METHODS OF PRODUCTIVITY MEASUREMENT AND ANALYSIS IN OECD COUNTRIES

Natalja Viilmann

Productivity is a key indicator in the measurement of economic performance. Therefore, the statistics offices in the region of the Organisation for Economic Cooperation and Development (OECD) have increasingly become engaged in the measurement of productivity. There are many issues with regard to that, for instance potential approaches to the development of statistics on total productivity and problems regarding productivity measurement in specific economic sectors (e.g. the measurement of capital services). The following is a brief overview of some interesting studies in the area of productivity statistics.

This summary is based on a research called "Productivity measurement and analysis", which was conducted in 2008 as a result of two workshops arranged by the OECD Statistics Directorate and the Directorate for Science, Technology and Industry.

The study gives an overview of growth and innovation in productivity and raises the issue of labour input measurement. Despite the considerable success and efforts made in this area, the measurement of actual working hours still remains problematic. The differences between the principles and key statistical sources used in various countries complicate the conduct of international comparisons. In addition, there is a risk of underestimating the contribution of labour force to economic growth, if the measurement of labour input neglects the structural changes that occur in the labour force over time. The study describes various indicators of labour input, which have been adjusted according to changes in skills, acquisition of education and labour market experience. The results demonstrate the influence of changes in human capital on the contribution of the labour force to economic growth. In addition, the study covers the approaches of capital input measurement and describes the experience of selected countries in the measurement of industry-level multi-factor productivity (MFP).

Productivity growth and innovation: The case of Spain and Switzerland

Changes in the size of capital and labour used for the production process do not fully explain economic developments, because qualitative changes that are difficult to measure quantitatively also play a significant role. Therefore, several analysis models describe the part of economic growth, which cannot be explained by a rise in capital or labour utilisation, with the MFP approach. In that case, the influence of labour and capital growth is subtracted from total growth, which results in growth caused by various other factors. Technological developments and improvement in labour quality are the most important among these factors.

One of the key sources for multi-factor productivity growth is innovation. In their study, Guellec and Pilat[1] have taken the impact of innovation on productivity under observation. They have broken GDP growth (per capita) down to two groups: labour utilisation (number of working hours per capita) and its productivity, i.e. the efficiency of labour (GDP per hour worked). Labour utilisation is affected by three components: average working time, the rate of labour participation and the rate of unemployment. Productivity growth is also associated with several factors: improvement in labour force composition[2], growth in capital stock and its quality, and closely innovation-linked MFP (improvement in skills, advanced technology, organisational and management changes, better logistic schemes, etc.).

Guellec and Pilat give an overview of the international comparison of productivity and innovation in OECD countries, where indicators include the proportion of expenses on development, the number of technological patents, the degree of economic openness, the share of people with a doctor of science degree and the publication of research articles. The authors show how productivity can be influenced by favourable conditions in the increasingly popular technical areas, such as information technology and communications (ICT), and bio- and nanotechnology.

In their study, Mas and Quesada[3] provide a detailed description of the impact of ICT on multi-factor productivity in Spain at the aggregate and industry level. Their analysis indicates that throughout the whole period under analysis (1995–2004) the productivity of industries using ICT more intensively exceeded that of the industries using ICT less actively. Furthermore, productivity growth in the fields of activity with greater use of ICT was stronger and its contribution to total economic growth was higher.

Rais and Sollberger[4] present an experimental methodology applied for the measurement of multi-factor productivity at the Federal Statistical Office of Switzerland. The main difficulties to overcome are a lack of data on capital stocks, multiple interpretation opportunities of various methods and the reluctance of entrepreneurs to participate in new statistical studies. Although final solutions are yet to be reached, dealing with methodical problems has also enabled to contemplate the opportunities of taking various capital groups into account.

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[1] Dominique Guellec and Dirk Pilat “Productivity Growth and Innovation in OECD” (OECD).
[2] For instance, in several OECD countries the education level of people aged 25 to 34 who are entering the labour market is higher than that of the people aged 65 to 74 who are leaving the labour market.
[3] Matilde Mas and Javier Quesada “The Role of ICT on the Spanish Productivity Slowdown” (València and Instituto Valenciano de Investigaciones Económicas).
[4] Gregory Rais and Pierre Sollberger “Multi-Factor Productivity Measurement“ (Federal Statistical Office of Switzerland).

Based on the data on Switzerland, Arvanitis and Sturm studied[5] how much innovations influence labour productivity in companies. Recently, Switzerland's economic and productivity growth has remained considerably below the OECD average, which makes the analysis of factors that affect productivity particularly topical for this country. The study was based on the results of three surveys (1996, 1999 and 2002), which included 793 industrial enterprises. Labour productivity growth was defined as growth in value added per employee. The factors that were tested as having an impact on productivity included changes in human capital[6] and basic innovation indicators[7]. The authors concluded that several factors of innovation, especially product innovations and entry into new markets, had a significant statistical effect on labour productivity.

