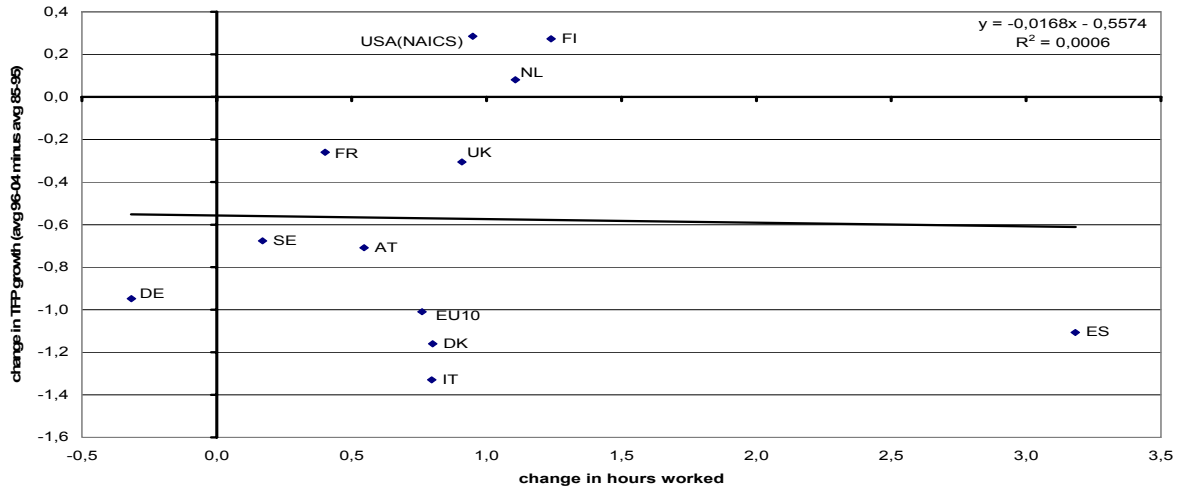
[60] Total hours worked by persons engaged.

period to a higher labour content of growth, similar short run labour input / TFP links are less supported in the literature, although they can occur due to, for example, sectoral output shifts or to the integration of low / high skilled workers into the workforce.

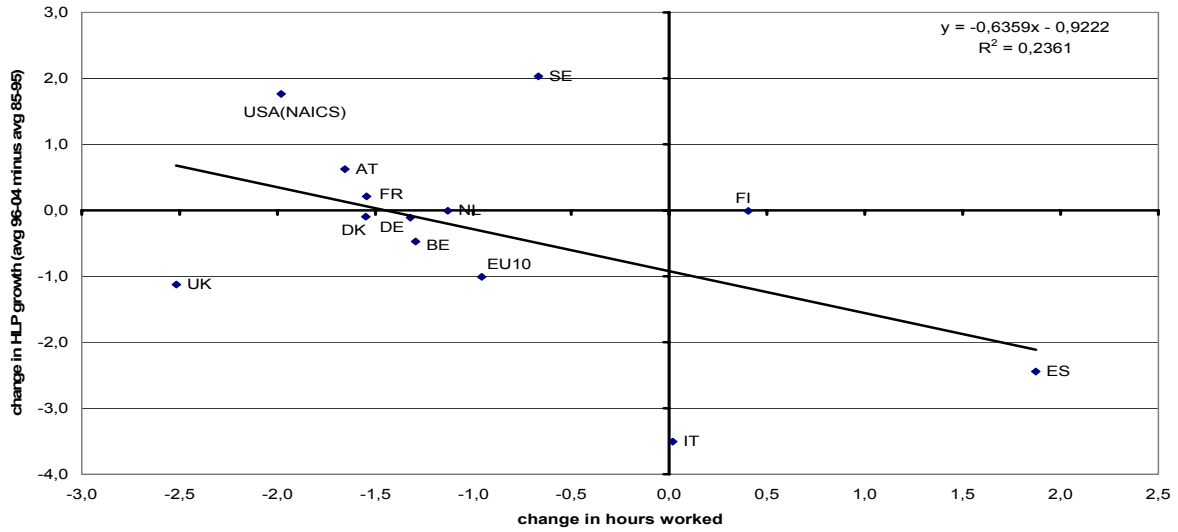
Total Industries

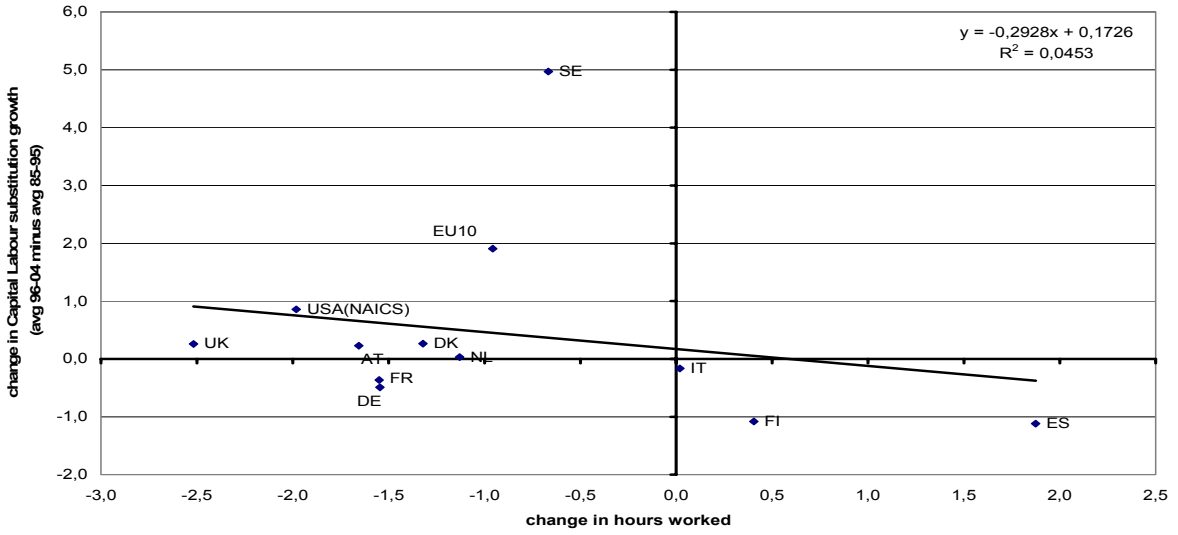


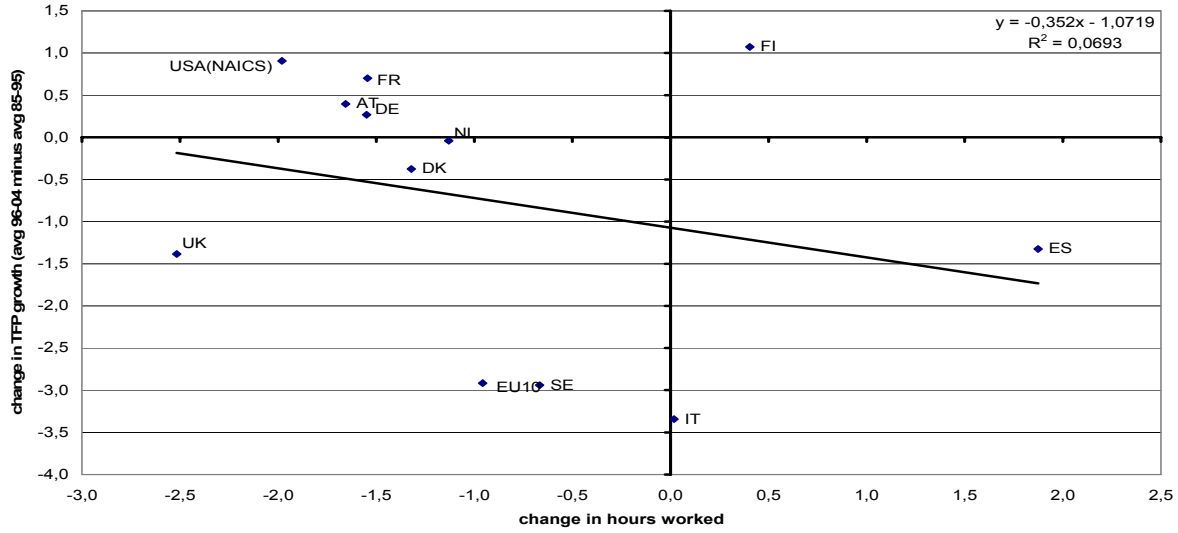




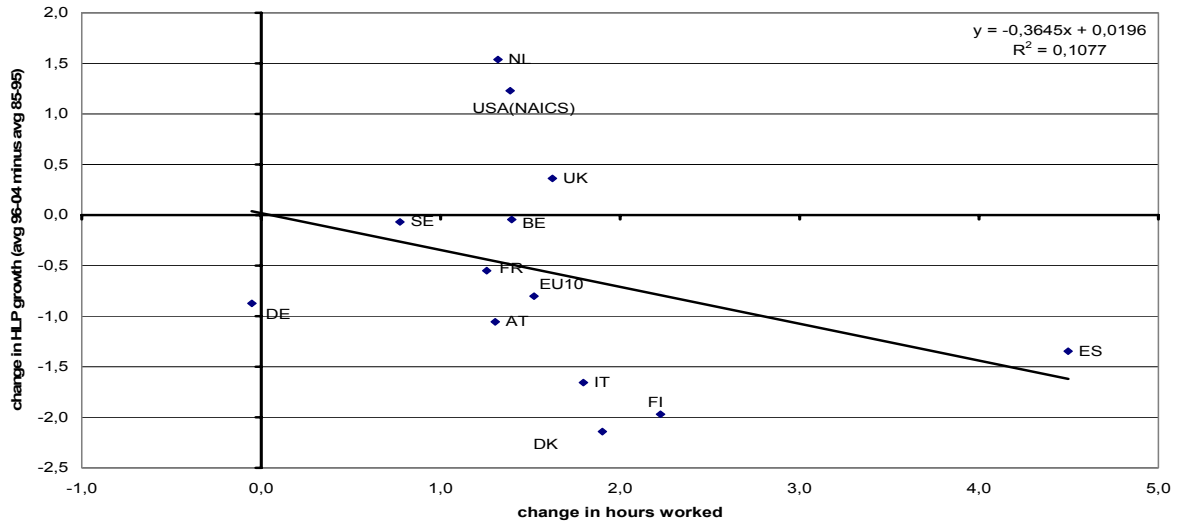
Manufacturing

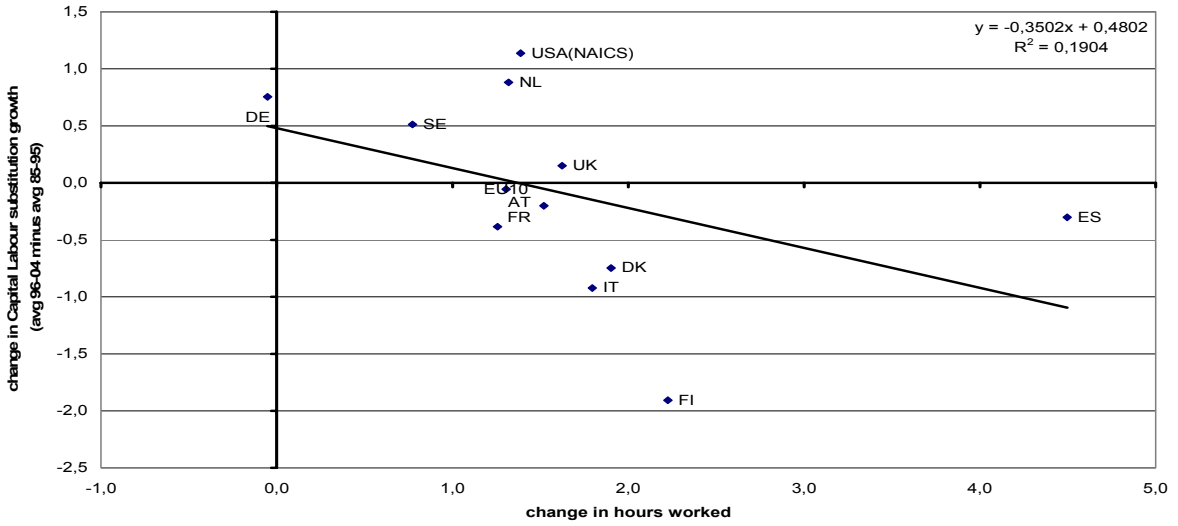


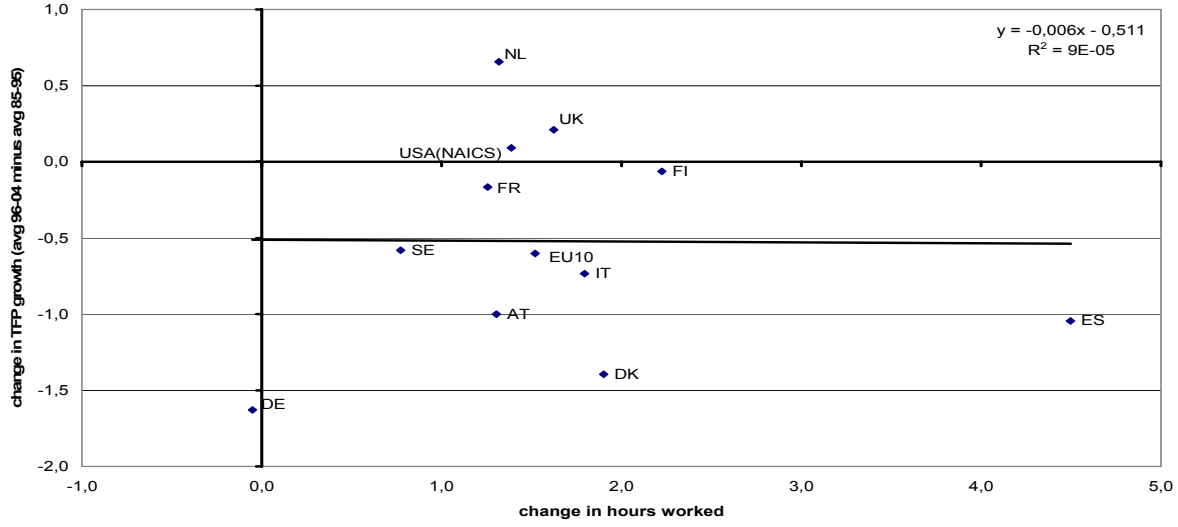




Private Services







Annex 5 : Labour Productivity Growth Accounting Analysis for the Euro Area + US

Given that one of the key conclusions of the GDP growth accounting breakdown in section 5 was that EU-US growth differences were heavily driven by labour productivity trends[61], the present annex looks at this latter variable in more detail. This productivity breakdown is based on a similar growth accounting methodology to that used for GDP in section 5[62]. For the purposes of this exercise, labour productivity growth can be explained by changes in the contributions from ICT and non-ICT capital deepening (i.e. changes in the ICT / non-ICT capital / labour ratios)[63], changes in labour quality (i.e. labour composition effects) and TFP[64]. As with the GDP growth accounting analysis, this labour productivity breakdown can only be carried out for a subset of the Member States due to the absence of capital stock and labour composition data series for some countries. Since there is a danger of some overlaps with the analysis in the main body of the paper, the present annex will compare a different EU aggregate (the Euro area[65]) with the US and the text will be kept as short as possible in order to avoid repetition with the material presented earlier.

5.1 : Sectoral breakdown of labour productivity : Table 1 provides a breakdown of labour productivity for the Euro area and for the US on the basis of the EU KLEMS datasets. The set of accompanying graphs (1a-1c) show the HP filtered trend contributions from the different components of labour productivity to the total change in labour productivity growth at the level of "total industries" and for the manufacturing and private services sectors. As with the similar sets of graphs provided in the main text, graphs 1a-1c have all the same scale and are additive. A small number of points can be highlighted :

- Table 1 and graphs 1a-1c confirm the broad trends discussed in the main text, most notably the key role of TFP in explaining the EU's productivity deterioration.

- Regarding labour quality issues, whilst table 1 shows that the labour composition effect in the US and the Euro area is clearly much stronger in the manufacturing sector compared

[61] Productivity increases in industries are economically crucial since they can be translated into improvements in price competitiveness or to increases in profits or the compensation of workers.

[62] Using the same growth accounting model and rearranging the terms allows labour productivity growth to be decomposed into four components; ICT and non-ICT capital deepening (i.e. the change in ICT and non-ICT capital services per hour worked); labour quality (i.e. labour services per hour worked); and TFP. The contribution of capital deepening to labour productivity growth is equal to the change in capital deepening weighted by the capital share (i.e. the share of capital compensation in nominal value added). The contribution of labour quality is equal to the change in labour services per hour worked weighted by the labour share (i.e. the share of labour compensation in nominal value added).

