1 *Introduction and overview*

1.1 Introduction

The late 1990s saw a major change in the comparative growth performance of Europe and the United States. After the Second World War labour productivity growth in Europe outstripped that of the United States, leading to rapid catch-up. This provided a strong foundation for rapid improvements in the standards of living across the continent. However, since 1995 US labour productivity growth has nearly doubled compared to earlier periods, while European growth rates have declined. The slowing growth and faltering emergence of the knowledge economy in Europe led to an ambitious action programme of the European Commission, called the 'Lisbon Agenda', aimed at boosting competitiveness and productivity through innovation. It emphasised the need to increase spending on research and development and higher education, and was combined with the aims of completing the single market, opening up sheltered sectors, improving the climate for business and reforming the labour markets while ensuring growth was environmentally sustainable. The urgency was reinforced in reviews of the Lisbon Agenda, in the Sapir report on economic growth in Europe and in various post-Lisbon strategy debates and conferences (European Commission 2004; Sapir *et al.* 2004).

The purpose of this book is to provide a comprehensive analysis of economic growth in Europe over the past three decades that allows an evaluation of progress in achieving the Lisbon goals. We analyse why European growth has been slower since the 1990s, both relative to its own past and relative to that of the United States, and we review a number of aspects of Europe's productivity performance and prospects. The main methodology used is the growth accounting approach that decomposes output growth into the growth of inputs and productivity growth. In this method, growth can be traced to increased investment in capital goods and increased use of (skilled)

labour, or to increases in the efficiency with which these inputs are used. Such productivity improvements can be the result of innovation and technical change, but also of reallocation of resources due to, for example, competitive pressure. We will argue that Europe's falling behind is the combined result of a severe productivity slowdown in traditional manufacturing and other goods production, and a concomitant failure to invest in and reap the benefits from information and communications technology (ICT), in particular in market services. These results stem from a detailed industry-level analysis employing new data on the sources of growth from the EU KLEMS Growth and Productivity Accounts. This database contains detailed measures of output, labour and capital inputs and derived variables such as labour productivity and multi-factor productivity. Such data have not been available on an internationally consistent basis until now. The book illustrates the scope for rich analysis and robust results that can be achieved from coherent measurement at the industry level.

Indeed, the main contribution of this book is to show the large differences in growth performance across industries and the implications for aggregate trends. The chapters provide a detailed analysis of Europe's productivity performance since the 1970s and highlight the importance of structural change and the shifting contributions of goods- and services-producing industries to aggregate growth. It unveils large variations across industries in the use of skilled labour and ICT capital and in the dynamics of productivity growth, not only between manufacturing and services, but also across detailed services industries such as trade, transport, financial, business and personal services. The EU KLEMS database has made these differences transparent for the first time and, as we will argue, should be the cornerstone for future analyses of European performance. Further study of the drivers of cross-country differences in productivity performance, such as the effect of restrictive entry regulations or innovation bottlenecks, will need to confront and explore this industry heterogeneity. The databases presented in this book should therefore be part of the standard toolbox of economists interested in growth and development across advanced countries, and the methodological perspectives we offer can provide a starting point for further work.

This chapter sets the scene for the remainder of the book and summarises its main findings. We start with an overview of the various perspectives on Europe's falling behind since the 1990s in section 1.2.

Much of this literature stresses the role of product and labour market regulations in driving productivity growth and the increasing importance of innovation in Europe's economy. To a large extent this work on the ultimate sources of growth relies heavily on coherent measures of input, output and productivity as derived within a growth accounting system. The analysis in this book follows a long history of theoretical and empirical research in this area, surveyed in section 1.3. Section 1.4 summarises the main findings of the book and outlines its main contributions to the literature. Section 1.5 concludes.

1.2 Perspectives on Europe's falling behind

Europe's growth performance relative to the United States since 1950 can be usefully divided into three periods: 1950–73, 1973–95 and 1995–2006. During the first period, rapid labour productivity growth in the European Union went together with a catching-up in terms of per capita income levels with the United States. The reasons for this dual catching-up process during the 1950s and 1960s have been extensively discussed in the literature (see, for example, Crafts and Toniolo 1996 and Eichengreen 2007). The arguments include elements of imitation of technology and incremental innovation combined with labour market institutions. Compared to other parts of the world, Europe after World War II already had a relatively well-educated population and a strong set of institutions for generating human capital and financial wealth, which allowed a rapid recovery of investment and absorption of new technologies developed elsewhere, notably in the United States, known as catching-up. The 'golden age' of post-World War II growth came to an end rather abruptly in the early 1970s, followed by a period of significantly slower growth lasting almost two decades on both continents (Maddison 1987). Table 1.1 shows that while US GDP per capita growth slowed from 2.4% in the period 1950–73 to 1.8% in 1973–95, EU-15 growth slowed substantially more from 4.7% to only 1.7%. The reasons for this slowdown in the growth rate in Europe include the gradual exhaustion of potential for catching-up and a slowdown of investment rates. Globally, pervasive changes in the international economic order through the breakdown of the Bretton Woods system of fixed exchange rates, coupled with a severe oil price shock in 1973, undermined the effectiveness of stabilisation policies. Further discussions on the global growth slowdown during this period