The measurement of labour input

Maynard[8] presents a comparative study regarding working hours in the US and Canada, which covers many statistical issues with regard to international comparison. One of them is related to preliminary data sources. Traditionally, labour utilisation in Canada is reflected by two databases: the household survey (where the people in the sample are asked whether they are employed, how much time they spend on work and whether they are paid for work) and the entrepreneurs' survey (where companies provide direct information about the number of employees and the duration of their working days). The results of the two surveys do not coincide neither in terms of total working hours nor changes in working hours.

Sørensen and Heurlén[9] from Statistics Denmark employ data on Denmark to assess the impact of statistical sources used for the calculation of working hours on the indicators of labour productivity and their international comparability.

Eldridge and Pabilonia[10] from the US Bureau of Labour Statistics study whether people actually work longer outside the office due to ICT development, which would result in the underestimation of working hours. Their research shows that the impact of this factor remained modest that during the period monitored.

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[5] Spyros Arvanitis and Jan-Egbert Sturm "Innovation and Labour Productivity Growth in Switzerland" (KOF Swiss Economic Institute).

[6] For instance, the percentage of people with tertiary education in employment.

[7] Yes/no answers to the following questions: did you update production types or the production process this year; did you apply at least one patent; did you start exporting to a new market, etc.

[8] Jean-Pierre Maynard "On the Importance of Using Comparable Labour Input to Make International Comparison of Productivity Levels" (Statistics Canada).

[9] Kamilla Heurlén and Henrik Sejerbo Sørensen "Labour Productivity Based on Integrated Labour Accounts – Does It Make Any Difference?" (Statistics Denmark).

[10] Lucy P. Eldridge and Sabrina Wulff Pabilonia "Are Those Who Bring Work Home Really Working Longer Hours? Implications for BLS Productivity Measures" (U.S. Bureau of Labor Statistics).

The measurement of the composition of labour input

Several countries have started to generate indicators of labour input adjusted by labour quality, and in some cases (e.g. Italy, Spain, the European Central Bank) there are significant differences between the adjusted and unadjusted time profiles of labour input. This has raised the issue of the comparability of such adjustments. Haine and Karutin[11] from the European Central Bank and Eldridge, Manser and Otto[12] from the US Bureau of Labour Statistics point out that unweighted working hours do not reflect labour input adequately, as they do not consider the educational achievements, skills or experience of the employees.

Baldassarini and Di Veroli[13] from the National Statistical Office of Italy provide a detailed description of the method for calculation of actual working hours and present evidence regarding changes in labour quality. Schwerdt (Ifo Institute for Economic Research) and Turunen[14] (European Central Bank) observe that in the 1990s, growth in labour quality was boosted by an increase in the share of people with higher education and people in their prime working age. As a result, labour input accounts for a larger share of productivity growth, reducing the contribution of production factors to total productivity.

The measurement of capital input

The measurement of capital input also raises several important methodological issues, for instance problems related to the comparison of the levels of return on capital and the stock of assets, and various assumptions regarding operating costs and depreciation. Paul Schreyer[15] (OECD) compares the levels of input, productivity and intensity of capital.

The measurement of capital does not include all assets, and this practice is not likely to change in the near term. Nevertheless, the inclusion of assets in the assets as stocks of research and development (R&D) raises a few methodological and practical issues. Edworthy[16] (Office for National Statistics, UK) presents the first empirical estimate for the

[11] Wim Haine and Andrew Kanutin "Main Sources of Quarterly Labour Productivity Data for the Euro Area" (European Central Bank).
[12] Lucy P. Eldridge, Marilyn E. Manser and Phyllis Flohr Otto "U.S. Quarterly Productivity Measures: Uses and Methods" (U.S. Bureau of Labor Statistics).
[13] Antonella Baldassarini and Nadia Di Veroli "Labour Input Productivity: Comparative Measures and Quality Issues" (National Statistical Office of Italy – Istat).
[14] Guido Schwerdt and Jarkko Turunen "Changes in Human Capital: Implications for Productivity Growth in the Euro Area" (Ifo Institute for Economic Research, European Central Bank).
[15] Paul Schreyer "International Comparisons of Levels of Capital Input and Multi-factor Productivity" (Organisation for Economic Co-operation and Development – OECD).
[16] Emma Edworthy and Gavin Wallis "Research and Development as a Value Creating Asset" (Office for National Statistics; HM Treasury).

R&D assets as stock, which also sheds light on the key practical issues (e.g. the composition of R&D costs, construction of suitable deflators, estimation of depreciation rates). This study boasts the first estimate calculation of the impact of R&D on productivity growth.

