Review of international best practice in the production of productivity statistics

Final Report

DIW ECON
the Consulting Company of DIW Berlin

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Responsibility for the contents of this report rests entirely with London Economics and DIW Econ.

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Table of Contents

Table of Contents

1   Introduction

The aim of this report is to provide evidence on international best practice in the production of productivity estimates to inform the UK Office for National Statistics' reform agenda to transform its suite of productivity statistics. This evidence was gathered through a desk review of material and information available on the websites of major national and international statistical organisations, a survey of these organisations, and consultations with their officials. The survey and subsequent interviews and e-mail exchanges gathered information on the production and dissemination of three main measures of productivity: labour productivity, capital productivity and total or multi-factor productivity.

The information gathered during the study is presented in two ways. The first compares the practices and approaches of the different statistical organisations covered by the study while the second provides more detailed organisation-specific information in a series of individual country reports.

Box 1   Measures of productivity

Labour productivity

Labour productivity is the amount of output produced by one unit of labour. The typical output measures used in this calculation are GDP or Gross Value Added. The labour measure used in labour productivity measures is generally the number of workers or hours worked.

Capital productivity

Capital productivity is the amount of output produced by one unit of capital. As in the case of labour productivity, the typical output measures used in this calculation are GDP or Gross Value Added. The measure of capital used is typically a measure of either (a) the stock of assets (capital) used in the production process or (b) capital services, which are a flow of productive services provided by capital that is employed in production

Total or multi-factor productivity

This productivity measure provides an estimate of the contribution of a bundle of factors of production to the production of one unit of output. This is often characterised as the overall efficiency with which these factors of productivity are combined in the productive process. The number of factors of production considered by total or multi-factor productivity measures ranges from 2 (labour and capital) to 3 or more (labour, capital, energy, materials, etc.).

In total, 21 national and international statistical organisations (NISOs) were invited to participate in the survey[1]. The survey includes, among others, questions about the productivity measures produced by the NISOs, the data used in the calculation of their productivity measures and the dissemination of information on their productivity statistics.

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[1] The survey questionnaire used in the on-line survey is attached at Annex 4.

No responses were obtained from three NISOS, namely:

- Statistics Japan declined to participate because the organisation does not produce any productivity statistics. Subsequently, the Japan Productivity Center was invited to participate in the survey but no response was received.
- Statistics Singapore declined to participate; and,
- No response was received from Statistics Korea.

The 18 NISOs whose responses are presented and discussed in the report are:

- Australian Bureau of Statistics
- BLS - Office of Productivity and Technology (USA)
- Central Statistical Bureau of Latvia
- Destatis, Statistisches Bundesamt Germany
- Eurostat
- Federal Statistical Office Switzerland
- Insee (France)
- International Labour Organization
- Istat (Italy)
- OECD
- Statistics Canada
- Statistics Denmark
- Statistics Estonia
- Statistics Finland
- Statistics Netherlands / CBS
- Statistics New Zealand
- Statistics Norway
- Statistics Sweden

Of these 18 NISOs, one (the Central Statistical Bureau of Latvia) does not produce any productivity statistics and one (INSEE) produces only one productivity measure for non-financial corporations. However, these two NISOs responded to a number of other survey questions.

Throughout this report the term NISOs will be used to refer to both national and international statistical organisations, while the term NSOs will be used to refer to national statistical organisations and the term ISOs will be used to refer to international statistical organisations.

2 Type of productivity measures produced and publication of productivity data

This section presents the types of productivity measures produced and information on the frequency at which these measures are produced, the timeliness of publication as well as the dissemination of productivity data for the 18 surveyed NISOs.

2.1 Types of productivity measures produced

The survey results show that:

- 17 of the 18 surveyed NISOs produce data on labour productivity, as does the ONS[2];
- Seven NISOs produce capital productivity data. The ONS has produced some first-pass estimates of such productivity statistics. These are experimental; and,
- Twelve of the surveyed NISOs and the ONS produce multi-factor productivity data.
- None of the surveyed NISOs publishes other productivity data. The ONS currently produce other productivity data (public service productivity estimates).

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[2] The Central Statistical Bureau of Latvia does not produce any productivity statistics. INSEE (France) produces labour productivity statistics but only for the sector of non-financial corporations (apparent labour productivity).

Table 1   Production and publication of various types of productivity measures

Statistical organisation	Labour productivity	Capital productivity	Multi-factor productivity
Office for National Statistics	✔	✔ [2]	✔
Australian Bureau of Statistics	✔	✔	✔
BLS-Office of Productivity and Technology	✔	✔	✔
Destatis (DE)	✔	✔	
Eurostat	✔		
Federal Statistical Office (CH)	✔	✔	✔
Insee (FR)	✔ [1]		
International Labour Organisation	✔		
Istat (IT)	✔	✔	✔
OECD	✔	✔	✔
Statistics Canada	✔		✔
Statistics Denmark	✔		✔
Statistics Estonia	✔		
Statistics Finland	✔		✔
Statistics Netherlands / CBS	✔		✔
Statistics New Zealand	✔	✔	✔
Statistics Norway	✔		✔
Statistics Sweden	✔		✔
Total number of NISOs publishing productivity data out of the 17 survey respondents publishing productivity data (excluding the ONS)	17	7	12

Source: Survey of NISOs. Number of respondents = 17 (excluding the ONS).
Notes: (1) Apparent labour productivity for the sector of non-financial corporations. (2) A first pass of such statistics was recently published by the ONS. These are still experimental statistics.

2.2　Periodicity at which productivity estimates are published

Of the NISOs having provided information on the periodicity[3] at which they publish productivity statistics:

- 17 NISOs publish labour productivity on an annual basis[4]
- 8 NISOs also publish labour productivity data on a quarterly basis

- 12 NISOs publish multi-factor productivity data on an annual basis
- none publish multi-factor productivity on a quarterly basis

- 7 NISOs publish capital factor productivity data on an annual basis
- none publish capital factor productivity on a quarterly basis

The ONS publishes labour productivity data on a quarterly frequency, but also includes annual labour productivity estimates in the publication. Multi-factor productivity data is published on an annual basis by the ONS. The ONS also produces quarterly estimates of public service productivity and annual estimates of health and total public service productivity.

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[3] Periodicity here refers to the frequency at which the data are published (e.g. is quarterly and/or annual labour productivity data available) not the frequency at which the publications are made available.

[4] In the case of Istat (Italy), the productivity data are annual but they are updated bi-annually in March and October each year.

Table 2   Periodicity at which productivity estimates are published

Statistical organisation	Labour productivity			Capital productivity			Multi-factor productivity		
	M	Q	A	M	Q	A	M	Q	A
Office for National Statistics		✔	✔			✔			✔
Australian Bureau of Statistics		✔	✔			✔			✔
BLS-Office of Prod. and Tech.		✔	✔			✔			✔
Destatis (DE)		✔	✔			✔			
Eurostat			✔						
Federal Statistical Office (CH)			✔			✔			✔
Insee (FR)		✔	✔						
International Labour Org.			✔						
Istat (IT)			✔ [1]			✔ [1]			✔ [1]
OECD		✔	✔			✔			✔
Statistics Canada		✔	✔						✔
Statistics Denmark			✔						✔
Statistics Estonia		✔	✔						
Statistics Finland			✔						✔
Statistics Netherlands / CBS			✔						✔
Statistics New Zealand			✔			✔			✔
Statistics Norway			✔						✔
Statistics Sweden		✔	✔						✔
Total number of NISOs publishing productivity data out of the 17 survey respondents publishing productivity data (excluding the ONS)		8	17			7			12

Source: Survey of NISOs. Number of respondents = 17 (excluding the ONS)
Notes: Frequency here refers to the frequency at which the data are published (e.g. is quarterly and/or annual labour productivity data available) not the frequency at which the publications are made available. M=monthly, Q=quarterly, A=annual and O = other. (1) = Productivity calculations are updated bi-annually in March and October each year. The periodicity of data is annual, nevertheless. (2) The experimental data published for the first time by the ONS in April 2017 are annual.

Annual productivity data are typically published on a calendar year basis.

The exceptions are Statistics New Zealand where the period covered by the data runs from March to February and the Australian Bureau of Statistics where the period begins in July and ends in June.

Table 3   Period for which the annual productivity data are published

Statistical organisation	Labour productivity	Capital productivity	Multi-factor productivity
Office for National Statistics	*Calendar year*	*Calendar year[1]-*	*Calendar year*
Australian Bureau of Statistics	July - June	July - June	July - June
BLS-Office of Prod. and Tech.	Calendar year	Calendar year	Calendar year
Destatis (DE)	Calendar year	Calendar year	-
Eurostat	Calendar year	-	-
Federal Statistical Office (CH)	Calendar year	Calendar year	Calendar year
Insee (FR)	Calendar year	-	-
International Labour Org.	Calendar year	-	-
Istat (IT)	Calendar year	Calendar year	Calendar year
OECD	Calendar year	Calendar year	Calendar year
Statistics Canada	Calendar year	-	Calendar year
Statistics Denmark	Calendar year	-	Calendar year
Statistics Estonia	Calendar year	-	-
Statistics Finland	Calendar year	-	Calendar year
Statistics Netherlands / CBS	Calendar year	-	Calendar year
Statistics New Zealand	March - February	March - February	March - February
Statistics Norway	Calendar year	-	Calendar year
Statistics Sweden	Calendar year	-	Calendar year

Source: Survey of NISOs. Number of respondents = 17 (excluding the ONS)
Note: Experimental data published in April 2017.

2.3   Timeliness of publication of productivity data

The delay between the end of the reporting period and the actual date of publication varies greatly among NISOs. International statistical organisations, which depend on the submission of data from national statistical organisations obviously report on a more extended timetable.

In the case of labour productivity, the delay among national statistical organisations ranges from:

* 31 to 67 days in the case of quarterly[5] labour productivity data (45 days[6] in the case of the ONS); and,
* 14 to 425 days in the case of annual labour productivity data.

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[5] The periodicity (quarterly / annual) here refers to the frequency at which the data are published (e.g. quarterly and/or annual labour productivity data) not the frequency at which the publications are made available.

[6] Flash estimate published by ONS.

In the case of capital productivity data, which are only published on an annual or bi-annual basis by the national statistical organisations in the survey sample, the delay ranges from 90 days to 365 days.

In the case of multi-factor productivity data published by the participating national statistical organisations, the delay ranges from 40 days to 440 days (461 days in the case of the ONS).

Among the three participating international statistical organisations, the delay ranges from 30 to 300 days in the case of annual labour productivity data and is 100 days for quarterly data in the case of the single international statistical organisation (OECD) producing such data. The same organisation publishes annual capital productivity and multi-factor productivity data with a delay of 320 days.

Table 4   Delay in number of days between the end of the reporting period and actual date of publication of the productivity data

Statistical organisation	Labour productivity		Capital productivity	Multi-factor productivity
	Q	A	A	A
Office for National Statistics	*45*	*-[7]*	*461[8]-*	*461*
Australian Bureau of Statistics	60	120	150	150
BLS-Office of Prod. and Tech.[1]	35	-	90	90
Destatis (DE)	55	14	270	-
Eurostat	-	90	-	-
Federal Statistical Office (CH)	-	240	260	260
Insee (FR)[2]	31	-	-	-
International Labour Org.[3]	-	30	-	-
Istat (IT)[4]	-	90	90	90
OECD[5]	100	300	320	320
Statistics Canada[6]	67	405	-	440
Statistics Denmark	-	140	-	440
Statistics Estonia	60	425	-	-
Statistics Finland	-	320	-	320
Statistics Netherlands / CBS[7]	-	180	-	180
Statistics New Zealand[8]	-	365	365	365
Statistics Norway	-	40	-	40
Statistics Sweden	60	60	-	60

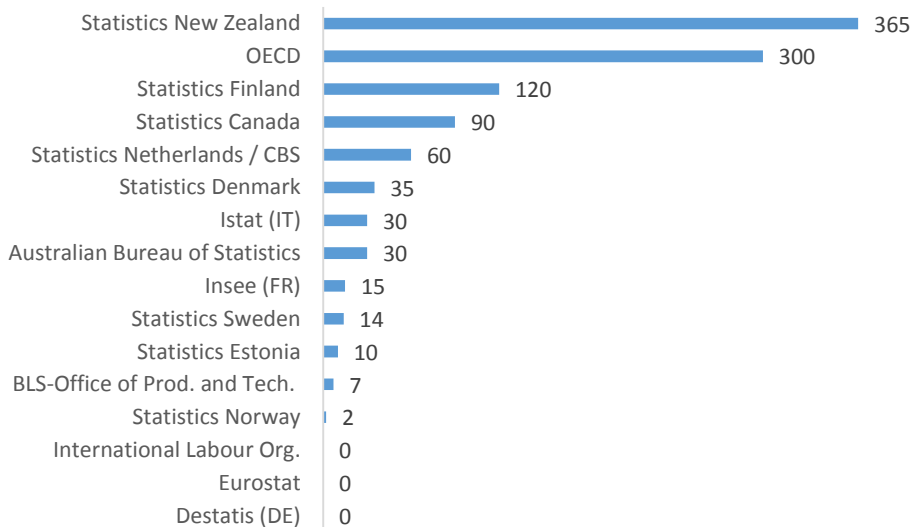*Source: Survey of NISOs. Number of respondents = 17 (excluding the ONS)*

Notes: (1) These statistics refer to the main major sector publications. Industry level estimates are published at a later date. Moreover, productivity statistics are first released as preliminary estimates, revised estimates are published at a later date. For labour productivity, annual averages are published together with the fourth quarter estimates. For capital and multi-factor productivity, 90 days was the lag of the most recent publication for 2016, between 2010 and 2015 the lag was between 126 and 190 days. (2) INSEE publishes three estimates for the same reference period. The first one is published after 31 days, the second one after 59 days and the final after 83 days. Annual estimates are published together with fourth quarter estimates. (3) New estimates are released in January and July of each year. (4) Productivity calculations are updated bi-annually in March and October each year. The periodicity of data is annual, nevertheless. (5) The numbers provided are on average across all countries covered by the OECD. The publication dates differ across countries. (6) Quarterly estimates are limited to the entire economy, the aggregate business sector and NAICS two-digit sub-sectors. In the first quarter of each year, Statistics Canada also publishes annual estimates. (7) 180 days relate to the preliminary estimates, final estimates are available after 550 days. (8) Productivity estimates for the measured sector are published with a one-year lag. Industry level productivity estimates are published with a two-year lag. The experimental capital productivity statistics were published with the Multi-factor productivity statistics in April 2017.

While the production speed of different NISOs varies, the secondary nature of productivity estimates means that there are clear dependencies on the production of other statistics – GDP and labour metrics in particular. Consequently, while the lag between the reporting period and publication is of interest, the time taken for these estimates to be published after all of the

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[7] Annual estimates are published together with estimates for the final quarter, they are not included in the flash estimates.

required inputs are available is also of interest. The reported delay between the publication dates of the last available data input and the publication of the headline productivity statistics for the same period varies greatly among NISOs, ranging from 0 day (Destatis, Eurostat and ILO) to 365 days (Statistics New Zealand) (Figure 1). In the case of the ONS the delay is 7 days. The median delay among the NISOs having responded to the survey is 22.5 days.

Figure 1   Time delay (in days) between the publication date of the last available data input used to calculate the main / headline productivity estimate, and the publication of the main / headline productivity statistics for the same period

Source: Survey of NISOs. Number of respondents = 16 (excluding the ONS)
Notes: In the case of Estonia, the delay ranges from 10 days to 60 days depending on the productivity measure. In the case of Italy, the delay was reported to be 1 month. In the case of the BLS, the delay is reported to be 1 week.

2.4   Dissemination of productivity statistics

The range of activities undertaken by NISOs to disseminate their productivity statistics varies. None of the 17 NISOs, which provided detailed responses to the survey, hold press conferences when new productivity data become available. Moreover, only:

- six NISOs (BLS-Office of Productivity and Technology, Istat (IT), OECD, Statistics Canada, Statistics Denmark and Statistics New Zealand) and the ONS issue productivity-related press releases; and,
- four of these six NISOs (BLS-Office of Productivity and Technology, Istat (IT), OECD and Statistics Denmark) and the ONS as well as the Federal Statistical Office (CH) and Statistics Netherlands / CBS use Twitter to inform the public about the publication of new productivity data. The OECD also uses Facebook.

Figure 2   Dissemination of productivity data -number of NISOs using different information channels

Press conference: 0
Press releases: 6
Social media: 6
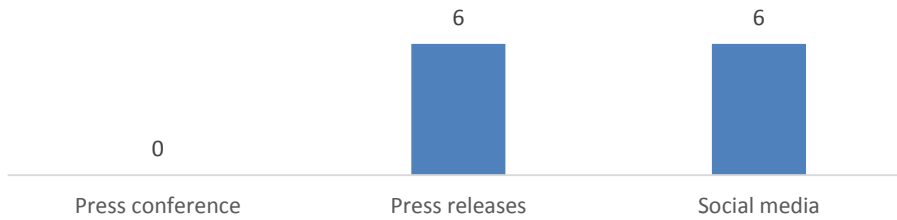
Source: Survey of NISOs
Notes: Twitter is used by the six NSOs (BLS-Office of Productivity and Technology, Federal Statistical Office (CH), ISTAT (IT), OECD, Statistics Denmark and Statistics Netherlands / CBS) for disseminating information about new productivity data through social media. The OECD also uses Facebook as an information channel.

Among the six NISOs issuing press releases announcing the publication of productivity data, five make them available to general on-line media. The ONS does so as well.

In the case of the four NISOs sending press releases to print media, three send them to both general and specialised financial/business media, while Statistics Denmark sends press releases to general print media only. The ONS sends the press release to both the general and specialised print media.

Two NISOs send press releases to general and specialised financial/business TV broadcast media. Three NISOs send press releases to radio broadcast media. Two of these three send press releases to both general and specialised radio broad cast media. The ONS sends press releases to both general and specialised radio and general and specialised TV broadcast media.

Table 5   Types of media organisations to which productivity-related press releases are sent

Statistical organisation	Print media: financial/business	Print media: general	Broadcast media (TV): financial/business	Broadcast media (TV): general	Broadcast media (Radio): financial/business	Broadcast media (Radio): general	Online media: financial/business	Online media: general	Other
Office for National Statistics	✔	✔	✔	✔	✔	✔	✔	✔	
BLS-Office of Productivity and Technology	✔	✔	✔	✔	✔	✔	✔	✔	
Istat (IT)	✔	✔	✔	✔	✔	✔	✔	✔	
OECD									✔ [1]
Statistics Canada	✔	✔					✔	✔	
Statistics Denmark		✔				✔		✔	
Statistics New Zealand								✔	
Total	3	4	2	2	2	3	3	5	1

Source: Survey of NISOs. Number of survey respondents = 6 (excluding the ONS)

Note: (1) = The data are updated on a rolling basis. However, once a year, the OECD produces a publication named OECD Compendium of Productivity Indicators for which there is an in-house press-release.