[63] As explained earlier in section 4 of the main text, there are two essential steps in the measurement of capital services. The first step is to estimate the productive capital stocks for each type of asset (using the perpetual inventory method and a geometric rate of depreciation). The second step is to aggregate the stocks into an overall capital services volume index by utilising the user costs of capital (which are computed by the ex post or ex ante **rates of return on capital** approaches) as capital compensation weights. This overall volume index is then weighted by the overall capital share in value added to provide a measure of the contribution of capital services (i.e. the services from all the different types of capital assets) to value added growth. The user costs of capital or the rental price is a measure of the price of the services provided by the asset. The ex-post rate of return is calculated using the data on capital compensation and the nominal capital stock. The ex-ante rate is often based on proxy measures such as the long term interest rate. The difference between the contributions of capital to value added growth based on capital stocks versus capital services is often referred to as capital efficiency gains (i.e. the quality of capital which is analogous to the quality of labour calculation implicit in the labour services measure).

[64] The contribution of an individual industry to the productivity growth of the total economy is calculated by weighting its labour productivity growth rate by its respective share in total economy value added.

[65] The full set of Euro area countries is not however available, with the aggregate used for the present analysis made up of the following 7 Member States (Germany, Spain, France, Italy, the Netherlands, Austria and Finland). This aggregation of countries represent close to 90% of Euro area GDP.

with other sectors, it is interesting to note the relatively greater level of up-skilling which appears to be taking place in the US in both the manufacturing and private services sectors compared with that in the Euro area. This is potentially an important factor in explaining the US's strong performance in these sectors relative to that of the Euro area since the mid-1990's.

- Graphs 1a-1c present the, period average, labour productivity results from table 1 in graphical form (with table 2 at the end of the annex giving the equivalent figures for the individual Euro area countries). These graphs confirm the key contribution of TFP to the US's labour productivity upturn since the mid-1990's and the fact that the US out-performance on the capital services side is mainly an ICT capital services phenomenon since the Euro Area has continued to gain more than the US (in terms of labour productivity) from its use of non-ICT assets[66].

Box : Tentative policy relevant insights from the Labour Productivity Growth Accounting Analysis

The main sources of labour productivity growth in an economy are investments in human capital (via education and training); investments in physical capital (i.e. ICT capital and non-ICT capital); and finally gains in efficiency (i.e. TFP). If one looks at the graphs comparing the contributions to labour productivity growth in the Euro Area and the US, one sees that the productivity differences are strongly driven by divergences in the efficiency with which the various labour and capital inputs are used in the respective economies rather than to differences in the contributions from the human and physical capital investments[67] themselves. This is not to say however that labour productivity growth in the increasingly knowledge based advanced economies has not benefited from investments in ICT and from the increasing use of more highly skilled labour. Table 1 shows that ICT capital deepening and compositional shifts in the labour force (i.e. an increasing share for skilled labour) have contributed 0.4% points and 0.1% points respectively to overall labour productivity growth over the period 1996-2004. These figures are not that different from the US (0.6 and 0.2). However, with regard to explaining overall EU-US productivity differences, it is clear that it is the "residual" driver of productivity growth, namely TFP, which is the key differentiating factor.

Consequently, with broadly similar human and physical capital contributions, understanding the large Euro Area-US productivity differences requires one to focus on TFP trends and on the underlying determinants of those trends. Interpreting TFP trends in services is particularly important, with a need to look at this issue from the perspective of "soft" technology gains (i.e. shifts in knowledge associated with organisational or managerial best practices) rather than "hard" technology gains (i.e. the introduction of efficiency enhancing, R&D generated, tangible technologies that are the dominant form of technology transfer in many manufacturing industries). A big area of current research in the productivity field is the extent to which "soft" technologies are diffused throughout an economy or between economies. Given the nature of these "intangible" innovations, there are concerns that the spillover channels from firm-to-firm and country-to-country may be very different and more limited (since, for example, many may be firm specific) than those associated with "tangible" innovations in other "goods-based" industries.

A big question is the extent to which the EU's TFP problems in service industries reflect market rigidities and a failure to exploit technology and innovation spillovers. In this context, the factors inhibiting the full integration / exploitation of ICT in many sectors of European production need to be identified and acted upon. For example, an important policy question in the retail and wholesale trade industry is why the Euro Area's TFP performance is so poor relative to the US despite having invested similar amounts of ICT capital. Can all of these Euro Area - US differences in this specific industry be interpreted solely from the perspective of measurement problems or can part of them be linked to issues such as the difficulty in integrating a radical innovation such as ICT in the value added chain of some EU member states ?

TFP includes the effects of non-technical innovations such as organisational and process innovations which are often more important in services than in manufacturing firms. It is in these types of, non technical, innovations where the EU appears to be having most problems although gaps also exist with the US in the manufacturing sector for the more technology based forms of innovation (e.g. ICT producing manufacturing).

From a policy perspective, therefore, on the basis of the analysis of the EU KLEMS datasets in this annex (and bearing in mind the need for caution in drawing firm conclusions given that EU KLEMS is still work-in-progress), efforts to improve the EU's medium to long run productivity performance (i.e. to make more productive use of its resources) would appear to require policy makers to implement measures aimed at ensuring **firstly**, the most effective deployment of skilled workers; **secondly**, the smooth shifting of all forms of capital and other scarce resources to the relatively most productive firms and industries; **thirdly**, the greater exploitation of ICT investments in a range of private service industries; and **finally**, sustained improvements in the EU's innovation capacity.

[66] Given that the Euro Area is already gaining more than the US from its investments in non-ICT assets, the solution to its productivity problem is unlikely to come simply from a generalised increase in capital deepening. The problem seems to lie more in terms of the productivity of capital in the EU rather than with the overall investment rate. The fact that labour productivity growth rates continue to decline in the Euro Area, despite having relatively high investment rates, suggests that the marginal productivity of capital may be declining. This could be linked to over-investment in certain traditional sectors, with any additional investments in these areas yielding less and less returns, and to under-investment in a range of the newer, high productivity growth, industries. Consequently, while Europe undoubtedly needs more investment, the more pressing need is for structural reforms in order to ensure that any resources liberated from the reform process will be directed to those sectors with the highest growth potential. In addition, since the Euro Area is now close to the technology frontier, with steady state physical investment levels, any additional productivity gains over the coming decades are more likely to be generated from a boost to knowledge investments and to a shift towards organisational / managerial best practices rather than from changes to our present physical investment to GDP ratio.

[67] This picture, however, must be qualified when talking about individual Euro Area Member States where the cross-country experiences are very different (see table 2).

Table 1 : EU15 + US – Results of Growth Accounting Analysis – Hourly Labour Productivity Growth and Contributions (Annual Average Volume Growth Rates in %)[68]

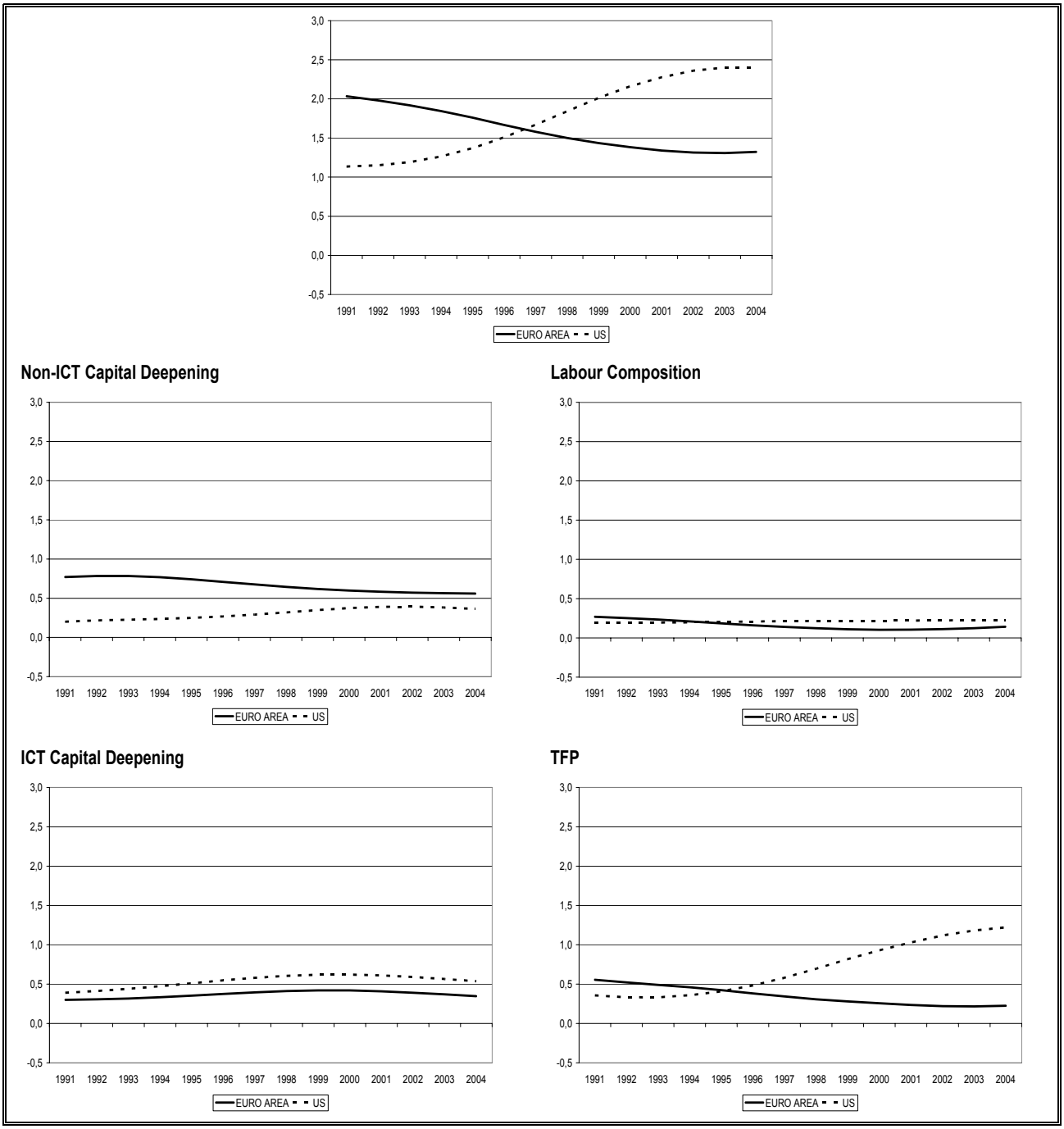
	Euro Area		US	
	1983-1995	1996-2004	1983-1995	1996-2004
"Total Industries"				
"Total Industries" Labour Productivity	**2.2**	**1.2**	**1.3**	**2.4**
"Total Industries" Decomposition				
1. ICT Capital Deepening	0.3	0.4	0.4	0.6
2. Non-ICT Capital Deepening	0.8	0.5	0.1	0.4
3. Labour Composition	0.3	0.1	0.2	0.2
4. TFP	0.6	0.1	0.6	1.1
Manufacturing Sector				
Manufacturing Labour Productivity	**3.4**	**2.1**	**3.4**	**5.1**
Manufacturing Decomposition				
1. ICT Capital Deepening	0.2	0.3	0.3	0.6
2. Non-ICT Capital Deepening	1.0	0.6	0.2	1.1
3. Labour Composition	0.2	0.2	0.3	0.5
4. TFP	1.9	1.0	2.5	2.9
Private Services Sector				
Private Services Labour Productivity	**2.0**	**0.8**	**0.9**	**2.4**
Private Services Decomposition				
1. ICT Capital Deepening	0.4	0.6	0.4	0.9
2. Non-ICT Capital Deepening	0.7	0.5	0.1	0.4
3. Labour Composition	0.2	0.0	0.2	0.3
4. TFP	0.7	-0.2	0.1	0.8

Source: EU KLEMS and own calculations

[68] Data is included for "Total Industries" and the "Manufacturing" and "Private Services" sectors ("Rest of Economy" sector is excluded).

Graph 1a : Euro Area + US – Graphs of Trend Contributions to the total change in Labour Productivity from ICT Capital Deepening, Non-ICT Capital Deepening, Labour Composition and TFP

-Total Industries (Annual % Change)-

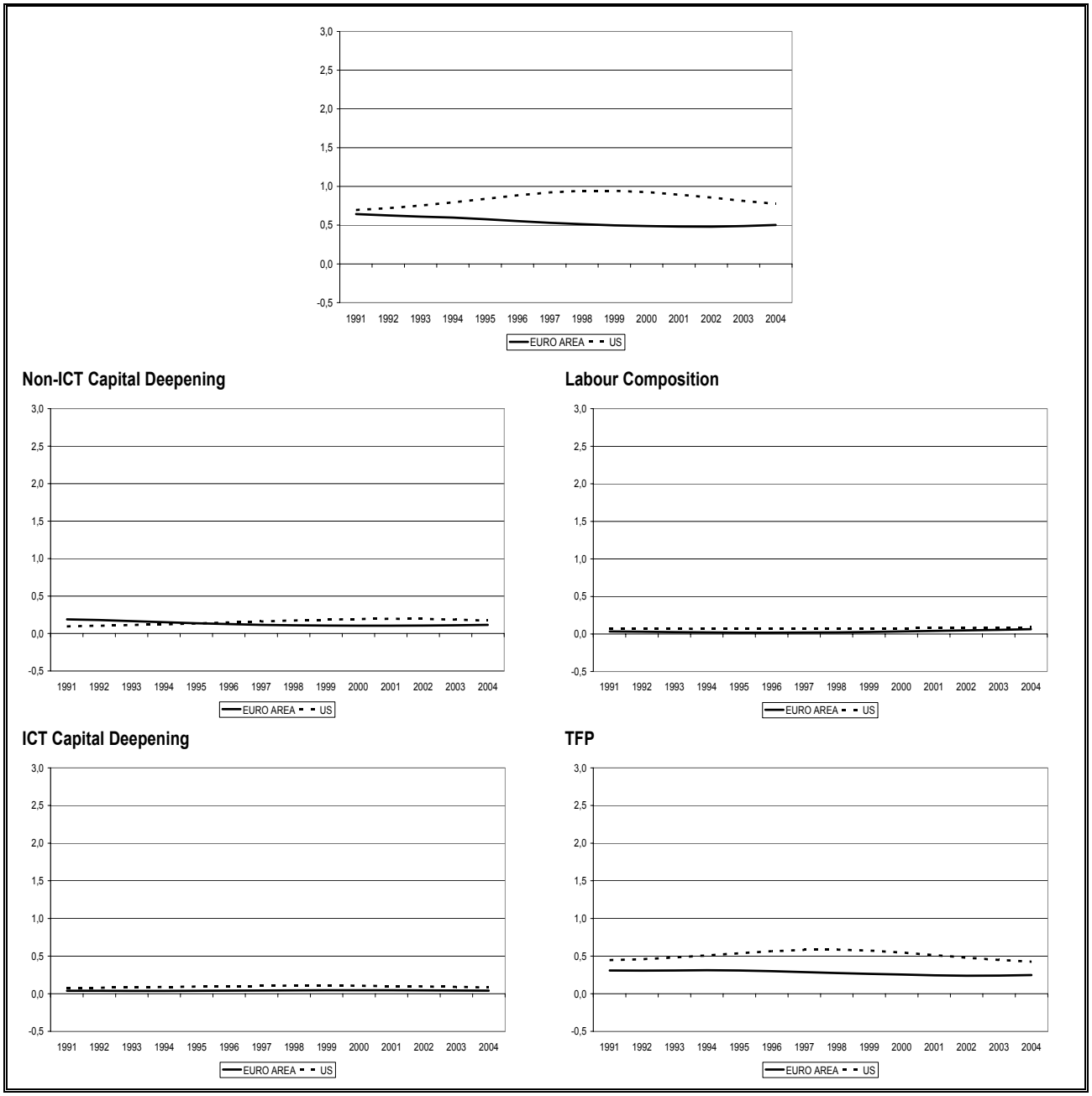


Note: Euro area is made up of 7 Member States (Germany, Spain, France, Italy, the Netherlands, Austria and Finland).

