

The OECD Productivity Database: An Overview

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Why an OECD Productivity Database?

In recent years, productivity and economic growth have been an important focus of OECD work. This work has included both efforts to improve the measurement of productivity growth, as shown in the development of the OECD Productivity Manual (OECD, 2001a), as well as work to enhance the understanding of the drivers of productivity performance (OECD, 2001b; OECD, 2003a; 2003b). During this work, questions about appropriate data choices and the measurement of productivity were examined on several occasions (e.g. Scarpetta et al., 2000; Schreyer and Pilat, 2001). At the same time, OECD members have shown a growing interest in internationally comparable productivity data as well as in underlying drivers of productivity growth.

The continued interest of many OECD member countries in productivity led to a decision to develop an OECD Productivity Database,² based on data that are considered to be as comparable and consistent across

countries as is currently possible.³ This database and related information on methods and sources was made publicly available through the OECD Internet site on 15 March 2004. This article briefly describes this OECD effort, which currently provides estimates of labour productivity, measured as GDP per hour worked, for 26 OECD countries. The database also includes estimates of capital services and multi-factor productivity for 14 OECD countries. The article describes the measurement challenges and data choices that have been made. It also briefly notes future work that is planned to further develop the database.

Sources of Data Underlying the OECD Productivity Database

The OECD productivity database combines – to the extent possible – a consistent set of data on GDP, labour input measured as total hours worked, and capital services. The following sources are used in the productivity database.

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2 The OECD Productivity Database is based on the work of four OECD Directorates, namely the Statistics Directorate; the Directorate for Science, Technology and Industry; the Directorate for Employment, Labour and Social Affairs; and the Economics Department.

3 At the same time, problems in comparing productivity growth have been noted in OECD work (e.g. Ahmad et al., 2003). Most of these problems are currently subject of statistical investigation.

Gross Domestic Product

Estimates for GDP are derived from the OECD *Annual National Accounts* (ANA). The data from ANA are based on the OECD's annual national accounts questionnaire to OECD member countries. The data resulting from this questionnaire differ somewhat from national sources and are more comparable across countries than those derived from OECD's quarterly national accounts, thanks to several small methodological adjustments that are made. However, the differences with other OECD sources, such as the *Quarterly National Accounts* and the *Economic Outlook* database, are minor for most countries.

Labour input

The estimates of labour productivity included in the database refer to GDP per hour worked; measures of GDP per person employed are not yet included. GDP per hour worked requires estimates of total hours worked that are consistent across countries. This consistency is achieved by matching the hours worked that are collected by the OECD for its annual *OECD Employment Outlook* with the conceptually appropriate measure of employment for each individual country, i.e. the measure of employment for that country that is consistent with the measure of hours worked collected by the OECD.

Estimates of average hours actually worked per year per person in employment are currently available on an annual basis for 24 OECD countries.⁴ The OECD Productivity Database includes, in addition, hours of work per employee for Hungary and Korea. These estimates are available from National Statistical Offices for 18 countries, seven of which are consistent with National Accounts concepts and coverage.

To develop these estimates, countries use the best available data sources for different categories of workers, industries and components of variation from usual or normal working time

(e.g. public holidays, annual leave, overtime, absences from work due to illness and to maternity, etc.). For example, in two countries (Japan and the United States) actual hours are derived from establishment surveys for regular or production/non-supervisory workers in employee jobs in the private sector, and from labour force surveys (LFS) for non-regular or managerial/supervisory employees, self-employed, farm workers and employees in the public sector. In three other countries (France, Germany and Switzerland), the measurement of annual working time relies on a component method based on standard working hours minus hours not worked due to absences plus hours worked overtime. Standard working hours are derived from an establishment survey (hours offered), an administrative source (contractual hours) and the labour force survey (normal hours), respectively. The coverage of workers is extended using standard hours reported in labour force surveys or other sources as hours worked overtime. Vacation time is either derived from establishment-survey data on paid leave or the number of days of statutory leave entitlements. Hours lost due to sickness are estimated from the number of days not worked from social security registers and/or health surveys.

On the other hand, the national estimates for 11 additional countries (i.e. Australia, Canada, the Czech Republic, Finland, Iceland, Mexico, New Zealand, the Slovak Republic, Spain, Sweden and the United Kingdom) rely mainly on labour force survey results. Annual working hours are derived using a direct method annualizing actual weekly hours worked, which cover all weeks of the year in the case of continuous surveys. But, for labour force surveys with fixed monthly reference weeks, this method results in averaging hours worked during 12 weeks in the year and, therefore, necessitates adjustments for special events, such as public holidays falling

⁴ These data are published for selected years in the annual *OECD Employment Outlook*, Statistical Annex Table F.