2.5   Availability of data used to construct the productivity data

Of the 17 surveyed NISOs who produce productivity data, 11 make all the data used in the construction of their productivity estimates available at the same time as the productivity data themselves. The ONS also does so.

These 11 NISOs include:

- Australian Bureau of Statistics
- BLS-Office of Productivity and Technology
- Destatis (DE)
- Eurostat
- Insee (FR)
- International Labour Organization
- Istat (IT)
- OECD
- Statistics Estonia
- Statistics Norway
- Statistics Sweden

The six NISOs not making the underlying data available at the same time are:

- Federal Statistical Office (CH)
- Statistics Canada
- Statistics Denmark
- Statistics Finland
- Statistics Netherlands / CBS
- Statistics New Zealand

2.6 Additional material made available with the release of the productivity data

In terms of additional material provided with the release of the productivity data, technical notes describing the methodology (14 NISOs) and factual information describing the productivity data (9 NISOs) are the most common (Figure 3). Less than half (7 NISOs) also provide commentary explaining the changes observable in the productivity data.

The ONS provides all three types of information, namely technical notes, factual information describing the data and an explanatory commentary.

Figure 3   Number of surveyed NISOs providing various types of information with the productivity data release
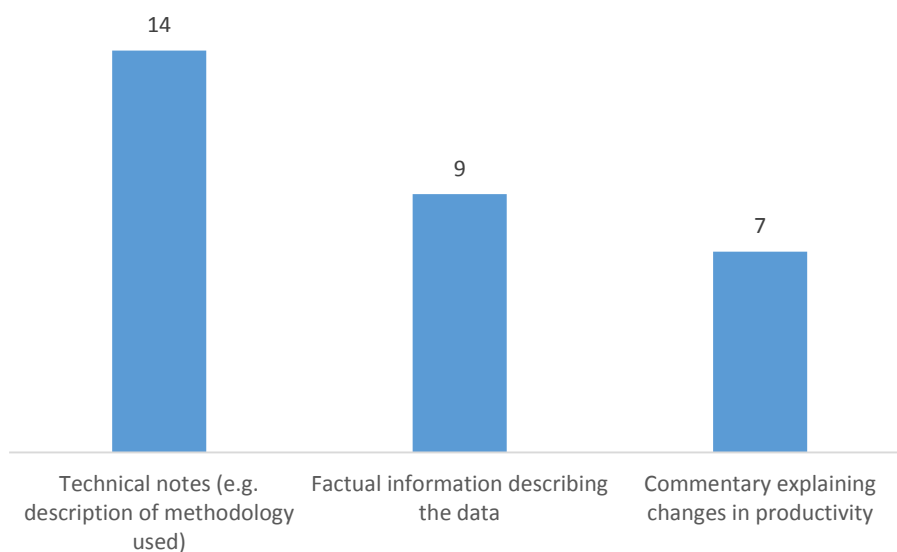
Source: Survey of NISOs
Note: In the case of Destatis, productivity is covered in the press release for GDP.

Table 6   Information provided with the productivity data release

Statistical organisation	Factual information describing the data	Commentary explaining changes in productivity	Technical notes (e.g. description of methodology used)
Office for National Statistics	✔	✔	✔
Australian Bureau of Statistics	✔		✔
BLS-Office of Productivity and Technology	✔		✔
Destatis (DE)			
Eurostat			✔
Federal Statistical Office (CH)			✔
Insee (FR)			
International Labour Organization			
Istat (IT)	✔	✔	✔
OECD	✔	✔	✔
Statistics Canada	✔	✔	✔
Statistics Denmark	✔	✔	✔
Statistics Estonia			✔
Statistics Finland	✔	✔	✔
Statistics Netherlands / CBS		✔	✔
Statistics New Zealand	✔	✔	✔
Statistics Norway			✔
Statistics Sweden	✔		✔
Total number of NISOs (excluding the ONS)	9	7	14

Source: Survey of NISOs.

Note: In the case of Destatis, productivity is covered in the press release for GDP. In the case of the OECD, the productivity publication is produced once a year but the productivity database, instead, is updated on a rolling basis, with corresponding metadata.

2.7   Presentation of productivity statistics

Of the 17 surveyed NISOs which responded to the survey question about the ways that productivity statistics are presented, 14 provide tables and 11 also provide some text and charts. All NISOs provide downloadable databases. The ONS also uses tables, text, charts and downloadable data in the dissemination of productivity information.

Figure 4   Number of NISOs using different ways to present productivity information
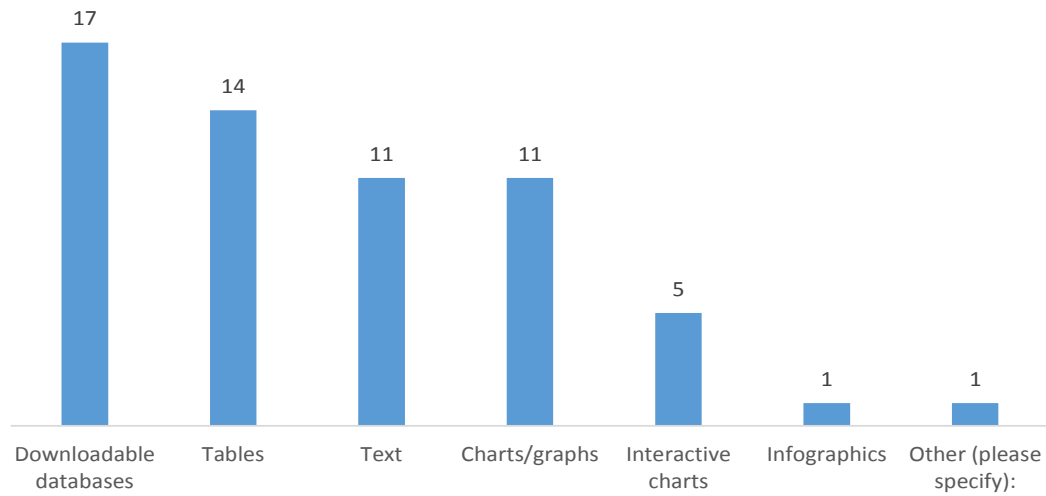
Note: In the case of Destatis, a scientific workshop.

Table 7   Different ways used to present the productivity information

Statistical organisation	Text	Tables	Charts/graphs	Infographics	Interactive charts	Downloadable databases	Other
Office for National Statistics	✔	✔	✔			✔	
Australian Bureau of Statistics	✔	✔	✔		✔	✔	
BLS-Office of Productivity and Technology	✔	✔	✔		✔	✔	
Destatis (DE)	✔	✔	✔			✔	✔ [1]
Eurostat		✔				✔	
Federal Statistical Office (CH)		✔				✔	
Insee (FR)						✔	
International Labour Organization						✔	
Istat (IT)	✔	✔	✔			✔	
OECD	✔		✔			✔	
Statistics Canada	✔	✔	✔	✔	✔	✔	
Statistics Denmark	✔	✔	✔			✔	
Statistics Estonia		✔				✔	
Statistics Finland	✔	✔	✔			✔	
Statistics Netherlands / CBS	✔	✔	✔		✔	✔	
Statistics New Zealand	✔	✔	✔		✔	✔	
Statistics Norway		✔				✔	
Statistics Sweden	✔	✔	✔			✔	
Total number of NISOs (excluding the ONS)	11	14	11	1	5	17	1

Note: (1) In the case of Destatis, a scientific workshop.

Of the 17 NISOs which responded to the question about whether they have changed in recent years the way they disseminate or present productivity statistics, only 7 NISOs indicated having done so.

Two NISOs added interactive charts:
- Australian Bureau of Statistics – introduction of interactive charts
- BLS-Office of Productivity and Technology – added all data in Excel format and added interactive charts

Two NISOs discontinued a publication containing productivity data
- International Labour Organization – discontinued the Key Indicators of the Labour Market publication, which included output per hour worked. As of now, ILO has discontinued publishing this indicator, but may reintroduce it at a later date
- Statistics Netherlands / CBS – the annual publication "Dutch growth accounts" was discontinued due to budget constraints

One combined their publications
- Statistics New Zealand combined their aggregate productivity statistics with their industry productivity statistics into a joint release titled "Productivity Statistics"

One NISO made a methodological change
- Statistics Finland - Disaggregation of capital inputs into sub-factors e.g., machinery and equipment, ICT and R&D)

One added a new chapter to their publication:
- The OECD added a new first chapter to their most recent OECD Compendium of Productivity Indicators publication. This chapter serves as an introductory chapter that gives the OECD an opportunity to cover, for example, current issues of interest and provide an overarching story that ties the rest of the publication together.

In the case of the ONS, the publication of productivity related material was aligned on quarterly "theme days" and provided more overarching commentary.

2.11   International best practices

Very few answers were received for the best practices survey question. The key finding is that no single statistical organisation is mentioned as a "best practice" benchmark for all best practice dimensions considered by the survey. But a few organisations are mentioned several times. These are:

- Australian Bureau of Statistics
- Bureau of Economic Analysis / BLS
- Statistics Canada

A few additional organisations (Conference Board, Eurostat, New Zealand Statistics and ONS) are also mentioned once.

Table 8   International best practices – judgement of survey respondents

Aspect of production and dissemination of productivity statistics	Name(s) of statistical organisation cited by survey respondents
Range and scope of productivity statistics	Statistics Canada (2x), OECD (2x), Australian Bureau of Statistics (1x), Bureau of Economic Analysis (1x), Conference Board(1x)
Underlying methodologies for labour productivity	Australian Bureau of Statistics (1x), Bureau of Economic Analysis (1x), Conference Board(1x), Statistics Canada (1x),
Underlying methodologies for MFP	Statistics Canada (3x), Australian Bureau of Statistics (2x), Eurostat (1x)
Underlying methodologies for capital productivity	Statistics Canada (1x)
Documentation and transparency of productivity statistics	ONS (1x)
Presentation, dissemination and communication of productivity statistics	Bureau of Economic Analysis (1x), Statistics New Zealand (1x)
Timeliness of productivity publications	Bureau of Economic Analysis/ BLS (1x)

Source: Survey of NISOs

3 Production of labour productivity statistics

This section sets out international practice in the production of labour productivity statistics, including the labour metrics which are typically used, the institutional sectors which are covered by different NISOs and the industrial detail which is included.

The number of hours worked is the most commonly used measure of labour used in the headline productivity estimate with 14 of the 17 NISOs surveyed indicating that they are using of this metric. The other labour measure which is used for headline labour productivity data is the number of workers or employed persons (6 NISOs). The ONS produces labour productivity using the number of employed persons, the number of jobs and the number of hours worked.

Table 9   Type of labour measures used in the headline labour productivity statistics

Statistical organisation	Number of employed persons	Number of FTE employed persons	Number of jobs	Number of hours worked	Other
Office for National Statistics	✔		✔	✔	
Australian Bureau of Statistics				✔	
BLS-Office of Productivity and Technology			✔	✔	
Destatis (DE)	✔			✔	
Eurostat	✔			✔	
Federal Statistical Office (CH)				✔	
Insee (FR)	✔				
International Labour Organization	✔				
Istat (IT)				✔	
OECD				✔	
Statistics Canada			✔	✔	
Statistics Denmark				✔	
Statistics Estonia	✔			✔	
Statistics Finland				✔	
Statistics Netherlands / CBS				✔	
Statistics New Zealand	✔ (1)				✔ (1)
Statistics Norway				✔	
Statistics Sweden				✔	
Total number of NISOs (excluding the ONS)	6	0	2	14	1

Source: Survey of NISOs. Number of survey respondents = 17 (excluding the ONS)
Notes: (1) headline measure based on number of hours paid; number of employed persons enters indirectly via number of hours paid

Of the 17 NISOs which provided information on the institutional sectors for which they publish labour productivity data:

- 13 publish labour productivity estimates for the economy as a whole;
- 6 for the total private business economy;
- 5 for the total market economy or private economy: and,
- 4 for the total non-financial private business economy.

The ONS publishes labour productivity data for the whole economy and the total market sector.

Table 10   Institutional sectors for which NISOs publish labour productivity statistics

Statistical organisation	Total Economy	Total market economy or private economy (i.e. excluding the general government sector)	Total private business economy	Total non-financial private business economy (i.e. private business economy excluding finance and insurance)
Office for National Statistics	✔	✔		
Australian Bureau of Statistics	✔	✔		
BLS-Office of Productivity and Technology	✔ [1]		✔ [1]	✔
Destatis (DE)	✔			
Eurostat	✔			
Federal Statistical Office (CH)	✔		✔	
Insee (FR)				✔ [2]
International Labour Organization	✔			
Istat (IT)		✔		
OECD	✔		✔	
Statistics Canada	✔		✔	
Statistics Denmark	✔	✔		
Statistics Estonia	✔			✔
Statistics Finland	✔	✔		
Statistics Netherlands / CBS	✔		✔	
Statistics New Zealand		✔		
Statistics Norway	✔		✔	
Statistics Sweden				✔
Total number of NISOS (excluding the ONS)	13	5	6	4

Source: Survey of NISOs. Number of survey respondents = 17 (excluding the ONS)

Notes: (1) Published as part of the multi-factor productivity program, not the labour productivity program. (2) Apparent labour productivity of non-financial corporations; The following measures of market economy / private economy are used by the NISOs:

- Office for National Statistics: market economy = private economy + public corporations
- Australian Bureau of Statistics: the market sector is broadly equivalent to total economy excluding general government and defence, health and social assistance, and education. More precisely, the market sector is defined as ANZIC 06 Divisions A to N plus Divisions R and S;
- BLS-Office of Productivity and Technology: excludes non-profit institutions, households, and general government. Two measures of general government are considered, one including government enterprises and one excluding government enterprises. BLS also publishes labour productivity estimates for the nonfarm business sector (business sector excluding the farm sector) and for the manufacturing, durable manufacturing and non-durable manufacturing sectors;
- Federal Statistical Office (CH) - includes financial corporations (S11), non-financial corporations (S12) and households (S14) following the SNA definitions;
- OECD: Main economic activities at the level A10 according to the ISIC Rev. 4. This includes activities from B to N, excluding sector L (real estate activities). The sector is called "Non-agriculture business sector excluding real estate";
- Statistics Canada: total economy minus the general government minus the non-profit Institutions serving households minus owner-occupied dwellings;
- Statistics Norway :market oriented industries except dwellings, oil and gas and international shipping
- Statistics Denmark also publish estimates for 1) "Non-farm business sector" (total private economy minus industries A and B) exclusive of dwellings and non-residential buildings and 2) "Market services" (total private economy minus industries A to F) exclusive of dwellings and non-residential buildings
- Statistics Netherlands: excludes general government, education and NACE 68 real estate;

The level of industry granularity of the published labour productivity data varies considerably with the BLS - Office of Productivity and Technology and Statistics Canada publishing such information up to some industries at the 6-digit classification level. In contrast, the industry labour productivity data published by the ONS are at the 1 and 2 digit NACE level.

Table 11   Industries for which NISOs publish labour productivity statistics

Statistical organisation	ISIC or equivalent 1- digit	ISIC or equivalent 2- digits	ISIC or equivalent 3- digits	Other	Maximum number of industries for which labour productivity statistics are published
Office for National Statistics	✔	✔			*50*
Australian Bureau of Statistics	✔				16
BLS-Office of Productivity and Technology			✔	Selected 4- and 6-digit level industries	380[1]
Destatis (DE)	✔			A10+	10+
Eurostat	✔				12
Federal Statistical Office (CH)	✔			+ groups of 2-digit level industries	48
International Labour Organization					
Istat (IT)				NACE A38	35
OECD	✔				8
Statistics Canada	✔	✔	✔	Up to 6-digit level for some industries	322[2]
Statistics Denmark			✔		117
Statistics Estonia		✔	✔		229
Statistics Finland		✔			63
Statistics Netherlands / CBS		✔		In addition aggregates of NACE rev.2 2-digit industries	38
Statistics New Zealand	✔			Sub-industries for manufacturing and agriculture	27[3]
Statistics Norway		✔		A64	64
Statistics Sweden				non-financial private commodity producers, non-financial private service providers	3
Total number of NISOS (excluding the ONS)	7	5	4		

Source: Survey of NISOs
Notes: (1) This number refers to the total unique industries for which the BLS publishes labour productivity estimates across their two production divisions. It includes the quarterly labour productivity series as well as the detailed (down to the 6-digit NAICS level) industry

series. (2) This refers to the detailed annual publication. 16 industries are included in the quarterly publication. (3) Stats NZ covers the 16 measured sector industries. In addition, Stats NZ also covers education and health. For agriculture Stats NZ covers 2 sub-industries and for manufacturing 9 sub-industries.

Besides the ONS, only 5 NISOs produce labour productivity data at sub-national level. These are

- Federal Statistical Office (CH) – 7 sub-national entities at NUTS2 level
- ISTAT – 21 sub-national entities at NUTS2 level
- Statistics Canada – 13 sub-national entities
- Destatis – 16 entities at NUTS1 level, 38 entities at NUTS2 level and 402 entities at NUTS3 level
- Statistics Estonia – 19 regions at NUTS3 level

Of these 5 NISOs, Statistics Canada and Destatis publish industry-level productivity statistics at a sub-national level. ONS has recently extended their range of published productivity statistics and now also publish experimental regional industry estimates of labour productivity.

4   Production of total or multi-factor productivity statistics

This section sets out international practice in the production of multi-factor productivity statistics, including the factors of production which are typically taken into account, the institutional sectors which are covered by different NISOs and the industrial detail which is included.

Multi-factor productivity measures the change in production output that cannot be accounted for by factors used as inputs in the production process. Most commonly the input factors taken into account are capital and labour, but other inputs such as energy, raw materials, services or land can also be taken into account. Multifactor productivity thus measures improvements (or declines) in production efficiency due to factors such as technological progress, managerial skills, etc.

Not surprisingly, labour and capital are taken into account in the main headline multi-factor productivity published by the 12 NISOs which responded to this particular part of the survey. This is also the case for the multi-factor productivity data published by the ONS.

Raw materials and energy are taken into account in the main headline multi-factor productivity estimates by only 2 NISOs (Statistics Netherlands and Statistics Sweden). Services and land are only taken into account by Statistics Netherlands.