Source: EU KLEMS and own calculations

Graph 1b : Euro Area + US – Graphs of Trend Contributions to the total change in Labour Productivity from ICT Capital Deepening, Non-ICT Capital Deepening, Labour Composition and TFP

-Manufacturing (Annual % Change)-

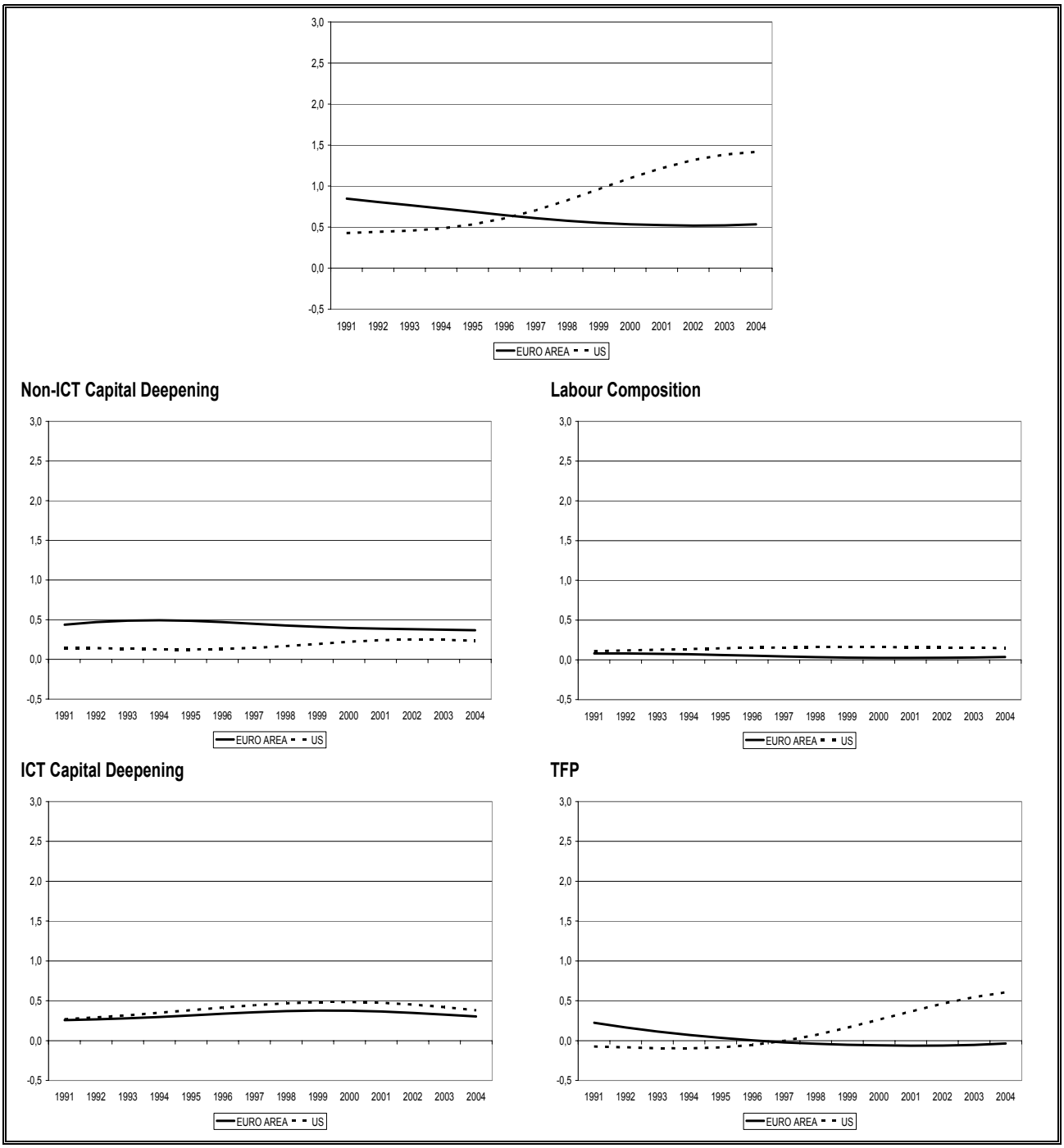


Note: Euro area is made up of 7 Member States (Germany, Spain, France, Italy, the Netherlands, Austria and Finland).

Source: EU KLEMS and own calculations

Graph 1c : Euro Area + US – Graphs of Actual Contributions to total change in Labour Productivity from ICT Capital Deepening, Non-ICT Capital Deepening, Labour Composition and TFP

-Private Services (Annual % Change)-



Note: Euro area is made up of 7 Member States (Germany, Spain, France, Italy, the Netherlands, Austria and Finland).

Source: EU KLEMS and own calculations

5.2 : Industry Breakdown : The present part of the annex gives an additional, industry level, breakdown for the Euro Area and for the US of the sectors discussed in 5.1. As one can see from graph 2a, the US had a labour productivity growth rate which was almost twice that of the Euro area over the period 1996-2004, with this out-performance being driven by its performances in both the manufacturing and private services sectors, mainly the latter. Within the manufacturing sector, graph 2b indicates that one key industry, electrical and optical equipment, has evidently played a large role in ensuring the strong productivity performance of the US. Regarding the private services sector, the graph confirms the earlier observation in the paper that industries such as wholesale and retail trade, financial intermediation and "other business services" are the big drivers of the US performance. The graph also brings out more strongly the problems in the "other business services" industry where one can see that the differences in the Euro Area and US performances are very large. The industry contributed close to 0.4% points of the total US labour productivity growth rate over the period (i.e. nearly 1/6 of the total), with almost the exact opposite occurring in the Euro area where "other business services" made a negative contribution of over 0.3% points. While it is not possible to accurately pinpoint what is driving these sharply contrasting trends, much of it is emanating from the real estate part of the industry.

Given the problems with "other business services", graph 3 only provides a labour productivity growth accounting breakdown for three of the top four best performing industries as shown in graph 2b, namely wholesale and retail trade; electrical and optical equipment; and financial services. Graph 3 decomposes hourly labour productivity in the three industries into the contributions from ICT capital deepening, non-ICT capital deepening, labour composition effects and TFP. The relative performance of both the US and the EU is established by taking the US contributions and subtracting the equivalent Euro Area contributions for the three industries. Since this labour productivity breakdown is just a re-working of the earlier growth accounting analysis, it is not surprising to find that the same broad conclusions can be drawn from graph 3, as from the earlier analysis for these industries in section 5.3 of the main paper. Consequently, to avoid repetition, only a few general remarks are made regarding each industry :

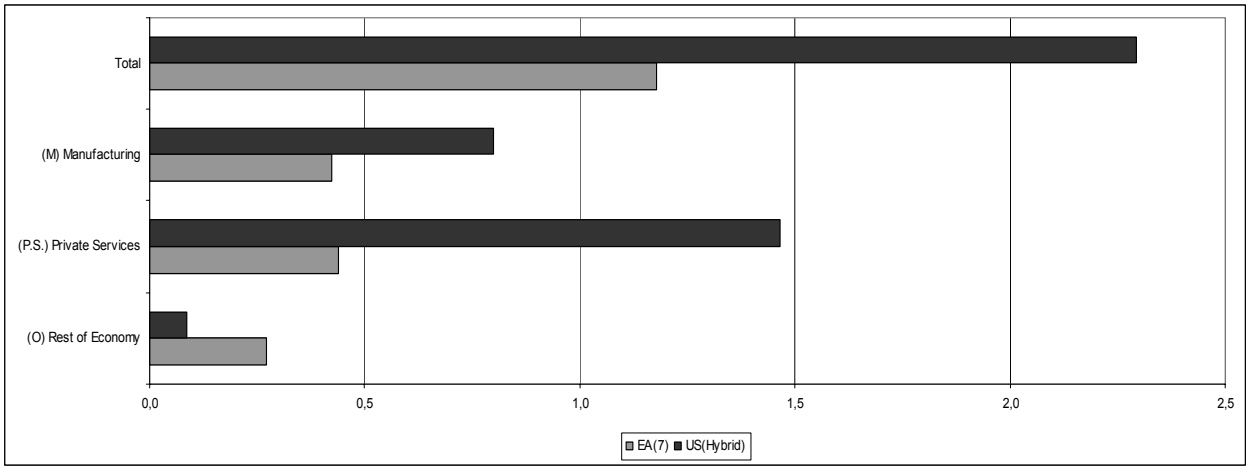
Electrical and optical equipment : Graph 3 shows firstly that this industry can, on its own, explain one quarter of the overall Euro area – US productivity gap, with virtually all of the latter being explained by TFP (which, for this particular industry, is mainly driven by technological change). Differences between the Euro Area and the US for this industry have little to do with the other three productivity determinants namely, ICT capital deepening, non-ICT capital deepening and labour composition effects, with all three making roughly equivalent (and small) contributions to productivity growth in both the US and the Euro Area.

Wholesale and retail trade : Again as with electrical and optical equipment, US-Euro area differences for this specific industry are being driven by just one of the four labour productivity determinants, namely TFP. Investment patterns (both ICT and non-ICT) as well as labour quality issues do not explain the labour productivity divergences in this particular industry.

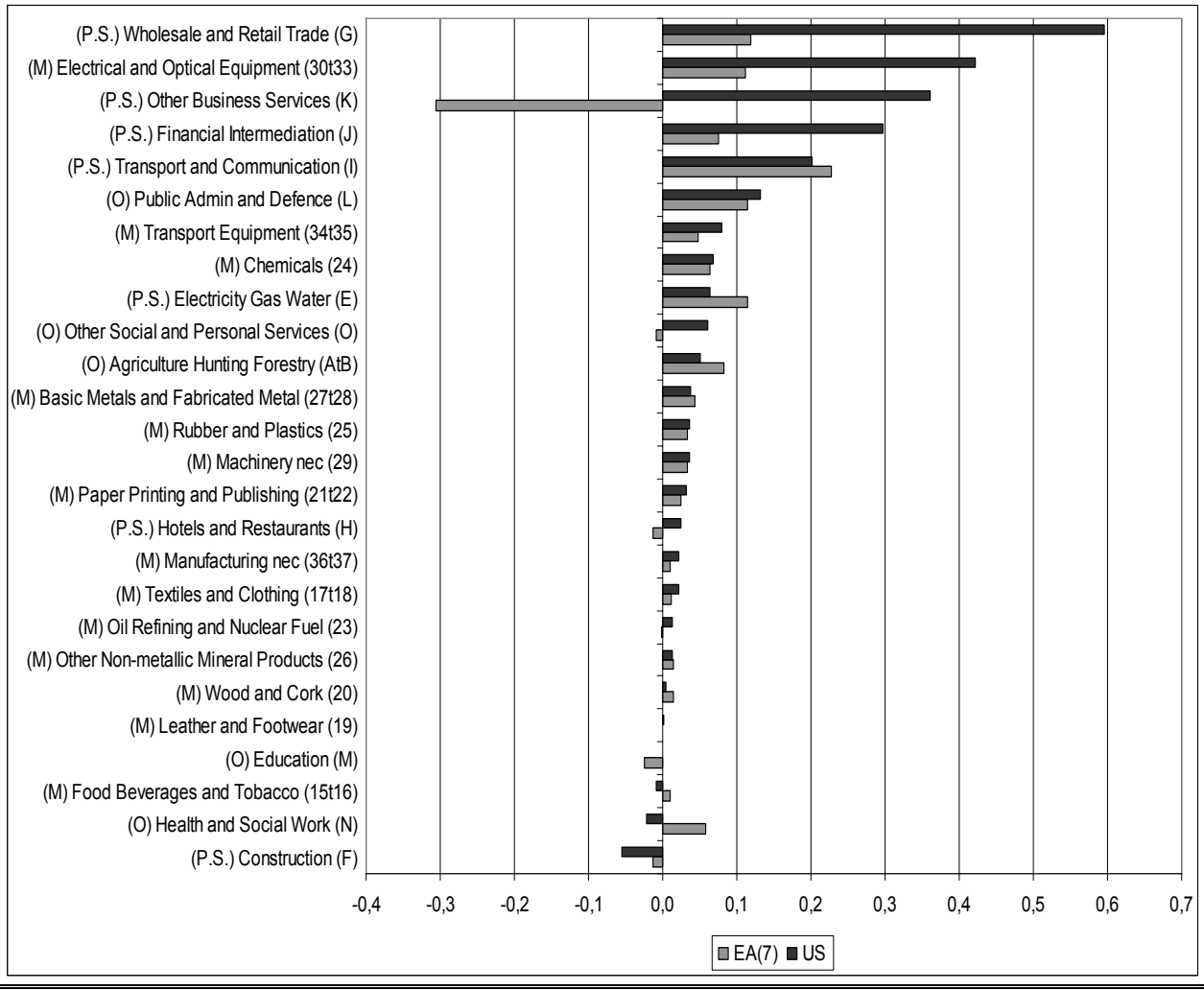
Financial intermediation : Here we see that the US-Euro area productivity contribution differentials are being driven by ICT capital deepening and TFP determinants (mainly the former). If one compares this result with the longer run trends shown for this industry in the earlier graph 9c in the main paper, one sees that whilst the out-performance of the US has been evident for total value added over the whole period 1981-2004, the gap in terms of TFP is a specific feature of the most recent 1996-2004 period.

Graph 2 : 3 Sector + 28 Industry Breakdown (1996-2004)
Contribution to Total Change in Euro Area and US Labour Productivity Growth

2a : 3 Sector Breakdown

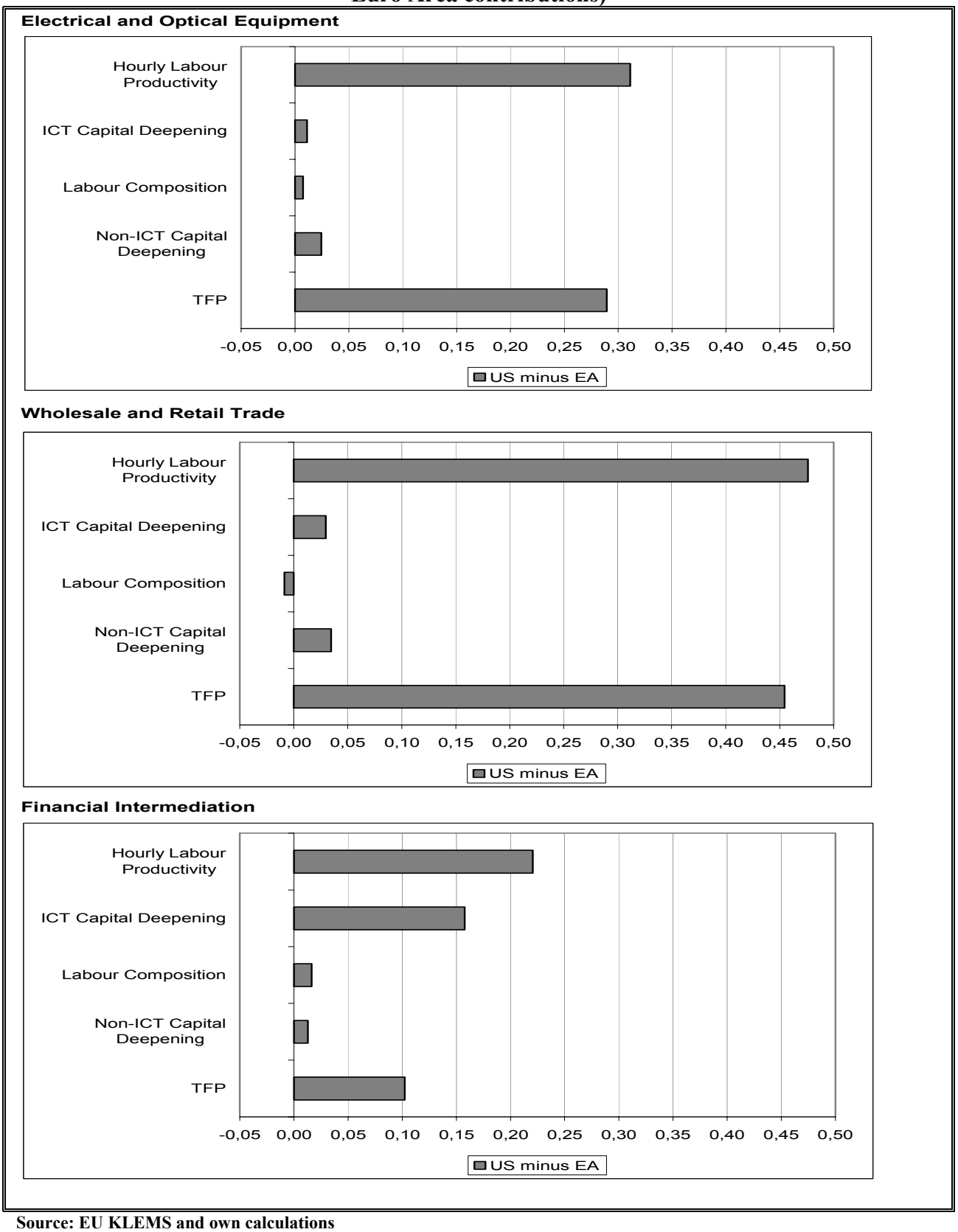


2b : A31 Industry Breakdown



Source: EU KLEMS and own calculations

Graph 3 : Labour Productivity Growth Accounting for 3 Key Industries -1996-2004 (US contributions to labour productivity growth in the specific industry less the equivalent Euro Area contributions)



Source: EU KLEMS and own calculations

Table 2 : Labour Productivity Growth Accounting for the available Euro Area Member States and the US* (1981-2004)