Table 1.1. ***Growth of GDP, GDP per capita and GDP per hour worked, EU-15 and USA, 1950–2006***

	GDP	GDP per capita	GDP per hour worked
1950–73			
EU-15	5.5	4.7	5.3
USA	3.9	2.4	2.5
1973–95			
EU-15	2.0	1.7	2.4
USA	2.8	1.8	1.2
1995–2006			
EU-15	2.3	2.1	1.5
USA	3.2	2.2	2.3

Notes: Average annual growth rates (in per cent). EU-15 refers to the fifteen countries constituting the EU up to 2004.
Sources: Calculations based on the Conference Board and Groningen Growth and Development Centre, Total Economy Database, January 2007, available at www.ggdc.net.

are provided by Crafts and Toniolo (1996), Baily and Kirkegaard (2004) and Eichengreen (2007).

While GDP per capita growth rates became quite similar during 1973–95, labour productivity growth in the EU-15 was still twice as fast as in the USA as unemployment rose and working hours declined. But after the mid 1990s, the patterns of productivity growth in Europe and the United States differed dramatically. In the United States, average annual labour productivity growth accelerated from 1.2% during the period 1973–95 to 2.3% during 1995–2006. Comparing the same two time periods, annual labour productivity growth in the European Union declined from 2.4 to 1.5%.

Two main perspectives on the causes of Europe's falling behind arose around the turn of the millennium. One perspective focused in particular on developments in labour and product markets. It has been suggested that an employment–productivity trade-off manifested itself in the era of increasing labour supply, arising from the reform of labour markets and tax systems in Europe. During the 1990s, substantial labour reforms were carried out in various European countries. These reforms appeared to be quite successful in terms of employment

creation as the declining trend in hours worked was reversed in many countries (see, for example, Garibaldi and Mauro 2002). It is frequently argued that the price paid for the employment miracle was a drop in labour productivity growth (Blanchard 2004; Dew-Becker and Gordon 2008). In addition, deep reforms took place in European product markets, in particular for manufacturing goods in the context of the single European market. Similar reforms in services markets though have been much slower and seen as an obstacle to growth. In particular, in the wake of the ICT revolution tighter regulation in product and labour markets has reduced flexibility and may delay the uptake of the new technologies available (Nicoletti and Scarpetta 2003; Griffith *et al.* 2007; Bassanini *et al.* 2009).

Another strand of the literature focuses more on institutional characteristics of educational and innovation systems in Europe and argues that the European slowdown is mainly related to difficulties in switching from growth based on imitation to growth based on innovation. As Europe gradually reached the technology frontier, future growth had increasingly to come from domestic innovation. Instead, Europe still relied on outdated inflexible industrial structures, with low and medium-tech manufacturing dominating and with declining productivity growth rates. This sector suffered from global competition from new EU member states and the emerging economies, especially India and China. In this view a strong innovation system based on increased R&D expenditures and reformed educational systems is the key to renewed European growth (Sapir *et al.* 2004; Aghion and Howitt 2006).

1.3 Growth accounting

Analyses of the European growth slowdown rely heavily on good measures of labour, capital and productivity, and the growth accounting approach appears to be especially useful in this regard. Using this methodology, measures of output growth can be decomposed into the contributions of inputs and productivity within a consistent accounting framework. It allows for an assessment of the relative importance of labour, capital and intermediate inputs to growth, and for measures of multi-factor productivity (MFP) growth to be derived. MFP measures play a major role in the analysis of growth and also feature prominently in this book. Under strict neo-classical assumptions,

MFP growth measures disembodied technological change, although in practice measured MFP can include a range of other effects. These include unmeasured inputs related to organisational change and other intangible investments, returns to scale, any externalities related to investment, as well as measurement errors. In addition MFP measured at the industry level includes the effects of reallocation of market shares across firms. All these effects can be broadly summarised as 'improvements in efficiency', as they improve the productivity with which inputs are used within the industry (see section 3.6 for a more detailed discussion). The reader is referred to the excellent summary of the historical roots and theoretical aspects of this method in Hulten (2001; updated 2010), including its production function origins, sources of biases, index number issues and links with growth models.

