Introduction

There are many different productivity measures for different purposes and policy makers and other users are not always aware of the conceptual and empirical reasons for differences between them. Productivity is a key indicator in the assessment of economic performance and a growing number of statistical offices in the OECD area have recently become engaged in the measurement of productivity. This work is raising many new questions for measurement, including the possible approaches to developing measures of aggregate productivity performance, as well as issues related to productivity measurement in specific sectors of the economy. Some of these measurement issues, especially those related to the measure of capital services, have been taking into account in the current process of revision of the System of National Accounts (SNA).

Productivity measurement and analysis are the main topics addressed in this book, which is the result of the contributions presented and discussed in two international workshops organized by the Statistics Directorate and the Directorate for Science, Technology and Industry of the OECD. The first workshop was organized jointly by the OECD and Fundacion BBVA and Instituto Valenciano de Investigaciones Economicas (IVIE) and held in Madrid in October 2005. The second workshop was organized jointly by the OECD and the Swiss Federal Statistical Office and the State Secretary for Economic Affairs of Switzerland and held in Bern in October 2006. The two workshops brought together about seventy representatives of statistical offices, central banks and other branches of government in OECD countries that are engaged in the analysis and the measurement of productivity developments at aggregate and industry levels.

In the following pages, we overview twenty three studies that all provide a different perspective on productivity measurement and/or analysis around five topics. The present volume is organised as follows. It starts out with conclusions and future directions from the Bern workshop presented by Erwin Diewert (University of British Columbia, Canada). The first Part provides an overview of productivity growth and innovation illustrated by an analysis for Spain and Switzerland. The first measurement issue addressed in the book, notably in Parts two and three, concerns the measure of labour input. Despite significant progress and effort in this area, the measurement of hours actually worked still suffers from a number of statistical problems. In particular, different concepts and basic statistical sources used in different countries leave open many questions of international comparability, as described in Part two. Furthermore, labour input contributions to economic growth may

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1 See OECD Measuring Capital (forthcoming).
2 More information on the workshops is available at the following address: http://www.oecd.org/statistics/productivity
be underestimated when labour input measures do not take into account changes in labour composition over time. Part three presents different labour input measures adjusted for changes in skills, educational attainment and labour market experience. The results underline the influence of changes in human capital on the contribution of labour input to economic growth. The fourth Part deals with different perspectives on capital input measurement and Part five presents a selection of country experiences in the measurement of industry-level multi-factor productivity.

Part 1: Productivity growth and innovation: the case of Spain and Switzerland

The part of economic growth that cannot be explained by increased utilisation of capital and labour is measured by multi-factor productivity (MFP). Among the sources of MFP growth, innovation is one of the most important. Dominique Guellec and Dirk Pilat (OECD) provide an international comparative perspective on productivity growth and innovation in OECD countries and show the influences of favourable conditions in the capacity to benefit from emerging technical fields such as information, communication and technology (ICT), biotechnology and nanotechnology. Matilde Mas and Javier Quesada's paper (University of Valencia and IVIE) provides detailed measures of the influence of ICT on MFP growth in Spain, at the aggregate and at the industry level. Gregory Rais and Pierre Sollberger (Swiss National Statistical Office - FSO) present the methodology adopted by the Swiss National Statistical Office - FSO for MFP measurement. Jan-Egbert Sturm (Swiss Institute for Business Cycle Research) examines to what extent different types of firm level innovations affect labour productivity of firms in Switzerland.

Part 2: The measurement of labour input

In Part two, a detailed comparative study between the USA and Canada on hours worked is presented by Jean-Pierre Maynard (Statistics Canada) and can serve as an excellent guide to the many statistical considerations that enter international comparisons of this kind. Henrik Sejerbo Sørensen and Kamilla Heurlén (Statistics Denmark) use Danish data to assess the influence of the choice of different statistical sources for working hours on labour productivity measures and on their international comparability. Lucy Eldridge and Sabrina Pabilonia’s paper (U.S. Bureau of Labour Statistics) addresses the question whether, due to ICT, persons actually work more outside their work place so that hours worked are underestimated. The result of their survey shows that, for the period under consideration, the impact was modest.