					Table 2a: Total Economy					
			Contribution from:							
	Labour Productivity Growth		**1, ICT Capital Deepening**		**2, Non-ICT Capital Deepening**		**3, Labour Composition**		**4, TFP**	
	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004
Austria	2,3	1,6	0,3	0,5	0,6	0,3	0,4	0,3	1,1	0,5
Finland	3,2	2,3	0,3	0,4	1,0	0,1	0,9	0,2	1,0	1,6
France	2,3	1,7	0,3	0,4	0,7	0,4	0,7	0,4	0,7	0,6
Germany	2,5	1,7	0,2	0,4	0,8	0,8	0,1	0,1	1,4	0,4
Italy	2,3	0,6	0,3	0,2	0,7	0,6	0,3	0,1	1,1	-0,3
Netherlands	1,3	1,4	0,4	0,5	0,3	0,2	0,2	0,1	0,4	0,6
Spain	2,6	0,3	0,4	0,3	1,0	0,3	0,6	0,4	0,6	-0,8
Euro Area*	**2,2**	**1,2**	**0,3**	**0,4**	**0,8**	**0,5**	**0,3**	**0,1**	**0,6**	**0,1**
US**	**1,3**	**2,4**	**0,4**	**0,6**	**0,1**	**0,4**	**0,2**	**0,2**	**0,6**	**1,1**
					Table 2b: Manufacturing					
			Contribution from:							
	Labour Productivity Growth		**1, ICT Capital Deepening**		**2, Non-ICT Capital Deepening**		**3, Labour Composition**		**4, TFP**	
	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004
Austria	4,1	4,6	0,2	0,5	0,8	0,6	0,3	0,3	2,8	3,2
Finland	5,6	5,8	0,4	0,4	1,5	0,8	0,6	0,3	3,1	4,3
France	3,7	3,9	0,2	0,5	1,4	0,7	0,5	0,5	1,5	2,2
Germany	3,0	2,6	0,2	0,2	0,8	0,5	0,3	0,4	1,5	1,6
Italy	3,7	-0,1	0,1	0,1	1,0	0,7	0,1	0,1	2,5	-1,0
Netherlands	3,5	2,8	0,4	0,5	0,7	0,4	0,3	0,3	2,1	1,6
Spain	3,5	0,5	0,4	0,3	1,3	0,4	0,3	0,4	1,5	-0,5
Euro Area*	**3,4**	**2,1**	**0,2**	**0,3**	**1,0**	**0,6**	**0,2**	**0,2**	**1,9**	**1,0**
US**	**3,4**	**5,1**	**0,3**	**0,6**	**0,2**	**1,1**	**0,3**	**0,5**	**2,5**	**2,9**
					Table 2c: Private Services					
			Contribution from:							
	Labour Productivity Growth		**1, ICT Capital Deepening**		**2, Non-ICT Capital Deepening**		**3, Labour Composition**		**4, TFP**	
	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004	1983-1995	1996-2004
Austria	2,1	1,1	0,4	0,7	0,6	0,4	0,2	0,2	0,8	0,0
Finland	3,1	1,3	0,3	0,4	1,3	-0,4	0,6	-0,1	0,8	1,4
France	2,0	1,3	0,3	0,4	0,6	0,3	0,5	0,3	0,5	0,3
Germany	2,6	1,7	0,3	0,6	0,7	1,1	0,1	0,1	1,5	-0,1
Italy	1,4	0,1	0,4	0,4	0,7	0,4	0,1	0,1	0,2	-0,8
Netherlands	0,7	1,9	0,4	0,7	0,1	0,3	0,2	0,1	0,0	0,8
Spain	1,6	-0,5	0,4	0,3	0,6	0,1	0,3	0,3	0,2	-1,1
Euro Area*	**2,0**	**0,8**	**0,4**	**0,6**	**0,7**	**0,5**	**0,2**	**0,0**	**0,7**	**-0,2**
US**	**0,9**	**2,4**	**0,4**	**0,9**	**0,1**	**0,4**	**0,2**	**0,3**	**0,1**	**0,8**

* Euro area (Aggregate of 7 countries shown in table) **Bureau of Labour Statistics (BLS)

Source: EU KLEMS and own calculations

Annex 6 : Other EU KLEMS Breakdowns

ICT producing / ICT using industries (Graphs 1-3)[69] : In order to isolate the key role played by ICT in influencing overall productivity developments, graphs 1-3 give a breakdown of the industries in EU KLEMS according to their ICT content. This breakdown into ICT producing, intensive ICT-using and less intensive ICT-using industries was developed by the Groningen Growth and Development Centre (GGDC) in earlier pre-EU KLEMS work on industry level productivity developments. Whilst there has been some questioning of the classification of certain industries (for example, doubts have been expressed regarding the inclusion of wholesale and retail trade in the intensive ICT-using category), nevertheless it can provide useful insights into the relative importance of the different channels (i.e. production, investment and spillover effects) via which ICT impacts on the respective economies.

The ICT focussed EU KLEMS breakdown shown in Graphs 1-3 confirms the main conclusions of the earlier GGDC analysis (which used data up to the year 2000), namely that EU-US productivity differentials reflected differences in the ICT-producing manufacturing and intensive ICT-using private services sectors. One additional point to add relative to the GGDC analysis is that the latest EU KLEMS figures show, in the period since 2000, that in the other categories of the economy where the EU had been dominant (e.g. intensive ICT using manufacturing; rest of manufacturing; ICT producing private services; rest of private services; and rest of economy sector), that the EU's relative position has deteriorated in all of these areas over the period 2001-2004.

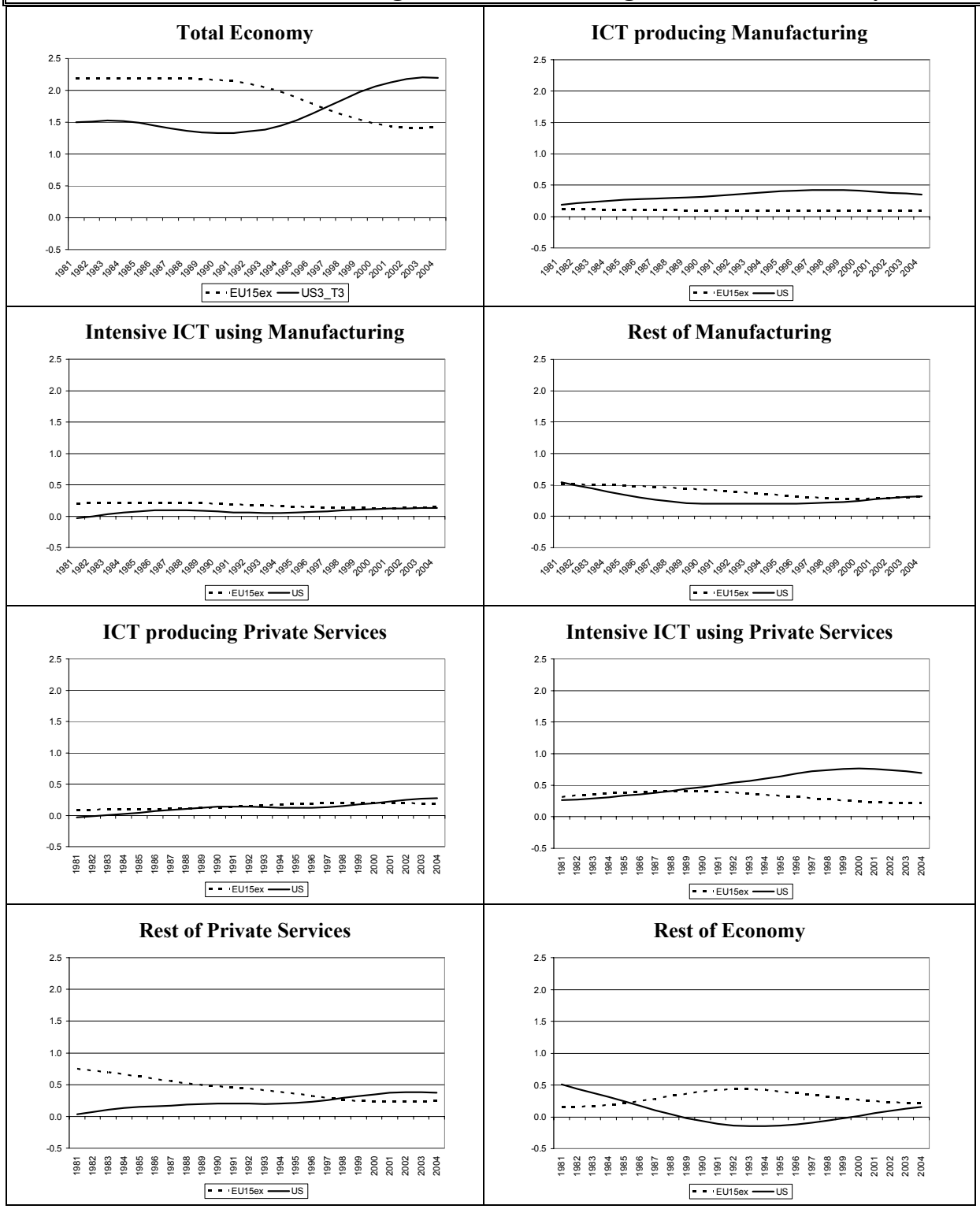
Skills Breakdown (Graphs 4-5) : These graphs provide a quick overview of the contribution of labour services to total value added and of the contribution of high, medium and low skilled workers to total labour services. It also shows the shares of these skills categories in total hours worked for the whole economy, with the impact of the surge in part-time work consequently taken into account. These graphs appear to suggest that the strong labour input performance of the EU's economy since the mid-1990's owes more to the integration of medium and high skilled workers than to a sharp increase in the employment of the low-skilled. This conclusion runs counter to popular perceptions and therefore needs further analysis and independent corroboration.

Breakdown for the EU of "Total Industries" into "Market" and "Non-Market" Economy Sectors (Graph 6) : This breakdown simply shows the value added, labour productivity and labour input trends for the market and non-market economy. The definition of the market economy is the one used by the EU KLEMS consortium, namely it excludes health (ISIC industry N), education (ISIC M), the government sectors (ISIC L) and real estate (ISIC 70) since the output in this latter industry mostly reflects imputed housing rents rather than the sales of firms. As one can see from the graphs, the breakdown looks reasonable, as reflected in the broad stability of the contribution of the non-market economy. The slightly more volatile patterns for

[69] ICT capital is often used as an indicator of the degree of penetration of new technologies in an economy. There are two possible measures of the importance of ICT capital : firstly, the share of ICT compensation in total capital compensation (which rose in the US from an average of 13% over the period 1981-1995 to an average of 20% for 1996-2004 – the equivalent figures for the EU15ex5 aggregate were 10% to 13%) and secondly the share of ICT capital in the total capital stock (where the change for the US was from 4% to 13% and for the EU15ex5 was from 2% to 4%). The first ICT measure is calculated using the rental price / user cost of capital whereas the second uses the market price of new ICT assets.

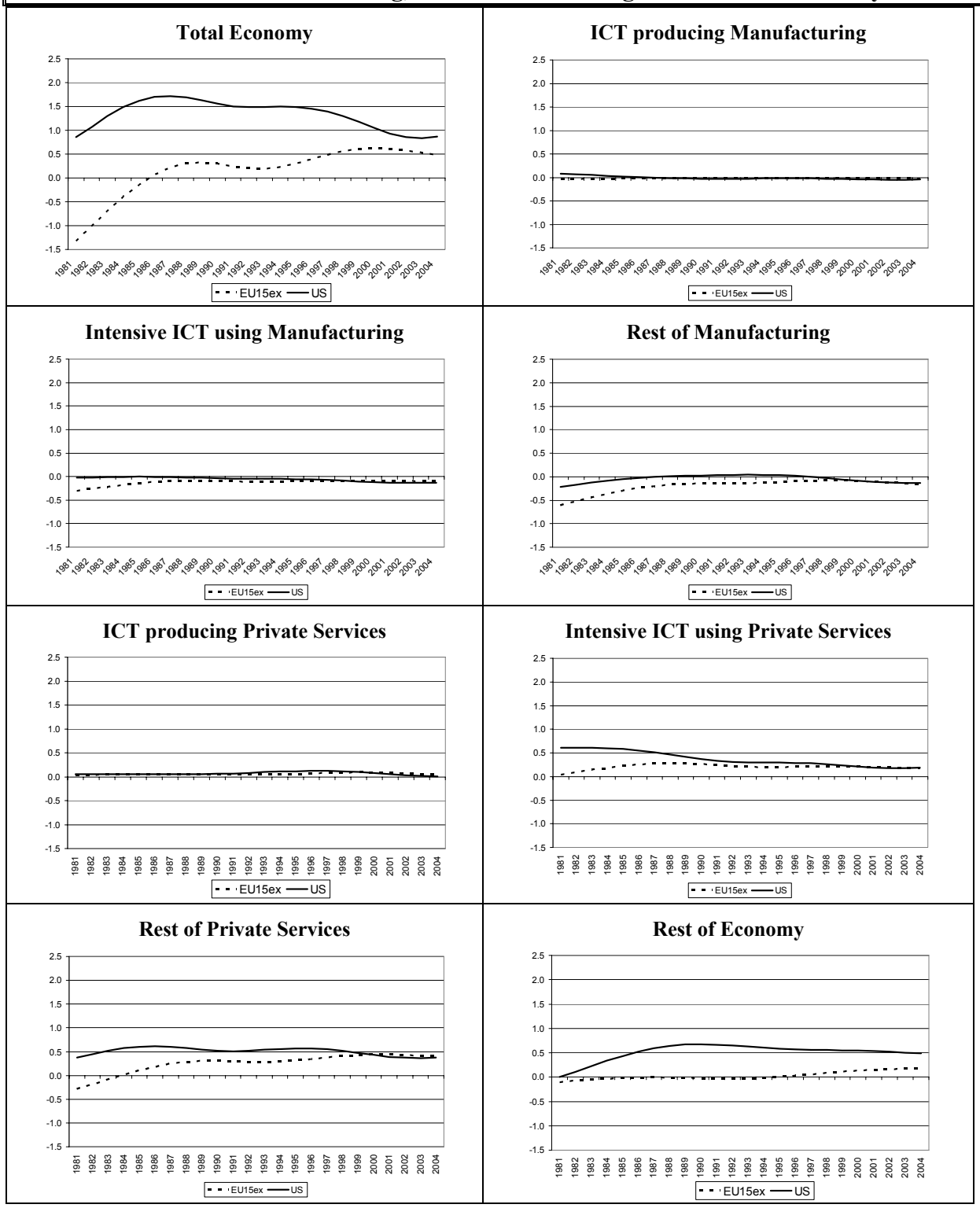
the US may be suggestive of the fact that many of the industries, most notably health and education, have relatively large private sector components.

Graph 1 : EU + US – Trend Contributions to the Growth in Hourly Labour Productivity - Breakdown into ICT-Producing, Intensive ICT-Using and "Rest of Economy" Sectors



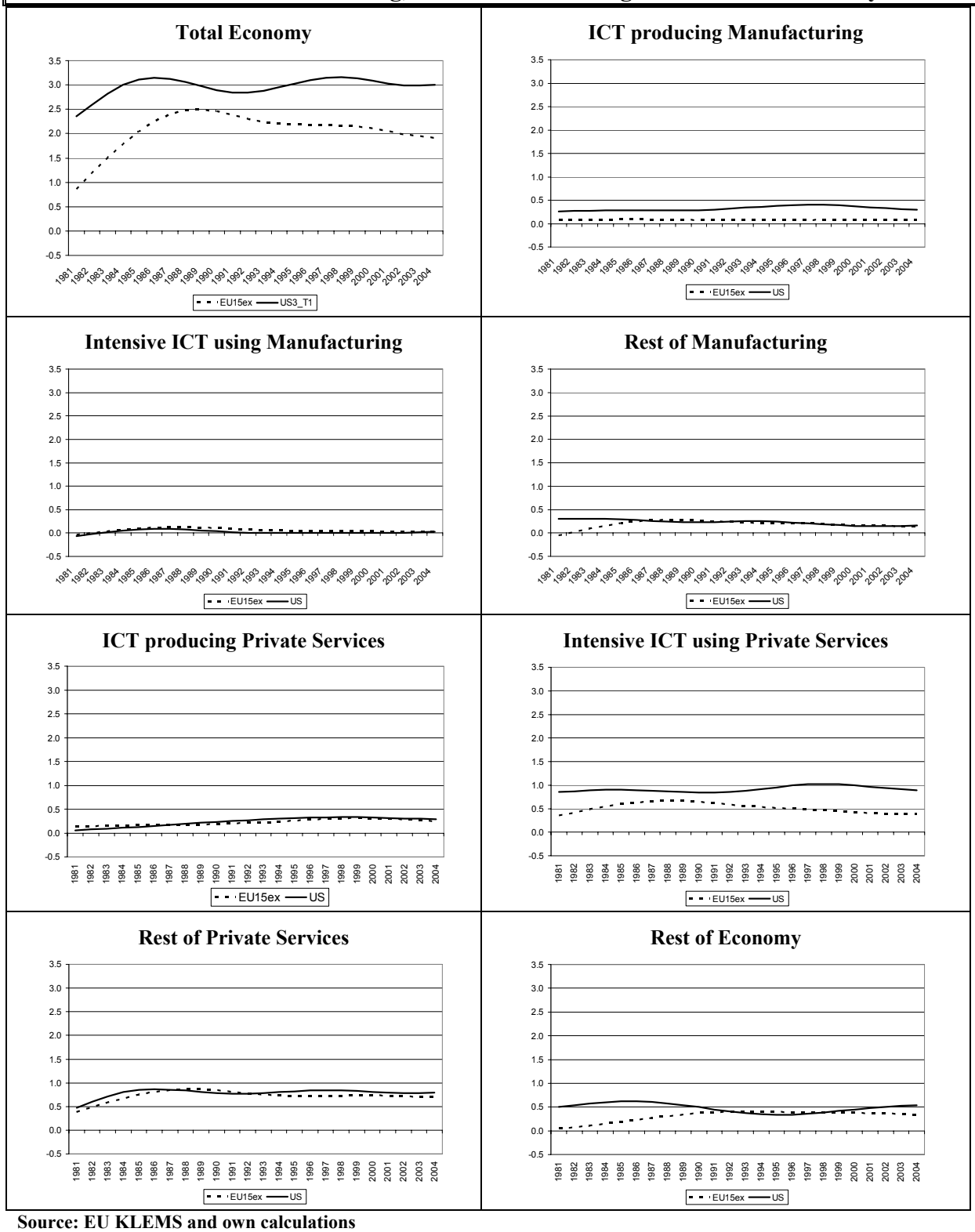
Source: EU KLEMS and own calculations

Graph 2 : EU + US – Trend Contributions to the Growth in Labour Input - Breakdown into ICT-Producing, Intensive ICT-Using and "Rest of Economy" Sectors



