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Eurostat's Capital Productivity Indicators (CAPIs)

Methodological note and quality aspects[1]

Contents

1 Introduction

Productivity is commonly defined as a ratio between the output volume and the volume of inputs. Productivity measures can be classified as:

- single factor productivity measures, relating a measure of output (value added) to a single measure of input (labour or capital); or

- multifactor productivity measures (MFP growth), relating a measure of output to a bundle of inputs.

Ideally, capital productivity should be calculated using data on capital services. However, when doing so, further information and assumptions are needed to aggregate detailed asset types into 'capital services'. Therefore, as a more practical and feasible approach, national accounts data on capital stocks are used to approximate the concept. This makes it possible to calculate the indicators directly from the available data as well as carry out plausibility checks of the released data on capital stocks[2].

Capital productivity indicators (CAPIs) are a set of indicators used to assess capital productivity evolution. Typically, capital productivity is defined as a ratio of a measure of output in real terms (e.g. value added in chain-linked volumes) to a measure of input in real terms (e.g. capital stock in chain-linked volumes). In addition, capital-labour ratios provide more detailed insights on the use of capital relative to labour. Changes to these indicators are referred to as 'capital deepening' and indicate whether more or less capital by asset type per unit of labour input is used over time.

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[2] Capital productivity indicators published here differ from those published by OECD, which are based on capital stocks constructed from data on gross fixed capital formation following a common methodology across countries. OECD calculates capital productivity as the 'ratio between the volume of output, measured as GDP, and the volume of capital input, defined as the flow of productive services that capital delivers to production, i.e. capital services'. For further details, see *OECD Compendium of Productivity Indicators 2019*, OECD Publishing, Paris. https://doi.org/10.1787/b2774f97-en, page 54.

2 Overview of indicators provided and quality aspects

2.1 Overview of indicators provided

Table 1 provides an overview of the capital productivity indicators which are published. These are based on data on net capital stocks, value added, and employment (number of persons and hours worked). Indicators are provided in terms of growth rates which are deemed comparable across countries.

TABLE 1 – OVERVIEW OF CAPITAL PRODUCTIVITY INDICATORS

EUROBASE CODE	Labour Productivity Indicators (LPIs)	FORMULA		TOTAL ECONOMY &TOTAL FIXED ASSET		TOTAL ECONOMY &MAIN ASSET TYPES *		BY INDUSTRY (A*21) &TOTAL FIXED ASSET	
		numerator	denominator	growth rate	Index	growth rate	Index	growth rate	Index
				1y 3y 5y 10y	2015=100	1y 3y 5y 10y	2015=100	1y 3y 5y 10y	2015=100
GVA_NCS	Gross value added per unit of net fixed assets	Value added in CLV	Capital stock in CLV	✦ ✦	✦			✦ ✦	✦
NCS_GVA	Net fixed assets to gross value added	Capital stock in CLV	Value added in CLV	✦ ✦	✦	✦ ✦	✦	✦ ✦	✦
NCS_EMP	Net fixed assets per employed person	Capital stock in CLV	Persons employed	✦ ✦	✦	✦ ✦	✦	✦ ✦	✦
NCS_HW	Net fixed assets per hour worked	Capital stock in CLV	Hors worked	✦ ✦	✦	✦ ✦	✦	✦ ✦	✦

* The 4 main asset types are the following: 1)N11K (Dwellings + Other buildings and structures); 2)N11M (Machinery and equipment and weapon systems); 3)N115(cultivated biological resources); 4)N117(intellectual property products) plus N1132 (ICT equipment).

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2.2 Coverage in terms of industry and asset type

Indicators are provided at the total economy level and at industry level, by A21 of NACE-Rev.2[3].

Eurostat does not disseminate some industries, mainly when the comparability or meaning of productivity indicators based on imputed rents, or on data from the non-market sector, where activities subject to market competition is controversial. For instance, for non-market activities, figures are often obtained by the cost method. Therefore, these data are not comparable with the data of regular market industries since value added or output in non-market activities is often measured through input methods. Given that market prices are not available, value added is calculated as the sum of compensation of employees, consumption of fixed capital and other taxes less subsidies on production, where compensation of employees is by far the largest (around 75% in EU countries) component.