Table 1
Measures of Annual Working Time and Employment
Included in the OECD Productivity Database

	Original source for annual actual working time per worker	OECD source for employment estimates
Australia	Labour Force Survey (National Accounts)	Annual National Accounts
Belgium	European Labour Force Survey	Annual National Accounts
Canada	Labour Force Survey (National Accounts)	Annual hours worked database
Czech Republic	Labour Force Survey	Annual hours worked database
Denmark	European Labour Force Survey	Annual National Accounts
France	Establishment Survey (National Accounts)	Labour Force Statistics
Finland	Labour Force Survey	Annual National Accounts
Germany	Administrative source	Annual National Accounts
Greece	European Labour Force Survey	Annual National Accounts
Iceland	Labour Force Survey	OECD Economic Outlook
Ireland	European Labour Force Survey	OECD Economic Outlook
Italy	European Labour Force Survey	Labour Force Statistics
Japan	Establishment Survey	Annual National Accounts
Mexico	Labour Force Survey	Annual National Accounts
Netherlands	European Labour Force Survey	Labour Force Statistics
New Zealand	Labour Force Survey	Labour Force Statistics
Norway	Establishment Survey/Labour Force Survey (National Accounts)	Annual National Accounts
Portugal	European Labour Force Survey	Annual National Accounts
Slovak Republic	Labour Force Survey	Labour Force Statistics
Spain	Labour Force Survey	Annual hours worked database
Sweden	Establishment Survey/Labour Force Survey (National Accounts)	Annual National Accounts
Switzerland	Labour Force Survey (National Accounts)	Annual hours worked database
United Kingdom	Labour Force Survey	OECD Economic Outlook
United States	Establishment Survey (National Accounts)	Annual National Accounts

Note: Employment estimates from the Annual National Accounts refer to the domestic concept of total employment. Estimates from other OECD sources also refer to total employment.

Source: OECD (2004)

outside the reference week (i.e. Canada and Finland). Finally, estimates of annual working time for seven other EU member states are derived by the OECD Secretariat by applying a variant of the component method to the results of the Spring European Labour Force Survey (ELFS). A summary of the various measures is shown in Table 1.

Two other considerations should be kept in mind. First, annual working-time measures are

reported either on a job or on a worker basis. To harmonize the presentation, annual hours worked measures can be converted between the two measurement units by using the share of multiple job holders in total employment, which is available in labour force surveys, although no further distinction is possible between second and more jobs.⁵

Second, given the variety of data sources, hours worked concepts retained in data sources,

5 For example, estimates of annual hours of work for the United States produced by the Office of Productivity and Technology of the Bureau of Labor Statistics are reported on a (per) job basis and are later converted by the OECD Secretariat to a per worker basis by multiplying the job-based annual hours of work by (1 + the share of multiple jobholders in total employment from the household-based Current Population Survey).

and measurement methodologies (direct measures or component methods⁶) used to produce estimates of annual working time, the quality and comparability of annual hours worked estimates are constantly questioned, and are subject to at least two probing issues:

- Labour force survey-based estimates are suspected of over-reporting hours worked compared to work hours reported in time-use surveys, in particular for those working long hours, such as managers and professionals.
- Employer survey-based estimates do not account for unpaid overtime hours and are sometimes suspected of under-reporting hours worked, with consequences for productivity levels and growth rates.

The comparability of measures of hours worked across OECD countries thus remains an issue, and work is currently underway, notably through the Paris Group, the UN city group on labour and compensation,⁷ to further improve the available measures of hours worked.

Capital input

The appropriate measure for capital input within the growth accounting framework is the flow of productive services that can be drawn from the cumulative stock of past investments in capital assets (OECD, 2001a). These services are approximated by the rate of change of the 'productive capital stock' – a measure that takes

account of wear and tear, retirements and other sources of reduction of the productive capacity of fixed assets. Flows of productive services of an office building, for instance, are the protection against rain or the comfort and storage services that the building provides to personnel during a given period (Schreyer, Bignon and Dupont, 2003). The price of capital services per asset is measured as their rental price. If there are markets for capital services, as is the case for office buildings, for instance, rental prices can be directly observed. For most assets, however, rental prices have to be imputed. The implicit rent that capital good owners 'pay' themselves gives rise to the terminology 'user costs of capital'.