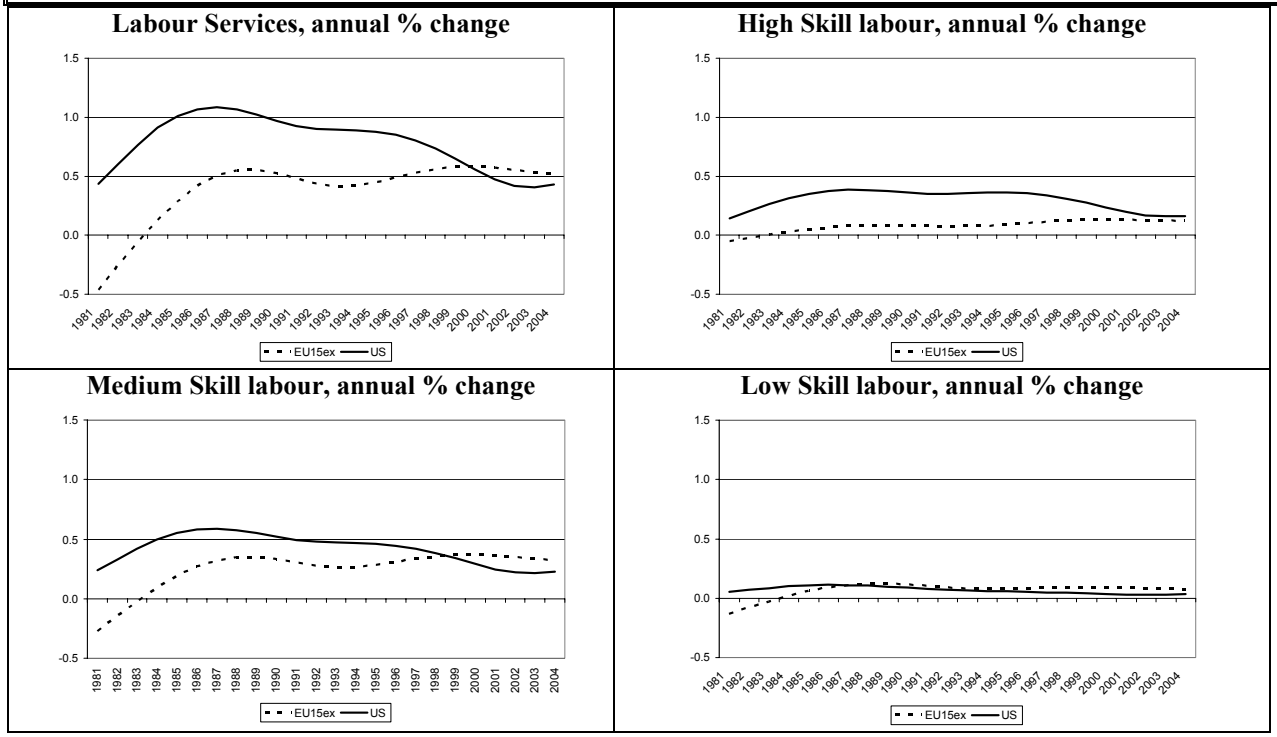
Source: EU KLEMS and own calculations

Graph 3 : EU + US – Trend Contributions to the Growth in Value Added - Breakdown into ICT-Producing, Intensive ICT-Using and "Rest of Economy" Sectors



Source: EU KLEMS and own calculations

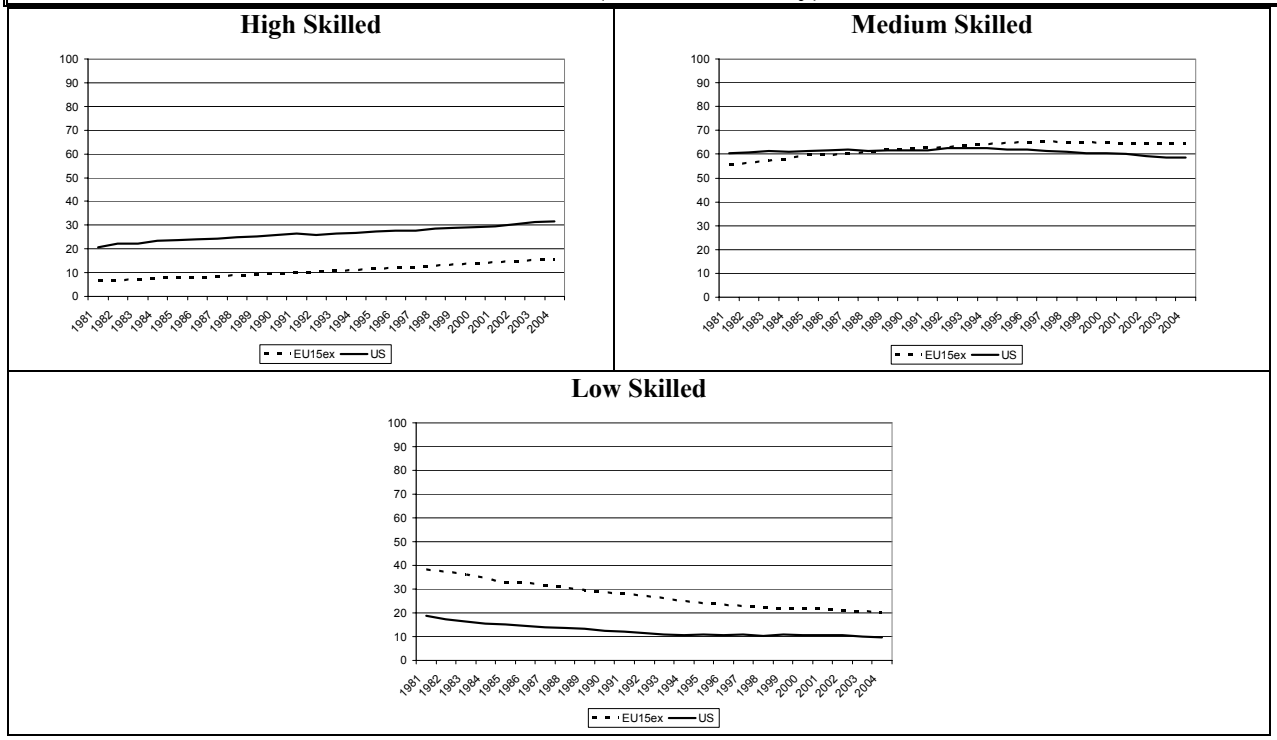
Graph 4 : EU + US – Trend Contributions to the Total Change in Labour Services / Value Added from High, Medium and Low Skilled Workers (Total Economy)*



*The contribution to value added for the different skill groups has been calculated by multiplying the total contribution of labour services to value added growth by the respective shares of high, medium and low skilled workers in total labour compensation.

Source: EU KLEMS and own calculations

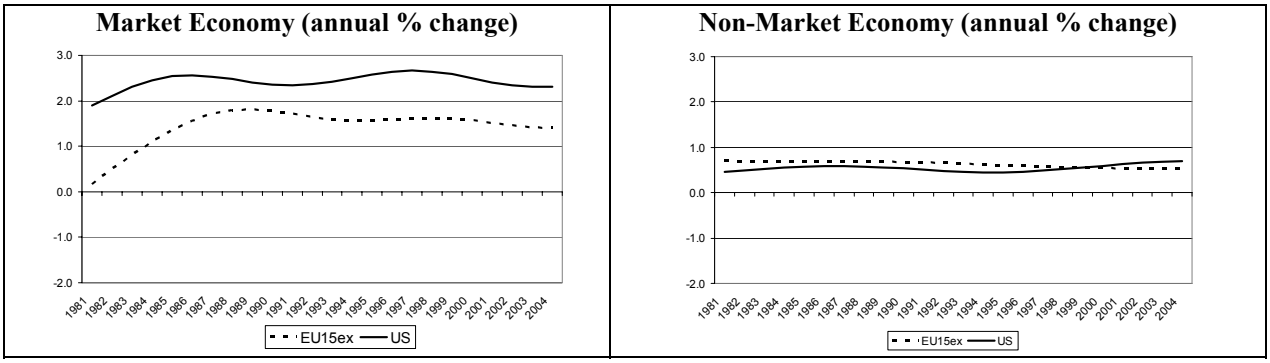
Graph 5 : EU + US – High, Medium and Low Skilled Workers – Shares of Total Hours Worked (Total Economy)



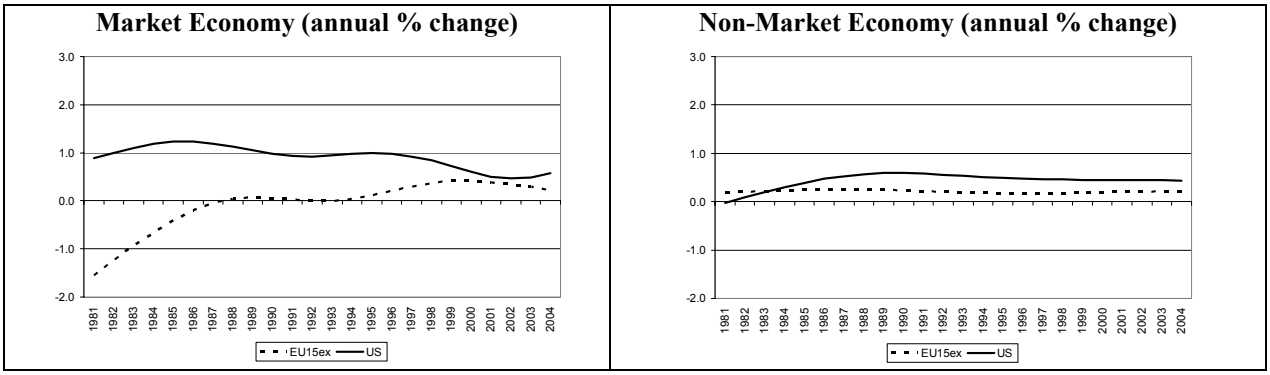
Source: EU KLEMS and own calculations

Graph 6 : EU + US – Trend Contributions to the Total Change in Value Added, Labour Input and Hourly Labour Productivity
- Breakdown into Market and Non-Market Economy Sectors

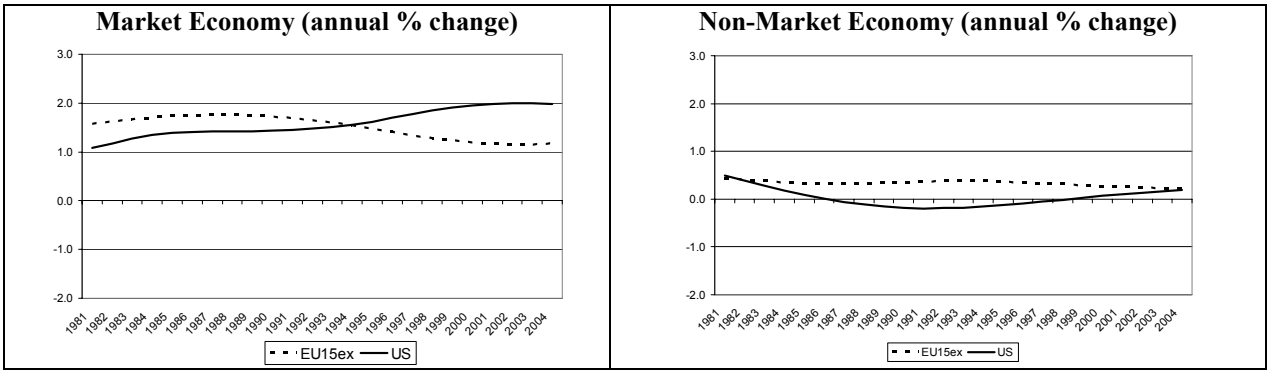
Market Economy and Non-Market Economy – Value Added



Market Economy and Non-Market Economy – Labour Input



Market Economy and Non-Market Economy – Hourly Labour Productivity



Source: EU KLEMS, Commission Services

Annex 7 : Mark-up Analysis

This annex, on the basis of the EU KLEMS datasets, provides estimates of mark-ups for a range of manufacturing and private service industries for ten EU Member States and the US, covering the period 1980-2004. These mark-up estimates are calculated on the basis of the Roeger (1995) method, with a short summary of the latter given below (which follows the description given in Martins et al. (1996b)).

Methodology used to calculate Mark-Ups : For the sake of simplicity, the present outline of the methodology only considers a production function with just capital and labour inputs. Whatever are the specific assumptions about the form of the production function, the following identity always holds:

$$\frac{P \cdot Q}{W \cdot L + R \cdot K} = \frac{\mu}{\lambda} \tag{1}$$

where Q, L and K are real value added, labour and capital inputs, and P, W and R are their respective prices. The coefficient μ is the mark-up ratio of prices over marginal costs and λ is an index of the degree of returns to scale (i.e. average costs / marginal costs). In theory, under the assumption of constant returns to scale (i.e. $\lambda=1$), the mark-up ratio could be directly derived from equation (1). In practice, however, the estimates of the rental price of capital R for individual industries are not available in level terms. Therefore, it is also not possible to have a "true" estimate of the income share of capital for each industry. Indeed, the latter requires an estimation of the average mark-up:

$$\frac{R \cdot K}{P \cdot Q} = \frac{\lambda}{\mu} - \alpha \qquad where \qquad \alpha = \frac{W \cdot L}{P \cdot Q} \tag{2}$$

For the reasons discussed above, the calculation of sectoral mark-up ratios has to be based on equations expressed in growth rates. Assume at this stage that μ and λ are constant. By taking the total differential and using (2), the equation (1) can then be expressed in a growth rate form:

$$\Delta(p+q) = \frac{\mu}{\lambda} \cdot \alpha \cdot \Delta(w+l) + \left(1 - \frac{\mu}{\lambda} \cdot \alpha\right) \cdot \Delta(r+k) \tag{3}$$

where lower case letters denote natural logs, Δ stands for the first-difference and α the labour share in value added. Now define the following expression:

$$NSR = \Delta(p+q) - \alpha \cdot \Delta(w+l) - (1-\alpha) \cdot \Delta(r+k) \tag{4}$$

NSR is the difference between the growth rate of nominal value-added and the weighted average of the growth rates of nominal inputs. This term can therefore be interpreted as a sort of nominal productivity 'residual', much in the same way as the usual *Solow* residual can be defined in volume terms. By using (3) and re-arranging equation (2), one finally gets the following expression:

$$NSR = \left(\frac{\mu}{\lambda} - 1\right) \cdot \alpha \cdot \left[\Delta(w + l) - \Delta(r + k)\right] \tag{5}$$

or even more simply:

$$\Delta(p + q) - \Delta(r + k) = \frac{\mu}{\lambda} \cdot \alpha \cdot \left[\Delta(w + l) - \Delta(r + k)\right] \tag{5a}$$

Equation (5) can also be re-expressed by using the *Lerner index* (*B = (P-MC)/P*), as follows:

$$NSR = \left(\lambda \cdot (B - 1) + 1\right) \cdot \left[\Delta(p + q) - \Delta(r + k)\right] \tag{6}$$

By adding an error term and assuming constant returns to scale, either equation (5) or (6) can be used to estimate the mark-up ratio. The Roeger (1995) derivation is based on the difference between the primal and dual productivity residuals but the final result is the same. The estimation has the advantage of not requiring the use of instrumental variables, as was the case with the original Hall (1986) approach. This is particularly important for analysing mark-ups across several countries where a set of comparable and/or relevant instrumental variables is just not available.

It is clear that with increasing returns to scale ($\lambda > 1$), this method produces a lower-bound estimate of the true mark-ups. Therefore, when the mark-up ratio estimates obtained through this method are significantly positive, this cannot be attributed to the presence of increasing returns to scale, as has been sometimes argued in the literature. On the contrary, taking into account returns to scale would lead to even higher estimates of the pure profits. Conversely, the presence of decreasing returns to scale induces an upward bias in the estimation of the mark-up.

The equations above can be easily extended in order to incorporate intermediate inputs and to express the mark-up ratio over gross output rather than value added. This correction is important, insofar as the mark-up over value added induces a clear upward bias in the estimation. By taking into account intermediate inputs, equation (5) becomes:

$$\begin{aligned} NSR^{GO} &= \Delta\left(p^{GO} + q^{GO}\right) - \alpha^{GO} \cdot \Delta(w + l) - \beta^{GO} \cdot \Delta(p_m + m) - \left(1 - \alpha^{GO} - \beta^{GO}\right) \cdot \Delta(r + k) \\ &= \left(\frac{\mu}{\lambda} - 1\right) \cdot \left[\alpha^{GO} \cdot \Delta(w + l) + \beta^{GO} \cdot \Delta(p_M + m) - \left(\alpha^{GO} + \beta^{GO}\right) \cdot \Delta(r + k)\right] \end{aligned} \tag{7}$$

or in the Lerner-index form:

$$NSR^{GO} = \left(\lambda \cdot (B - 1) + 1\right) \cdot \left[\Delta\left(p^{GO} + q^{GO}\right) - \Delta(r + k)\right] \tag{8}$$

where p^{GO} and q^{GO} correspond to logarithms of gross output and its respective price, m and p_M to intermediate inputs and their prices, and α^{GO} and β^{GO} to the share of labour and intermediate inputs in gross output value, respectively.

