

# Introduction

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The recent economic crisis that started in 2008 hit most countries to a varying extent. The crisis was particularly severe in some advanced economies but also in less advanced ones in the Western Hemisphere. Though the crisis was triggered in the financial sector with the burst of the housing bubble in the US it spread quickly to other countries in most parts of the world and negatively affected growth differentially across sectors of the economies. In particular, industries like construction and the automobile industry have been severely affected. This was accompanied by an unprecedented collapse of world trade and negative impacts on employment, which manifested in rising unemployment rates especially for low-qualified people. Most of the countries are now recovering from this severe slump, though this is happening at different speeds and patterns of recovery are mostly affected by macroeconomic imbalances like public and private deficits, monetary policy issues and international imbalances like external debts. Thus, though there are signs of recovery, the world economy and particular countries are still in a shaky state. There is now a vast amount of literature focusing on the explanation and impacts of the economic crisis at the macroeconomic level, with little emphasis on sectoral developments, which is mostly dealt with, however, in the literature on the trade collapse. Also with respect to the recovery, the sectoral patterns in relation to output and productivity growth and thus also employment growth are less debated. The chapters in this book address this by focusing on the sectoral aspect of growth before the crisis, which should allow us to also draw some conclusions for the potential recovery in the individual countries and individual sectors.

This volume, therefore, presents a set of papers that have been developed under the EU KLEMS project ([www.euklems.org](http://www.euklems.org)) where KLEMS stands for 'Capital (K), Labour, Energy, Material, Services'. This ambitious project was developed from 2003 to 2009 by a large consortium of researchers led by the Groningen Growth and Development Centre (GGDC) in the Netherlands. It was supported by the European Commission, Research Directorate-General as part of the 6th Framework

Programme, Priority 8, Policy Support and Anticipating Scientific and Technological Needs.

The EU KLEMS project has been especially designed to analyse the characteristics of growth in industrialized countries and, in particular, the patterns followed by productivity and its determinants. A recent volume, co-authored by Timmer et al. (2010), provides a detailed description of the methodology followed by the project as well as its main aggregate results.<sup>1</sup>

The methodology followed is 'growth accounting', and its most immediate theoretical foundation is the extensive work by Dale W. Jorgenson and colleagues. Three contributions are especially relevant from our perspective: the pioneering work co-authored with Zvi Griliches in 1967; the ambitious study with Frank M. Gollop and Barbara M. Fraumeni, published in 1987; and the most recent work by Mun S. Ho and Kevin Stiroh (2005).<sup>2</sup> In the first of these studies the authors lay down the theoretical basis. The second performs an exhaustive application on the experience of the US economy, while the third places the emphasis on information and communication technology (ICT) as the driver of economic growth in the United States since the mid-1990s.

KLEMS type models are characterized by two differential features.<sup>3</sup> First, the consideration of gross output, in addition to value-added, as an important variable when analysing the characteristics of growth in economies. Gross output is equal to value-added plus the intermediate inputs used in the processes of production. Both for value-added and for gross output, growth that is not explained by primary and intermediate inputs is called *total factor productivity* (TFP), or also *multifactor productivity* (MFP). We will use the first term in this volume.

The second characteristic of KLEMS models is their high degree of disaggregation into sectors or industries. Normally the standard models focus on the economy as a whole, on the private sector, or on the five major sectors: agriculture, energy, manufacturing, construction and market services. KLEMS models, however, consider that there exists enormous heterogeneity among the sectors of the economy, heterogeneity that is essential to unravel if we wish to attain a thorough knowledge of the factors driving economic growth. In particular, the recent developments in Western economies, in which new ICT has played a significant role, show the importance of distinguishing among different industry characteristics. In this respect, it is considered important to distinguish the sectors that either produce or are intensive users of this type of asset from those that present a lower penetration of ICT. Only when a very high level of sector disaggregation is available is it feasible to undertake studies of this nature.

The EU KLEMS database does not only consider the two traditional primary inputs (capital and labour), but also takes into account the

Table 0.1 EU KLEMS project consortium members

Members	Country
Groningen Growth and Development Centre (GGDC, University of Groningen)	The Netherlands
National Institute of Economic and Social Research (NIESR)	UK
Harvard University	US
Amsterdam Institute for Business and Economic Research (AMBER, Free University Amsterdam)	The Netherlands
Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)	France
Centre for Economic and Business Research (CEBR)	Denmark
Deutsches Institut für Wirtschaftsforschung (DIW)	Germany
Fachhochschule Konstanz	Germany
Federaal Planbureau (FPB)	Belgium
Helsinki School of Economics (HSE)	Finland
Istituto di Studi e Analisi Economica (ISAE)	Italy
Instituto Valenciano de Investigaciones Económicas (Ivie)	Spain
Netherlands Bureau for Economic Policy Analysis (CPB)	The Netherlands
Osterreichisches Institut für Wirtschaftsforschung (WIFO)	Austria
Pellervo Economic Research Institute (PTT)	Finland
The Conference Board Europe (TCB)	Belgium
University of Birmingham	UK
The Vienna Institute for International Economic Studies (wiiw)	Austria

Source: Authors.

changes occurring in their composition over the course of time. For the labour factor, it distinguishes three characteristics of the workforce relating to sex, age groups and levels of education. In terms of capital, it considers eight kinds of assets, with special reference to three associated with ICT: hardware, software and communications. Capital contribution is measured according to the services it provides and not by its market value.