Any increase in the value of intermediate consumption will not affect value added, given that this increase implies an identical increase in output. On the contrary, any increase of compensation of employees implies an identical increase in value added. The use of the cost approach for obtaining a measure of output has direct implications on the productivity analysis.

This cost method can lead to a misleading conclusion when an increase in compensation of employees (value added), without a change in the labour input (neither in composition nor in volume) increases the nominal productivity but not the real productivity (volume). However, even if employment (in volume or in composition) increases, which accounts for the compensation increase, nominal and real productivity remain almost unchanged as the numerator and the denominator of the productivity indicator are

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[3] See Appendix Table A.1.

impacted more or less in the same proportion. In this situation, any analysis relating to either labour productivity or total factor productivity will be affected by these shortcomings in the underlying data [4].

Similarly, the rent of owner-occupied dwellings in the absence of a sufficiently large rental market, the ESA 2010 (par. 3.79) suggests using the user cost approach. Besides, the inclusion of the output of services of owner occupied dwellings that is carried out without employment, would raise the average level of productivity.

Moreover, looking at the total capital stock by industry, the values of the data for sections T (activities of households as employers; undifferentiated goods- and services- producing activities of households for own use) and U (activities of extraterritorial organisations and bodies) are either missing or null.

Consequently, Eurostat decided to exclude the following industries from its portfolio on labour productivity indicators and CAPIs:

- L – real estate activities;

- O – public administration and defence, compulsory social security;

- P – education;

- Q – human health services, residential care and social work activities;

- T – activities of households as employers; undifferentiated goods - and services - producing activities of households for own use;

- U – activities of extra-territorial organisations and bodies.

Nevertheless, these activities are included in the total economy's indicators.

Regarding **asset types**, Eurostat, on the basis of a quality analysis carried out, has decided to provide the indicators for total fixed assets, the four main asset types (N11KN, N11MN, N115N, N117N) and ICT equipment (N1132N). Indicators are not provided for the detailed asset types, except for ICT equipment. The reason for not providing these indicators is the non-availability of data by industry and detailed assets, which are not compulsory at the A*21 industry level.

The following asset types are provided and termed 'main asset types':

- N11N – total fixed assets (net);

- N11KN – total construction (net);

- N11MN – machinery and equipment and weapon systems (net);

- N115 – cultivated biological resources (net);

- N117 – intellectual property products (net);

plus
- N1132N refers to ICT equipment (net).

2.3 Data sources

Data are officially transmitted by Member States to Eurostat under the ESA 2010 transmission programme. Gross value added (in chain-linked volumes) are taken from series *nama_10_a64 (national accounts aggregates by industry (up to NACE A*64))*. Net capital stocks are taken from series *nama_10_nfa_st (cross-classification of fixed assets by industry and by asset (stocks)) from table 20*. The

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[4] For more details, see OECD (1997) 'Productivity Measurement For the Non-Market Services', Document
STD/NA(97)14. Available at https://www.oecd.org/sdd/na/2666071.pdf

number of people employed (in thousands) and the number of hours worked (in thousands) are taken from series *nama_10_a64_e (national accounts employment data by industry (up to NACE A*64))*.

However, capital stock data in chain-linked volumes are not transmitted by countries and therefore have to be calculated from data related to current and previous year replacement costs[5].

2.4 Availability and comparability recommendations

Results (based on data available on February 2021) are available for the EU-27 countries (excluding Croatia), Norway and the UK, in most cases from 1995 onwards. For Bulgaria, Malta, Poland, Portugal, Romania, Slovenia, Slovakia, and Spain data are available from 2000 onwards. Unlike labour productivity indicators, no aggregate for the EU-27 (or other groups) is yet available, as data aggregates are not available for capital stocks.

Capital stock data at the total economy level as well as by asset type (the transmission of which is compulsory) are available in full.

When combining industry level and asset type, completeness declines with further disaggregation. Providing data by industry and some (main) assets is not compulsory at the A*21 industry level, though many countries supply them.