Mark up estimates 1980-2004

	ISIC Codes	Austria	Denmark	Germany	Spain	Finland	France	Italy	Netherlands	Sweden	UK	US
Agriculture, Forestry & Fishing	AtB	0,45	0,33	0,28	0,52	0,46	0,40	0,38	0,37	0,50	0,30	0,22
Mining & Quarrying	C	0,35	0,71	0,31	0,27	0,23	0,30	0,61	0,80	0,16	0,57	0,19
Manufacturing	**D**	**0,10**	**0,10**	**0,10**	**0,11**	**0,13**	**0,10**	**0,14**	**0,11**	**0,13**	**0,11**	**0,12**
Electricity, Gas & Water Supply	E	0,30	0,44	0,28	0,25	0,33	0,23	0,10	0,12	0,54	0,22	0,25
Construction	F	0,18	0,08	0,20	0,13	0,12	0,21	0,25	0,11	0,10	0,21	0,02
Wholesale & Retail Trade	G	0,34	0,22	0,17	0,28	0,18	0,20	0,39	0,27	0,22	0,21	0,21
Hotels & Restaurants	H	0,27	0,13	0,09	0,27	0,07	0,20	0,28	0,26	0,17	0,28	0,14
Transport, Storage & Communication	I	0,25	0,15	0,23	0,26	0,29	0,19	0,17	0,23	0,19	0,15	0,21
Financial Intermediation	J	0,38	0,23	0,33	0,30	0,26	0,25	0,33	0,26	0,52	0,14	0,33
Private Services	**E+G+H+I+J**	**0,31**	**0,21**	**0,22**	**0,27**	**0,23**	**0,21**	**0,29**	**0,24**	**0,28**	**0,19**	**0,24**
Total Private Sector	**AtB+C+D+E+F+G+H+I+J**	**0,22**	**0,17**	**0,16**	**0,19**	**0,18**	**0,17**	**0,22**	**0,20**	**0,20**	**0,17**	**0,17**

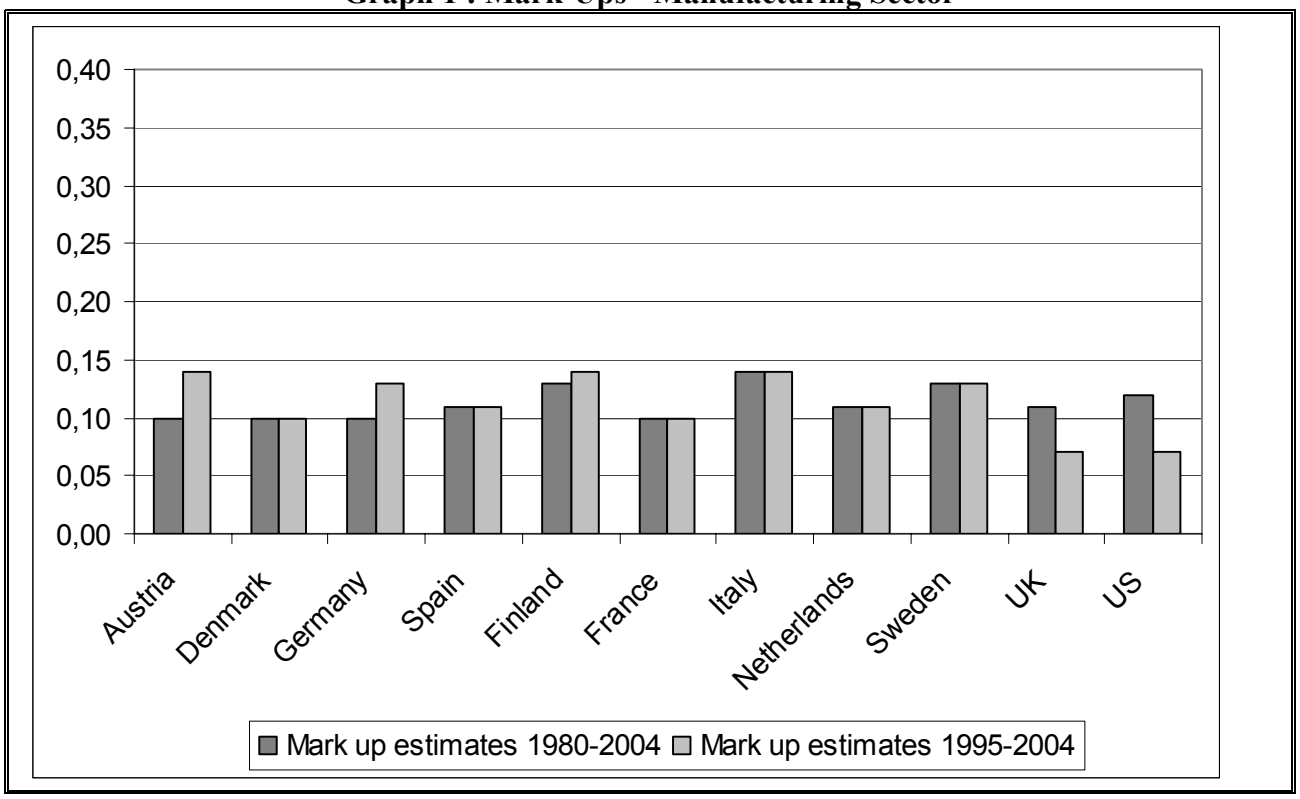
Mark up estimates 1995-2004

	ISIC Codes	Austria	Denmark	Germany	Spain	Finland	France	Italy	Netherlands	Sweden	UK	US
Agriculture, Forestry & Fishing	AtB	0,42	0,33	0,30	0,48	0,43	0,37	0,52	0,36	0,50	0,30	0,26
Mining & Quarrying	C	0,27	0,74	0,39	0,14	0,15	0,32	0,48	0,72	0,16	0,47	0,19
Manufacturing	**D**	**0,14**	**0,10**	**0,13**	**0,11**	**0,14**	**0,10**	**0,14**	**0,11**	**0,13**	**0,07**	**0,07**
Electricity, Gas & Water Supply	E	0,27	0,43	0,36	0,28	0,32	0,19	0,29	0,05	0,54	0,24	0,40
Construction	F	0,28	0,10	0,16	0,13	0,12	0,20	0,24	0,12	0,10	0,18	-0,05
Wholesale & Retail Trade	G	0,34	0,18	0,25	0,28	0,24	0,20	0,33	0,25	0,22	0,18	0,24
Hotels & Restaurants	H	0,20	0,12	0,09	0,29	0,08	0,18	0,35	0,22	0,17	0,16	0,13
Transport, Storage & Communication	I	0,34	0,18	0,28	0,25	0,35	0,10	0,24	0,22	0,19	0,17	0,24
Financial Intermediation	J	0,50	0,25	0,44	0,32	0,37	0,29	0,17	0,24	0,52	0,10	0,37
Private Services	**E+G+H+I+J**	**0,34**	**0,20**	**0,30**	**0,28**	**0,29**	**0,19**	**0,29**	**0,22**	**0,27**	**0,16**	**0,27**
Total Private Sector	**AtB+C+D+E+F+G+H+I+J**	**0,25**	**0,17**	**0,20**	**0,20**	**0,20**	**0,16**	**0,22**	**0,18**	**0,19**	**0,14**	**0,16**

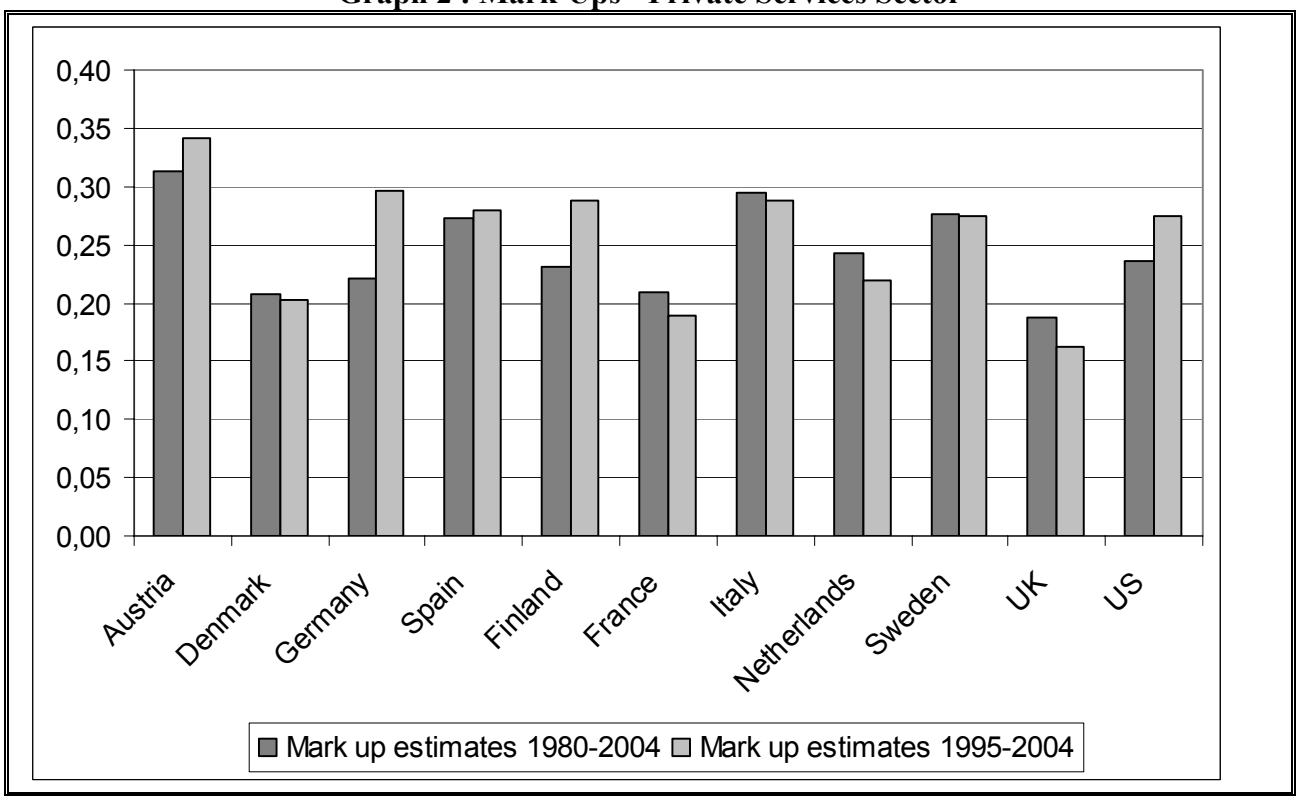
* Based on method laid out in Roeger (1995)

**Note: The US is calculated using a "hybrid" data source which is drawn from two US sources (US-NAICS and US-SIC)

Graph 1 : Mark-Ups - Manufacturing Sector



Graph 2 : Mark-Ups - Private Services Sector



Annex 8 : Additional Background Tables

Table 1 : Geometric Depreciation Rates used in EU KLEMS
(Minimum and maximum over industries)

Asset Type	Minimum over industries	Maximum over industries
Residential Structures	0.011	0.011
Non-Residential Structures	0.023	0.069
Infrastructure	0.023	0.069
Transport Equipment	0.061	0.246
Computing Equipment	0.315	0.315
Communications Equipment	0.115	0.115
Other Machinery and Equipment	0.073	0.164
Products of Agriculture and Forestry	0.073	0.164
Other Products	0.073	0.164
Software	0.315	0.315
Other Intangibles	0.315	0.315

*** See the "Methodology of the first public release of the EU KLEMS Growth and Productivity Accounts" for a list of the depreciation rates by industry (appendix Table 1) (www.euklems.net)**

Table 2 : Value Added Growth Rates, Value Added Shares and Individual Industry Contributions to total economy Value Added Growth (EU + US : 1981-2004)

	EU15						USA (NAICS)					
	Value Added Growth rates		Value Added Shares		Contribution to Total Change in Value Added		Value Added Growth rates		Value Added Shares		Contribution to Total Change in Value Added	
	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004
Total Industries	2,04	2,17	1,00	1,00	2,04	2,17	2,78	3,24	1,00	1,00	2,78	3,24
Manufacturing	1,53	1,51	0,21	0,20	0,34	0,30	2,97	3,04	0,19	0,16	0,58	0,51
Private Services	2,80	2,78	0,51	0,54	1,43	1,50	3,24	3,95	0,53	0,57	1,73	2,24
Rest of Economy	1,07	1,42	0,27	0,26	0,29	0,37	1,77	1,85	0,28	0,27	0,49	0,50
Agric.,For.& Fish. (AtB)	1,62	1,37	0,03	0,02	0,04	0,03	3,35	4,55	0,02	0,01	0,09	0,06
Mining (Energy) (10t12)	-5,24	-1,90	0,02	0,01	-0,13	-0,01	1,03	-0,14	0,02	0,01	0,02	0,00
Mining (13t14)	-10,58	-1,14	0,00	0,00	-0,05	0,00	6,17	-8,22	0,00	0,00	0,01	-0,01
Food & Beverages (15)	0,96	0,51	0,02	0,02	-0,03	0,01	1,76	-0,43	0,02	0,02	0,03	-0,01
Tobacco (16)	0,96	-0,60	0,00	0,00	0,00	0,00	4,61	-0,42	0,00	0,00	0,01	0,00
Textiles (17)	-0,69	-2,14	0,01	0,01	-0,01	-0,01	2,75	-1,82	0,00	0,00	0,01	-0,01
Clothing (18)	-0,69	-2,98	0,01	0,00	0,00	-0,01	0,57	-4,87	0,00	0,00	0,00	-0,01
Leather & Footwear (19)	0,44	-3,50	0,00	0,00	0,00	-0,01	-3,56	-4,34	0,00	0,00	0,00	0,00
Wood & Cork (20)	1,62	2,05	0,00	0,00	0,01	0,01	1,99	0,68	0,00	0,00	0,01	0,00
Pulp & Paper (21)	1,43	1,19	0,01	0,01	0,01	0,01	1,44	-0,47	0,01	0,01	0,01	0,00
Printing & Publishing (22)	1,83	0,56	0,01	0,01	0,02	0,01	0,08	-0,53	0,01	0,01	0,00	-0,01
[Publishing (221)]	1,83	1,18	0,01	0,01	0,01	0,01	0,14	1,17	0,01	0,01	0,00	0,01
Oil & Nuclear Fuel (23)	-0,69	-2,53	0,00	0,00	0,00	-0,01	5,42	1,86	0,00	0,00	0,03	0,01
Chemicals (24)	3,92	2,91	0,02	0,02	0,09	0,06	2,90	2,43	0,02	0,02	0,06	0,05
[Pharmaceuticals (244)]	3,92	5,47	0,01	0,01	0,02	0,04	6,97	5,89	0,00	0,01	0,02	0,03
Rubber & Plastics (25)	3,90	2,94	0,01	0,01	0,04	0,03	5,58	3,47	0,01	0,01	0,04	0,03
Other Minerals (26)	1,09	1,05	0,01	0,01	0,01	0,01	1,94	2,63	0,01	0,00	0,01	0,01
Basic Metals (27)	2,11	0,14	0,01	0,01	0,03	0,00	-1,64	1,01	0,01	0,01	-0,02	0,01
Fabricated Metal (28)	-0,79	2,01	0,02	0,02	-0,02	0,04	2,07	0,38	0,02	0,01	0,03	0,01
Machinery nec (29)	1,01	0,93	0,02	0,02	0,02	0,02	-0,30	0,40	0,02	0,01	-0,01	0,01
Computers (30)	7,43	5,66	0,00	0,00	0,02	0,01	46,79	58,75	0,00	0,00	0,13	0,14
Electrical Machinery (31)	1,55	0,73	0,01	0,01	0,02	0,01	1,17	-0,47	0,01	0,00	0,01	0,00
[Insulated Cables (313)]	1,55	-2,58	0,00	0,00	0,00	0,00	0,99	-4,45	0,00	0,00	0,00	0,00
Communications Eq. (32)	5,13	9,19	0,01	0,01	0,03	0,06	14,92	18,71	0,01	0,01	0,15	0,22
[Semiconductors (321)]	5,13	13,86	0,00	0,00	0,01	0,03	20,82	26,73	0,01	0,01	0,14	0,20
[Telecom.Eq. (322)]	5,13	9,00	0,00	0,00	0,02	0,03	3,60	3,84	0,00	0,00	0,01	0,02
[Radio & TV (323)]	5,13	1,96	0,00	0,00	0,01	0,00	10,23	-3,10	0,00	0,00	0,00	0,00
Medical Instruments (33)	3,62	4,59	0,01	0,01	0,02	0,03	0,93	1,13	0,01	0,01	0,01	0,01
Motor Vehicles (34)	1,61	2,82	0,01	0,01	0,03	0,04	4,56	3,13	0,01	0,01	0,08	0,04
Other Transport Eq. (35)	0,11	1,78	0,01	0,00	0,00	0,01	-0,71	1,37	0,01	0,01	0,01	0,01
Manufacturing nec (36t37)	0,36	0,44	0,01	0,01	0,00	0,00	2,75	2,88	0,01	0,01	0,02	0,02
Electricity, Gas & Water (E)	2,70	2,51	0,03	0,02	0,08	0,06	4,02	1,34	0,02	0,02	0,09	0,02
Construction (F)	0,64	1,25	0,06	0,06	0,03	0,08	0,96	1,55	0,04	0,05	0,05	0,07
Motor Vehicles-Retail (50)	1,95	2,00	0,02	0,02	0,04	0,03	4,27	4,97	0,03	0,02	0,11	0,12
Wholesale Trade (51)	2,50	2,94	0,04	0,04	0,09	0,11	4,52	6,57	0,05	0,05	0,22	0,32
Retail Trade (52)	2,41	1,74	0,04	0,04	0,11	0,08	3,73	4,69	0,05	0,05	0,20	0,24
Hotels & Restaurants (H)	0,98	1,78	0,02	0,02	0,02	0,04	2,45	2,84	0,02	0,02	0,06	0,07
Inland Transport (60)	3,15	2,32	0,03	0,03	0,10	0,06	2,61	1,35	0,02	0,02	0,04	0,02
Water Transport (61)	6,16	9,55	0,00	0,00	0,01	0,03	2,98	-0,27	0,00	0,00	0,00	0,00
Air Transport (62)	-0,25	1,33	0,00	0,00	0,00	0,01	6,68	7,83	0,00	0,01	0,03	0,04
Aux. Transport Services (63)	3,06	3,15	0,02	0,02	0,05	0,05	3,37	3,35	0,01	0,01	0,02	0,02
Telecommunications (64)	4,45	8,17	0,03	0,02	0,12	0,20	2,53	4,76	0,03	0,03	0,08	0,15
Financial services (65)	2,43	4,05	0,04	0,04	-0,03	0,15	2,48	3,72	0,04	0,04	0,09	0,16
Insurance & Pensions (66)	2,43	-2,86	0,01	0,01	-0,01	-0,03	1,74	0,00	0,02	0,03	0,04	0,00
Aux. Financial Services (67)	2,43	5,17	0,01	0,01	-0,01	0,04	11,33	16,07	0,01	0,02	0,10	0,26
Real Estate Services (70)	3,43	1,99	0,09	0,11	0,32	0,22	2,44	2,84	0,10	0,10	0,25	0,30
Renting of Machinery (71)	4,84	4,88	0,01	0,01	0,04	0,05	2,56	3,85	0,00	0,00	0,01	0,02
Computer Services (72)	4,86	7,89	0,01	0,02	0,05	0,12	10,63	9,85	0,01	0,02	0,10	0,19
R&D (73)	3,17	1,33	0,00	0,00	0,01	0,01	4,84	-7,45	0,01	0,01	0,04	-0,03
Other Business Services (74)	4,53	3,17	0,06	0,07	0,25	0,22	3,70	4,04	0,06	0,08	0,22	0,32
Public Admin. & Defence (L)	1,58	0,93	0,08	0,07	0,12	0,07	0,92	0,96	0,10	0,09	0,09	0,08
Education (M)	1,72	0,90	0,06	0,06	0,10	0,06	1,25	1,93	0,04	0,05	0,05	0,09
Health & Social Work (N)	2,28	2,58	0,06	0,06	0,13	0,16	1,91	2,11	0,07	0,08	0,13	0,16
Sewage & Refuse (90)	2,26	1,23	0,01	0,01	0,00	0,01	1,17	1,67	0,00	0,00	0,00	0,01
Club Activities (91)	2,26	0,94	0,00	0,01	0,00	0,00	2,56	2,94	0,01	0,01	0,02	0,02
Recreational (92)	2,26	2,93	0,01	0,02	0,01	0,05	5,88	4,20	0,01	0,02	0,07	0,08
Other Services (93)	2,26	0,80	0,01	0,01	0,00	0,01	3,33	2,67	0,01	0,01	0,02	0,02