Capital input is measured as the volume of capital services, assumed to be in a fixed proportion to the productive capital stock.⁸ The productivity database includes capital services data with calculations based on the perpetual inventory method (PIM). The PIM calculations are carried out by the OECD, using service lives for different assets that are common across countries and correcting for differences in deflators for information and communication technology assets. Sources for the investment series by type of asset underlying the capital services series are national statistical offices⁹ and the Groningen Growth and Development Centre Total Economy Growth Accounting Database¹⁰ (www.ggdc.net).

6 However, both methods can be summarized by the following identity: Annual hours per worker = Standard weekly hours worked x Number of weeks actually worked over the year = Weekly hours actually worked x 52 weeks, considering weekly reference period for reporting hours worked.

7 A UN city group consists of representatives of statistical offices and addresses specific methodological issues. Since the groups are often named after cities, they are informally known as "city groups." See <http://unstats.un.org/unsd/methods/citygroup/index.htm>.

8 See Schreyer, Bignon and Dupont (2003) for a more extensive explanation and for details of the computation of capital services.

9 For Australia, Canada, France, Japan, Italy, Germany, and the United States.

10 For Austria, Belgium, Denmark, Finland, Greece, Ireland, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. The GGDC data, developed as part of a project by the European Commission, uses investment series provided by national statistical offices but complements them with estimates when there are gaps or insufficient asset breakdown. OECD uses these data to avoid creating yet another set of estimates.

Measures of multi-factor productivity in the OECD Productivity Database

The following methodology has been applied for the computation of multi-factor productivity (MFP) measures:

Rates of change of output

Output (Q) is measured as GDP at constant prices for the entire economy. Year-to-year changes are computed as logarithmic differences: $\ln\left(\frac{Q_t}{Q_{t-1}}\right)$

Rates of change of labour input

Labour input (L) is measured as total hours actually worked in the entire economy. Data on total hours has been specifically developed for the database as discussed above. Year-to-year changes are computed as logarithmic differences.

Rates of change of capital input

Capital services are computed for seven different types of assets (S_t^i $i = 1, 2, \dots, 7$) and aggregated to an overall rate of change of capital services by means of a Törnqvist index. The seven asset types are: (i) information technology hardware, (ii) communications equipment, (iii) other products of agriculture, metal products and machinery, (iv) transport equipment, (v) non-residential construction, (vi) software, (vii) other products.

$$\ln\left(\frac{S_t}{S_{t-1}}\right) = \sum_{i=1}^7 \frac{1}{2}(v_t^i + v_{t-1}^i) \ln\left(\frac{S_t^i}{S_{t-1}^i}\right)$$

$$\text{with } v_t^i \equiv \frac{u_t^i S_t^i}{\sum_{i=1}^7 u_t^i S_t^i}$$

where v_t^i is the share of each asset in the total value of capital services $\sum_{i=1}^7 u_t^i S_t^i$. In this expression, the value of capital services for each asset is measured by $u_t^i S_t^i$ where u_t^i is the user cost price per unit of capital services and S_t^i is the quantity of capital services in year t.

Cost shares of inputs

The total cost of inputs is the sum of the remuneration for labour input and the remuneration for capital services. Remuneration for labour input has been computed as the average remuneration per employee multiplied by the total number of persons employed. Thus, it is assumed that the wage per self-employed worker is equal to the average compensation per employed worker. This adjustment is necessary to correct for self-employed persons whose income is not part of the compensation of employees as registered in the national accounts. The above assumption is dictated by data constraints – whether it is a realistic one, remains open. The data on compensation of employees, the number of employees as well as the number of self-employed are derived from the OECD Annual National Accounts.

$$w_t L_t = \left(\frac{\text{COMP}_t}{\text{EE}_t}\right) E_t$$

where

$w_t L_t$: remuneration for labour input in period t

COMP_t : compensation of employees in period t

EE_t : number of employees in period t

E_t : total number employed (employees plus self-employed) in period t.