The indicators are provided in terms of index (2015=100) and in percentage changes (previous year, t-3, t-5, and t-10) and are broadly comparable across countries, industries and asset types [6].

3 Capital productivity indicators

3.1 Gross value added per unit of net fixed assets

Definition

Gross value added per unit of net fixed assets is a capital productivity indicator similar to the labour productivity indicator (value added divided by labour input like persons employed or hours worked). It shows how many units of output are produced with a unit of capital stock (input), while other inputs remain constant. Capital productivity increases occur when the growth of output is higher than the growth of capital inputs.

The indicator (see Formula 1) is obtained by dividing gross value added (in chain-linked volumes) by net capital stock (in chain-linked volumes). B1G is gross value added (in chain-linked volumes), while N11N denotes the net capital stock for total fixed assets (in chain-linked volumes). Both data are measured in million units of national currency. A conversion to a common currency is not necessary as both the numerator and the denominator are expressed in national currency units and cancel out.

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[5] For this, we set $X_{CLV,t} = X_{CRC,t}$ (where CLV refers to chain-linked volumes and CRC for current replacement costs) for the reference year $t = T$. The series in chain-linked volumes is then calculated as $X_{CLV,t+1} = X_{CLV,t} \frac{X_{PYR,t+1}}{X_{CRC,t}}$ for $t > T$, and $X_{CLV,t} = X_{CLV,t+1} / \frac{X_{PYR,t+1}}{X_{CRC,t}}$ for $t < T$ (where PYR refers to previous year replacement costs)

[6] Level indicators need an assessment of differences concerning the construction of capital stocks in the individual countries. The Task Force on fixed asset and on consumption of fixed capital under ESA 2010 (FIX-CAP TF) was set up by Eurostat to discuss problems related to compiling this data and to further improving its quality.

Formula	Units	
$$GVA\_NCS = \dfrac{B1G}{N11N}$$	CLV15_MNAC	**Gross value added** Chain-linked volumes (2015), million units of national currency
	CLV15_MNAC	**Net capital stock for total fixed assets** Chain-linked volumes (2015), million units of national currency

Availability and comparability recommendations and other information

This indicator, that can be seen as capital productivity based on net capital stock, is provided:

- for the total economy and total fixed assets and

- by industry A*21 and total fixed assets.

Unlike the others indicators described below, it is not provided by main asset types for both methodological reasons and ease of interpretation. Though computable, the interpretation of changes in output according to only one type (or group) of asset can be misleading. This is in line with labour productivity indicators which are also not distinguished by different types of labour.

3.2 Net fixed assets to gross value added

Definition

Net fixed assets to gross value added is the inverse of the previous indicators (capital productivity). The level of capital-output ratio shows how many units of capital stocks are required to produce a unit of output. An increase in this ratio indicates that more capital is needed per unit of output.

The indicator (see Formula 2) is obtained by dividing net capital stock (in chain-linked volumes) by gross value added (in chain-linked volumes). $NxxN$ denotes net capital stocks (in chain-linked volumes) of a generic asset type, while B1G is gross value added (in chain-linked volumes). Both data are measured in million units of national currency. A conversion to a common currency is not necessary as both the numerator and the denominator are expressed in national currency units and cancel out.

Formula	Units	
$$NCS\_GVA = \dfrac{NxxN}{B1G}$$	CLV15_MNAC	**Net capital stock for total fixed assets, main assets + ICT** Chain-linked volumes (2015), million units of national currency
	CLV15_MNAC	**Gross value added** Chain-linked volumes (2015), million units of national currency

Availability and comparability recommendations and other information

This indicator is provided:

- for the total economy and total fixed assets,

- by industry (A*21) and total fixed assets, and

- for the total economy and main asset types (N11KN, N11MN, N115N, N117N and ICT equipment N1132N).

3.3 Net fixed assets per employed person

Definition

Net fixed assets per employed person is a capital-labour ratio that relates capital stock to labour input, in this case persons employed. It shows how intensively a specific asset type is used in an industry in relation to the use of labour input. The growth rate is usually referred to as 'capital deepening'.