Source: EU KLEMS and own calculations

Table 3 : Labour Input Growth Rates, Labour Input Shares and Individual Industry Contributions to total economy Labour Input Growth (EU + US : 1981-2004)

	EU15						USA (NAICS)					
	Labour Input Growth rates		Labour Input Shares		Contribution to Total Change in Labour Input		Labour Input Growth rates		Labour Input Shares		Contribution to Total Change in Labour Input	
	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004
Total Industries	-0,20	0,78	1,00	1,00	-0,20	0,78	1,44	0,95	1,00	1,00	1,44	0,95
Manufacturing	-1,99	-0,97	0,22	0,18	-0,44	-0,17	-0,31	-1,98	0,19	0,15	-0,06	-0,27
Private Services	0,71	1,58	0,45	0,50	0,32	0,78	2,09	1,39	0,48	0,51	1,01	0,71
Rest of Economy	-0,22	0,54	0,33	0,32	-0,07	0,17	1,51	1,54	0,33	0,34	0,49	0,52
Agric.,For.& Fish. (AtB)	-3,83	-2,40	0,09	0,06	-0,33	-0,13	-0,27	1,08	0,02	0,02	-0,01	0,02
Mining (Energy) (10t12)	-8,14	-6,99	0,00	0,00	-0,03	-0,01	-3,61	-0,26	0,01	0,00	-0,02	0,00
Mining (13t14)	-3,75	-1,62	0,00	0,00	-0,01	0,00	-1,07	-1,47	0,00	0,00	0,00	0,00
Food & Beverages (15)	n.a.	-0,32	0,02	0,02	n.a.	-0,01	0,08	0,15	0,02	0,02	0,00	0,00
Tobacco (16)	n.a.	-4,07	0,00	0,00	n.a.	0,00	-7,39	-2,71	0,00	0,00	0,00	0,00
Textiles (17)	n.a.	-3,50	0,01	0,01	n.a.	-0,02	-1,40	-5,55	0,01	0,00	-0,01	-0,02
Clothing (18)	n.a.	-4,48	0,01	0,01	n.a.	-0,03	-2,56	-10,78	0,01	0,00	-0,02	-0,04
Leather & Footwear (19)	-3,24	-3,24	0,00	0,00	-0,02	-0,01	-4,67	-8,68	0,00	0,00	-0,01	0,00
Wood & Cork (20)	-1,53	-1,15	0,01	0,01	-0,01	-0,01	0,88	-0,61	0,01	0,01	0,01	0,00
Pulp & Paper (21)	-1,96	-1,65	0,01	0,00	-0,01	-0,01	0,17	-3,07	0,01	0,01	0,00	-0,01
Printing & Publishing (22)	-0,25	-0,94	0,01	0,01	0,00	-0,01	1,16	-1,89	0,02	0,01	0,02	-0,02
[Publishing (221)]	n.a.	-0,24	0,00	0,00	n.a.	0,00	0,69	-1,07	0,01	0,01	0,01	-0,01
Oil & Nuclear Fuel (23)	-3,55	-1,54	0,00	0,00	0,00	0,00	-1,31	-2,31	0,00	0,00	0,00	0,00
Chemicals (24)	-2,10	-1,13	0,01	0,01	-0,03	-0,01	-0,24	-1,16	0,01	0,01	0,00	-0,01
[Pharmaceuticals (244)]	n.a.	1,27	0,00	0,00	n.a.	0,00	1,77	3,32	0,00	0,00	0,00	0,01
Rubber & Plastics (25)	-0,14	0,04	0,01	0,01	0,00	0,00	1,68	-1,56	0,01	0,01	0,01	-0,01
Other Minerals (26)	-2,23	-0,81	0,01	0,01	-0,02	-0,01	-0,08	-0,13	0,01	0,00	0,00	0,00
Basic Metals (27)	-3,90	-2,01	0,01	0,01	-0,04	-0,01	-2,82	-3,18	0,01	0,01	-0,02	-0,01
Fabricated Metal (28)	-1,56	0,12	0,02	0,02	-0,03	0,00	-0,72	-1,11	0,02	0,01	-0,01	-0,01
Machinery nec (29)	-2,12	-0,69	0,02	0,02	-0,05	-0,01	-1,05	-2,75	0,02	0,01	-0,02	-0,03
Computers (30)	-0,42	-3,14	0,00	0,00	0,00	0,00	-0,92	-6,36	0,00	0,00	0,00	-0,01
Electrical Machinery (31)	-1,58	-1,57	0,01	0,01	-0,02	-0,01	0,60	-3,54	0,01	0,00	0,01	-0,01
[Insulated Cables (313)]	n.a.	-3,23	0,00	0,00	n.a.	0,00	1,60	-4,23	0,00	0,00	0,00	0,00
Communications Eq. (32)	-2,08	-1,65	0,01	0,00	-0,01	-0,01	0,86	-3,50	0,01	0,01	0,01	-0,02
[Semiconductors (321)]	n.a.	0,28	0,00	0,00	n.a.	0,00	0,79	-2,73	0,01	0,00	0,01	-0,01
[Telecom.Eq. (322)]	n.a.	-1,50	0,00	0,00	n.a.	0,00	1,31	-5,18	0,00	0,00	0,00	-0,01
[Radio & TV (323)]	n.a.	-5,05	0,00	0,00	n.a.	0,00	-1,51	-3,12	0,00	0,00	0,00	0,00
Medical Instruments (33)	-1,94	0,03	0,01	0,01	-0,01	0,00	-1,23	-0,80	0,01	0,01	-0,01	0,00
Motor Vehicles (34)	-2,25	0,43	0,01	0,01	-0,03	0,01	1,86	-1,43	0,01	0,01	0,02	-0,01
Other Transport Eq. (35)	-3,97	-0,79	0,01	0,00	-0,03	0,00	-1,86	-1,56	0,01	0,01	-0,01	-0,01
Manufacturing nec (36t37)	-1,10	-0,67	0,01	0,01	-0,01	-0,01	0,56	-0,53	0,01	0,01	0,01	0,00
Electricity, Gas & Water (E)	-0,93	-2,31	0,01	0,01	-0,01	-0,02	-0,16	-2,11	0,01	0,00	0,00	-0,01
Construction (F)	-0,79	1,10	0,08	0,08	-0,06	0,09	1,25	2,73	0,06	0,06	0,08	0,17
Motor Vehicles-Retail (50)	-0,28	1,13	0,02	0,02	-0,01	0,03	1,44	0,21	0,03	0,03	0,05	0,01
Wholesale Trade (51)	0,16	0,70	0,05	0,05	0,01	0,03	1,09	0,08	0,05	0,04	0,05	0,00
Retail Trade (52)	0,30	0,57	0,08	0,08	0,02	0,05	1,43	1,09	0,09	0,09	0,13	0,09
Hotels & Restaurants (H)	1,68	1,97	0,04	0,05	0,07	0,10	2,26	1,87	0,05	0,05	0,11	0,10
Inland Transport (60)	-0,27	0,12	0,03	0,03	-0,01	0,00	0,56	1,29	0,02	0,02	0,01	0,02
Water Transport (61)	-2,58	-1,18	0,00	0,00	0,00	0,00	-1,31	0,44	0,00	0,00	0,00	0,00
Air Transport (62)	-0,02	0,65	0,00	0,00	0,00	0,00	5,33	-0,23	0,00	0,00	0,02	0,00
Aux. Transport Services (63)	0,40	3,21	0,01	0,02	0,01	0,05	0,22	1,01	0,01	0,01	0,00	0,01
Telecommunications (64)	-0,46	-0,39	0,02	0,01	-0,01	-0,01	0,59	-0,36	0,02	0,02	0,01	0,00
Financial services (65)	n.a.	0,09	0,02	0,02	n.a.	0,00	1,24	2,24	0,02	0,02	0,03	0,04
Insurance & Pensions (66)	n.a.	-0,40	0,01	0,01	n.a.	0,00	1,75	0,35	0,02	0,02	0,03	0,01
Aux. Financial Services (67)	n.a.	1,37	0,01	0,01	n.a.	0,01	5,43	2,05	0,00	0,01	0,02	0,01
Real Estate Services (70)	2,78	2,01	0,01	0,01	0,02	0,02	0,93	2,21	0,01	0,01	0,01	0,03
Renting of Machinery (71)	1,92	3,21	0,00	0,00	0,00	0,01	3,53	1,96	0,00	0,00	0,01	0,01
Computer Services (72)	5,19	6,70	0,01	0,01	0,04	0,09	7,97	6,01	0,01	0,01	0,05	0,08
R&D (73)	1,37	1,60	0,00	0,00	0,00	0,01	9,39	1,23	0,00	0,00	0,04	0,01
Other Business Services (74)	4,29	4,06	0,05	0,09	0,23	0,34	5,16	1,46	0,08	0,10	0,38	0,15
Public Admin. & Defence (L)	0,31	-0,32	0,07	0,07	0,02	-0,02	-0,61	-0,56	0,07	0,05	-0,05	-0,03
Education (M)	0,99	1,53	0,05	0,05	0,05	0,08	1,79	1,93	0,10	0,11	0,18	0,20
Health & Social Work (N)	1,82	1,68	0,07	0,08	0,13	0,14	3,55	2,43	0,08	0,10	0,30	0,25
Sewage & Refuse (90)	n.a.	2,52	0,01	0,01	n.a.	0,02	3,88	1,89	0,00	0,00	0,01	0,01
Club Activities (91)	n.a.	0,30	0,01	0,01	n.a.	0,00	2,61	2,13	0,01	0,02	0,04	0,04
Recreational (92)	n.a.	2,80	0,02	0,02	n.a.	0,05	2,65	2,05	0,02	0,02	0,04	0,04
Other Services (93)	n.a.	1,77	0,01	0,01	n.a.	0,02	1,50	0,80	0,01	0,01	0,02	0,01

Source: EU KLEMS and own calculations

Table 4 : Labour Productivity Growth Rates, Value Added Shares and Individual Industry Contributions to total economy Labour Productivity Growth (EU + US : 1981-2004)