Part 3: The measurement of the composition of labour input

A number of countries have started to develop labour input measures adjusted for labour quality and in some cases (e.g. Italy, Spain, the European Central Bank…) there are important

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3 The terms Multifactor productivity (MFP) and Total factor productivity (TFP) are used interchangeably in the present text.
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Differences between unadjusted and adjusted time profiles of labour input. Papers presented in this Part raise the issue of international comparability of such adjustments. Wim Haine and Andrew Karutin (European Central Bank), as well as Lucy Eldridge, Marilyn Manser and Phyllis Otto (U.S. Bureau of Labour Statistics) remark that un-weighted hours worked is an incomplete measure of labour input because it does not account for differences in educational attainment, skills and experience between workers. Antonella Baldassarini and Nadia Di Veroli (ISTAT) present both a detailed description of the method for estimating hours actually worked and evidence of changes in labour quality. Guido Schwerdt (Ifo Institute) and Jarkko Turunen (European Central Bank) observe that the increase of labour quality in the 1990’s was driven by an increase in the share of workers with tertiary education and workers in prime age. As a result, a longer part of output growth is explained by labour input, reducing the contribution of total factor productivity to euro area growth.

Part 4: The measurement of capital input

This Part examines a range of important methodological questions in the measure of capital input, including the comparison of levels of capital productivity, the scope of assets, and different assumptions in the estimate of user costs and depreciation. Paul Schreyer (OECD) aims to compare levels of capital input, levels of capital productivity and capital intensity. Not all assets are recognised in capital measurement, and full coverage is unlikely to occur in the near future. However, including assets as stocks of research and development (R&D) raise some methodological and practical issues. Emma Edworthy’s paper (Office for National Statistics) presents a first empirical estimate for the R&D capital stock which sheds light on the main practical issues associated with implementation (composition of R&D expenditures, construction of appropriate deflators, estimation of depreciation rates); and then proposes a first estimate of the impact of R&D in productivity growth. Dean Parham’s paper (Australian Productivity Commission) questions whether the planned national accounts treatment of R&D as ‘just another type of asset’ has any implications about how R&D assets would be treated in productivity measurement. This provides an interesting link with paper by Matilde Mas (University of Valencia and IVIE) on infrastructure capital given that there are a number of common characteristics between physical infrastructure capital and ‘knowledge infrastructure’. In addition, Mas contribution comes with a clear definition of infrastructure assets and shows how their growth contribution can be measured.

Service lives of assets that feed into measures of capital services tend to vary significantly across countries, and it is not always clear whether such differences reflect economic reality or differences in statisticians’ assumptions. Massimiliano Iommi and Cecilia Jona-Lasinio’s (ISTAT) contribution presents the methodology adopted by ISTAT to calculate capital services focusing on an assessment of the impact of the different assumptions on depreciation rates and rates of return in the estimate of the user cost of capital and on age-efficiency profiles in the calculation of productive capital stock.
Part 5: The Measurement of industry level multi-factor productivity

A growing number of OECD member countries are involved in MFP measurement and Part five presents experimental results on industry-level MFP measures which show that they are feasible but fraught with measurement issues. Recurring issues are the output measurement in service industries, the availability of capital data by type of asset and by industry and the choice of the rate of return for capital services by industry. Dirk van den Bergen, Myriam van Rooijen-Horsten, Mark de Haan and Bert Balk’s paper (Statistics Netherlands) presents the experience of Statistics Netherlands in industry-level MFP measures. Eric Bartelmann, Carol Corrado and Paul Lengermann (Free University of Amsterdam and U.S. Federal Reserve Board) address the question whether information on recent industry productivity developments can be used to compute estimates of the trend in aggregate multi-factor productivity growth. Paul Roberts’ paper (Australian Bureau of Statistics) discusses the present work on the measurement of multifactor productivity at the industry level in Australia and provides a detailed summary of measurement issues related to this topic. Harold Creusen, Björn Vroomen, Henry van der Wiel and Fred Kuypers (CPB Netherlands Bureau for Economic Policy Analysis) analyse the productivity performance of the Dutch retail trade for the period 1993–2002 and focus on competition and innovation as important drivers of productivity growth. The study of Swedish economic growth by Hans-Olof Hagen and Thomas Skyttesvall (Statistics Sweden) describes the implementation of capital services and MFP measures following a KLEMS decomposition of the business sector. Hak K., Pyo, Keun Hee, Rhee and Bongchan Ha’s paper (Seoul National University, Korea Productivity Center, Pukyong National University) aims to identify the source of economic growth by industry in Korea, where the catch-up process with industrial nations in its late industrialisation has been predominantly driven by the manufacturing sector and by increasing inputs without an increase in efficiency with which these inputs are used.