Table 12   Factors of production which are taken into account in the estimation of the main/headline multi-factor productivity estimates

Statistical organisation	Labour	Capital	Energy	Raw Materials	Services	Land
Office for National Statistics	✔	✔				
Australian Bureau of Statistics	✔	✔				
BLS-Office of Productivity and Technology	✔	✔				
Federal Statistical Office (CH)	✔	✔				
Istat (IT)	✔	✔				
OECD	✔	✔				
Statistics Canada	✔	✔				
Statistics Denmark[1]	✔	✔				
Statistics Finland	✔	✔				
Statistics Netherlands / CBS[2]	✔	✔	✔	✔	✔	✔
Statistics New Zealand	✔	✔				
Statistics Norway	✔	✔				
Statistics Sweden	✔	✔	✔	✔		
Total number of NISOs (excluding the ONS)	12	12	2	2	1	1

Source: Survey of NISOs

Notes: (1) Statistics Denmark: Labour (quality adjusted), IT-capital, non-IT-capital; (2) Statistics Netherlands / CBS - inventories and mineral and energy reserves. However, land, mineral and energy reserves, and inventories are not separately identified.

4 NISOs, in addition to Statistics Netherlands and Statistics Sweden, produce additional multi-factor productivity measures that take other factors such as raw materials and energy into account:

- Australian Bureau of Statistics publishes experimental productivity estimates for KLEMS (K-capital, L-labour, E-energy, M-materials, and S-purchased services)
- BLS-Office of Productivity and Technology publishes KLEMS estimates for detailed industries
- Statistics Canada produces KLEMS estimates for detailed industries
- Statistics Denmark produces KLEMS productivity estimates based on labour (quality adjusted), IT capital, non-IT capital, energy, materials, services

The UK ONS does not currently produce KLEMS multi-factor productivity estimates.

Of the 12 NISOs having provided information on the sectors for which they publish multi-factor productivity data (Table 13):

- 6 publish multi-factor productivity estimates for the economy as a whole;
- 5 and the ONS for the total market economy or private economy;
- 4 for the total private business economy; and,
- 1 for the total-non-financial private business economy.

As in the case of labour productivity, the level of granularity at which the multi-factor productivity data are published varies greatly among the NISOs. But the granularity never extends beyond the 4-digit level, typically because of data constraints (Table 14).

Only Statistics Canada publishes multi-factor productivity data at a sub-national level. Data are provided for 13 sub-national entities. Moreover, Statistics Canada also publishes industry-level multi-factor productivity data at a sub-national level.

Table 13   Economic sectors for which NISOs publish multi-factor productivity statistics

Statistical organisation	Total Economy	Total market economy or private economy (i.e. excluding the general government sector)[1]	Total private business economy	Total non-financial private business economy (i.e. private business economy excluding finance and insurance)
Office for National Statistics		✔		
Australian Bureau of Statistics		✔		
BLS-Office of Productivity and Technology	✔		✔	
Federal Statistical Office (CH)	✔			
Istat (IT)		✔		
OECD	✔			
Statistics Canada	✔		✔	
Statistics Denmark		✔		
Statistics Finland	✔	✔		
Statistics Netherlands / CBS	✔		✔	
Statistics New Zealand		✔		
Statistics Norway			✔	
Statistics Sweden				✔
Total number of NISOs (excluding the ONS)	6	5	4	1

Source: Survey of NISOs. Number of respondents = 12 (excluding the ONS)
Notes: The following measures of market economy / private economy are used by the NISOs:

- Office for National Statistics: market economy = private economy + public corporations
- Australian Bureau of Statistics: the market sector is broadly equivalent to total economy excluding general government and defence, health and social assistance, and education. More precisely, the market sector is defined as ANZIC 06 Divisions A to N plus Divisions R and S;
- BLS-Office of Productivity and Technology: excludes non-profit institutions, households, and general government. Two measures of general government are considered, one including government enterprises and one excluding government enterprises. BLS also publishes labour productivity estimates for the nonfarm business sector (business sector excluding the farm sector) and for the manufacturing, durable manufacturing and non-durable manufacturing sectors;
- Federal Statistical Office (CH): includes only the following institutional sectors (according to the SNA):non-financial corporations (S.11), financial corporations (S.12) and households (S.14);
- OECD: Main economic activities at the level A10 according to the ISIC Rev. 4. This includes activities from B to N, excluding sector L (real estate activities). The sector is called "Non-agriculture business sector excluding real estate";
- Statistics Canada: total economy minus the general government minus the non-profit Institutions serving households minus owner-occupied dwellings;
- Statistics Norway : market oriented industries except dwellings, oil and gas and international shipping
- Statistics Denmark also publish estimates for 1) "Non-farm business sector" (total private economy minus industries A and B) exclusive of dwellings and non-residential buildings and 2) "Market services" (total private economy minus industries A to F) exclusive of dwellings and non-residential buildings
- Statistics Netherlands: excludes general government, education and NACE 68 real estate;

Table 14   Industries for which NISOs publish multi-factor productivity statistics

Statistical organisation	ISIC or equivalent 1- digit	ISIC or equivalent 2- digits	ISIC or equivalent 3- digits	Other	Maximum number of industries for multi-factor productivity statistics are published
Office for National Statistics	✔				*10*
Australian Bureau of Statistics	✔			ANZSIC 06	16
BLS-Office of Productivity and Technology			✔	selected NAICS 4-digit industries	145
Federal Statistical Office (CH)					-
Istat (IT)				A*38 industry classification from ESA 2010.	35
OECD					-
Statistics Canada			✔	NAICS 2012 (North American Industry Classification)	39[1]
Statistics Denmark	✔				69
Statistics Finland		✔			63
Statistics Netherlands / CBS		✔		Either NACE 2 or an aggregate of several NACE 2 digits	38
Statistics New Zealand	✔			Sub-industries for manufacturing and agriculture	27[2]
Statistics Norway				Agriculture, fisheries, mining, manufacturing, electricity, construction, trade, transport, ICT, finance	12
Statistics Sweden			✔		52
Total number of NISOs (excluding the ONS)	3	2	3		

Source: Survey of NISOs. Number of respondents = 12 (excluding the ONS)
Notes: (1) 15 industries are included in the first publication. Estimates for a total of 39 industries are published at a later date; (2) The measured sector consists of 16 industries. In addition, Stats NZ also covers education and health. For agriculture Stats NZ covers 2 sub-industries and for manufacturing 9 sub-industries.

5 Capital productivity

This section sets out international practice in the production of capital productivity statistics, including the institutional sectors which are covered by different NISOs and the industrial detail which is included.

7 NISOs provided information on capital productivity statistics:

- 4 publish capital productivity estimates for the economy as a whole;
- 3 for the total market or private economy;
- 1 for the total private business economy; and,
- none for the total-non-financial private business economy.

Table 15   Economic sectors for which NISOs publish capital productivity statistics

Statistical organisation	Total Economy	Total market economy or private economy (i.e. excluding the general government sector)	Total private business economy	Total non-financial private business economy (i.e. private business economy excluding finance and insurance)
ONS		✔		
Australian Bureau of Statistics		✔		
BLS-Office of Productivity and Technology	✔		✔	
Destatis (DE)	✔			
Federal Statistical Office (CH)	✔			
Istat (IT)		✔		
OECD	✔			
Statistics New Zealand		✔		
Total number of NISOs (excluding the ONS)	4	3	1	0

Source: Survey of NISOs. Number of survey respondents = 7
Notes: The following measures of market economy / private economy are used by the NISOs:

- Office for National Statistics: market economy = private economy + public corporations. Capital productivity data are experimental.
- Australian Bureau of Statistics: the market sector is broadly equivalent to total economy excluding general government and defence, health and social assistance, and education. More precisely, the market sector is defined as ANZIC 06 Divisions A to N plus Divisions R and S
- BLS-Office of Productivity and Technology: excludes non-profit institutions, households, and general government. Two measures of general government are considered, one including government enterprises and one excluding government enterprises. BLS also publishes labour productivity estimates for the nonfarm business sector (business sector excluding the farm sector) and for the manufacturing, durable manufacturing and non-durable manufacturing sectors
- OECD: Main economic activities at the level A10 according to the ISIC Rev. 4. This includes activities from B to N, excluding sector L (real estate activities). The sector is called "Non-agriculture business sector excluding real estate"

Of these seven NISOs, five also publish capital productivity estimates at an industry level, only one does so at the 3-digit level.

Table 16   Industries for which NISOs publish capital productivity statistics

Statistical organisation	ISIC or equivalent 1- digit	ISIC or equivalent 2- digits	ISIC or equivalent 3- digits	Other	Maximum number of industries for labour productivity statistics are published
ONS[1]	✔				10
Australian Bureau of Statistics	✔			ANZSIC 06	16
BLS-Office of Productivity and Technology			✔	selected NAICS 4-digit industries	145
Destatis (DE)				A10+ classification from ESA 2010	10 (+ manu-facturing)
Federal Statistical Office (CH)					-
Istat (IT)				NACE Rev. 2 A38 A*38	35
OECD					-
Statistics New Zealand	✔			Sub-industries for manufacturing and agriculture	27[2]
Total number of NISOs (excluding the ONS)	2	0	1		

Source: Survey of NISOs. Number of survey respondents = 7 (excluding the ONS);
Notes (1) The ONS data are experimental. (2) The measured sector consists of 16 industries. In addition, Stats NZ also covers education and health. For agriculture Stats NZ covers 2 sub-industries and for manufacturing 9 sub-industries.

Destatis is the only NISO which publishes capital productivity estimates at a sub-national level (NUTS1)

6　Availability of data used to calculate productivity

Alongside their productivity statistics, several NSIs make available the data which they use to produce their estimates. This section sets out the datasets most commonly made available as well as whether input-output data is made available.

The datasets most commonly made available are gross value added or GDP, and number of hours worked both at the whole economy level and industry level. Production value[8], capital stock data and data on the number of persons employed are also made available by a majority of NISOs, again both at the whole economy level and industry level. The same observation applies for data at the sub-national level.

The ONS publishes gross value added at the industry, national and sub-national level in both current and constant prices, as well as the number of jobs, and the number of hours worked. In addition the ONS publishes production values at industry and national level in (current prices), the number of persons employed, capital stocks, and capital services.

Figure 5　Published datasets that may serve as a basis for productivity calculations at the national/whole economy level
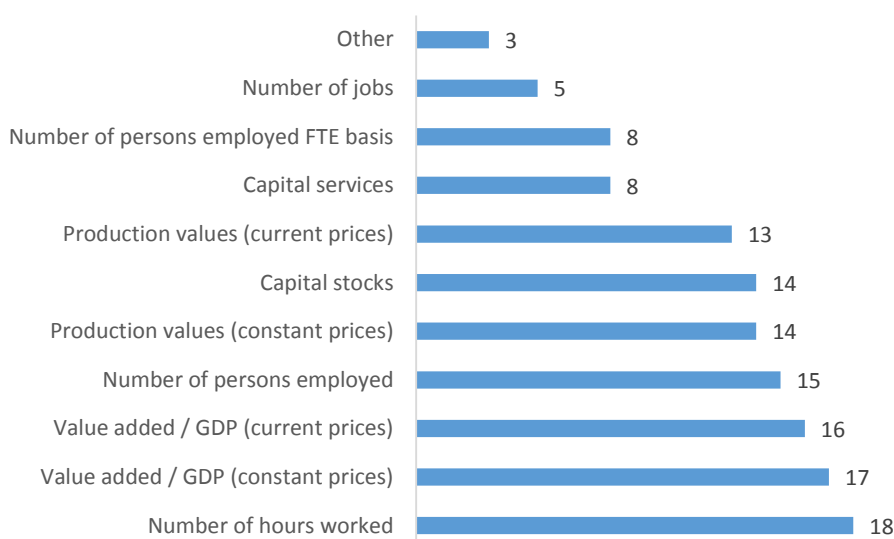
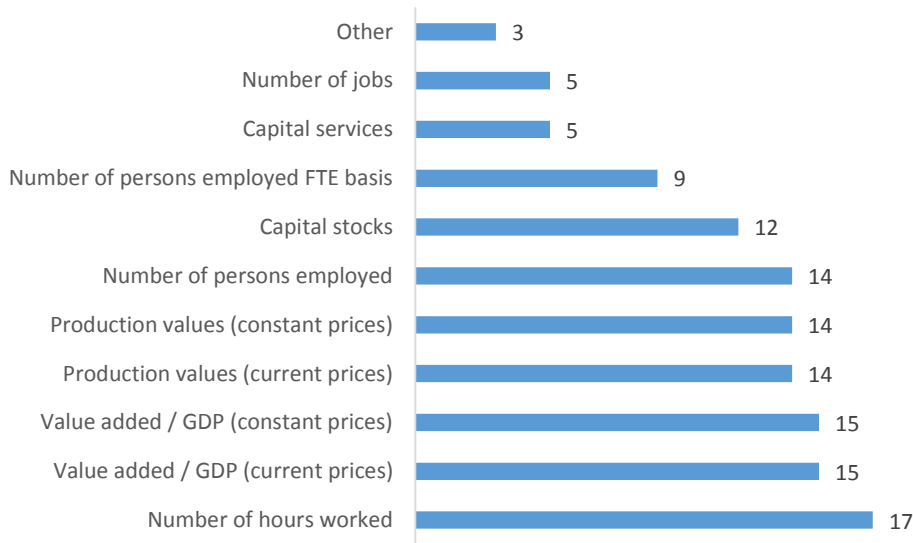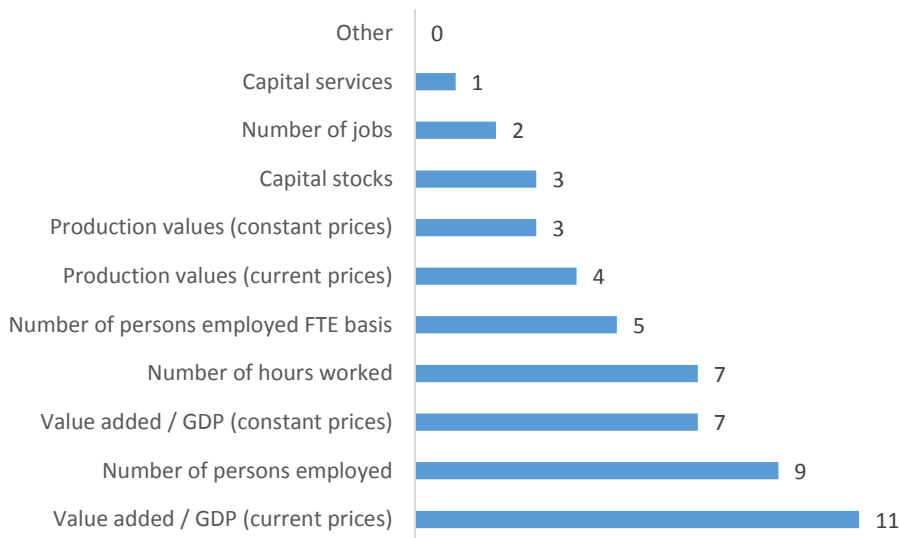*Source: Survey of NISOs. Number of survey respondents = 18 (excluding the ONS)*
Notes: Other includes the following:
- Australian Bureau of Statistics - Productivity growth cycles, combined inputs (capital and labour) indices, Incomes shares for value added based MFP, capital rental prices (incorporated and unincorporated), intermediate inputs indices, cost shares for gross output base MFP)
- Statistics Finland - user costs, IRR, depreciation rate
- Statistics Netherlands - full time equivalent jobs.

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[8] Production value is the total value of production. It includes value added plus the cost of intermediate inputs.

Figure 6   Published datasets that may serve as a basis for productivity calculations at industry level

Category	Value
Other	3
Number of jobs	5
Capital services	5
Number of persons employed FTE basis	9
Capital stocks	12
Number of persons employed	14
Production values (constant prices)	14
Production values (current prices)	14
Value added / GDP (constant prices)	15
Value added / GDP (current prices)	15
Number of hours worked	17

Source: Survey of NISOs. Number of survey respondents = 18 (excluding the ONS)
Notes: Other includes the following:
- Australian Bureau of Statistics - Productivity growth cycles, combined inputs (capital and labour) indices, Incomes shares for value added based MFP, capital rental prices (incorporated and unincorporated), intermediate inputs indices, cost shares for gross output base MFP)
- Statistics Finland - user costs, IRR, depreciation rate
- Statistics Netherlands – full-time equivalents

Figure 7   Published datasets that may serve as a basis for productivity calculations at sub-national level

Category	Value
Other	0
Capital services	1
Number of jobs	2
Capital stocks	3
Production values (constant prices)	3
Production values (current prices)	4
Number of persons employed FTE basis	5
Number of hours worked	7
Value added / GDP (constant prices)	7
Number of persons employed	9
Value added / GDP (current prices)	11

Source: Survey of NISOs. Number of survey respondents = 18 (excluding the ONS)
Notes: Other includes the following:
- Australian Bureau of Statistics - Productivity growth cycles, combined inputs (capital and labour) indices, Incomes shares for value added based MFP, capital rental prices (incorporated and unincorporated), intermediate inputs indices, cost shares for gross output base MFP)
- Statistics Finland - user costs, IRR, depreciation rate
- Statistics Netherlands – full-time equivalents

Of the 18 NISOs which responded, 15 publish input-output data, all of which are annual. The ONS also publishes annual input-output data. Fourteen of the NISOs and the ONS publish the input-output data at basic prices, and of these organisations, four and the ONS also publish input-output data at purchasers' prices. Eleven of the 15 NISOs and the ONS publish the input-output data only in current prices, 1 in constant prices only and 3 in current and constant prices.

Table 17   Prices at which input-output data are published

Statistical organisation	Price Base			Specific price		
	Purchasers	Basic	Market	Current	Constant	Current and constant
Office for National Statistics	✔	✔		✔		
Australian Bureau of Statistics	✔	✔	✔	✔		
Central Statistical Bureau of Latvia		✔		✔		
Destatis (DE)	✔	✔		✔		
Eurostat		✔		✔		
Federal Statistical Office (CH)		✔		✔		
Insee (FR)	✔	✔		✔		
Istat (IT)		✔				✔
OECD	✔	✔		✔		
Statistics Canada		✔		✔		
Statistics Denmark		✔				✔
Statistics Finland		✔		✔		
Statistics Netherlands / CBS		✔				✔
Statistics New Zealand		✔			✔	
Statistics Norway		✔		✔		
Statistics Sweden			✔	✔		
Total number of NISOs (excluding the ONS)	4	14	2	11	1	3

Source: Survey of NISOs Number of survey respondents = 15 (excluding the ONS)
Notes: The three NISOs that do not publish input-output tables are: ILO, the Bureau of Labor Statistics (US) and Statistics Estonia. For the US input-output tables are available from the Bureau of Economic Analysis. For Estonia input-output tables are only available for 2010. ILO does not publish input-output tables.

7   Methodology and inputs

This section presents international practice regarding methodology and inputs used in the production of productivity statistics in the areas of output measurement, labour input, and capital measurement.