The indicator (see Formula 3) is obtained by dividing net capital stock (in chained-linked volumes) by number of persons employed. $NxxN$ denotes net capital stocks (in chain-linked volumes) for a generic asset type; net capital stocks (in chained-linked volumes) are measured in the national currency. EMP_PER_DC denotes the number of persons employed (in thousands, in domestic concept). As only growth rates are considered, a conversion into a common currency is not required.

Formula	Units	
$$NCS\_EMP = \frac{NxxN}{EMP\_PER\_DC}$$	CLV15_MNAC	**Net capital stock for total fixed assets, main assets + ICT** Chain-linked volumes (2015), million units of national currency
	THS_PER	**Total employment** thousand persons, domestic concept

Availability and comparability recommendations and other information

This indicator is provided:

- for the total economy and total fixed assets,

- by industry (A*21) and total fixed assets, and

- for the total economy and main asset types (N11KN, N11MN, N115N, N117N and ICT equipment N1132N).

3.4 Net fixed assets per hour worked

Definition

Net fixed assets per hour worked is a capital-labour ratio that links capital stock to labour input, measured in hours worked. It shows how intensively a specific asset type is used in an industry in relation to the use of labour input. As regards the growth rate, it is referred to as 'capital deepening' in the literature on productivity.

The indicator (see Formula 4) is obtained by dividing net capital stock (in chained-linked volumes) by number of hours worked. $NxxN$ denotes net capital stocks (in chain-linked volumes) for a generic asset type; net capital stocks (in chained-linked volumes) are measured in the national currency. EMP_HW_DC denotes the number of hours worked (in thousands, in domestic concept). As only growth rates are considered, a conversion into a common currency is not required.

Formula	Units	
$$NCS\_HW = \frac{NxxN}{EMP\_HW\_DC}$$	CLV15_MNAC	**Net capital stock for total fixed assets, main assets + ICT** Chain-linked volumes (2015), million units of national currency
	THS_HW	**Hours worked** Thousand hours worked, domestic concept

Availability and comparability recommendations and other information

This indicator is provided:

- for the total economy and total fixed assets,

- by industry (A*21) and total fixed assets, and

- for the total economy and main asset types (N11KN, N11MN, N115N, N117N and ICT equipment N1132N).

Appendix

Industry list (A*21)

TABLE A.1 – INDUSTRY LIST A*21

Nr	A*21 Code	Description	Divisions
1	A	Agriculture, forestry and fishing	01-03
2	B	Mining and quarrying	05-09
3	C	Manufacturing	10-33
4	D	Electricity, gas, steam, and air conditioning supply	35
5	E	Water supply; sewerage, waste management and remediation activities	36-39
6	F	Construction	41-43
7	G	Wholesale and retail trade; repair of motor vehicles and motorcycles	45-47
8	H	Transportation and storage	49-53
9	I	Accommodation and food service activities	55-56
10	J	Information and communication	58-63
11	K	Financial and insurance activities	64-66
12	L	Real estate activities	68
13	M	Professional, scientific and technical activities	69-75
14	N	Administrative and support service activities	77-82
15	O	Public administration and defence; compulsory social security	84
16	P	Education	85
17	Q	Human health and social work activities	86-88
18	R	Arts, entertainment, and recreation	90-93
19	S	Other service activities	94-96
20	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	97-98
21	U	Activities of extraterritorial organisations and bodies	99

Note: CAPIs are not provided for industries in light grey.

Acronyms

B1G	Gross value added
CAPIs	Capital Productivity Indicators
CLV	Chain-linked volumes
D1	Compensation of employees
DC	Domestic concept
EMP_PER	Number of persons employed
EMP_HW	Number of hours worked by persons employed
ESA2010	European System of National Accounts 2010
HW	Hours worked
ICT	Information and Communication Technologies
LPI	Labour Productivity Indicators
MFP	Multi-Factor Productivity
MNAC	Millions of national currency
NACE	Statistical classification of economic activities
$NxxN$	Capital stocks (net) code for a generic (xx) asset type
PER	Persons
THS	Thousands