Application of the growth accounting methodology has come in several waves. The first coincided with the main theoretical breakthroughs from the end of the 1950s to the 1970s and includes the seminal contributions of Tinbergen (1942), Solow (1957), Denison (1962), Jorgenson and Griliches (1967) and Diewert (1976). Although this first wave dealt mainly with the USA, various growth accounting studies on the European countries followed, including Carré *et al.* (1975) for France and Matthews *et al.* (1982) for the United Kingdom. The second wave, partly overlapping with the first, included a series of international comparative studies, including Denison (1967), Christensen *et al.* (1981) and Maddison (1987). In 1987, Jorgenson, Gollop and Fraumeni (1987) published their standard work outlining the growth accounting approach based on the KLEMS methodology, which measured the growth contributions of capital (K), labour (L), energy (E), material inputs (M) and service inputs (S), as well as the composition of these inputs to identify quality changes. Jorgenson (1995a, b) provides a compendium of studies made in the first two waves.

The third wave of growth accounting, during the 1990s, was triggered by the intensifying debate on the sources of the rapid growth in East Asia and other emerging economies, and the future of what was perceived by some primarily as an unsustainable input-driven growth process (Krugman 1994; Young 1995; Collins and Bosworth 1996; Nelson and Pack 1999). Further impetus came from the rise of ICT as an increasingly important source of growth in advanced economies. The Solow productivity paradox – that 'you can see the computer age

everywhere but in the productivity statistics' (Solow 1987) – led to a surge in studies trying to explain the US growth acceleration, as well as why Europe was lagging behind.

In the first round of studies, aggregate growth trends in the United States were analysed. Accelerating labour productivity growth was mainly attributed to increasing investment in ICT goods and improvements in MFP (Jorgenson and Stiroh 2000; Oliner and Sichel 2000). Industry-level MFP trends were still unavailable, but rough estimates by 'backing out' MFP growth in IT production suggested that most of the aggregate MFP acceleration could be traced back to rapid technological change in ICT-goods-production.[1] However, as more detailed industry-level data became available, the focus broadened to include not only ICT-goods-producing industries but also service industries that are heavy users of ICT. This research was initially based on an analysis of labour productivity (Nordhaus 2002; Stiroh 2002), but quickly the needed data on industry capital were developed and the focus shifted to MFP. Studies by Triplett and Bosworth (2004) and Jorgenson, *et al.* (2003; 2005) showed that the biggest contributors to aggregate ICT-capital deepening were a limited number of service industries, in particular trade, finance and business services. In addition to growth in ICT-goods manufacturing, rising MFP growth in these service industries appeared also to be important in explaining the US productivity acceleration.

After some delay, similar studies became available on European growth. The first set of growth accounting studies for Europe relied heavily on private data sources on ICT expenditure collected outside the System of National Accounts (Schreyer 2000; Daveri 2002). They found that although ICT-investment *growth* also accelerated in Europe, its lagging behind the USA was mainly due to lower *levels* of ICT investment. This conclusion was confirmed once investment series from National Accounts became available (Colecchia and Schreyer

[1] The latter point is stressed especially by Gordon (2000). Triplett and Bosworth (2004) and Jorgenson *et al.* (2005) show that this 'backing out' of ICT-production MFP from aggregate MFP can be highly misleading as it generates only a *net* measure of MFP growth outside ICT-production. Industry-level studies show that MFP growth rates outside ICT-goods manufacturing have also been high. However, high growth in some industries was cancelled out by low or negative MFP growth in many others, as discussed in more detail in the chapters below.

2002; van Ark *et al.* 2002; Vijselaar and Albers 2004; Timmer and van Ark 2005). Typically, they found that the contribution of ICT capital deepening to aggregate labour productivity growth in Europe was only half of what the contribution was in the USA. In contrast to the USA, aggregate MFP growth in Europe did not accelerate. This difference could only partly be attributed to the smaller ICT-producing sector in Europe compared to that in the USA and hence must be sought elsewhere in the economy (Pilat *et al.* 2002; van Ark *et al.* 2003; Timmer and van Ark 2005).[2]