Eighteen research centres and institutions have taken part in the project under the direction of the GGDC, associated with the University of Groningen in the Netherlands, and the National Institute of Economic and Social Research (NIESR) in the United Kingdom, with Dale W. Jorgenson of the University of Harvard being the intellectual leader. The Organisation for Economic Co-operation and Development (OECD), The Conference Board (TCB) and various institutions based in Japan, South Korea, Australia and Canada have also taken part. Table 0.1 provides the list of the institutions that have participated in the project.

A provisional version of the database was released in November 2007, and the final one in March 2008. The database made public in November 2009 is the most recent version and covers the period 1970–2007, with data on 25 countries of the European Union (EU-25). Data for the two latest entrants, Romania and Bulgaria, is not available yet. The information is extended to the United States, Australia, Japan and South Korea.<sup>4</sup> However, the coverage is very different according to country and period of time. The hard core, integrated by the countries that present the most complete coverage, is formed by ten of the first 15 countries belonging to the European Union (EU-15). In the EU KLEMS database, this group receives the collective name of EU-15ex. Most of the growth accounting exercises, undertaken based on these data, are available for them. More limited but still fairly complete information is available for the most recent period, 1995–2007, for the remaining five countries of the EU-15 (Sweden, Luxembourg, Greece, Portugal and Ireland), plus Poland, Slovakia, Hungary, Czech Republic and Slovenia. For the remaining countries, Cyprus, Malta, Latvia, Lithuania and Estonia, the coverage both in terms of time and by number of variables is much more limited and also of lower quality. The composition of the different aggregation of countries provided by the EU KLEMS database appears in Table 0.2. These definitions will also be used in this volume.

## CONTENTS OF THE VOLUME

The volume is divided into three parts. Part I provides an overview of the main findings of the EU KLEMS project from an overall perspective. Part II offers a detailed analysis of the individual countries' performance, while Part III presents some additional results obtained by using the EU KLEMS database on specific topics.

Most of the chapters concentrate on the most recent period, 1995–2009. The update of the EU KLEMS database is carried out by using The Conference Board (TCB) Total Economy Database (TED) for the years 2008 to 2010 given that 2007 is the last year available in EU KLEMS. Both databases are elaborated following the same methodology, making them perfectly comparable. The main difference is that TED provides information only for the main aggregates. Chapter 1 uses the TCB up to 2010 while all chapters in Part II of the volume use the update to 2009, thus allowing the consequences of the first years of economic crisis to be analysed.

Part I contains three chapters. In Chapter 1, Matilde Mas presents an overview of the main results obtained by the project, focusing on the most

Table 0.2 Composition of the EU KLEMS country groups

EU KLEMS Country Groups	Definition	Members
EU-15	Includes member countries on 1 January 1995	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, the Netherlands and UK
EU-15ex	Includes the ten countries from the former group, EU-15, for which growth accounting exercises can be performed for an extended period	Austria, Belgium, Denmark, Finland, France, Germany, Italy, Spain, the Netherlands and UK
EU-10	Includes the ten new member states that joined the EU on 1 May 2004  In this study, the EU-10 does not correspond to the first ten members of the European Union	Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia
EU-25	This group represents all EU member countries on 1 May 2004 and is therefore the sum of EU-15 and EU-10	Austria, Belgium, Cyprus, Czech, Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, the Netherlands and UK
Eurozone	Includes all countries belonging to the Euro Area on 1 January 2001	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain and the Netherlands
EurozoneEX	Includes those countries in the Euro Area for which growth accounting exercises can be performed for an extended period	Austria, Belgium, Finland, France, Germany, Italy, Spain and the Netherlands

Source: Authors.

recent period, 1995–2010, for the main aggregates. The chapter highlights the importance of taking a closer look at the industry composition of output as well as the compositions of inputs, which is the essence of the KLEMS models. It also focuses on the key role played by ICT in productivity growth. Chapter 2, co-authored by Dale W. Jorgenson, Mun S. Ho and Jon D. Samuels, reviews the trajectory followed by productivity analysis since the traditional approaches by Kuznets and Solow. It begins by presenting the methodology for productivity measurement and finishes with the presentation of a new data set on US productivity growth for 70 industries for the period 1960–2007. In Chapter 3, Bart van Ark, Mary O'Mahony and Marcel P. Timmer present an overview of Europe's productivity performance in comparative perspectives, focusing on trends, causes and recent developments.

