

ANNEX A. THE OECD PRODUCTIVITY DATABASES PDB AND PDBI

Since its launch in 2004, the *OECD Productivity Database (PDB)* has provided annual estimates of labour and multifactor productivity growth (MFP) as a tool to analyse the drivers of economic growth in OECD member countries. In 2011, the OECD further developed this tool by providing new harmonised productivity measures at the industry level in a new *OECD Productivity Database by industry (PDBi)*. The two databases include the following indicators:

- **Growth in labour productivity:** Labour productivity is measured as GDP in basic prices (Gross Value Added) per hour worked. At the total economy level data are currently available for the period 1970-2011 for 34 OECD countries and some geographical zones. At the industry level data cover the period 1985-2011 for 14 industries or sectors and currently 17 countries based on the new ISIC Rev.4 classification (see Table A1 below, Annex D).
- **Capital input measures:** Estimates of capital services at the whole economy level are available in *PDB* (for 19 OECD countries) for the period 1985-2010. Net capital stocks by industry are currently available in *PDBi* for 8 countries and 14 industries according to ISIC Rev.4 (see Table A1 below, Annex D), for the period 1990-2010 for most countries.
- **Labour and capital cost shares:** Data are available for the period 1985-2010 for most countries.
- **Multifactor productivity:** Estimates are available for 19 OECD countries in *PDB* and 8 countries in the *PDBi*, for the period 1985-2010.
- **Labour productivity levels:** Data are available up to 2011, for all OECD countries and some geographical zones in the *PDB*.

Both the *PDB* and *PDBi* are updated on a continuous basis as new data become available. They are accessible through the OECD Internet site, at: www.oecd.org/statistics/productivity.

The OECD Productivity Database (total economy) (PDB)

The *PDB* combines a consistent set of data on GDP, labour input (measured as total hours worked) and capital services. The detailed measures and data sources used are as follows:

Labour input

Within the *PDB*, labour input is defined as total hours worked of all persons engaged in production. The default source for total hours worked is generally the OECD's *Annual National Accounts*. However, for a number of countries, the national accounts do not provide data on hours worked and, so, other sources have to be used. Estimates of average hours actually worked per year per person in employment are currently available on an annual basis for 34 OECD member countries and in the *PDB* and in the *OECD's Employment Outlook*. See Annex B below for more details

Capital input

Capital input (K) is measured as the volume of capital services, which is the appropriate measure for capital input within the growth accounting framework (see Annex C, and Schreyer, *et al.*, 2003 for more details on the source data used and the computation of capital services). The *OECD Productivity database* publishes capital services data with calculations based on the perpetual inventory method (PIM). The PIM calculations are carried out by the OECD, using an assumption of common service lives for given assets for all countries, and by correcting for differences in the national deflators used for information and communication technology (ICT) assets.¹ The investment series by type of asset are sourced from national statistical offices² and for some countries from the *EUKLEMS database* (<http://www.euklems.net>).³

Multifactor productivity (MFP)

In simple terms, MFP can be described as the change in output that cannot be explained by changes in the quantity of capital and labour inputs used to generate output. In the *PDB* it is measured by deducting the growth of labour and capital inputs from output growth as follows:

$$\ln\left(\frac{MFP^t}{MFP^{t-1}}\right) = \ln\left(\frac{Q^t}{Q^{t-1}}\right) - \ln\left(\frac{X^t}{X^{t-1}}\right),$$

where Q is output measured as real GDP. X relates to total inputs used and the rate of change of these inputs is calculated as a weighted average of the rate of change of labour and capital input, with the respective cost shares as weights. Aggregation of these inputs is by way of the Törnqvist index:

$$\ln\left(\frac{X^t}{X^{t-1}}\right) = \frac{1}{2} (s_L^t + s_L^{t-1}) \ln\left(\frac{L^t}{L^{t-1}}\right) + \frac{1}{2} (s_S^t + s_S^{t-1}) \ln\left(\frac{K^t}{K^{t-1}}\right).$$