7.1   Output measures

Depending on the exact measure of productivity and methodological approach, NISOs use a wide range of output measures for productivity estimation. The most common measure, applied by 13 NISOs of the 17 having answered this question, is gross value added (GVA) at constant prices. GDP in constant prices is a widespread alternative measure, applied by 7 NISOs, used when there is no disaggregation with regard to industries. Furthermore, 4 NISOs state that they follow approaches based on production values in constant prices as an output measure for productivity estimates.

For each of the above measures - GDP, value added and production values - there is also a number of NISOs compiling productivity estimates based on current price output measures.

The Office for National Statistics uses gross value added at constant or current prices as their output measure for productivity depending on the application.

Figure 8   Definition of output used for productivity measurement
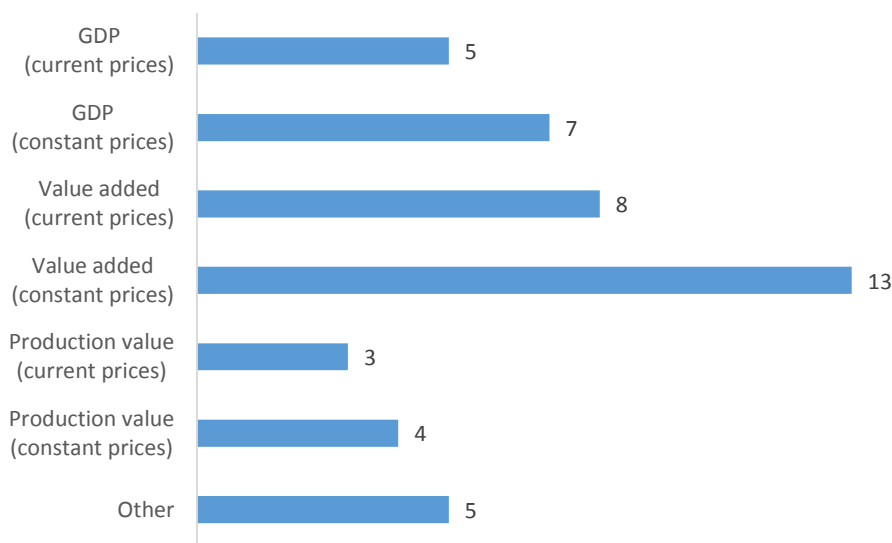
Source: Survey of NISOs
Notes: Other definitions of output used for productivity measurement include the following:
- Australian Bureau of Statistics: gross output at constant prices
- Destatis Germany: Estimates for GDP / GVA at current prices per person employed and hour worked are also published in the National Accounts – but these estimates are not labelled "productivity" measures
- Statistics Estonia: Industry labour productivity estimates are based on value added (current prices) as well as turnover.
- Statistics Netherlands: Consolidated production both at current and constant prices
- Bureau of Labour Statistics US: sectoral output

When it comes to output measurement for cross-industry comparison, there are two general approaches: gross output and value added. Gross output measures include intermediate

consumption as inputs (often referred to as the "KLEMS" approaches, see Box 2),[9] while value added measures give the value of production less the value of intermediate inputs. (Schreyer 2001). These two measures – while related – will not necessarily produce the same results. For instance, the growth of multi-factor productivity for an industry and its interpretation will vary if a gross output measure is used in preference to a value added measure. The MFP growth rate resulting from using gross output as the output measure captures "the rate of neutral, disembodied technical change" (cf. Schreyer 2001). On the other side, productivity growth rates that use value-added based output measures on an industry level rather reflect the "industry's capacity to translate technical change into income and into a contribution to final demand" (cf. Schreyer 2001). Therefore, it is important to note that the resulting growth rates of these two different approaches are not comparable to each other.

When it comes to measuring output for the total economy or spatial units, GDP is the measure which is most commonly used. As the most prominent aggregate measure for economic activity and value creation, GDP is easily available from the national accounts, adding up the production of all sectors corrected for deliveries.

The widespread use of both current and constant price output measures has a simple background: Current price measures are suitable for comparison of output levels between industries or spatial units at a specific point in time. As such, they are of special interest for international organisations such as ILO and Eurostat. Moreover, for international comparisons of real productivity, as conducted by these two organisations, international best practice relies on purchasing power parity (PPP) exchange rates.

However, when the focus is on output and productivity growth over time, it is necessary to compute constant price output data. The price-quantity decomposition is generally a major challenge for national accountants and it can impact the quality of productivity measurement. For NISOs, the development of industry-specific producer price indices is a substantial field of work in the improvement of productivity measures. The disentangling of price and quantity changes is primarily an issue in the services sector, particularly in sectors experiencing rapid quality change.

The limited observability of output volumes in the services sector is one of the crucial challenges for national accountants. A rise in turnover may either be the result of a price increase or it may reflect a real increase in quantity or quality of the service. One solution to overcome this challenge is the use of input based indicators for the deflation of output series. However, this kind of assumption immediately affects measured productivity (cf. Schreyer 2001).

Generally, the separate deflation of input and output series greatly enhances the quality of productivity estimates, as price indices for different kinds of outputs may vary considerably. This is especially apparent with industry-specific productivity figures: Along supply chains, one industry's output serves as another industry's input. Production volumes used for productivity growth calculation directly depend on the choice of price indices for deflation. When one aggregate deflator is used for both inputs and outputs of a certain industry, relative price changes of inputs and output are misinterpreted for changing productivity. Therefore, international best practice draws on double deflation of value added figures, which is an important requirement for

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[9] CBS Netherlands uses consolidated production as output measure, which excludes intermediate consumption of own deliveries.

calculating meaningful productivity figures. The Office for National Statistics is currently working towards a set of double deflated accounts.

In the case of non-market activities, given the lack of prices to determine the value of outputs, measurement of output is mostly based on the value of inputs. For example, it is difficult to observe the quantity and value of the output produced by school teachers. Thus, output of public institutions is in many cases approximated by factor compensation, which means that measured productivity growth is zero by assumption. Due to the crucial conceptual difficulties with the measurement of non-market activities, these areas of the economy are very often exempt from productivity calculations – or at least, there are no industry-specific estimates. Among the NISOs that have participated in the survey, 12 publish multi-factor productivity estimates, but only half of them do so for the total economy. The remaining six publish aggregates that exclude the government sector as a minimum. The ABS furthermore states that they are currently developing concepts to set up productivity estimates for the health and education industries, to be followed by the social services (ABS 2017). The ONS produces separate estimates of public service productivity, derived from the approaches laid out in the Atkinson review.

Box 2   **The EU-KLEMS Project**

The EU KLEMS Project[10] was first initiated by the European Commission in 2003 as a means to create an internationally comparable database on productivity based on a growth decomposition approach. The EU KLEMS Growth and Productivity Accounts break inputs down into capital (K), labour (L), energy (E), materials (M) and services (S) at the industry level. KLEMS productivity calculations are conducted for all EU member states as well as some non-EU countries such as the US, Japan and Canada.

The EU KLEMS approach aims to create long-range industry-level productivity series, which are consistent across countries. The growth accounting methodology draws on standard macroeconomic production functions, weighting input factors with their revenue shares. Based on this, growth in each industry's gross output or value added, respectively, evolves as a combination of growth in hours worked, labour composition, ICT capital services, non-ICT capital services, and total factor productivity.

The Consortium members of the EU KLEMS Project include a variety of economic research institutions and universities from different EU member states, for example:
- the University of Groningen,
- the Groningen Growth and Development Centre (GGDC, Groningen),
- the National Institute of Economic and Social Research (NIESR, London),
- the German Institute for Economic Research (DIW Berlin), and
- the Conference Board Europe (TCBE, Brussels)[11].

The objectives of EU KLEMS are manifold. The main objective was the establishment of an industry level database - consisting of both a statistical and an analytical module – thereby achieving an integrated system of growth, productivity and national accounts for the European

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[10] Information available at: http://www.euklems.net/

[11] Cf.: http://www.euklems.net/project_site.html, last accessed on 3.5.2017

Union. Further targets included new methodological approaches (using for example industry level purchasing power parities) as well as policy-oriented research. Lastly, the Commission aimed at establishing an official, industry level statistical system in the European Union (cf. DG ECFIN, 2007).

Generally, EU KLEMS' estimates of growth and productivity are consistent with the European System of National Accounts (ESA 2010). The data on output, value added, employment, gross fixed capital formation, prices and capital stocks are consistent with Eurostat data at the corresponding industry levels (EU KLEMS Growth and Productivity Accounts, 2016 Release[12]).

7.2   Labour input

The compilation of labour input data for productivity calculations is conceptually straightforward and easy to understand, compared with output and capital input measures. The main reason for this is that the notion of labour input has natural units of calculation, to be specific, the time spent on the creation of a certain product by a number of individual people.

The most common unit in headline labour productivity measures is hours worked. There is a widespread consensus that hours worked is superior to all other measures in terms of most accurately describing labour input. Nevertheless, headcounts have the major advantage of better data availability. For instance, number of jobs figures are most easily available and may thus serve as a first proxy for labour input, although the changing nature of the labour market (e.g. the 'gig economy') may affect this. Depending on its construction, this kind of measure may disregard the impact of self-employment, in contrast to the number of persons employed or full-time equivalent persons employed, both of which are more difficult to obtain. Moreover, headcounts of any type disregard changes in the average number of hours worked, for example with regards to part-time work or overtime hours.

For quarterly labour productivity data, which 8 of the NISOs having participated in the survey started to publish (see Figure 2), seasonal adjustment is also an issue. Labour input series and output series both have a seasonal component, and in order to not mistake differences in seasonal variation between the series for changes of productivity, either the numerator and denominator should be adjusted for seasonal patterns, or the ratio of these two should be adjusted.

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[12] http://www.euklems.net/TCB/2016/Metholology_EU%20KLEMS_2016.pdf

Quality adjusted labour

In addition to measuring labour input in different units – ranging from workers and job to hours worked – some NSIOs also produce measures of 'quality adjusted' labour input. The aim of these measures is to account for variation in the composition of the labour force through time. As workers are thought to vary in their productive potential – in part reflecting workers' past investments in human capital such as educational achievement, as well as their general abilities – an increase in the supply of labour by one worker type may have a greater impact on output than an increase in the supply of labour by another type of worker. Quality adjusted measures of labour input attempt to account for these differences in productive potential, producing a measure which resembles the 'effective supply of labour'. As a result, a quality adjusted labour index will be more sensitive to changes in the hours supplied by relatively high productivity workers than a simple measure of hours worked.

Of the 18 participating NSIOs, 8 have quality adjusted labour input data. The remaining 10 state that they do not consider quality adjustments of labour input.

Figure 9   Compilation and/or publication of quality adjusted labour data

Source: Survey of NISOs. Number of respondents = 18

All eight of these NISOs produce quality adjusted multi-factor productivity estimates for their headline multi-factor productivity measure. Three out of the eight NISOs produce quality adjusted labour productivity estimates of their headline labour productivity measure. The ONS also publishes quality-adjusted labour input data which is not used as an input into their headline labour productivity statistics but as input for multi-factor productivity estimates.

36

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Figure 10 Availability of headline labour and multi-factor productivity measures using quality-adjusted labour input data
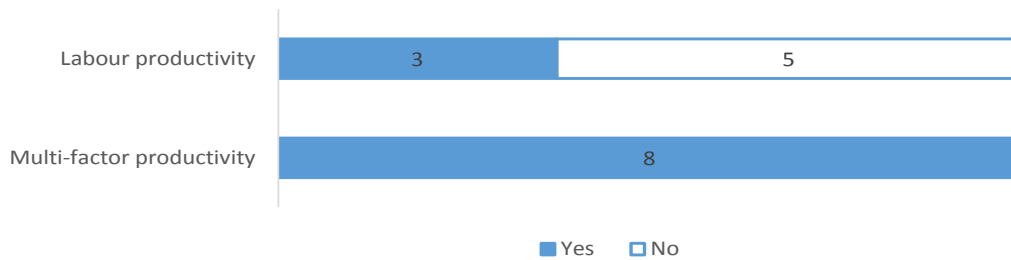
Source: Survey of NISOs. Number of respondents = 8
Notes:

- Labour productivity: Statistics Canada uses quality adjusted labour input data for all headline measures. The Australian Bureau of Statistics (ABS) and Stats NZ (New Zealand) also construct additional quality adjusted labour productivity estimates of their headline labour productivity measures. In the case of Australia this additional labour productivity estimate is only constructed for annual estimates, quarterly labour productivity estimates are not quality adjusted. In the case of New Zealand, quality adjusted labour productivity estimates are constructed for the measured sector, but not at industry level. Statistics Denmark does not use labour quality adjustment for their headline labour productivity estimates. However, they do produce. Statistics Denmark uses quality-adjusted labour input data for other labour productivity estimates, however, no quality adjustment is made for the headline labour productivity estimates. The remaining four NISOs do not produce quality adjusted labour productivity estimates.

- Multi-factor productivity: All eight NISOs produce quality quality adjusted multi-factor productivity estimates for their headline measure. However, the following points should be noted: The Bureau of Labor Statistics (US) uses quality adjusted labour input data for total economy and industry level multi-factor productivity measures. Quality adjusted labour input data is not used for (KLEMS) multi-factor productivity estimates for 4-digit NAICS industries. The Australian Bureau of Statistics (ABS) and Stats NZ (New Zealand) also construct additional quality adjusted multi-factor productivity estimates of their headline multi-factor productivity measures. In the case of New Zealand, quality adjusted labour productivity estimates are constructed for the measured sector, but not at industry level.

The methods used to construct measures of quality adjusted labour vary, but typically involves weighting different worker types by a measure of their relative productivity. As worker-level productivity is not observed, NSIOs group workers together based on their observable attributes and weight the labour supplied by the average earnings of the group.

The number and choice of factors on which NSIOs group workers in their quality adjustment process varies. Most prevalently, NISOs control for employed persons' individual

- education levels (7 in 8);
- the specific industries they are working in (7 in 8);
- ages (6 in 8);
- gender (6 in 8).

The ONS takes all of these factors into account for their quality adjusted labour productivity estimates. However, some NISOs consider other factors as well: Statistics Canada weights labour quality with regard to the status of persons employed, i.e. they differentiate between self-employed and employees. Statistics Netherlands takes into account whether working contracts are subject to collective wage agreements.

Figure 11 **Factors taken into account when constructing quality adjusted labour data**
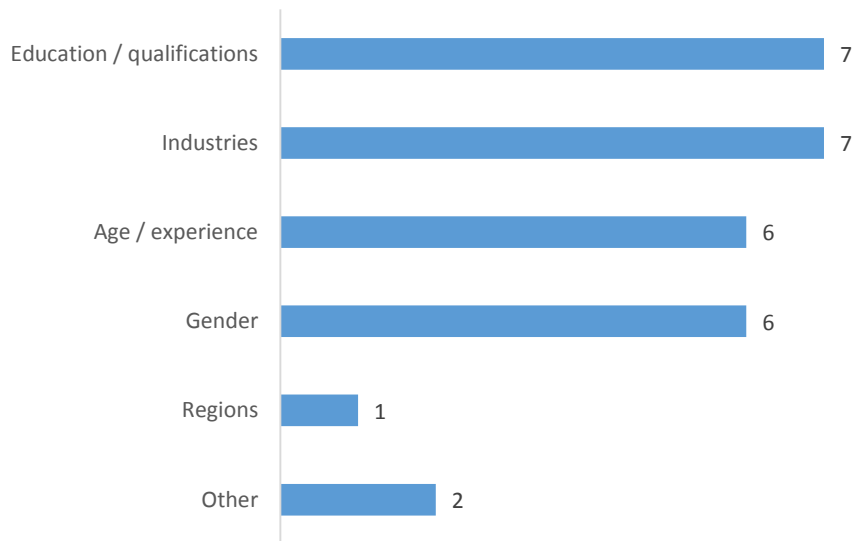
Source: Survey of NISOs. Number of respondents = 8
Notes: Other factors include:
- Statistics Canada: distinction between class of worker self-employed and employees
- Statistics Netherlands: collective wage agreements (in or out)

The data serving as an input to quality adjustments mostly stem from the national labour force surveys, supplemented by census data, register data and other employment statistics.

The number of different categories taken into account per factor, and hence the overall number of categories, also varies across the participating NISOs. The number of categories per industry ranges from 2 (Statistics Canada) to 120 (Statistics Sweden).

7 of 8 NISOs which produce quality adjusted labour data do so at an industry level, and only 1 (Statistics Canada) produces quality adjusted labour data at a regional level.

Once industries and regions are taken into account, the number of categories of labour force quality adjustments range from 70 (Statistics New Zealand) to 8,372 (Statistics Canada).

The ONS covers 36 categories for each of 10 industries, resulting in a total of 360 employment characteristics.[13]

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[13] The October 2017 release expanded the range of industries from 10 to 19, resulting in 684 worker types.

Table 18   Employment characteristics taken into account when constructing quality adjusted labour data

Statistical organisation	Age / experience	Education / qualifications	Gender	Other	Categories per industry	Industries	Regions	Worker types
Office for National Statistics	*3*	*6*	*2*		***36***	*19*		***684***
Australian Bureau of Statistics	5	4	2		**40**	16		**640**
BLS-Office of Productivity and Technology	3	7	2		**42**	63		**2,646**
Statistics Canada				2[1]	**2**	322	13	**8,372**
Statistics Denmark		5			**5**	19		**95**
Statistics Finland	3	3	2		**18**	33		**594**
Statistics Netherlands / CBS	6	3	2	2[2]	**72**	64		**4,608**
Statistics New Zealand	7	5	2		**70**			**70**
Statistics Sweden	5	12	2		**120**	52		**6,240**
Total number of NISOs (excluding the ONS)	6	7	6	2	**-**	7	1	**-**

Source: London Economics and DIW Econ

Notes: (1) class of worker, i.e. whether workers are self-employed or paid workers; (2) types of working contract, i.e. with/without collective wage agreement.

8 Capital measurement

Overview – capital stocks and capital services

Capital input measurement represents one of the major challenges of productivity analysis.

Due to the limited observability of the stock of fixed assets used in production processes, statistical agencies mostly choose a modelling approach based on the Perpetual Inventory Method (PIM). Gross fixed capital formation[14] (GFCF), which is a published component of National Accounts, forms the main basis of capital stock calculations. Along the way to the calculation of capital input, there are two key issues: One is how to cumulate the flow of past investments and depreciate stocks of assets with productive capacity. The second is how to measure the quantity and quality of productive services from these assets.

Conceptual difficulties in this area are among the main reasons that some statistical agencies refrain from publishing multi-factor and capital productivity estimates. The same applies to the decomposition of changes in labour productivity with regard to (different types of) capital intensity: Measuring capital intensity of production likewise requires comprehensive sets of capital stock estimates.