Chapters 1 and 3 concentrate on the main geographical aggregations within the European Union, such as EU-25, EU-15 and EU-10. In addition, some insights are also provided into the significant differences existing among the countries belonging to the European Union. For this reason, Part II is devoted to highlighting the particular experiences of each individual country. The strategy followed was to present the growth patterns of countries that are, somehow, related. Thus, Chapter 4, co-authored by Mary O'Mahony, Laurence Nayman, Martin Gornig and Bernd Görzig, presents the main results for the three biggest countries in the EU: France, the United Kingdom and Germany. Chapter 5, co-authored by Chantal Kegels, Michael Peneder and Henry van der Wiel, is devoted to three small countries: Belgium, the Netherlands and Austria. In Chapter 6, Matilde Mas, Carlo Milana and Lorenzo Serrano analyse the pattern of growth in Spain and Italy, countries that share the lowest productivity growth rates of all the EU countries during the years of expansion. Chapter 7, by Hans-Olof Hagén, presents the economic performance of three countries that also have many aspects in common, the Nordic countries belonging to the EU: Sweden, Denmark and Finland. Chapter 8, co-authored by Peter Havlik, Sebastian Leitner and Robert Stehrer is devoted to analysing the behaviour of the New Member Countries that joined the EU in May 2004 over the period 1995–2009. Part II finishes with a chapter by Kyoji Fukao, Tsutomu Miyagawa, Hak Kil Pyo and Keun Hee Rhee on the growth performance of two Asian countries, Japan and South Korea, which have participated very actively in the EU KLEMS project.

Part III is then devoted to specific topics that can be addressed using this database or are related to it. In Chapter 10 Nicholas Oulton and Ana Rincón-Aznar provide a stress test to the database, emphasizing the role and sensitivity of the usage of the implied average return to capital used

with respect to capital input measures and the contribution of capital to output growth. In Chapter 11 Robert Inklaar and Marcel P. Timmer focus on the issue of convergence across industries and countries, pointing towards the issue of a proper measurement of productivity. In particular this chapter shows the industry-specific patterns of convergence or non-convergence of productivity across industrialized countries. In Chapter 12 Michael Landesmann and Robert Stehrer investigate the role of skills in European manufacturing competitiveness, particularly on productivity growth and export performance, underpinning the positive role of skills for sectoral competitiveness. Piero Esposito and Robert Stehrer then in Chapter 13 analyse the differentiated relation of labour demand and high-tech capital, foreign direct investment and outsourcing patterns, differentiating between the Western European economies and the Central and Eastern European economies as target countries of outsourcing. In Chapter 14, Henry van der Wiel, Harold Creusen, George van Leeuwen and Eugene van der Pijll provide evidence of total factor productivity convergence at the firm level. The analysis undertaken for the Netherlands reveals the importance of the national frontier rather than the global one in the catching-up process and the usage of R&D for imitation purposes in the catching-up process. Finally, in Chapter 15 Hyun Jeong Kim and Hak Kil Pyo focus on total factor productivity levels pointing towards measurement issues and providing evidence for six EU countries together with Japan, Korea and the US.

## NOTES

1. There are still ongoing projects that partly link to the EU KLEMS project, in particular the WORLD KLEMS project (led by Dale W. Jorgenson), see [www.worldklems.net](http://www.worldklems.net), and the World Input-Output Database (WIOD) Project (led by the Groningen Growth and Development Centre), see [www.wiod.org](http://www.wiod.org).
2. Most of the studies by Dale W. Jorgenson on the subject have been collected in three volumes entitled *Productivity* published by MIT Press in 1995, 1996 and 2005 (with Ho and Stiroh).
3. A review of the approaches most frequently used in the analysis of productivity can be found in *Measuring Productivity*, OECD (2001).
4. At present the WORLD KLEMS project is being set up with the aim of extending it to Latin America (LA KLEMS), and Asia (ASIA KLEMS). In LA KLEMS, the four biggest countries in the area are participants: Mexico, Brazil, Argentina and Chile; and in ASIA KLEMS, China, India and Singapore are participants along with Japan and South Korea who are already present. Russia and Turkey have also shown interest in participating. In August 2010 WORLD KLEMS was launched internationally at the University of Harvard. Further details can be found at [www.worldklems.net](http://www.worldklems.net).

## REFERENCES

- Jorgenson, D.W. (1995), *Productivity*. Volume 1: *Postwar U.S. Economic Growth*, Cambridge, MA: MIT Press.
- Jorgenson, D.W. (1996), *Productivity*. Volume 2: *International Comparisons of Economic Growth*, Cambridge, MA: MIT Press.
- Jorgenson, D.W. and Z. Griliches (1967), 'The explanation of productivity change', *Review of Economics Studies*, **34** (3), 249–83.
- Jorgenson, D.W., F.M. Gollop and B.M. Fraumeni (1987), *Productivity and U.S. Economic Growth*, Cambridge, MA: Harvard Economic Studies.
- Jorgenson, D.W., M.S. Ho and K.J. Stiroh (2005), *Productivity*. Volume 3: *Information Technology and the American Growth Resurgence*, Cambridge, MA: MIT Press.
- OECD (2001), *Measuring Productivity*. *OECD Manual. Measurement of Aggregate and Industry-Level Productivity Growth*, Paris, Organisation for Economic Co-operation and Development.
- Timmer, M.P., R. Inklaar, M. O'Mahony and B. van Ark (2010), *Economic Growth in Europe, A Comparative Industry Perspective*, Cambridge UK: Cambridge University Press.