Thereby, Labour input (L) is measured as total hours actually worked and capital input is measured as capital services (K). These are computed separately for each type of assets ($K_i^t = 1, 2, \dots, 7$, reflecting the seven asset types in the *PDB*) and aggregated to an overall rate of change of capital services, using a Törnqvist index:

$$\ln\left(\frac{S^t}{S^{t-1}}\right) = \sum_{i=1}^7 \frac{1}{2} (v_i^t + v_i^{t-1}) \ln\left(\frac{K_i^t}{K_i^{t-1}}\right).$$

Thereby, v_i^t is the contribution that asset i makes to total capital services in year t and K_i^t is the quantity of capital services provided by asset i in year t .

¹ The following average service lives are assumed for the different assets: 7 years for IT equipment, 15 years for communication equipment, other equipment, and transport equipment, 40 years for non-residential construction, and 3 years for software.

² Australia, Canada, Finland, France, Germany, Ireland, Italy, Japan, Korea, New Zealand, Spain, Sweden, Switzerland, the United States.

³ Austria, Belgium, Denmark, the Netherlands, Portugal, the United Kingdom.

Cost shares of inputs

The total cost of inputs is the sum of the labour input cost and the cost of capital services. The *OECD Annual National Accounts* records the income of the self-employed as *mixed income*. This identity includes both the compensation to labour and capital. As such, for the *PDB*, total labour input costs for the self-employed and employees are computed as the average remuneration per employee multiplied by the total number of persons employed. The source for data on compensation of employees and for the number of employees as well as the number of self employed is the *OECD Annual National Accounts*.

$$w^t L^t = \left(\frac{COMP^t}{EE^t} \right) E^t,$$

where $w^t L^t$ reflects the total remuneration for labour input in period t , $COMP^t$ is the compensation of employees in period t , EE^t is the number of employees in period t , and E^t the total number of employed persons, *i.e.*, employees plus self-employed, in period t .

Total capital input cost is computed as the sum over the user costs of each capital asset type i , $u_i^t K_i^t$, where u_i^t is the user cost per unit of capital services provided by asset type i .

Total cost of inputs is then given by:

$$C^t = w^t L^t + \sum_{i=1}^7 u_i^t K_i^t.$$

And the corresponding cost shares for labour and capital are

$$s_L^t \equiv \frac{w^t L^t}{C^t} \text{ for labour input and } s_S^t \equiv \frac{\sum_{i=1}^7 u_i^t K_i^t}{C^t} \text{ for capital input.}$$

Note that under perfect competition and constant returns to scale, the observed Solow residual can be viewed as an unbiased estimate of MFP growth. In this case, the shares of capital and labour in output valued at marginal costs measure the elasticity of output with respect to inputs. However, this is no longer the case under imperfect competition (see Schreyer, 2010, and Oliveira Martins *et al.*, 1996). As shown in Hall (1990), a way of overcoming this problem is to calculate MFP using cost rather than revenue shares, as is done in the *OECD Productivity Database*.

The OECD Productivity Database by Industry (PDBi)

In essence, the conceptual approach used to estimate productivity in the *PDBi* follows that in the *PDB*. However the same quantity (and quality) of data that is available for the whole economy estimates in the *PDB* is not always available at the detailed industry level. Hence some approximations are necessary making that, in practice, some differences prevail between the whole economy estimates and those given in the *PDB* arise.

The *PDBi* currently provides productivity estimates for 14 different industries (activities) each defined in accordance with the *International Standard Industry Classification (ISIC) Rev.4* (see Table A1 below for more detailed information on data coverage for countries and industries, and Annex D).

Labour input

As in the *PDB*, labour input in the *PDBi* is based on total hours worked by all persons engaged in production (broken down by industry) sourced from the *OECD STAN database*. In the past, when this variable was not available, estimates of total hours worked of employees from the *OECD STAN database* were used as a proxy. If neither total hours worked by all persons engaged nor total hours worked by employees were available in the *OECD STAN database*, then total hours worked at the level of the total economy from the *PDB* were distributed across industries according to the structure of total employment across industries.