Parham[17] (Australia's Productivity Commission) questions whether it is correct to consider R&D as 'just another type of asset' in national accounts and how to treat R&D assets in productivity measurement. This establishes a fascinating association with the study of Mas[18] (University of Valencia and IVIE) on the capital of infrastructure, given that physical infrastructure capital and 'knowledge infrastructure' have much in common. Mas also presents a clear definition of infrastructure assets and shows how to measure their contribution to growth.

The use of assets, which also affect the indicators of capital services, tend to vary substantially across countries, and it is not always clear whether such differences reflect economic reality or differences in the assumptions of statisticians. Iommi and Jona-Lasinio[19] present the methodology adopted by the Statistical Office of Italy (ISTAT), where the measurement of capital services is focused on the assessment of the various assumptions on depreciation rates and the rates on return in the measurement of the user cost of capital, and on age-efficiency profiles in the measurement of productive capital stock.

The measurement of industry-level multi-factor productivity

A growing number of OECD countries are involved in multi-factor productivity measurement. They describe the experimental results on industry-level multi-factor productivity measures, which show that they are feasible but they also entail problems regarding measurement. Recurrent problems include the measurement of output in the services sector, the availability of capital data by asset types and economic sectors, and the choice of the rate of return for capital services by economic sectors. The study of van den Bergen, van Rooijen-Horsten, de Haan and Balk[20] presents the experience of Statistics Netherlands in industry-level MFP measures.

Bartelsmann, Corrado and Lengermann[21](Free University of Amsterdam and US Federal Reserve Board) address the issue whether the information on recent developments in

[17] Dean Parham "Empirical Analysis of the Effects of R&D on Productivity: Implications for productivity measurement?" (Productivity Commission, Australia).
[18] Matilde Mas "Infrastructures and New Technologies as Sources of Spanish Economic Growth" (Universitat de Valénicia and Instituto Valenciano de Investigacionece Econòmicas).
[19] Massimiliano Iommi and Cecilia Jona-Lasinio "New Technologies and the Growth of Capital Services: A Sensitivity Analysis for the Italian Economy over 1980–2003" (Istat – Directorate of National Accounts).
[20] Dirk van den Bergen, Myriam van Rooijen-Horsten, Mark de Haan and Bert M. Balk "Productivity Measurement at Statistics Netherlands" (Statistics Netherlands).
[21] Carol Corrado, Paul Lengermann, Eric J. Bartelsman and Joseph Beaulieu "Sectoral Productivity in the United States: Recent Developments and the Role of IT" (Federal Reserve Board; Free University of Amsterdam and Tinbergen Institute; Brevan Howard, Inc.).

industry productivity can be used to compute estimates of growth trends in aggregate multi-factor productivity.

Roberts[22] (Australian Bureau of Statistics) discusses issues related to the measurement of MFP at the industry level in Australia, and provides a detailed summary of the measurement problems in that respect.

Creusen, Vroomen and van de Wiel[23] from CPB Netherlands Bureau for Economic Policy Analysis, analyse the productivity of the Dutch retail trade for the period 1993–2002, focusing on competition and innovation as the drivers of productivity growth.

The study of Hagen and Skytesvall[24] (Statistics Sweden) on Sweden's economic growth describes the implementation of capital services and MFP measures based on the KLEMS decomposition of the business sector.[25]

Pyo, Keun, Rhee and Ha[26] (Seoul National University, Korea Productivity Center and Pukyong National University) strive to determine the sources of economic growth by economic sectors in Korea, where the catch-up process with industrial countries has been primarily facilitated by the manufacturing sector and by increasing inputs (capital and labour force) without an improvement in the efficiency of inputs.

Conclusion

Economic analyses employ various productivity indicators, depending on the aim and object of analysis. Policy makers and other statistics users are not always aware of the conceptual and empirical reasons for differences between different analyses, which may cause misunderstandings.

Hopefully, this brief overview offers an insight into the issues of productivity measurement for the more experienced as well as random users of statistics.

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[22] Paul Roberts "Estimates of Industry Level Multifactor Productivity in Australia: Measurement Initiatives and Issues" (Australian Bureau of Statistics).
[23] Harold Creusen, Björn Vroomen and Henry van der Wiel "Shopping with Friends Give More Fun; How Competition, Innovation and Productivity Relate in Dutch Retail Trade" (CPB Netherlands, Bureau for Economic Policy Analysis).
[24] Tomas Skytesvall and Hans-Olof Hagén "Economic Growth in Sweden, New Measurements" (Statistics Sweden).
[25] KLEMS – a method used to analyse productivity, where the impact of factors such as capital (K), labour (L), and intermediate inputs such as energy (E), materials (M) and services (S) on production are monitored separately.
[26] Hak K. Pyo, Keun Hee, Rhee and Bongchan Ha "Estimates of Labor and Total Factor Productivity by 72 Industries in Korea" (Seoul National University, Korea Productivity Center ja Pukyong National University).