Statistical agencies construct capital stocks by accumulating flows of past investment expenditures using the PIM. The most important factors determining the quality of capital stock estimates include the revaluation of vintages of assets into a single period's prices (due to asset price changes occurring over time) and assumptions with regard to asset efficiency loss (ABS 2017). As productive assets deteriorate over their service lives due to wear and tear, stocks of assets must be corrected for efficiency losses. The productive capacity of an asset is described by its age-efficiency profile. Based on remaining expected service life and age-related productive efficiency, age-price profiles reflect the evolution of an asset's value. Age-price and age-efficiency profiles are structurally linked, but they are in general not identical.

In order to obtain consistent measures of capital stocks across all vintages, it is necessary to construct investment price indices assuming constant quality of assets to deflate GFCF series. Such price indices are challenging to construct for several reasons. For example, it is difficult to determine long price series of constant quality ICT capital due to rapid technological progress. Another example relates to the limited observability of intellectual property products, which makes it particularly difficult to decompose price and volume changes, particularly where these products are produced for own use. However, results for productivity developments will have a significant bias if asset price changes are mistaken for volume changes (ABS 2017). Consequently, similar to output measurement, the compilation of high-quality capital input series is conditional on the availability of highly granular price indices for fixed assets.

As a next step towards capital inputs, the construction of capital stocks using the PIM requires assumptions on the useful life-length of productive assets. The cumulative flow of investments at constant prices corrected for retired assets constitutes the gross capital stock. However, for productivity analysis it is necessary to weight different vintages of capital assets, as the productive capacity declines over the service life of an asset due to wear and tear (or economic obsolescence). For example, a transport vehicle loses productive efficiency after a number of

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[14] GFCF: Total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets such as land improvements (see OECD 2009, Glossary).

years, as the frequency of breakdowns, and thus the amount of repair time, increases due to wear and tear of its parts. Consequently, the productive capital stock is computed by applying age-efficiency functions to the gross capital stock, separately for different types of assets (Schreyer 2001).

However, productive capital stocks do not directly serve as inputs to production, but they deliver a flow of services used in the production process. Following the OECD (Schreyer 2001, 2004), capital services are the appropriate measure of capital inputs in productivity analysis. However, due to the lack of direct observability, the flow of capital services is usually assumed proportionate to the asset-specific productive capital stock, i.e. the stock of assets corrected for loss of efficiency due to ageing (Schreyer 2001, Harper 1982). Capital services are calculated "bottom up", i.e. they form an aggregate across different vintages of each type of asset and across asset types. Aggregation to overall capital services requires the determination of weights for each vintage and type of asset. Age-efficiency functions (see below) serve as weights for aggregation across vintages, aggregation across different types of assets draws on production theory.

The OECD Measuring Productivity manual states that production theory clearly calls for user costs of capital as appropriate weights for capital services from different types of assets. User costs of capital denote the per-period amount of theoretical rentals that the user of an asset could charge themselves or others to use the asset in production (Schreyer 2001). They comprise:

- the opportunity cost of financing the asset, i.e. the rate of return that the user expects from using the asset, which may or may not be realised.
- depreciation due to ageing, which covers the loss of productive capacity resulting from physical decay as well as the reduction of expected future service life, and
- re-valuation of assets due asset specific price changes.

An extended concept of capital services also covers taxation effects. User costs of capital as computed by the BLS and ABS include components reflecting corporate income taxes, tax depreciation allowances, investment tax credits and indirect taxes (Schreyer 2001). However, taxation effects are difficult to compute for sub-national and industry levels. For example, on the industry level, the BLS estimates internal rates of return by gross operating surplus, which arises as a residual figure from output, labour compensation and intermediate consumption for each industry. This approach disregards effects of indirect business taxation (BLS 1997).

The use of capital costs as weights for (productive) stocks of different assets assigns higher importance to short-lived assets, which may represent a significant cost to their user who knows that they will have to use the benefits of holding these assets quickly. Due to higher rates of consumption of fixed capital for those assets, their relative share in the stocks is small compared with long-lived assets, even if long-term investment expenditures are of equivalent value over time.

A majority of NISOs, 11 among the 13 NISOs using capital input to construct productivity estimates, use capital services as a capital input measure for productivity estimates. Only three NISOs state to use net capital stocks, however all of them combine them with capital services or productive stocks, whilst three use productive capital stocks and one agency uses gross capital stocks data.

Figure 12   Measures of capital used for productivity estimates
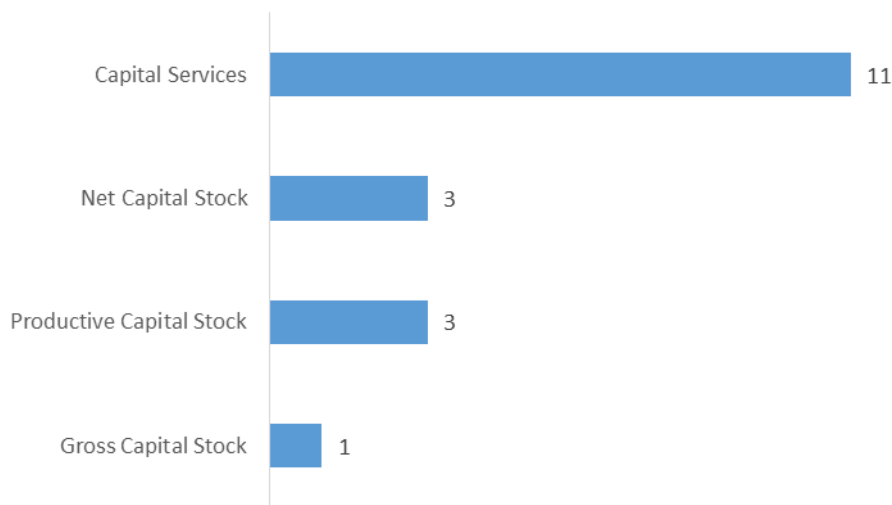
Source: Survey of NISOs. Number of respondents = 13

Notes: List of agencies who use two or more capital input measures:

- Australian Bureau of Statistics: productive capital stock and capital services
- Bureau of Labor Statistics (US): capital services and net capital stock
- Statistics Denmark: capital services and net capital stock
- Statistics Netherlands/CBS: productive capital stock and net capital stock
- Statistics New Zealand: Capital services calculated from productive capital stock for most assets. Addition of land from government valuation data.

Restricting capital productivity estimates to the ratio of output to gross stocks of assets saves statistical agencies from making assumptions with regard to the relative productive efficiency of different vintages of assets as well as the weighting of different types of assets.

However, the gross stock of assets does not necessarily reflect productive capacities: For example, a very old machine, which frequently causes production interruptions and requires maintenance, delivers less output than an otherwise identical new machine. A short-lived asset, delivering services of the same economic value as another long-lived asset in a certain period, will be assigned less weight in the gross stocks due to its lower acquisition cost. If flows from different assets receive weights based on their age and the relative user costs of capital, the representation will be more balanced. Hence, the ratio between output and gross stocks should be carefully interpreted in the context of capital productivity.

For supranational institutions such as Eurostat, collecting data from a number of national statistical offices, it is especially difficult to compile comprehensive sets of consistent capital input estimates. Not all statistical offices actually construct estimates for productive capital stocks and user costs of capital. Among those who do, assumptions with regard to functional forms and parameters differ. For some types of assets, such as buildings or cars, different environments may reasonably explain different specifications with regard to their age profiles. In other cases, such as ICT equipment, there is little reason to believe that there are systematic discrepancies between countries. Although statistical agencies generally follow individual approaches, there has been some effort for international comparison of methodologies. For example, a joint OECD and Eurostat taskforce conducted a survey on the assumptions used by statistical agencies with regard to life lengths and depreciation of structures, such as dwellings and other buildings (Eurostat and OECD 2015). There is also a debate on whether productive capital stocks and capital services

estimates should indeed be part of official statistics. Some experts support the idea that those estimates depend too much on economic theory, such that they form a piece of economic analysis which should remain separate and distinguishable from official statistics. The ESA 2010 (Eurostat and European Commission 2013) has adopted the concept of capital services for market production, although it refrains from prescribing how to estimate them. It includes references to capital services measurement in the growth accounts section.

As multi-factor productivity estimates draw on measures for capital input, this debate naturally pertains to this area. Similar to the weighting of different types and vintages of assets, the aggregation of labour and capital input flows to construct an overall index for inputs requires assumptions on the relative shares in the production process. The standard approach derived from macroeconomic theory is to use the factor income shares of capital and labour in order to weight their relative contributions to production processes. Indeed, in their responses various statistical agencies hint to the assumptions behind their multi-factor productivity estimates – such as constant returns to scale and perfect market competition as a basis for using factor shares as weights in the production processes (ABS 2017).

A further point to consider is exhaustiveness of the assets included in production analysis. For instance, assets which are not, or not fully, included in gross fixed capital formation are frequently neglected as factors of production (Schreyer 2001). This holds for non-produced assets such as land and mineral reserves, or inventories. The contribution of factors of production which are not accounted for in productivity analysis is attributed to other factors, which implies biased results. Consequently, productivity estimates also lack comparability when statistical agencies include varying ranges of assets in their productivity estimation.

Age profiles

Declining age-efficiency profiles map the loss of productive capacity of assets due to ageing. The productive capacity of fixed assets reduces over time as a result of wear and tear (Schreyer2001, 2009), i.e. their physical contributions to production decline.[15] Therefore, the accumulation of past investments under perpetual inventory methods uses age-efficiency functions. Age-efficiency functions map the productive efficiency of all vintages relative to a new asset of the same type and quality.

There is a range of plausible age-efficiency patterns for assets. Initial efficiency is usually defined as 100 percent. Efficiency is mostly assumed to decrease monotonically over the service life of an asset and to approach zero towards the end of it. In some cases, it is reasonable to assume that an asset retains full productive capacity over its service life and drops to zero at retirement. An intuitive example could be a light bulb that burns steadily for a certain number of hours before it breaks (Harper, 1982). This age-efficiency profile is referred to as a "one-hoss-shay" pattern. One-hoss-shay efficiency profiles generate a constant stream of in-period revenue since the assets retain their full ability to produce services until the end of their service life (Schreyer2001 and Baldwin et al., 2005). The gross capital stock can be seen as a special type of productive capital stock where all assets retain their full productive capacity until retirement.

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[15] Normal obsolescence due to technological change is also considered a source for a declining productive efficiency of assets, see e.g. OECD (2009), Eurostat and European Commission (2013), Harper (1982).

Consumption of fixed capital, or depreciation, describes the declining value of an asset over its service life. Age-price profiles are related to age-efficiency profiles as, at each point in time, the price of an asset maps the discounted flow of services to be expected from the asset over its full life-length. **Error! Reference source not found.** displays different shapes of age-efficiency and the corresponding age-price profiles they relate to. Besides time-discounted expected future services from the asset, age-price profiles also account for changes in the price for new assets of constant quality, thus mapping the relative price of an aged asset as compared to a new asset of the same initial productive efficiency.

When abstracting from the time-discount rate and asset price inflation, the one-hoss-shay efficiency pattern yields a linearly decreasing age-price pattern. This is due to the constant stream of services delivered by the asset. In effect, after half the asset's service life, it retains exactly half its initial value. In contrast, if efficiency of an asset declines over time, the early production periods have higher shares in the initial asset value than the later periods. For example, linear profiles write off the productive efficiency of a fixed asset by a constant amount each period over the life-length of the asset. As a consequence, the depreciation pattern runs convex to the origin (see **Error! Reference source not found.**). Although there might be little reason to believe that efficiency indeed declines linearly, the linear pattern might be a first approximation of an arbitrary efficiency decline towards zero. Also, it produces an insightful illustration of the relation between age-efficiency and age-price patterns.

Under a geometric profile, efficiency declines at a constant rate. Geometric efficiency profiles have some major analytical advantages, which is why many statistical agencies prefer working with them: A geometric pattern of efficiency losses implies geometric depreciation at the same constant rate. Furthermore, as the rate of efficiency loss remains constant, there is no need for a vintage accounting system. Third, under geometric efficiency patterns, depreciation does not depend on the rate of return (Harper 1982). However, considering an individual asset, the pattern of geometric age-efficiency creates some conflict with intuition: A fast rate of decline implies that an asset loses most of its efficiency during the early periods of its life. This scenario seems unrealistic considering many types of assets. For example, transport vehicles and buildings are likely to deliver nearly the same output in the first year of service as in the second. On the other hand, a slow rate of efficiency decline may yield more realistic patterns in the early service life. But it implies that efficiency levels remain substantially higher than zero throughout long timespans, which Harper (1982) describes as "a substantial tail of services well beyond the end of an asset's presumed life span".

Hyperbolic efficiency profiles are characterised by a "concave-to-the-origin" profile (Statistics Canada, 2015) associated with small efficiency losses in the early years of the asset's service life and more rapid efficiency losses appearing in the later service life of the asset. Due to this specific characteristic the hyperbolic form is often considered a realistic pattern as well as a beneficial one since it eliminates the "large troublesome tail found on a geometric form" (Harper 1982). The age-price pattern following hyperbolic efficiency profiles is a convex curve. Leading NISOs, including the ABS, the BLS, Statistics New Zealand, and the CBS Netherlands use hyperbolic age-efficiency profiles. Parameter selection generally differs for equipment and structures, as efficiency losses for equipment tend to occur faster. For computers and intangibles, such as software, it is also common to assume one-hoss-shay patterns, i.e. no efficiency losses (e.g. see Statistics New Zealand 2014, Statistics Netherlands 2009).

44

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Figure 13   Age-efficiency and age-price profiles
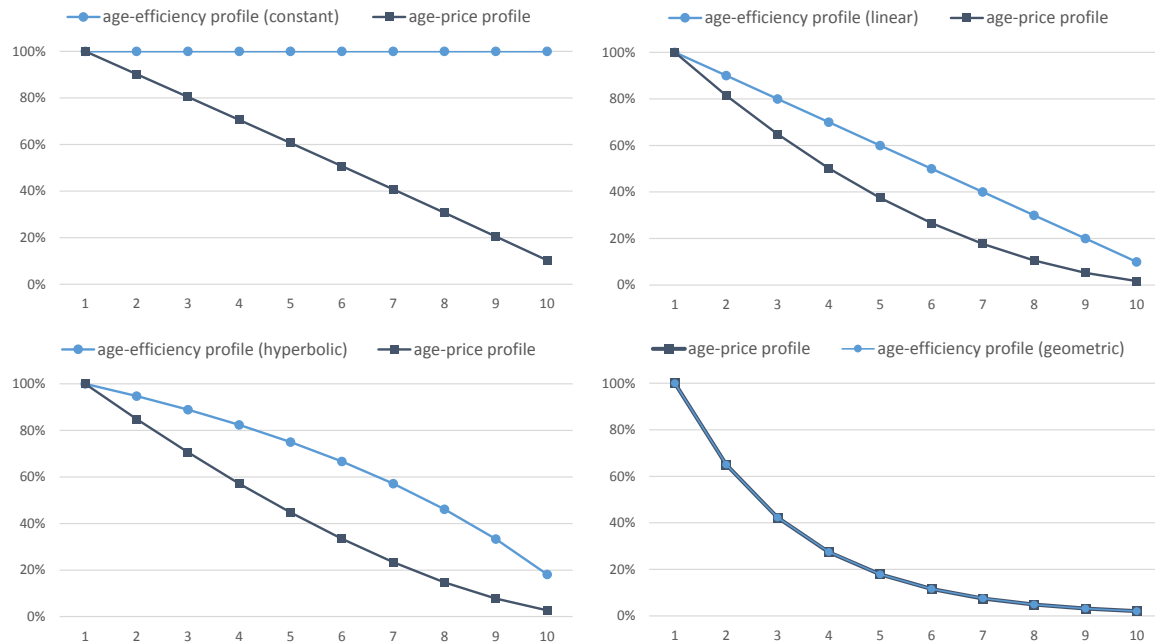
Source: DIW Econ, following OECD (2009). All assets have an assumed service life of 10 years. The rate of return is 5%, prices for new assets of the same type and quality are assumed constant.

Except for the one-hoss-shay pattern, all mentioned age-efficiency profiles yield convex age-price profiles under standard assumptions with regard to rate of return and asset life (Harper 1982). As efficiency losses are difficult to observe directly, statistical agencies mostly rely on price data for the computation of net capital stocks as well as productive stocks. The similarity of price profiles generated by a variety of efficiency profiles makes it difficult to statistically infer underlying efficiency profiles. Furthermore, it generally seems reasonable to assume that efficiency profiles differ widely across types of assets. Harper (1982) concludes his analysis of different efficiency profiles and related depreciation patterns with: "the existing literature and evidence offer little basis for preferring any one efficiency form."

Supposing that depreciation patterns for the computation of the net (wealth) capital stock should be consistent with plausible age-efficiency profiles, the set of appropriate age-price profiles is limited: As discussed above, if an asset retains its full efficiency until the end, the corresponding price profile tends to be linear (unless asset lives are long and rates of return are high). Declining efficiency profiles principally yield convex price profiles. In line with these patterns, the ESA 2010 allows two options for the calculation of fixed capital consumption: It generally calls for the linear method. In cases where the efficiency decline pattern of an asset requires it, the ESA suggests the geometric depreciation method (Eurostat and European Commission 2013). The ONS accordingly uses linear and geometric depreciation methods for calculating consumption of fixed capital.

It is important to note that age profiles of single assets are generally different from those for entire cohorts of assets (unless geometric profiles are used). Retirement of assets does usually not occur at a fixed age but follows a distribution around the expected service life. The overall combined age-efficiency and retirement profile of a cohort is an average of age-efficiency profiles of single assets within the cohort, weighted by probability of retirement.

Retirement of fixed assets[16]

Retirement of fixed assets refers to the point in time when they have depreciated to a value of zero. There is usually a random component associated with withdrawal of a fixed asset from production, which is why not all assets of the same type and vintage retire simultaneously. The modelling of a distribution of capital retirement around the expected lifetime of an asset accounts for this heterogeneity. In contrast, age-efficiency functions map the gradual decline of productive capacity conditional on survival (Schreyer 2001). The specific choice of retirement function and its parameters may vary for different types of assets – but the modelling approaches do usually not assume variation across industries (for the same type of asset).

Of the 14 NISOs having responded to this survey question, 8 NISOs reported that they have a statistical basis for determining the actual service life of each type of fixed assets (such as, for example, machinery or ICT equipment). The ONS uses survey data as a statistical basis for different types of fixed assets, although not all of the data refer to a recent survey year.

9 NISOs provided information on how they determine the service lives of each type of asset: 8 NISOs make use of a combination of actual data and estimations/assumptions and 1 NISO makes use of estimations/assumptions only.