Capital input

Unlike the *PDB* where investment data by 7 asset types are used to construct estimates of the value of capital services, at the industry-level, data are generally only available for total capital. Hence, the *PDBi* estimate of net capital stock cannot take account of differences in relative productivity of different types of assets. One consequence of this simplification is that industry-level data are not directly comparable with the economy-wide MFP data that are based on capital services.

The *PDBi* provides time-series of capital input by industry based on a common methodology for all countries. Harmonised net capital stocks by industry are computed using the Perpetual Inventory Method (PIM) based on national investment series. This estimates constant price values of capital stocks by summing prior investments and netting out depreciation and retirement. A standard approach with geometric rates of depreciation (δ) is applied so that the stock for each industry i at the beginning of period t , K_i^t is computed as follows:

$$K_i^t = I_i^{t-1} + (1 - \delta)I_i^{t-2} + (1 - \delta)^2 I_i^{t-3} + \dots + (1 - \delta)^{T-1} I_i^{t-T-2} + (1 - \delta)^T,$$

where I_i^{t-1} is gross fixed capital formation made by industry i in year $t-1$.

The measurement of capital costs is based on the same underlying approach as used in the *PDB*. In each industry, it measures a user cost of capital composed of an exogenous real rate of return and the rate of depreciation. The real rate of return used to calculate capital input is country specific, defined in its *ex ante* formulation, and is taken from the long run constant rate as given in the *PDB*.

Multifactor productivity and cost shares

Notwithstanding the differences in the data sources used to construct the *PDB* and the *PDBi* estimates of MFP, the approach used to measure the cost shares of labour and capital, follow the same conceptual model as given above in the *PDB*. Hence at the level of each industry, MFP growth is measured as follows:

$$MFP_i^t = \Delta \ln(Q_i^t) - \bar{\alpha}_i^t \Delta \ln(L_i^t) - (1 - \bar{\alpha}_i^t) \Delta \ln(K_i^t).$$

Thereby, $\alpha_i^t = \frac{w_i^t L_i^t}{w_i^t L_i^t + u_i^t K_i^t}$ is the share of labour in total costs in industry i , $\bar{\alpha}_i^t = 0.5(\bar{\alpha}_i^{t-1} + \bar{\alpha}_i^t)$ its average over two periods, $(1 - \bar{\alpha}_i^t)$ is the share of capital in total costs, Q_i^t is real value-added, L_i^t the labour input from the *OECD STAN database*, and K_i^t the capital input computed as described above.

Table A.1. Data coverage in the OECD Productivity Database by Industry, ISIC Rev4