During the workshops, panel discussions raised a number of suggestions regarding work that could be undertaken by the OECD in relation to productivity measurement. Suggestions included the following:

- Build a general framework or guidelines for best practices on labour input measures: a set of guidelines or recommendations on how to implement labour input measures would be very valuable for the national accounts and for productivity measurement. While conceptual work on labour is being carried out by the Paris Group, this is not necessarily done for purposes of productivity measurement (i.e. with a concept of labour input in mind) nor with a view to ensuring consistency with output measures. At a practical level, OECD started looking at national practices for estimating hours worked by industry for National Accounts and determining practices and target definitions.

- Measures of labour composition: hours worked constitutes an incomplete measure as input for productivity and several countries already started to develop adjusted labour input

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4 The Paris Group is an informal exchange group of labour statisticians belonging to national statistical agencies and international organizations (OECD, ILO, Eurostat) created under the auspices of the United Nations at the beginning of 1997 to address selected problems in statistical methods in the area of “labour and compensation” statistics.
measures. OECD should develop measures of labour composition to harmonize adjustments across countries and to improve international comparability of hours worked.

– **Build a general framework or guidelines for best practices on capital input measures:** OECD should provide guidance on standard use of user costs in the computation of capital services. Greater harmonisation of approaches and international comparisons of the assumptions underlying measures of depreciation and capital are important and OECD should also derive standard measures of depreciation and net capital stock.

– **Innovation and productivity:** the planned capitalization of Research and Development (R&D) in the national accounts raises a number of practical issues about their measurement, in particular their deflation and their depreciation. International guidance will be needed to maximise comparability across countries. It was also noted that investment in innovation was in all probability much larger than investment in R&D and that capitalising and measuring all such expenditure is a long-term challenge for analysts.

– **Microdata:** several papers in the book employ microdata for analysis and it is generally felt that this constitutes an important avenue for work. Productivity measures and analyses based on microdata may need more attention. Microdata analysis complements industry-level and macro-economic productivity analysis in a very useful way and the OECD is encouraged to continue its efforts to pull together national work on microdata and to enhance international comparability of such analyses.

– **The measure of industry-level productivity:** a growing number of statistical offices are involved in the compilation of estimates of multi-factor productivity (MFP) by industry replying to the increased demand for analyses of market structure. This work also raises methodological questions and the OECD is encouraged to provide internationally comparable MFP estimates which also should be consistent with MFP data for the whole economy.

– **Definition of business sector:** several notions of ‘business sector’ exist that are not necessarily compatible with each other. A better common understanding about the definition and calculation of business sector productivity would be helpful. OECD should draft a Working Paper discussing an activity based definition of the business sector, analysing it in the context of productivity measurement and make recommendations.

– **Infrastructure capital:** this area is attracting a good deal of policy attention but remains ill-defined and ill-measured. A common understanding of what constitutes infrastructure assets and how they can be brought out in existing capital measures would be helpful as would some international data on their size and evolution.

– **Comparisons of productivity levels across countries:** this remains a highly policy-relevant indicator. Extension of labour productivity comparisons to MFP comparisons is desirable. At the same time, many statistical problems remain and productivity level comparisons are often of unknown quality. It is therefore important to accompany level comparisons with some indications of statistical confidence so as to avoid an impression of precision that is not warranted by the underlying data. The OECD is encouraged to continue its work in this direction, including the development and improvement of Purchasing Power Parities (PPP) for international productivity comparisons.
- **Communication:** communication at the national and international level is therefore important so as to be clear what measures mean and why national and international measures may differ.

- **Productivity of non-market producers:** many countries attach high priority to better measurement of the productivity, outputs and inputs of non-market producers. This responds directly to analytical and policy requirements as well as to a forthcoming EU Regulation. The OECD Statistics Committee has also endorsed work in this area and the OECD National Accounts and Financial Statistics Division and the OECD Structural Economic Statistics Division are advancing the subject matter, in particular with regard to health and education output.

- **Environment and productivity:** conventional productivity measures are sometimes criticised for not taking negative effects on the environment into account, thereby overstating productivity and economic growth. Conceptual and empirical work to link productivity measures with the use of natural resources and emissions would be welcome.

- **Firm dynamics and productivity growth:** there is growing empirical evidence suggesting that firm demography impacts on growth in aggregate productivity, even if this impact may vary across countries. Size of firm, entry and exit of firms and survival appear to be important dimensions in productivity analysis as firm turnover accounts increasingly in the process of reallocation of resources. The OECD should be involved in the assessment of the influence of firm dynamics and business environment conditions on productivity growth.
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