10 in 14 NISOs state that they use retirement functions for the compilation of capital stocks serving as input data for productivity measurement. As is the case with depreciation, NISOs apply a variety of distribution functions to estimate the timing of capital retirement:

- 4 in 10 NISOs use truncated normal,
- 3 use Winfrey,
- 1 uses log-normal,
- 1 uses Weibull,
- 1 uses Gamma distribution functions.

As the functional form to estimate asset retirements, the Office for National Statistics uses the truncated normal and the Weibull distribution.

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[16] A discussion of the characteristics of the different retirement functions can be found in Annex 3.

Figure 14   Different retirement functions used to estimate capital stocks
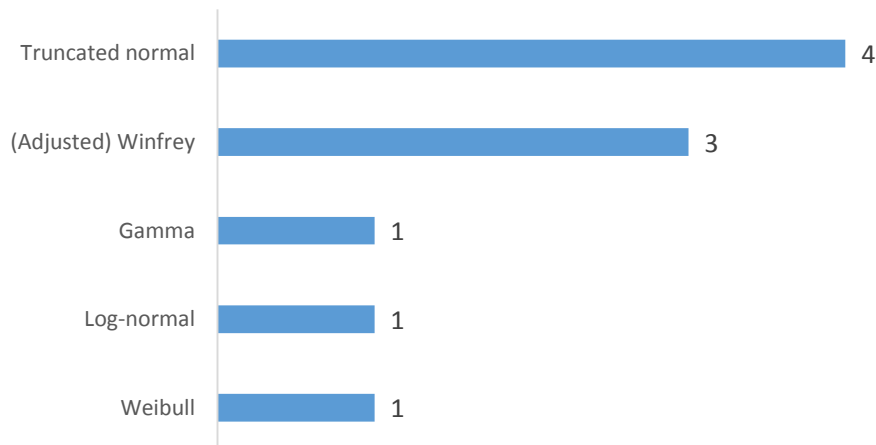
Notes:
- Statistics Denmark: (adjusted) Winfrey, R2 (residential and non-residential building) and L4 (other assets)
- Istat Italy: A Geometric model is used instead of a retirement function for R&D capital stock (Truncated normal is used for other fixed assets).

Other topics in capital input measurement

Of the 14 NISOs providing information on the calculation of capital stocks, 8 NISOs stated that they take transactions in used assets into account for capital stock calculation. One NISO stated that consideration of used assets was only possible with specific assets (cars). There are indeed major issues with regard to considering used assets, mainly due to the – possibly unknown – age of the asset when it is resold and if indeed service lives and age-efficiency profiles differ across industries (van den Bergen et al. 2009). The use of geometric methods alleviates this issue, though. The ONS does not separately identify and treat transactions in used assets.

None of the NISOs make use of adjustment for capacity utilisation of capital. Variations in capital utilisation may occur as a result of business fluctuations or a time lag between the acquisition of a fixed asset and the time when it becomes productive, e.g. due to further development or if it has not been completely produced. The lack of regard for capital utilisation rates implies the assumption of proportionality between capital services as an input to the production process and the existing productive stock of capital (ABS 2017). This is a sensible approach when starting to estimate average capital productivity of the entirety of existing stocks, but it yields an imprecise measure of productivity of capital which is actually being utilised as part of the production process. Furthermore, for multi-factor productivity calculation and decomposition of labour productivity growth, omitted variation in the utilisation of capital leads to biased results. When assets become inactive, but still form part of the capital input in productivity calculations, measured productivity is lower than if the idle stock was excluded. The disregard of variability in capital utilisation is thus a driver of the "strong pro-cyclical swings" in measured multi-factor productivity rates (Schreyer 2001). This notwithstanding, none of the NISOs account for capital utilisation. Seen in a different light, variation in capital utilisation is one source for potential changes in measured productivity.

Another important topic for capital input measurement is intellectual property assets, which are especially difficult to observe, including their service lives. Whereas NISOs report a good availability of survey data regarding R&D and software, only few have survey data on databases or entertainment, literary and artistic originals. The availability of survey data is not systematically different with regard to purchased assets and assets produced for own use. The ONS has survey observations for all intellectual property products presented in the figure below. However, even if information from surveys is generally available, the compilation of stocks of different types of intellectual property assets includes modelling in large parts. This especially pertains to assets produced for own use that lack a price to determine their economic value. In the absence of output prices, the value of assets produced for own use is usually derived from the value of inputs. This approach implicitly assumes that there is no productivity growth in the production of assets.

What adds to the challenges of limited observability is that intellectual property assets have significantly gained importance over the last decades and their service lives are comparatively short (Schmalwasser and Schidlowski 2006). In light of increasingly globalised production chains, the spatial record of ownership of intellectual property assets, and assumptions with regard to their rates of efficiency loss and retirement, affect measured productivity growth.

Figure 15   Availabiltity of survey observations on intellectual property assets
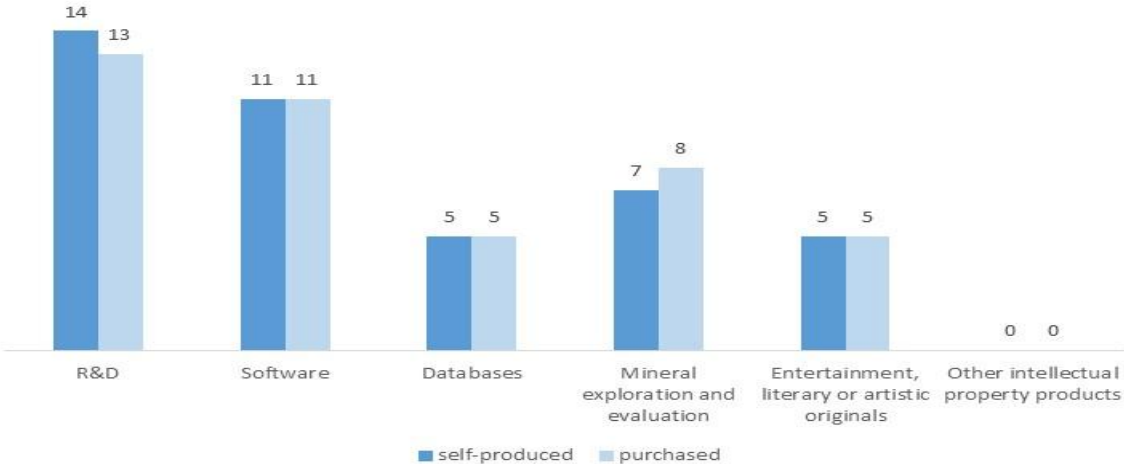
Source: Survey of NISOs. Number of respondents = 14
Notes: For all intangible assets it was possible to choose both "self-produced" as well as "purchased" for survey observation.

Half of the 14 responding NISOs state that the capital stocks or services estimates used as inputs for productivity are identical to the capital stock or service estimates published in their national accounts. This relates to the use of productive capital stocks for productivity calculation (see above.)

Of the 5 NISOs that provided descriptions of other source data sources they use to produce capital stock estimates (and how they differ from the National Accounts), the following answers were provided:

- Usage of productive capital stocks in productivity analysis, which is not included in the National Accounts. Capital Services are not included in National Accounts. (Statistics Finland)
- Distinction between
    - Capital stocks used in productivity estimates are "productive" measures (i.e., they take into account efficiency decay) while capital stocks from national accounts are "wealth" measures (i.e., they take into account the price decay, or depreciation);
    - Capital stocks used in Istat productivity measures only refer to the private sector component in each industry (i.e., they are computed excluding the capital stock of the S13 sector in each industry) (Istat Italy)
- Difference in depreciation methods. US National Accounts[17] use geometric depreciation. Office of Productivity and Technology uses hyperbolic. (Bureau of Labour Statistics US)
- Distinction: capital stock according to the National Accounts is published for its own sake; for multi-factor and capital productivity measures, capital services are calculated and published alongside the productivity series (and only there). The principal source data for both capital measures is the same (GFCF by type of asset, both at current and previous year prices), and in addition to this, some macroeconomic data (interest rates, labour share in GDP etc.) is used for calculation of capital services. (Federal Statistical Office Switzerland)

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[17] Produced by the Bureau of Economic Analysis.

9   Reliance on other agencies

This section sets out the results of the survey regarding the dependence of different NISOs on other organisations for inputs for their productivity estimates. Of the 17 NISOs which provided a response to the survey questions on their dependence on other agencies to provide data required for the production of the productivity data:

- Only three NISOs reported depending on other agencies for labour data while the three ISOs do depend on the provision of data from the NSOs:
  - BLS-Office of Productivity and Technology relies on other agencies for a small number of detailed industries: for air transportation, employment data from Department of Transportation and for line-haul railroads, employment data from Department of Transportation and Association of American Railroads.
  - Destatis (DE) – Hours worked per employee
  - Eurostat – data are provided by NSOs of Member States
  - Federal Statistical Office (CH) – Social insurance contribution data from the compensation offices for the compulsory old-age pension system
  - ILO – labour data from the NSOs
  - OECD – Labour input data are sourced from the National Accounts transmitted to the OECD by the NSOs. For very few countries, the OECD relies on labour input series published by other international organisations like the Asian Productivity Organisation or The Conference Board.

- Only one NSO for capital data
  - BLS-Office of Productivity and Technology – Investment in equipment, structures, stock of inventories from Bureau of Economic Analysis. Farmland from the Department of Agriculture. Investment in equipment, structures, and stock of inventories for detailed manufacturing industries from Bureau of the Census. Capital stocks of airframes and engines for air transportation from Bureau of Transportation Statistics. Investment in equipment, structures, and land for railroad transportation from the Surface Transportation Board and AMTRAK.

- Two NSOs and two ISOs reported depending on other agencies for other data
  - BLS-Office of Productivity and Technology – Energy, Material, Purchased Services from Bureau of Economic Analysis. Nominal compensation and profits from Bureau of Economic Analysis. For detailed manufacturing industries: materials, fuels, and electricity, from the Bureau of the Census. For air transportation, materials, services, fuels, and electricity from the Bureau of Transportation Statistics. For railroad transportation: energy, materials, and services from Surface Transportation Board, Association of American Railroads, AMTRAK, Energy Information Administration, and the Edison Electric Institute.
  - Eurostat – all the data are provided by NSOs
  - Federal Statistical Office (CH) – Various interest rate series from the Swiss National Bank
  - ILO – data on GDP at PPP and GDP in constant US$ from World Bank

- OECD – Capital input (capital services) are estimated at the OECD followed the methodology described in Schreyer et al. (2003). To apply this method, the OECD collects gross fixed capital formation (GFCF) series by asset type at the total economy level, primarily from national accounts transmitted by NSOs to the OECD

The ONS does not depend on external data for any of its productivity estimates, although this may change as administrative datasets are increasingly used to estimate GVA and GDP in the National Accounts.

10 Conclusions and recommendations

10.1 Conclusions

Productivity statistics are presented in a variety of forms, using varying data inputs and production methodologies around the world. Users comparing international productivity performance should ensure they are aware of these differences to inform their work. Looking across this variation amongst the sample of countries included in this study, a small number of statistical organisations (the Australian Bureau of Statistics, the US Bureau of Economic Analysis and Bureau of Labour Statistics, and Statistics Canada) are mentioned a number of times by their peers as leaders for different aspects of the production and dissemination of productivity statistics. This review does not identify a clear 'best in class' producer in terms of all aspects of the scope, range, availability and dissemination of productivity data.

Key areas of variation include:

- Only 8 NISOs out of the 17 organisations produce quarterly labour productivity data. The ONS produces such quarterly productivity statistics.
- The delay between the end of the reporting period and the actual date of publication of the productivity data in the UK is the second longest (97 days) among the group of statistical organisations publishing labour productivity statistics, although flash estimates are available from ONS with a shorter 45-day delay.
- Eleven of the 17 NISOs and the ONS produce annual multi-factor productivity estimates (none produce such productivity data on a quarterly basis). All the NISOs and the ONS take account of labour and capital in the estimation of their main or headline multi-factor productivity and only two consider additional factors of production.
- The delay with which the ONS headline multi-factor productivity data are released is the longest among this group.
- There is noticeable variation among the NISOs in terms of the number of industries for which productivity estimates are produced; with the ONS being broadly in the middle of the group.
- In terms of methodology used to produce productivity estimates, almost all NISOs and the ONS use the number of hours worked as the measure of labour in their headline labour productivity estimate.
- Capital services rather than capital stocks are typically used as the measure of capital input in the estimation of the multi-factor productivity estimates, although some countries consider this an overly derived estimate to include in an official estimate.
- In terms of the type information provided with the release of the headline productivity data, only nine of NISOs surveyed and the ONS provide factual information describing the data, and only 7 NISOs and the ONS provide a commentary explaining changes in the productivity figures.
- In terms of the ways the productivity information is disseminated, it is interesting to note that only one NISOs uses infographics and only five use interactive charts.

10.2 Recommendations

The key recommendations flowing from the analysis in the present report are the following:

52

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Recommendations about the scope of ONS measures

1. Compared to current publication plans, a measure of capital productivity would bring the ONS into line with the complement of regular productivity metrics that are published by leading NSIs. This should be produced at the greatest level of detail that the underlying data will support.

2. The ONS MFP model is in line with international practice, but 'best in class' models of this kind include more factors of production in a KLEMS output-based model. These include energy, raw materials, services and land. ONS should consider whether they can produce a KLEMS based model with existing data sources.

Granularity of ONS measures

3. Industrial granularity of ONS labour productivity measures is mid-pack, and the industrial granularity of MFP is among the most limited of the countries surveyed. ONS should consider extending its industry detail in both these areas.

4. ONS should also consider extending its regional productivity data. Class-leaders in this area can produce regional MFP statistics.

Production speed

5. The ONS flash estimate of labour productivity is published in a similar time-frame to international practice. However, ONS could consider increasing the industrial detail available at this release.

6. The ONS MFP estimate is among the slowest of the countries surveyed: ONS should see its plans to improve the timeliness of MFP through to improve its standing in this area.

Productivity inputs and methods

7. ONS is among 8 surveyed NISOs to calculate Quality adjusted labour input (QALI). Others use QALI in a version of their labour productivity system. ONS might consider doing this.

8. The level of detail at which QALI estimates are calculated in the UK is lower than in many of the countries surveyed. ONS should consider the feasibility of increasing the granularity of the QALI release.

9. ONS should consider international best practice in the use of age efficiency and age price profiles in their capital services system.

11 Country reports

The present section contains country reports for:

- Australia - Australian Bureau of Statistics
- Canada - Statistics Canada
- Denmark - Statistics Denmark
- Estonia – Statistics Estonia
- Eurostat
- Finland – Statistics Finland
- France - Insee
- Germany - Destatis
- International Labour Organization (ILO)
- Italy – Istat
- Latvia - Central Statistical Bureau of Latvia
- Netherlands - Statistics Netherlands
- New Zealand - Statistics New Zealand
- Norway – Statistics Norway
- Organisation for Economic Co-operation and Development (OECD)
- Sweden – Statistics Sweden
- Switzerland - Federal Statistical Office
- UK - Office for National Statistics
- USA - Bureau of Labor Statistics

11.1   Australia - Australian Bureau of Statistics

Productivity Estimates Published by

Australian Bureau of Statistics

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✓	✗

The Australian Bureau of Statistics produces **capital, labour** and **multi-factor productivity** estimates for i) the market sector and ii) each industry division within the market sector; specifically:

Productivity Data Published

- **GDP per capita** (annual and quarterly) in the *Australian National Accounts: National Income, Expenditure and Product* (cat. no. 5206.0).

- **GDP / value added per hour worked** as estimates of **labour productivity** (annual and quarterly) for the market sector and the whole economy in the *Australian National Accounts: National Income, Expenditure and Product* (cat. no. 5206.0).

- **Capital, labour and multi-factor productivity** estimates (annual) for the market sector in the *Australian System of National Accounts* (cat. no. 5204.0) and each industry within the market sector in the *Estimates of Industry Multifactor Productivity* (cat. no. 5260.0.55.002). Productivity estimates are also published for twelve selected industries[18].

- Experimental industry level **KLEMS** ((Capital (K), Labour (L), Energy (E), Materials (M) and Services (S)) **multi-factor productivity** Estimates (annual) in *Experimental Estimates of Industry Level KLEMS Multifactor Productivity* (cat. no. 5260.0.55.004).

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[18] This is the closest approximation to the earlier definition of the market sector under ANZSIC93.

Table 19   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital services, productive capital stock	Number of hours worked	Labour and capital
Other measures based on	-	GDP per capita[19]	Labour, capital, energy, raw materials, services, land
Periodicity	Annual	Annual, quarterly	Annual
For annual, what is the period?	July-June	July-June	July-June
Timeliness (lag between end of reference period and publication of productivity statistics)	150 days	60 days quarterly, 120 days annual	150 days
Sectoral coverage	Total market economy or private economy	Total economy / total market economy or private economy	Total market economy or private economy
Published at sub-national level?[20]	no	no	no
If yes, at which levels?		-	-
Sub-national entities covered	-	-	-
Regional classification	-	-	-
Published at industry level?	yes	yes[21]	yes
If yes, which?	ANZSIC 06	ANZSIC 06	ANZSIC 06
Industries covered	16	16	16
Industry-level estimates published at sub-national level?	no	no	no

Source: Australian Bureau of Statistics

■ **Definition of total market economy or private economy:** This refers to the total market sector. The market sector is broadly equivalent to total economy excluding general government[22] and defence, health and social assistance, and education. More precisely, the market sector is defined as ANZIC 06 Divisions A to N, plus Divisions R and S

■ **Availability of Input-Output Tables:** yes

   □ **Frequency:** Annual

   □ **Price Base:** Purchasers prices, basic prices and market prices

   □ **Price(s) at which IO tables are published:** Current prices

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[19] ABS is working on publishing a set of labour accounts providing estimates of the number of jobs. These can then be used to estimate output per number of jobs.

[20] ABS is working on publishing sub-national productivity estimates. These are scheduled to be released in 2017.

[21] ABS is working on publishing hours worked data by industry on a national accounts scope.

[22] The official definition is an industry-based definition. As such the market economy includes some government organisations. For example, the ABS is part of the Professional, Scientific and Technical Services industry and, therefore, is included in the market sector estimate.

- ■ **Production Speed:** 30 days

    This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry, sub-national and national level production values (current/ constant prices), value added/GDP (current/ constant prices), number of persons employed, number of persons employed FTE basis, number of hours worked, and capital stocks. At industry and national level, ABS also publishes capital services data.

Other data published by the ABS that may serve as input to productivity calculations, at industry and national level, include: productivity growth cycles, combined inputs (capital and labour) indices, incomes shares for value added based MFP, capital rental prices (incorporated and unincorporated), intermediate inputs indices, cost shares for gross output base MFP.