Growth in GDP per hour worked		AUT	CZE	DNK	FIN	FRA	DEU	HUN	ITA	LUX	NLD	NOR	PRY	SVK	SVN	ESP	SWE
TOTAL EXCL. REAL ESTATE		96-11	96-11	85-10	85-11	85-11	92-11	96-10	93-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	94-11
AGRICULTURE, HUNTING, FORESTRY & FISHING		96-11	96-11	85-10	85-11	85-11	92-11	96-10	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	85-11
INDUSTRY INCLUDING ENERGY		96-11	96-11	85-10	85-11	85-10	92-11	01-07	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	94-11
MINING AND QUARRYING		96-11	96-11	85-10	85-11	85-10	92-11	96-07	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	85-11
MANUFACTURING		96-11	96-11	85-10	85-11	85-10	92-11	96-10	85-11	03-11	88-10	85-11	01-09	96-11	01-10	01-10	85-11
Machinery and equipment		96-11	96-11	85-10	85-11	85-11	92-10	96-07	85-11	03-11	88-10	85-11	01-09	96-11	01-10	01-10	94-11
Transport equipment		96-11	96-11	85-10	85-11	85-11	92-10	96-07	85-11	03-11	88-10	85-11	01-09	96-11	01-10	01-10	94-11
UTILITIES ²⁾		96-11	96-11	85-10	85-11	85-10	92-11	01-07	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	94-11
CONSTRUCTION		96-11	96-11	85-10	85-11	85-11	92-11	96-10	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	85-11
BUSINESS SECTOR SERVICES EXCL. REAL ESTATE		96-11	96-11	85-10	85-11	85-11	92-11	96-10	93-11	03-11	88-10	85-11	01-09	98-11	01-10	01-10	94-11
Wholesale & retail trade, repair of motor vehicles		96-11	96-11	85-10	85-11	85-11	92-11	96-07	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	94-11
Accommodation & food services		96-11	96-11	85-10	85-11	85-11	92-11	96-07	85-11	03-11	85-10	85-11	01-09	96-11	01-10	01-10	94-11
Growth in MEP		AUT	CZE	DNK	FIN	FRA	DEU	HUN	ITA	LUX	NLD	NOR	PRY	SVK	SVN	ESP	SWE
TOTAL EXCL. REAL ESTATE		96-10	97-10	97-10	85-10		95-10					85-10					
AGRICULTURE, HUNTING, FORESTRY & FISHING		96-10	97-10	97-10	85-10		95-10		85-10			85-10					
INDUSTRY INCLUDING ENERGY		96-10	98-10	97-10	85-10		95-10		85-10			85-10					
MINING AND QUARRYING		96-10	98-10	97-10	85-10		95-10		85-10			85-10					
MANUFACTURING		96-10	98-10	97-10	85-10		95-10		85-10			85-10					
Machinery and equipment		96-10	98-10	97-10	85-10		95-10		85-10			85-10					
Transport equipment		96-10	97-10	97-10	85-10		95-10		85-10			85-10					
UTILITIES ²⁾		96-10	97-10	97-10	85-10		95-10		85-10			85-10					
CONSTRUCTION		96-10	97-10	97-10	85-10		95-10		85-10			85-10					
BUSINESS SECTOR SERVICES EXCL. REAL ESTATE		96-10	98-10	97-09	85-10		95-10		85-10			85-10					
Wholesale and retail trade, repair of motor vehicles		96-10	97-10	97-09	85-10		95-10		85-10			85-10					
Accommodation & food services		96-10	97-10	97-10	85-10		95-10		85-10			85-10					

Notes: (1) Based on STAN coverage (31 October 2012). Includes preliminary estimates to be released later this year. Hours worked for total employment or/and capital input data is missing for Belgium, Canada, Chile, Estonia, Greece, Iceland, Ireland, Israel, Japan, Korea, Mexico, New Zealand, Poland, Switzerland, Turkey, the United Kingdom and the United States.

2) Electricity, gas, steam, air conditioning and water supply, sewerage, waste management and remediation activities.

References

Hall, R. (1990), Invariance Properties of Solow's Productivity Residual, in P. Diamond (ed.), *Growth, Productivity, Unemployment*, MIT Press, Cambridge, Massachusetts.

Oliveira-Martins, J., S. Scarpetta and D. Pilat (1996), Mark-up ratio in Manufacturing Industries, Estimates for 14 OECD Countries, *OECD Economic Department Working Papers*, N°162. This work has also been published in "Mark-ups Pricing, Market Structure and the Business Cycle"; *OECD Economic Studies*, N°34, OECD, Paris.

Schreyer, P. (2010), Measuring Multifactor Productivity when Rates of Return Are Exogenous, in Diewert et al. (2010), *Price and Productivity Measurement*, Vol.6.



From:
OECD Compendium of Productivity Indicators 2012

Access the complete publication at:
<https://doi.org/10.1787/9789264188846-en>

Please cite this chapter as:

OECD (2012), "Annex A: The OECD productivity databases PDB and PDBI", in *OECD Compendium of Productivity Indicators 2012*, OECD Publishing, Paris.

DOI: <https://doi.org/10.1787/9789264188846-9-en>

This work is published under the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein do not necessarily reflect the official views of OECD member countries.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for public or commercial use and translation rights should be submitted to rights@oecd.org. Requests for permission to photocopy portions of this material for public or commercial use shall be addressed directly to the Copyright Clearance Center (CCC) at info@copyright.com or the Centre français d'exploitation du droit de copie (CFC) at contact@cfcopies.com.