A detailed study of labour productivity growth at the industry level by van Ark *et al.* (2003) suggested that much of the failure of Europe to achieve its own labour productivity growth revival in the late 1990s could be traced to the same industries that performed so well in the United States, particularly trade and finance; this was confirmed by O'Mahony and van Ark (2003). Labour productivity growth in these industries lagged behind severely in Europe, and given their high ICT intensity in the USA, Europe's problem seemed to be related to slow ICT adoption. In this type of study, industries were grouped into ICT-producing, ICT-using and non-ICT-using based on the ICT intensity of industries in the USA. The basis for allocation to particular groups was, however, weak and results were sensitive to the choices made (Daveri 2004). In addition, it presumed a common ranking of industries on the basis of ICT use across all countries. Without detailed information on ICT and non-ICT investment for individual industries and countries, it remained unclear which industries were responsible for the gap in ICT investment between Europe and the USA and sluggish European MFP growth. Inklaar *et al.* (2005) were the first to consider the experience in Europe using a comprehensive dataset that separated ICT and non-ICT investment at the industry level, but this was limited to four EU countries: France, Germany, the Netherlands and the UK.[3]

In conclusion, this section highlights that a significant research effort in the past was devoted to explanations of Europe's poor relative

[2] The ICT-producing sector might also have additional productivity-enhancing effects through technology spillovers to other sectors. However, there is little evidence so far: a case study of Finland did not find much support for this (Daveri and Silva 2004).

[3] At the same time various individual country studies appeared, such as Oulton (2002) on the UK and Daveri and Jona-Lasinio (2005) on Italy.

productivity performance, but much of this was carried out at a time when detailed industry-level data were not available, and much of the literature refers to a limited set of countries. With evidence of the increasing importance of ICT and market services for growth, there was also renewed attention to measurement issues (Griliches 1992; Sichel 1997; Triplett and Bosworth, 2004) and international comparability of national statistics. Work at the OECD highlighted problems in comparability of ICT investment and price deflators and output measurement of market services (Schreyer 2002; Ahmad 2003; Wölfl 2003). Clearly, there was an increasing need for new methods, comparable statistics and convergence in methods of measuring productivity. The aim of the EU KLEMS initiative set up in 2004 was to meet this demand. This resulted in the construction of the EU KLEMS Growth and Productivity Accounts that provide the main building block for the comparative analysis of economic growth in Europe in this book.

1.4 Book summary and contribution

This book provides the detailed analysis required to delve deeply into the reasons for Europe's poor productivity performance since the 1990s, both relative to its own past and relative to the USA. Our main focus is on the performance of the European Union as a whole, given the increasing integration of the European economies and the growing importance of pan-European policies. Throughout the book we analyse growth in the European Union on the basis of data for ten of the fifteen countries constituting the EU before 2004, namely Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain and the United Kingdom. Together the ten countries provided 93 per cent of the EU GDP in 1995. Occasionally, though, we also provide analysis of individual countries to illustrate the diversity of growth paths within Europe.

The main dataset used in our analysis is the EU KLEMS database that provides comparable and harmonised statistics on inputs, outputs and productivity trends for a wide range of countries from 1970 onwards within a growth accounting framework. The EU KLEMS database was constructed by a consortium of seventeen research institutes across Europe in close co-operation with national statistical institutes, as described in the Preface. The acronym KLEMS stands

for capital (K), labour (L), energy (E), material (M) and services (S) inputs at the industry level. The database is publicly available at www.euklems.net. In addition to growth statistics, we rely on new estimates of relative levels of productivity across countries that allow for analysis of catch-up and convergence. Throughout the book, we devote considerable attention to a discussion of the details of the data employed and of the main methodological perspectives, illustrated with numerical examples. This function is fulfilled in Chapter 3 for growth accounting and in Chapter 6 for level accounting. The international effort that went into constructing the databases and the choice of methods of analysis together mean that the discussion in this book presents more information on Europe's relative performance than has been available in the literature to date. This allows for a deeper investigation of the main differences between high- and low-performing countries and industries. More generally, it illustrates to the research and policy community the benefits of analysis based on detailed data.

We argue that an industry perspective provides important additional insights when compared to more aggregate analyses. For example, the industries that appear to be responsible for the European slowdown, mainly in manufacturing and other goods production, are not the same as those driving the increasing gap with the USA, which are mainly in trade and business services. Given the large variation in the technological characteristics and regulatory environments of these industries, this has profound implications for further policy analysis. In addition, we show throughout the book the consequences of using detailed input measures that take account of heterogeneity in inputs. For example, accounting for the changing skill distribution of the labour force and the increasing use of ICT-capital assets can lead to rather different measures of MFP growth. In addition, comparisons of MFP levels are highly sensitive to the use of cross-country price ratios across industries. The impact of the use of crude or more data-intensive measures of productivity in growth and convergence analysis is discussed throughout the book. We also stress the numerous measurement problems that still hinder this type of analysis and argue that the benefits from additional data detail have to be weighed against the reliability of these data and the desire to achieve international comparability. As such, the book provides new methodological perspectives and so is useful not only as a guide to the EU KLEMS database, but also as a primer on the use of data in economic growth analysis.