Output

The Australian Bureau of Statistics defines output for productivity estimates as value added at constant prices and gross output at constant prices.

Labour Input

The ABS constructs quality-adjusted labour input data. While there is no quality adjustment for the quarterly labour productivity estimates, annual labour productivity estimates for the market sector and below are produced on both hours worked and quality adjusted labour input basis. Annual multi-factor productivity estimates for the market sector are also produced on hours worked and quality adjusted basis. KLEMS multi-factor productivity is only produced on a quality adjusted basis.

Quality adjusted labour input indices are published for the market sector as well as each industry within the market sector, and twelve selected industries. For each industry, labour quality adjustment takes into account age, education and gender. Hours worked indices are combined, for each group, using a Törnqvist index with the weights given by income shares. The data used for quality adjustments is Australian Census data; inter-census periods are interpolated. The ABS produces all labour data inputs used for productivity estimates themselves.

Capital Stocks and Capital Services

The ABS publishes both capital stock and services data at the total economy and industry level (ANZSIC 06, equivalent to ISIC 1 digit level). Capital stocks are published at current (replacement) costs / current prices, year-to-year chained prices, while capital services are published in index form. The Australian Bureau of Statistics uses capital services and productive capital stock data for productivity estimates.

The ABS uses the perpetual inventory method for calculating gross and net stocks of fixed assets. Depreciation based on hyperbolic age efficiency is assumed with regard to consumption of fixed

capital. Furthermore, assets are assumed to retire following a Winfrey distribution. The ABS does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, software, and entertainment, literary or artistic originals (self-produced and purchased), and mineral exploration and evaluation (purchased only). The ABS estimates or approximates any data on intangibles which is not available from surveys.[23]

The statistical basis for actual service life of fixed assets is determined by estimations and/or assumptions. Moreover, the average service life of different types of assets is estimated by industry.

The ABS does not rely on other agencies to provide capital data input. The capital stock estimates used for productivity calculations are identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released
Information included	■ Factual information describing the data ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Interactive charts ■ Downloadable databases
Recently introduced	■ Interactive charts
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

Further Information

Capital productivity

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[23] More detailed information on methodology used and assets included can be found in Chapter 19 of Australian Bureau of Statistics (2016). *Australian System of National Accounts: Concepts, Sources and Methods, 2015*.

- Australian Bureau of Statistics (2016). *Estimates of Industry Multifactor Productivity, 2015-16.* Catalogue no. 5260.0.55.002. Retrieved 19/04/2017. Available at:

  http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/5260.0.55.002Feature%20Article12015-16?opendocument&tabname=Summary&prodno=5260.0.55.002&issue=2015-16&num=&view=

Labour Productivity

- Australian Bureau of Statistics (2016). *Australian System of National Accounts, 2015-16.* Catalogue no. 5204.0. Retrieved 19/04/2017. Available at:

  http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02015-16?OpenDocument

- Australian Bureau of Statistics (2017). *Australian National Accounts: National Income, Expenditure and Product, Dec 2016*. Catalogue no. 5206.0. Retrieved 19/04/2017. Available at:

  http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/52AFA5FD696482CACA25768D0021E2C7?OpenDocument

Total/multi-factor productivity

- Australian Bureau of Statistics (2016). *Estimates of Industry Multifactor Productivity, 2015-16.* Catalogue no. 5260.0.55.002. Retrieved 19/04/2017. Available at:

  http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/5260.0.55.002Feature%20Article12015-16?opendocument&tabname=Summary&prodno=5260.0.55.002&issue=2015-16&num=&view=

Documentation / meta-data

- Australian Bureau of Statistics (2016). *Australian System of National Accounts: Concepts, Sources and Methods, 2015.* Catalogue no. 5216.0. Retrieved 19/04/2017. Available at:

  http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/8AC0D9921051E17BCA2570B300807D36?OpenDocument

Key manuals/reference guides used:

Capital productivity

- OECD (2009). *Measuring Capital OECD Manual.* Second Edition. Retrieved 19/04/2017. Available at:

  https://www.oecd.org/std/productivity-stats/43734711.pdf

Labour productivity

- Australian Bureau of Statistics (2016). *Australian System of National Accounts: Concepts, Sources and Methods, 2015.* Catalogue no. 5216.0. Retrieved 19/04/2017. Available at:

http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/5216.0?OpenDocument

Total/multi-factor productivity

■ OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf

■ Australian Bureau of Statistics (2016). *Information Paper: Experimental Estimates of Industry Level KLEMS Multifactor Productivity, 2015.* Catalogue no. 5260.0.55.003. Retrieved 19/04/2017. Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/249D1E3809315861CA257F09001370F6?OpenDocument

Annex: Published data that may serve to calculate productivity statistics

Table 20   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	X	X	X
Production values (constant prices)	X	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	X	X	X
Number of jobs	°	°	°
Number of hours worked	X	X	X
Capital stocks	X	X	X
Capital services	°	X	X
Other (outlined below)	°	X	X

Notes: X= data are published; ° = no data are published
Source: Australian Bureau of Statistics

Other Sources: Productivity growth cycles, combined inputs (capital and labour) indices, Incomes shares for value added based MFP, capital rental prices (incorporated and unincorporated), intermediate inputs indices, cost shares for gross output base MFP)

11.2   Canada – Statistics Canada

Productivity Estimates Published by

Statistics Canada

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✔	✔	✘

Statistics Canada publishes **labour and multi-factor productivity** estimates at i) the national level, ii) the industry level, iii) the sub-national level, and iv) for industries at the sub-national level; specifically:

■ **Output per hour worked** as a measure of **labour productivity** at the national level, the aggregate business sector, and at the industry level as part of the *National Labour Productivity Measures* program (annual and quarterly).

Productivity Data Published

■ **Labour productivity** estimates at **sub-national** level for the Canadian provinces and territories for the total economy as well as at the industry level as part of the *Provincial and Territorial Labour Productivity Measures* program (annual).

■ **Multi-factor productivity** estimates for the aggregate business sector and major sub-sectors at the national level and sub-national level as part of the multi-factor productivity program *Productivity Measures and Related Variables - National and Provincial* (annual).

■ **KLEMS multi-factor productivity** estimates at the national level for detailed industries as part of the multi-factor productivity program *Productivity Measures and Related Variables - National and Provincial* (annual).

Table 21   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of jobs, number of hours worked	Capital, labour
Other measures based on	-	Capital, labour, energy, raw materials and services
Periodicity	Annual, quarterly	Annual
For annual, what is the period?	January - December	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	67 days quarterly[24], 405 days annual	440 days
Sectoral coverage	Total economy, total private business economy	Total economy, total private business economy
Published at sub-national level?	yes	yes
If yes, at which levels?	State, province, region level	State, province, region level
Sub-national entities covered	13	13
Regional classification	Provinces and territories	Provinces and territories
Published at industry level?	yes	yes
If yes, which?	NAICS 2012	NAICS 2012
Industries covered	322[25]	39[26]
Industry-level estimates published at sub-national level?	yes	yes

Source: Statistics Canada

■ **Definition of Private Business Economy:** Total private business economy equals: Total economy minus the general government minus the Non-profit Institutions serving households minus owner-occupied dwellings

■ **Availability of Input-Output Tables:** yes

   □ **Frequency:** Annual

   □ **Price Base:** Basic prices

   □ **Price(s) at which IO tables are published:** Current prices

■ **Production Speed:** 90 days

   This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

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[24] Quarterly estimates are limited to the entire economy, the aggregate business sector and NAICS two-digit sub-sectors. In the first quarter of each year, Statistics Canada also publishes annual estimates. For more details see: Statistics Canada (2017). *Labour Productivity Measures – National (Quarterly) (LPM).* Retrieved 03/05/2017. Available at: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5042#a1

[25] This refers to the detailed annual publication. 16 industries are included in the quarterly publication.

[26] 15 industries are included in the first publication. Estimates for a total of 39 industries are published at a later date.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry, sub-national and national level production values (current/ constant prices), value added/GDP (current/ constant prices), number of jobs, number of hours worked, capital stocks, and capital services.

Output

Statistics Canada defines output for productivity estimates as GDP at current/ constant prices, value added at current/ constant prices and production value at current/ constant prices.

Labour Input

Statistics Canada constructs quality-adjusted labour input data, which is used for all main/headline labour and multi-factor productivity calculations. Statistics Canada derives labour input data (hours worked/paid) at the aggregate level and by industry for each province and territory, taking into account the class of worker; i.e. whether workers are self-employed or paid workers. Statistics Canada uses data from the Labour Force Survey for quality adjustments[27]. Statistics Canada does not rely on other agencies to provide labour data inputs for their productivity statistics calculations.

Capital Stocks and Capital Services

Statistics Canada publishes both capital stock and capital services data for the total economy and by industry (NAICS), asset, and provinces and territories. Capital stocks and services data are published at current (replacement) costs / current prices, constant (replacement) costs at specific base year / constant prices (base year), and year-to-year chained prices. Statistics Canada uses capital services data for productivity estimates.

Statistics Canada uses the perpetual inventory method for calculating gross stocks of fixed assets. Geometric depreciation is assumed with regard to consumption of fixed capital. Furthermore, assets are assumed to retire following a truncated normal distribution. Statistics Canada does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced intangible assets. Assets covered are R&D, mineral exploration and evaluation, and software. Capital stocks and services data do not include information from surveys capturing purchased intangible assets. Statistics Canada partly estimates or approximates data on intangibles, which is not available from surveys.[28]

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[27] For more information, data sources and methodology of the Labour Force Survey see:
http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3701.
For metadata on quality adjustment see:
http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&lang=en&db=imdb&adm=8&dis=2&SDDS=5103

[28] Link to metadata listing all the types of assets included in the capital stock and services data and describing the methodology employed: http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&lang=en&db=imdb&adm=8&dis=2&SDDS=2820. Stock

The actual service life of fixed assets is determined by estimations and/or assumptions. Moreover, the average service life of different types of assets is estimated by industry.

Statistics Canada does not rely on other agencies to provide capital data input. The capital stock estimates used for productivity calculations are identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Infographics ■ Interactive charts ■ Downloadable databases
Recently introduced	■ No recent changes
Announcement of new releases	■ Via press conferences: no ■ Via press releases: yes – print media: general and financial/business, online media: general and financial/business ■ Via social media: no

Further Information

Capital Stocks

■   Statistics Canada (2016). *Stock and consumption of fixed capital, 2015.* Retrieved 19/04/2017. Available at:

http://www.statcan.gc.ca/daily-quotidien/161118/dq161118b-cansim-eng.htm

Labour Productivity

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and consumption of fixed capital can be found via the following links: http://www.statcan.gc.ca/daily-quotidien/161118/dq161118b-cansim-eng.htm.

- ■ Statistics Canada (2016). *Labour Productivity Measures - Provinces and Territories (Annual) (CPA).* Retrieved 19/04/2017. Available at:

  http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&lang=en&db=imdb&adm=8&dis=2&SDDS=5103

Total/multi-factor productivity

- ■ Statistics Canada (2017). *Productivity Measures and Related Variables - National and Provincial (Annual).* Retrieved 19/04/2017. Available at:

  http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&lang=en&db=imdb&adm=8&dis=2&SDDS=1402

Documentation / meta-data

- ■ Statistics Canada (2017). *Table 383-0033: Labour productivity and related measures by business sector industry and by non-commercial activity consistent with the industry accounts, provinces and territories. annual.* Retrieved 19/04/2017. Available at:

  http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3830033&&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=

Press release

- ■ Statistics Canada (2016). *Productivity Labour productivity rises following a decline in the second quarter.* Retrieved 19/04/2017. Available at:

  http://www.statcan.gc.ca/daily-quotidien/161202/dq161202b-eng.htm

Key manuals/reference guides used:

Labour Productivity

- ■ Statistics Canada (2016). *Labour Productivity Measures - Provinces and Territories (Annual) (CPA).* Retrieved 19/04/2017. Available at:

  http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&lang=en&db=imdb&adm=8&dis=2&SDDS=5103

66

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Annex: Published data that may serve to calculate productivity statistics

Table 22   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	X	X	X
Production values (constant prices)	X	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	°	°	°
Number of persons employed FTE basis	°	°	°
Number of jobs	X	X	X
Number of hours worked	X	X	X
Capital stocks	X	X	X
Capital services	X	X	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Statistics Canada

11.3   Denmark – Statistics Denmark

Productivity Estimates Published by

Statistics Denmark / Danmarks Statistik

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✔	✔	✘

Statistics Denmark produces **labour** and **total factor productivity** estimates for i) the total private economy, ii) sectors and iii) each industry division; specifically:

Productivity Data Published

- **Gross value added per hour worked** as estimates of **labour productivity** (annual) for industries, sectoral aggregates and the total economy in *Labour Productivity by Industry and Price* (Cat. No. NP23)*.*

- **Labour and total factor productivity** are estimated annually for industries, sectoral aggregates and the total economy in *Productivity by Industry, Type and Unit Price* (Cat. No. NP25)*.*

- **KLEMS productivity** is estimated on an irregular basis for industries, sectoral aggregates and the total economy in *Productivity, KLEMS by Industry, Type and Price Unit* (Cat. No. NP28)*.*

Table 23   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of hours worked	Labour (quality adjusted), IT-capital, non-IT-capital
Other measures based on	-	Labour (quality adjusted), IT capital, non-IT capital, energy, materials, services[29]
Periodicity	Annual	Annual
For annual, what is the period?	January - December	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	140 days	440 days
Sectoral coverage	Total economy, total market economy or private economy, non-farm business sector, market services	Total market economy or private economy, non-farm business sector, market services
Published at sub-national level?	no	no
If yes, at which levels?	-	-
Sub-national entities covered	-	-
Regional classification	-	-
Published at industry level?	yes	yes
If yes, which?	ISIC 3-digit	ISIC 1-digit
Industries covered	117	69
Industry-level estimates published at sub-national level?	no	no

Source: Statistics Denmark

- ■ **Definition of total market economy or private economy:** Total economy excluding general government sector

- ■ **Definition of non-farm business sector:** Total private economy minus industries A and B exclusive of dwellings and non-residential buildings

- ■ **Definition of market services:** Total private economy minus industries A to F exclusive of dwellings and non-residential buildings

- ■ **Availability of Input-Output Tables:** yes
  - □ **Frequency:** Annual
  - □ **Price Base:** Basic prices
  - □ **Price(s) at which IO tables are published:** Current and constant prices

- ■ **Production Speed:** 35 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

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[29] KLEMS productivity estimates are published irregularly, every 4 to 5 years. A new release is planned for 2018.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry and national level production values (current/ constant prices), value added (current/ constant prices), number of persons employed, number of hours worked and capital stocks; at sub-national level production values (current/ constant prices), value added (current/ constant prices), number of persons employed and number of hours worked.

Output

Statistics Denmark defines output for productivity estimates as value added at constant prices. Production values at constant prices are used for KLEMS calculations at an irregular basis.

Labour Input

Statistics Denmark constructs quality-adjusted labour input data, which is used for all multi-factor productivity calculations. There is no labour quality adjustment for the headline labour productivity estimate. Labour quality adjustment takes into account education and industries. Statistics Denmark utilises register-based statistics for individuals regarding education and industry for labour quality adjustments.[30] Statistics Denmark produces all labour input data for productivity estimates on its own.

Capital Stocks and Capital Services

Statistics Denmark publishes capital stocks data for the total economy and on industry level (ISIC 1-digit). Capital stocks data are published at current (replacement) costs/current prices and at year-to-year chained prices. Statistics Denmark uses net capital stock and capital services data for productivity estimates.

Statistics Denmark uses the perpetual inventory method for calculating gross and net stocks of fixed assets. Geometric depreciation is assumed with regard to consumption of fixed capital. Furthermore, assets are assumed to retire following an adjusted Winfrey distribution. Statistics Denmark does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, mineral exploration and evaluation, software and entertainment, literary or artistic originals. Statistic Denmark does not estimate or approximate any data on intangibles, which is not available from surveys.[31]

The statistical basis for actual service life of fixed assets is determined by estimations and/or assumptions. Moreover, the average service life of different types of assets is estimated by industry.

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[30] Link to metadata on labour quality adjustment:
http://www.dst.dk/en/Statistik/dokumentation/documentationofstatistics/productivity/statistical-presentation (see section on "Data Description").

[31] Link to metadata listing all types of assets included in the capital stock:
http://www.dst.dk/en/Statistik/dokumentation/documentationofstatistics/fixed-capital-stock.

Statistics Denmark does not rely on other agencies to provide capital data input. The capital stock estimates used for productivity calculations are identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable datasets
Recently introduced	■ Nothing changed in recent years

Announcement of new releases	■ Via press conferences: no
	■ Via press releases: yes
	  □ Print media: General
	  □ Broadcast Media (Radio): General
	  □ Online Media: General
	■ Via social media: Yes
	  □ Twitter

Further Information

Labour Productivity

■ Statistics Denmark (2017). *NP23: labour productivity by industry and price unit*. Retrieved 03/08/2017. Available at: https://www.statistikbanken.dk/np23

Total/multi-factor productivity

■ Statistics Denmark (2017). *NP25: productivity by industry, type and price unit.* Retrieved 03/08/2017. Available at: https://www.statistikbanken.dk/np25 (headline MFP measure)

■ Statistics Denmark (2017). *NP28: [NA ESA95REV, DB07] productivity, klems by industry, type and price unit (discontinued).* Retrieved 03/08/2017. Available at: https://www.statistikbanken.dk/np28 (other MFP measure)

Documentation/meta-data

■   Statistics Denmark (n.d.). *Documentation of Statistics - Productivity.* Retrieved 03/08/2017. Available at:

http://www.dst.dk/en/Statistik/dokumentation/documentationofstatistics/productivity

Press release

■   Statistics Denmark (n.d.). *Produktivitet og input-output.* Retrieved 03/08/2017. Available at:

http://dst.dk/en/Statistik/emner/nationalregnskab-og-offentlige-finanser/produktivitet-og-input-output/produktivitet

Key manuals/reference guides used:

Labour productivity

■   OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
https://www.oecd.org/std/productivity-stats/2352458.pdf

Total/multi-factor productivity

■   OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
https://www.oecd.org/std/productivity-stats/2352458.pdf
■   Different papers and books by D.W. Jorgenson

72

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Annex: Published data that may serve to calculate productivity statistics

Table 24   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	X	X	X
Production values (constant prices)	X	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	X	X	X
Capital stocks	°	X	X
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Statistics Denmark

11.4   Estonia - Statistics Estonia

Productivity Estimates Published by

Statistics Estonia

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✔	✘	✘

Statistics Estonia produces **labour productivity** estimates for i) the total economy ii) the total non-financial private business sector and iii) 229 industries; specifically:

Productivity Data Published

■ **GDP per hour worked / person employed** as **labour productivity** estimates (quarterly and annual) for the whole economy in *Labour productivity and Unit Labour Cost (Cat. No. NAL0013).*

■ **Labour productivity estimates** (quarterly and annual) based on value added and turnover for the total economy and industries in *Enterprises productivity measures by economic activity at current prices (Cat. No. FS0411)* and *Enterprises' value added and productivity measures by economic activity (Cat. No. FS0008).*

■ **Labour productivity** estimates (annual) based on value added and turnover for regions and the total economy *in Enterprises' value added and productivity measures by county (Cat. No. FS027).*

Table 25   Productivity Estimates Published

Productivity Measure	Labour Productivity
Main / headline measure based on	Number of employed persons, number of hours worked
Other measures based on	Number of employed persons, number of hours worked, personnel costs
Periodicity	Annual / quarterly
For annual, what is the period?	Jan-Dec; Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Timeliness (lag between end of reference period and publication of productivity statistics)	425 days annual / 60 days quarterly
Sectoral coverage	Total economy, total non-financial business economy
Published at sub-national level?	Yes
If yes, at which levels?	Regions
Sub-national entities covered	19
Regional classification	NUTS 3
Published at industry level?	Yes
If yes, which?	ISIC 2- and 3-digit
Industries covered	229
Industry-level estimates published at sub-national level?	No

- **Definition of Total Non-Financial Business Economy:** private business economy excluding finance and insurance, S. 11 sector according to SNA.
- **Availability of Input-Output Tables:** (yes)
  - ☐ **Frequency:** published only for 2010
  - ☐ **Price Base:** Basic prices
  - ☐ **Price(s) at which IO tables are published:** Current prices
- **Production Speed:** 10/60 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at sub-national level value added / GDP (current prices), number of persons employed, number of hours worked; at industry level: production value (current prices), value added/GDP (current prices), number of persons employed, number of FTE persons employed, number of hours worked; at national level: value added (current/ constant prices), number of persons employed, number of hours worked.