	EU15						USA (NAICS)					
	Labour Productivity Growth rates		Value Added Shares		Contribution to Total Change in Labour Productivity		Labour Productivity Growth rates		Value Added Shares		Contribution to Total Change in Labour Productivity	
	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004	1981-1995	1996-2004
Total Industries	2,24	1,39	1,00	1,00	2,24	1,39	1,34	2,29	1,00	1,00	1,34	2,29
Manufacturing	3,52	2,47	0,21	0,20	0,75	0,48	3,29	5,02	0,19	0,16	0,63	0,80
Private Services	2,09	1,20	0,51	0,54	1,06	0,65	1,16	2,56	0,53	0,57	0,62	1,47
Rest of Economy	1,28	0,87	0,27	0,26	0,35	0,23	0,27	0,30	0,28	0,27	0,07	0,09
Agric.,For.& Fish. (AtB)	5,45	3,77	0,03	0,02	0,14	0,07	3,62	3,46	0,02	0,01	0,09	0,05
Mining (Energy) (10t12)	2,90	5,09	0,02	0,01	-0,02	0,03	4,64	0,12	0,02	0,01	0,05	-0,01
Mining (13t14)	-6,82	0,49	0,00	0,00	-0,03	0,00	7,24	-6,74	0,00	0,00	0,01	-0,01
Food & Beverages (15)	n.a.	0,83	0,02	0,02	n.a.	0,02	1,67	-0,58	0,02	0,02	0,03	-0,01
Tobacco (16)	n.a.	3,47	0,00	0,00	n.a.	0,00	12,00	2,29	0,00	0,00	0,02	0,00
Textiles (17)	n.a.	1,35	0,01	0,01	n.a.	0,01	4,15	3,74	0,00	0,00	0,02	0,01
Clothing (18)	n.a.	1,51	0,01	0,00	n.a.	0,01	3,13	5,91	0,00	0,00	0,01	0,01
Leather & Footwear (19)	3,68	-0,26	0,00	0,00	0,01	0,00	1,11	4,34	0,00	0,00	0,00	0,00
Wood & Cork (20)	3,15	3,20	0,00	0,00	0,01	0,01	1,11	1,29	0,00	0,00	0,01	0,00
Pulp & Paper (21)	3,39	2,83	0,01	0,01	0,02	0,02	1,26	2,60	0,01	0,01	0,01	0,01
Printing & Publishing (22)	2,08	1,49	0,01	0,01	0,02	0,02	-1,08	1,36	0,01	0,01	-0,01	0,02
[Publishing (221)]	n.a.	1,42	0,01	0,01	n.a.	0,01	-0,56	2,25	0,01	0,01	0,00	0,02
Oil & Nuclear Fuel (23)	2,86	-0,99	0,00	0,00	0,01	0,00	6,72	4,17	0,00	0,00	0,04	0,01
Chemicals (24)	6,03	4,04	0,02	0,02	0,13	0,08	3,14	3,59	0,02	0,02	0,06	0,07
[Pharmaceuticals (244)]	n.a.	4,20	0,01	0,01	n.a.	0,03	5,19	2,57	0,00	0,01	0,02	0,01
Rubber & Plastics (25)	4,04	2,91	0,01	0,01	0,04	0,03	3,90	5,02	0,01	0,01	0,03	0,04
Other Minerals (26)	3,32	1,86	0,01	0,01	0,03	0,02	2,03	2,76	0,01	0,00	0,01	0,01
Basic Metals (27)	6,01	2,15	0,01	0,01	0,07	0,02	1,17	4,18	0,01	0,01	0,01	0,02
Fabricated Metal (28)	0,77	1,89	0,02	0,02	0,01	0,04	2,79	1,49	0,02	0,01	0,04	0,02
Machinery nec (29)	3,14	1,62	0,02	0,02	0,07	0,04	0,74	3,15	0,02	0,01	0,01	0,04
Computers (30)	7,85	8,80	0,00	0,00	0,02	0,01	47,71	65,11	0,00	0,00	0,13	0,15
Electrical Machinery (31)	3,13	2,31	0,01	0,01	0,04	0,02	0,58	3,07	0,01	0,00	0,00	0,01
[Insulated Cables (313)]	n.a.	0,65	0,00	0,00	n.a.	0,00	-0,61	-0,22	0,00	0,00	0,00	0,00
Communications Eq. (32)	7,21	10,85	0,01	0,01	0,04	0,06	14,07	22,21	0,01	0,01	0,14	0,24
[Semiconductors (321)]	n.a.	13,58	0,00	0,00	n.a.	0,03	20,02	29,46	0,01	0,01	0,13	0,21
[Telecom.Eq. (322)]	n.a.	10,50	0,00	0,00	n.a.	0,03	2,29	9,02	0,00	0,00	0,01	0,03
[Radio & TV (323)]	n.a.	7,02	0,00	0,00	n.a.	0,01	11,73	0,02	0,00	0,00	0,00	0,00
Medical Instruments (33)	5,56	4,55	0,01	0,01	0,03	0,03	2,17	1,93	0,01	0,01	0,02	0,02
Motor Vehicles (34)	3,86	2,38	0,01	0,01	0,06	0,04	2,70	4,56	0,01	0,01	0,04	0,06
Other Transport Eq. (35)	4,09	2,57	0,01	0,00	0,02	0,01	1,15	2,93	0,01	0,01	0,03	0,02
Manufacturing nec (36t37)	1,46	1,11	0,01	0,01	0,01	0,01	2,20	3,41	0,01	0,01	0,02	0,02
Electricity, Gas & Water (E)	3,63	4,82	0,03	0,02	0,10	0,11	4,18	3,45	0,02	0,02	0,10	0,06
Construction (F)	1,42	0,15	0,06	0,06	0,09	0,01	-0,29	-1,18	0,04	0,05	-0,01	-0,06
Motor Vehicles-Retail (50)	2,23	0,87	0,02	0,02	0,04	0,02	2,84	4,76	0,03	0,02	0,07	0,11
Wholesale Trade (51)	2,34	2,24	0,04	0,04	0,09	0,09	3,43	6,49	0,05	0,05	0,16	0,31
Retail Trade (52)	2,11	1,17	0,04	0,04	0,09	0,05	2,30	3,60	0,05	0,05	0,13	0,18
Hotels & Restaurants (H)	-0,70	-0,19	0,02	0,02	-0,01	0,00	0,19	0,97	0,02	0,02	0,00	0,02
Inland Transport (60)	3,42	2,19	0,03	0,03	0,10	0,05	2,05	0,06	0,02	0,02	0,04	0,00
Water Transport (61)	8,74	10,72	0,00	0,00	0,02	0,03	4,30	-0,70	0,00	0,00	0,00	0,00
Air Transport (62)	-0,23	0,68	0,00	0,00	0,00	0,00	1,35	8,06	0,00	0,01	0,01	0,04
Aux. Transport Services (63)	2,66	-0,06	0,02	0,02	0,04	0,00	3,15	2,34	0,01	0,01	0,02	0,02
Telecommunications (64)	4,91	8,56	0,03	0,02	0,13	0,21	1,94	5,12	0,03	0,03	0,06	0,16
Financial services (65)	n.a.	3,96	0,04	0,04	n.a.	0,15	1,24	1,47	0,04	0,04	0,04	0,07
Insurance & Pensions (66)	n.a.	-2,46	0,01	0,01	n.a.	-0,02	-0,01	-0,36	0,02	0,03	0,00	-0,01
Aux. Financial Services (67)	n.a.	3,81	0,01	0,01	n.a.	0,03	5,90	14,02	0,01	0,02	0,06	0,23
Real Estate Services (70)	0,64	-0,02	0,09	0,11	0,06	0,00	1,51	0,63	0,10	0,10	0,15	0,07
Renting of Machinery (71)	2,92	1,67	0,01	0,01	0,02	0,02	-0,96	1,89	0,00	0,00	0,00	0,01
Computer Services (72)	-0,33	1,19	0,01	0,02	0,00	0,02	2,66	3,84	0,01	0,02	0,03	0,08
R&D (73)	1,79	-0,27	0,00	0,00	0,01	0,00	-4,55	-8,68	0,01	0,01	-0,02	-0,03
Other Business Services (74)	0,24	-0,89	0,06	0,07	0,01	-0,06	-1,46	2,58	0,06	0,08	-0,08	0,21
Public Admin. & Defence (L)	1,27	1,25	0,08	0,07	0,10	0,09	1,53	1,52	0,10	0,09	0,15	0,13
Education (M)	0,73	-0,62	0,06	0,06	0,04	-0,04	-0,55	0,00	0,04	0,05	-0,02	0,00
Health & Social Work (N)	0,46	0,90	0,06	0,06	0,03	0,06	-1,63	-0,33	0,07	0,08	-0,11	-0,02
Sewage & Refuse (90)	n.a.	-1,28	0,01	0,01	n.a.	-0,01	-2,71	-0,23	0,00	0,00	-0,01	0,00
Club Activities (91)	n.a.	0,64	0,00	0,01	n.a.	0,00	-0,05	0,81	0,01	0,01	0,00	0,01
Recreational (92)	n.a.	0,13	0,01	0,02	n.a.	0,00	3,23	2,15	0,01	0,02	0,04	0,04
Other Services (93)	n.a.	-0,97	0,01	0,01	n.a.	-0,01	1,82	1,87	0,01	0,01	0,01	0,01

Source: EU KLEMS and own calculations

Table 5a : Value Added, Labour and Capital Shares (EU)

EU15ex6	Value Added - Share in Total Value Added		Hours Worked - Share in Total Hours Worked		Labour Share in Total Value Added		Capital Share in Total Value Added		ICT Compensation - Share in Total Capital Compensation		Non-ICT Compensation - Share in Total Capital Compensation		ICT Capital - Share of Total Capital Stock		Non-ICT Capital - Share of Total Capital Stock	
	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004
Total Industries	1,00	1,00	1,00	1,00	0,68	0,66	0,32	0,34	0,10	0,13	0,90	0,87	0,02	0,04	0,98	0,96
Sectors																
Manufacturing (D)	0,22	0,20	0,22	0,18	0,16	0,14	0,06	0,06	0,08	0,12	0,92	0,88	0,03	0,06	0,97	0,94
Private Services (G+H+I+JtK+E+F)	0,51	0,54	0,45	0,50	0,31	0,31	0,20	0,24	0,10	0,14	0,90	0,86	0,01	0,04	0,99	0,96
Rest of Economy (AtB+C+LtQ)	0,27	0,26	0,33	0,32	0,22	0,21	0,05	0,05	0,10	0,11	0,90	0,89	0,01	0,03	0,99	0,97
Industries																
Agriculture Hunting Forestry (AtB)	0,03	0,02	0,08	0,05	0,03	0,01	0,00	0,00	0,93	0,01	0,07	0,99	0,00	0,00	1,00	1,00
Food Beverages and Tobacco (15t16)	0,02	0,02	0,03	0,02	0,01	0,01	0,01	0,01	0,06	0,07	0,94	0,93	0,02	0,04	0,98	0,96
Textiles and Clothing (17t18)	0,02	0,01	0,02	0,01	0,01	0,01	0,00	0,00	0,06	0,11	0,94	0,89	0,02	0,05	0,98	0,95
Leather and Footwear (19)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,11	0,94	0,89	0,02	0,04	0,98	0,96
Wood and Cork (20)	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,08	0,07	0,92	0,93	0,03	0,04	0,97	0,96
Paper Printing and Publishing (21t22)	0,02	0,02	0,02	0,02	0,01	0,01	0,00	0,01	0,13	0,15	0,87	0,85	0,04	0,10	0,96	0,90
Oil Refining and Nuclear Fuel (23)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,06	0,95	0,94	0,02	0,04	0,98	0,96
Chemicals (24)	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,08	0,10	0,92	0,90	0,03	0,06	0,97	0,94
Rubber and Plastics (25)	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,06	0,10	0,94	0,90	0,02	0,05	0,98	0,95
Other Non-metallic Mineral Products (26)	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,06	0,07	0,94	0,93	0,02	0,04	0,98	0,96
Basic Metals and Fabricated Metal (27t28)	0,03	0,03	0,03	0,03	0,02	0,02	0,01	0,01	0,05	0,08	0,95	0,92	0,02	0,04	0,98	0,96
Machinery nec (29)	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,11	0,14	0,89	0,86	0,03	0,07	0,97	0,93
Electrical and Optical Equipment (30t33)	0,03	0,02	0,03	0,02	0,02	0,02	0,01	0,01	0,15	0,23	0,85	0,77	0,06	0,14	0,94	0,86
Transport Equipment (34t35)	0,02	0,02	0,02	0,02	0,02	0,02	0,00	0,00	0,08	0,15	0,92	0,85	0,03	0,07	0,97	0,93
Manufacturing nec (36t37)	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,09	0,11	0,91	0,89	0,03	0,06	0,97	0,94
Electricity Gas Water (E)	0,03	0,02	0,01	0,01	0,01	0,01	0,02	0,01	0,07	0,07	0,93	0,93	0,02	0,03	0,98	0,97
Construction (F)	0,06	0,06	0,08	0,08	0,05	0,05	0,01	0,01	0,04	0,06	0,96	0,94	0,02	0,05	0,98	0,95
Wholesale and Retail Trade (G)	0,10	0,10	0,15	0,16	0,08	0,07	0,02	0,03	0,13	0,14	0,87	0,86	0,04	0,11	0,96	0,89
Hotels and Restaurants (H)	0,02	0,02	0,04	0,05	0,02	0,02	0,00	0,00	-0,11	0,00	1,11	1,00	0,02	0,04	0,98	0,96
Transport and Communication (I)	0,08	0,07	0,06	0,06	0,06	0,05	0,02	0,02	0,22	0,29	0,78	0,71	0,09	0,17	0,91	0,83
Financial Intermediation (J)	0,05	0,05	0,03	0,03	0,04	0,03	0,02	0,02	0,20	0,32	0,80	0,68	0,06	0,20	0,94	0,80
Other Business Services (K)	0,17	0,21	0,08	0,12	0,06	0,08	0,11	0,14	0,07	0,10	0,93	0,90	0,00	0,02	1,00	0,98
Public Admin and Defence (L)	0,07	0,07	0,07	0,07	0,06	0,06	0,01	0,01	0,15	0,20	0,85	0,80	0,01	0,02	0,99	0,98
Education (M)	0,06	0,06	0,05	0,05	0,06	0,06	0,00	0,00	0,12	0,22	0,88	0,78	0,01	0,04	0,99	0,96
Health and Social Work (N)	0,06	0,06	0,07	0,08	0,05	0,05	0,01	0,01	0,10	0,10	0,90	0,90	0,02	0,05	0,98	0,95
Other Social and Personal Services (O)	0,03	0,04	0,04	0,05	0,02	0,02	0,01	0,01	0,12	0,12	0,88	0,88	0,03	0,06	0,97	0,94

Source: EU KLEMS and own calculations

Table 5b : Value Added, Labour and Capital Shares (US)

US (NAICS)	Value Added - Share in Total Value Added		Hours Worked - Share in Total Hours Worked		Labour Share in Total Value Added		Capital Share in Total Value Added		ICT Compensation - Share in Total Capital Compensation		Non-ICT Compensation - Share in Total Capital Compensation		ICT Capital - Share of Total Capital Stock		Non-ICT Capital - Share of Total Capital Stock	
	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004	1981- 1995	1996-2004
Total Industries	1,00	1,00	1,00	1,00	0,67	0,66	0,33	0,34	0,13	0,20	0,87	0,80	0,04	0,13	0,96	0,87
Sectors																
Manufacturing (D)	0,19	0,16	0,19	0,15	0,14	0,11	0,05	0,05	0,11	0,16	0,89	0,84	0,03	0,14	0,97	0,86
Private Services (G+H+I+JtK+E+F)	0,53	0,57	0,48	0,51	0,31	0,34	0,22	0,23	0,15	0,22	0,85	0,78	0,07	0,21	0,93	0,79
Rest of Economy (AtB+C+LtQ)	0,28	0,27	0,33	0,34	0,22	0,22	0,06	0,05	0,09	0,17	0,91	0,83	0,02	0,06	0,98	0,94
Industries																
Agriculture Hunting Forestry (AtB)	0,02	0,01	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,99	0,98	0,00	0,02	1,00	0,98
Food Beverages and Tobacco (15t16)	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,01	0,06	0,09	0,94	0,91	0,02	0,09	0,98	0,91
Textiles and Clothing (17t18)	0,01	0,01	0,02	0,01	0,01	0,00	0,00	0,00	0,04	0,09	0,96	0,91	0,02	0,07	0,98	0,93
Leather and Footwear (19)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,09	0,96	0,91	0,02	0,07	0,98	0,93
Wood and Cork (20)	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,07	0,08	0,93	0,92	0,01	0,07	0,99	0,93
Paper Printing and Publishing (21t22)	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,10	0,15	0,90	0,85	0,03	0,14	0,97	0,86
Oil Refining and Nuclear Fuel (23)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,09	0,13	0,91	0,87	0,02	0,09	0,98	0,91
Chemicals (24)	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,10	0,18	0,90	0,82	0,04	0,17	0,96	0,83
Rubber and Plastics (25)	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,03	0,06	0,97	0,94	0,01	0,06	0,99	0,94
Other Non-metallic Mineral Products (26)	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,16	0,10	0,84	0,90	0,03	0,10	0,97	0,90
Basic Metals and Fabricated Metal (27t28)	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,11	0,12	0,89	0,88	0,02	0,10	0,98	0,90
Machinery nec (29)	0,02	0,01	0,02	0,01	0,01	0,01	0,00	0,00	0,14	0,21	0,86	0,79	0,06	0,20	0,94	0,80
Electrical and Optical Equipment (30t33)	0,03	0,03	0,03	0,02	0,02	0,02	0,01	0,01	0,25	0,32	0,75	0,68	0,07	0,20	0,93	0,80
Transport Equipment (34t35)	0,03	0,02	0,02	0,02	0,02	0,02	0,00	0,00	0,26	0,26	0,74	0,74	0,05	0,17	0,95	0,83
Manufacturing nec (36t37)	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,10	0,13	0,90	0,87	0,03	0,12	0,97	0,88
Electricity Gas Water (E)	0,02	0,02	0,01	0,00	0,01	0,01	0,02	0,01	0,07	0,09	0,93	0,91	0,01	0,04	0,99	0,96
Construction (F)	0,04	0,05	0,06	0,06	0,04	0,04	0,00	0,01	0,04	0,17	0,96	0,83	0,01	0,14	0,99	0,86
Wholesale and Retail Trade (G)	0,13	0,12	0,17	0,16	0,10	0,09	0,03	0,03	0,11	0,16	0,89	0,84	0,03	0,11	0,97	0,89
Hotels and Restaurants (H)	0,02	0,02	0,05	0,05	0,02	0,02	0,01	0,01	0,04	0,05	0,96	0,95	0,01	0,03	0,99	0,97
Transport and Communication (I)	0,06	0,06	0,05	0,05	0,04	0,04	0,02	0,02	0,37	0,54	0,63	0,46	0,16	0,35	0,84	0,65
Financial Intermediation (J)	0,07	0,08	0,04	0,04	0,04	0,05	0,03	0,04	0,34	0,36	0,66	0,64	0,17	0,45	0,83	0,55
Other Business Services (K)	0,18	0,21	0,10	0,13	0,07	0,09	0,11	0,12	0,10	0,15	0,90	0,85	0,11	0,35	0,89	0,65
Public Admin and Defence (L)	0,10	0,09	0,07	0,05	0,08	0,07	0,02	0,02	0,10	0,18	0,90	0,82	0,01	0,04	0,99	0,96
Education (M)	0,04	0,05	0,10	0,11	0,04	0,04	0,00	0,00	0,06	0,15	0,94	0,85	0,02	0,11	0,98	0,89
Health and Social Work (N)	0,07	0,08	0,08	0,10	0,06	0,06	0,01	0,01	0,10	0,16	0,90	0,84	0,03	0,10	0,97	0,90
Other Social and Personal Services (O)	0,03	0,03	0,04	0,05	0,02	0,03	0,01	0,01	0,32	0,38	0,68	0,62	0,14	0,26	0,86	0,74

Source: EU KLEMS and own calculations

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