The total cost of inputs is then given by:

$C_t = w_t L_t + \sum_{i=1}^7 u_t^i S_t^i$ and the corresponding cost shares are

$$s_t^L \equiv \frac{w_t L_t}{C_t} \text{ for labour input and}$$

$$s_t^S \equiv \frac{\sum_{i=1}^7 u_t^i S_t^i}{C_t} \text{ for capital input.}$$

Total inputs

The rate of change of total inputs is a weighted average of the rate of change of labour and capital input with the respective cost shares

as weights. Aggregation is by way of a Törnqvist index number formula:

$$\ln\left(\frac{X_t}{X_{t-1}}\right) = \frac{1}{2}(s_t^L + s_{t-1}^L)\ln\left(\frac{L_t}{L_{t-1}}\right) + \frac{1}{2}(s_t^S + s_{t-1}^S)\ln\left(\frac{S_t}{S_{t-1}}\right)$$

Multi-factor productivity

Multi-factor productivity is measured as the difference between output and input change, or as ‘apparent multi-factor productivity’:

$$\ln\left(\frac{\text{MFP}_t}{\text{MFP}_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \ln\left(\frac{X_t}{X_{t-1}}\right)$$

Why does the OECD publish different productivity measures?

The release of the OECD Productivity Database adds several new measures to the already available OECD estimates of productivity growth. In particular, the *OECD Economic Outlook* currently includes estimates of labour productivity growth for the business sector in its Annex Tables. These measures were developed for different purposes and should thus be considered of equal value to those published in the Productivity Database. The following differences should be noted between the two series:

- The measures for labour and multi-factor productivity in the OECD Productivity Database refer to the total economy. They are based on a detailed assessment of labour and capital input, which incorporates adjustments for average hours worked per person employed and for capital services. These economy-wide productivity measures provide a close link to changes in GDP per capita.
- The measures of labour productivity in the *OECD Economic Outlook* cover the business sector only and do not adjust for average hours worked and for capital services. The main advantage of these measures is that they exclude a large part of the economy, i.e. the public sector, in which productivity is

typically poorly measured. Measures of business sector productivity are also important because this sector ultimately determines the development of potential output and the economy’s tax base.

In the medium term, OECD intends to develop more sophisticated measures of productivity for the business sector, incorporating adjustments for hours worked and capital services. Data constraints currently do not permit this for most OECD countries, primarily due to lack of data on capital services for the business sector.

Moving forward

The newly established OECD Productivity Database marks an improvement from the previous situation, as it provides a single and consistent source of data for OECD work on productivity. Several areas still require further work, including:

- *Hours worked.* The current compilation of national estimates of average hours actually worked per person in employment requires further work to build greater confidence in their comparability. This work should focus on comparing the main components of variations in working time derived from alternative sources (i.e. annual leave and public holidays, absence due to sickness and maternity, paid and unpaid overtime). In addition, estimates of hours worked should be developed that are consistent with employment series based on different concepts and reporting units, e.g. jobs or persons employed.
- *Labour composition.* The OECD Productivity Database does not yet include estimates of labour composition. Such estimates are included in a recent study for the G7 countries, however (Jorgenson, 2003). These suggest that the contribution of labour composition to labour productivity growth has

declined in most G7 countries over the second half of the 1990s, Italy being the only exception. Inclusion of such estimates in the OECD Productivity Database is planned over the coming year, depending on data availability.

Capital input. Measures of capital services only cover about 15 OECD countries for which sufficient detailed investment series are available. Ideally, this database should be extended to a broader range of OECD countries.

Methodological adjustments. Certain problems still affect the comparability of estimates of productivity growth across OECD countries, for example, differences in the treatment of software investment, both as regards nominal investment data and the appropriate deflator for ICT investment. Some work can be undertaken to adjust for these differences in cross-country comparisons.

The business sector. In the medium term, OECD intends to develop more sophisticated measures of productivity for the business sector, incorporating adjustments for hours worked and capital services. Data constraints currently do not permit this for most OECD countries, primarily due to lack of data on capital services for the business sector.

Productivity levels. The database already integrates some estimates of productivity levels for OECD countries. Further work in this area is underway, e.g. through the development of a reader on productivity levels, which should enable a more solid basis for such estimates. Increasing the comparability of estimates of hours worked across countries continues to be the main challenge in this area.

In conclusion, progress has been made over the past year to establish an OECD reference database

for productivity which could be used by government officials and researchers in the OECD area. Further work will be needed, however, some of which is planned for the coming years.

The OECD Productivity Database will be updated on a regular basis as new data become available. It is accessible through the OECD Internet site, at: www.oecd.org/statistics/productivity. Comments on the database are most welcome.

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