Output

Statistics Estonia uses GDP at constant and current prices for its headline labour productivity publication. Moreover, industry labour productivity estimates are based on value added (current prices) as well as turnover.

Labour Input

Statistics Estonia does not rely on other agencies to provide labour input data for productivity estimates. Furthermore, Statistics Estonia does not construct quality-adjusted labour input data.

Capital Stocks and Capital Services

Statistics Estonia stated to publish neither capital stocks nor capital services.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.

| Information included | ■ Technical notes (e.g. description of methodology used) |

| Presentation | ■ Tables |
| | ■ Downloadable databases |

| Recently introduced | ■ Nothing changed recently |

Announcement of new releases	■ Via press conferences: no
	■ Via press releases: no
	■ Via social media: no

Further Information

Labour Productivity

■ Statistics Estonia (n.d.). *NAL0013: labour productivity and unit labour cost (esa 2010) (quarters). Retrieved 03/08/2017.* Available at:

http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=NAL0013&ti=LABOUR+PRODUCTIVITY+AND+UNIT+LABOUR+COST+%28ESA+2010%29+%28QUARTERS%29&path=../I_Databas/Economy/23National_accounts/015Auxiliary_indicators/&lang=1 (headline labour productivity measure)

■ Other labour productivity estimates:

☐ Industry level labour productivity estimates:

Statistics Estonia (n.d.). *FS008: enterprises' value added and productivity measures by economic activity (emtak 2008) and number of persons employed.* Retrieved 03/08/2017. Available at:

http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=FS008&ti=ENTERPRISES%27+VALUE+ADDED+AND+PRODUCTIVITY+MEASURES+BY+ECONOMIC+ACTIVITY+%28EMTAK+2008%29+AND+NUMBER+OF+PERSONS+EMPLOYED&path=../I_Databas/Economy/09Financial_statistics_of_enterprises/04Enterprises_financial_key/02Annual_statistics/&lang=1

☐ Quarterly labour productivity estimates:

Statistics Estonia (n.d.). *FS0411: enterprises productivity measures by economic activity (emtak 2008) at current prices (2001-2016, quarters).* Retrieved 03/08/2017. Available at:

http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=FS0411&ti=ENTERPRISES+PRODUCTIVITY+MEASURES+BY+ECONOMIC+ACTIVITY+%28EMTAK+2008%29+AT+CURRENT+PRICES+%28QUARTERS%29&path=../I_Databas/Economy/09Financial_statistics_of_enterprises/04Enterprises_financial_key/04Short_term_statistics/&lang=1

☐ Sub-national level:

Statistics Estonia (n.d.). *FS027: enterprises' (with 20 or more persons employed) value added and productivity measures by county*. Retrieved 03/08/2017. Available at:

http://pub.stat.ee/px-web.2001/Dialog/varval.asp?ma=FS027&ti=ENTERPRISES%27+%28WITH+20+OR+MORE+PERSONS+EMPLOYED%29+VALUE+ADDED+AND+PRODUCTIVITY+MEASURES+BY+COUNTY&path=../I_databas/Economy/09Financial_statistics_of_enterprises/04Enterprises_financial_key/02Annual_statistics/&search=FS027&lang=1

Documentation / meta-data

Not applicable

Key manuals/reference guides used:

Labour productivity

Not applicable

Annex: Published data that may serve to calculate productivity statistics

Table 26   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	°
Production values (constant prices)	°	°	°
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	°	°	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	°	X	°
Number of jobs	°	°	°
Number of hours worked	X	X	X
Capital stocks	°	°	°
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Statistics Estonia

11.5   Eurostat

Productivity Estimates Published by

Eurostat

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✔	✘	✘

Eurostat produces **labour productivity** estimates i) on EU level, ii) for national economies and iii) for industries; specifically:

Productivity Data Published

■ **GDP per hour worked** as estimates of **labour productivity** (annual) for national economies and the EU as a whole in *Labour productivity per hour worked* (Cat. No. tsdec310).

■ **GDP per hour worked / person employed** as estimates of nominal **labour productivity** (annual) for national economies and on EU-level in *Labour productivity per person employed and hour worked* (Cat. No. tesem160).

■ **Labour productivity** estimates (annual) for 12 industries in *Apparent labour productivity by NACE Rev.2* (Cat No. tin00152).

Table 27   Productivity Estimates Published

Productivity Measure	Labour Productivity
Main / headline measure based on[32]	Hours worked / Hours worked and number of persons employed
Other measures based on	-
Periodicity	Annual
For annual, what is the period?	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)	90 days
Sectoral coverage	Total economy
Published at sub-national level?	no
If yes, at which levels?	-
Sub-national entities covered	-
Regional classification	-
Published at industry level?	yes
If yes, which?	ISIC 1-digit level
Industries covered	12
Industry-level estimates published at sub-national level?	no

Source: Eurostat

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[32] Eurostat produces two separate datasets: Labour productivity per hour worked (with real GDP) and labour productivity per person employed and hour worked *with nominal GDP)

- ■ **Availability of Input-Output Tables:** yes
  - ☐ **Frequency:** Annual
  - ☐ **Price Base:** Basic prices
  - ☐ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** 0 days

  Eurostat collects data from countries and republishes them. Labour productivity data are calculated from data on GDP and employment sent by countries.

Methodology

Data that may serve to calculate productivity

Published data that may serve as inputs to productivity calculations include: at sub-national level (NUTS 2, 3): value added / GDP (current prices), number of persons employed, number of persons employed FTE basis; at industry level: production values (current / constant prices), value added (current / constant prices), number of persons employed, number of persons employed FTE basis, number of hours worked; at national and EU-level: production value (current / constant prices), value added (current / constant prices), number of persons employed, number of persons employed at FTE basis and number of hours worked.

Output

Eurostat defines output for productivity estimates as GDP at current and constant prices.

Labour Input

Eurostat does not publish quality-adjusted labour input data now. However, together with the Joint Research Centre, Eurostat has developed a framework for quality adjustment with regard to educational achievement, in order to account for large structural differences between countries across the EU. There are plans to publish quality-adjusted labour data in the course of 2017.

Capital Stocks and Capital Services

Eurostat does publish neither capital stock nor capital services data. However, there are plans to develop capital input data in the future. The implementation will take some years because national statistical offices are reluctant to deliver official capital stocks, due to the necessity of making assumptions, e.g. with regard to intangibles and intellectual property.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.

Information included	■ Not applicable – data are released on the Eurostat website.
	■ Technical notes available on Eurostat website.[33]
Presentation	■ Tables
	■ Downloadable databases
Recently introduced	■ Nothing was changed recently.
Announcement of new releases	■ Via press conferences: no
	■ Via press releases: no
	■ Via social media: no

Further Information

Labour Productivity

■ Eurostat (2017). *Labour productivity per hour worked (ESA 2010).* Retrieved 03/08/2017. Available at:

http://ec.europa.eu/eurostat/web/products-datasets/product?code=tsdec310 (headline labour productivity measure)

■ Other labour productivity publication:

☐ Per person employed:

Eurostat (2016). *Labour productivity per person employed and hour worked (EU28=100).* Retrieved 03/08/2017. Available at:

http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tesem160&plugin=1

☐ On industry level:

Eurostat (2016). *Apparent labour productivity by NACE Rev. 2.* Retrieved 03/08/2017. Available at:

http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tin00152

Documentation / meta-data

■ /

Key manuals/reference guides used:

Labour productivity

■   OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 28   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	X	X	X
Number of jobs		°	°
Number of hours worked	°	X	X
Capital stocks	°	°	°
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Eurostat

11.6   Finland - Statistics Finland

Productivity Estimates Published by

Statistics Finland

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✖	✔	✔	✖

Productivity Data Published

The Statistics Finland produces **labour** and **multi-factor productivity** estimates for i) the total economy ii) the total private economy and iii) 63 industries; specifically:

■ **Gross value added per hour worked** as estimates of **labour productivity** and **multi-factor productivity estimates** (annual) for industries, sectors and the whole economy in *Productivity Surveys*.

Table 29   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of hours worked	Labour and capital
Other measures based on	Number of hours worked	Labour and capital
Periodicity	Annual	Annual
For annual, what is the period?	January-December	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)	320 days	320 days
Sectoral coverage	Total economy, total market economy or private economy, public sector	Total economy, total market economy or private economy, public sector
Published at sub-national level?	no	No
If yes, at which levels?	-	-
Sub-national entities covered	-	-
Regional classification	-	-
Published at industry level?	yes	Yes
If yes, which?	ISIC 2-digit	ISIC 2-digit
Industries covered	63	63
Industry-level estimates published at sub-national level?	no	no

Source: Statistics Finland

82

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

■ **Definition of Private Business Economy:** /
■ **Availability of Input-Output Tables:** yes
    □ **Frequency:** Annual
    □ **Price Base:** Basic prices
    □ **Price(s) at which IO tables are published:** Current prices
■ **Production Speed:** 120 days
    This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as inputs to productivity calculations include: Production values (constant prices), value added / GDP (constant prices), capital stocks, user costs of capital, internal rates of return and, depreciation rates. All data are published at industry and national economy level.
Statistics Finland publishes all data required for capital services and capital productivity calculations. However, capital productivity estimates are not explicitly published.

Output

Statistics Finland defines output for headline productivity estimates as value added at constant prices. Production values at constant prices are used for additional productivity calculations.

Labour Input

Statistics Finland defines labour input for labour productivity estimates as hours worked. They also publish a decomposition of labour input changes; however, there is no labour quality adjustment for labour productivity estimates. Quality-adjusted labour input data are used for multi-factor productivity calculations. Labour quality adjustment takes into account age, gender, education and industries. Statistics Finland relies on the Labour Force Survey (LFS) and employment statistics for labour quality adjustments.[34] Statistics Finland produces all labour input data for productivity estimates on its own.

Capital Stocks and Capital Services

Statistics Finland publishes capital stocks and capital services data for the total economy and on industry level (ISIC 2-digit). Capital stocks and services are published at constant (replacement) costs / constant prices. Statistics Finland uses capital services data for productivity estimates.

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[34] Links to metadata on labour quality adjustment:
http://tilastokeskus.fi/til/tyti/index_en.htm
http://tilastokeskus.fi/til/tyokay/index_en.html

Statistics Finland uses the perpetual inventory method for calculating gross stocks of fixed assets. Geometric depreciation is assumed with regard to consumption of fixed capital. Furthermore, neither adjustments for capacity utilisation of capital nor transactions of used assets are taken into account for the calculation of capital stocks.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Self-produced assets include R&D, software and databases. Purchased intangibles cover R&D, mineral exploration and evaluation, software, databases and entertainment, literary and artistic originals. Statistics Finland estimates or approximates data on intangibles if information from surveys is not available.[35]

Statistics Finland does not have any statistical basis for determining the actual service lives of fixed assets. Statistics Finland does not rely on another agency to provide capital input data.

The capital stocks / services estimates used for productivity calculations differ from those published in the national accounts. Productivity analysis relies on productive stocks, whereas the national accounts include gross stocks and net wealth.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable datasets
Recently introduced	■ Yes, added disaggregation of capital input into e.g. machinery, equipment, ICT and R&D
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

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[35] Link to metadata listing all the types of assets included in the capital stock:
http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__ttut/170_ttut_tau_107.px/?rxid=441396c3-09c4-4b73-b886-b5c24a45bfa3

84

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Further Information

Labour Productivity

- Statistics Finland (n.d.). *Labour productivity by industry 1976-2015, value added.* Retrieved 03/08/2017. Available at:

  http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__ttut/120_ttut_tau_102.px/?rxid=441396c3-09c4-4b73-b886-b5c24a45bfa3 (headline labour productivity estimate)

- Statistics Finland (n.d.). *Labour productivity by industry 1976-2015, production.* Retrieved 03/08/2017. Available at:

  http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__ttut/140_ttut_tau_104.px/?rxid=23fbc4a1-5394-4e5a-9afc-5dd818401caf (other labour productivity estimate)

Total/multi-factor productivity

- Statistics Finland (n.d.). *Multi-factor productivity by industry 1976-2015, value added.* Retrieved 03/08/2017. Available at:

  http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__ttut/110_ttut_tau_101.px/?rxid=441396c3-09c4-4b73-b886-b5c24a45bfa3 (headline multi-factor productivity estimate)

- Statistics Finland (n.d.). *Multi-factor productivity by industry 1976-2015, production.* Retrieved 03/08/2017. Available at:

  http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__kan__ttut/130_ttut_tau_103.px/?rxid=23fbc4a1-5394-4e5a-9afc-5dd818401caf (other multi-factor productivity estimate)

Documentation / meta-data

- Statistics Finland (2016). P*roductivity surveys.* Productivity surveys [e-publication]*.* Retrieved 03/08/2017. Available at:

  http://www.stat.fi/meta/til/ttut_en.html

Press release

- Statistics Finland (2016). *Releases.* Productivity surveys [e-publication]*.* Retrieved 03/08/2017. Available at:

  http://www.stat.fi/til/ttut/tie_en.html

Key manuals/reference guides used:

Labour productivity

- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:

  https://www.oecd.org/std/productivity-stats/2352458.pdf

- Papers by D.W. Jorgenson

Total/multi-factor productivity

- ■ OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf
- ■ EU KLEMS methodology. See EU Klems website http://www.euklems.net [retrieved 08/08/2017] for more information.

Annex: Published data that may serve to calculate productivity statistics

Table 30   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	°	°
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	°	°	°
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	°	°
Other (outlined below)	°	X	X

Notes: X= data are published; ° = no data are published
Source: Statistics Finland

- ■ **Other Sources**: User costs of capital, internal rates of return, depreciation rate

11.7   France - Insee

Productivity Estimates Published by

	Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
Productivity Data Published	✖	✔	✖	✖

Insee only publishes apparent labour productivity for the sector of non-financial corporations, defined as gross value added (at current prices) per paid worker.

Table 31   Productivity Estimates Published

Productivity Measure	Labour Productivity
Main / headline measure based on[36]	Number of employed persons
Other measures based on	-
Periodicity	Quarterly and annual
For annual, what is the period?	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	31 days[37]
Sectoral coverage	Sector of non-financial corporations
Published at sub-national level?	No
If yes, at which levels?	-
Sub-national entities covered	-
Regional classification	-
Published at industry level?	No
If yes, which?	
Industries covered	-
Industry-level estimates published at sub-national level?	No

Source: Insee

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[36] Apparent labour productivity in sector of non-financial corporations

[37] INSEE publishes three estimates for the same reference period. The first one is published after 31 days, the second one after 59 days and the final after 83 days. Annual estimates are published together with fourth quarter estimates.

- ■ **Definition of Private Business Economy:** -
- ■ **Availability of Input-Output Tables:** yes
  - ☐ **Frequency:** Annual
  - ☐ **Price Base:** Purchasers' prices, basic prices
  - ☐ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** 15 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics: days

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at national and industry level production values (current / constant prices), value added/GDP (current / constant prices), number of persons employed, number of persons employed FTE basis, number of hours worked, and capital stocks.

Output

Insee defines output for productivity estimates as value added at current prices.

Labour Input

Insee does not construct quality-adjusted labour input data. Insee does not rely on other agencies to provide labour input data for productivity estimates.

Capital Stocks and Capital Services

Insee publishes capital stocks data for the total economy, the business economy, and on industry level (38 industries using a specific French grouping). Capital stocks data are published at current (replacement) costs/current prices and at year-to-year chained prices.

Insee uses the perpetual inventory method (PIM) for calculating gross and net stocks of fixed assets for most assets. For housing assets a mix of surveys and PIM is used. Linear depreciation is assumed with regard to consumption of fixed capital. Furthermore, assets are assumed to retire following a log-normal distribution. Insee does not adjust for capacity utilisation of capital, and does not take transactions of used assets into account for capital stock calculations.

Capital stocks data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D (purchased and self-produced), software, and entertainment, literary or artistic originals (self-produced only). Insee estimates or approximates data on intangibles, which is not available from surveys.

The statistical basis for actual service life of fixed assets is determined by estimations and/or assumptions. The average service life of different types of assets is not estimated by industry.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ No specific information
Presentation	■ Excel tables only
Recently introduced	■ No innovation has been introduced recently
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

Further Information

Labour Productivity:

■ INSEE (2017). *Comptes nationaux trimestriels au 4e trimestre 2016. Comptes de la Nation en base 2010 - Résultats détaillés*. Retrieved 19/04/2017. Available at:
https://www.insee.fr/fr/statistiques/2592576?sommaire=2570699

Key manuals/reference guides used:

None

Annex: Published data that may serve to calculate productivity statistics

Table 32   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	°	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	X	X
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Insee

11.8   Germany - Destatis

Productivity Estimates Published by

Destatis - Statistisches Bundesamt Bundesamt (and *working group Regional Accounts – "Volkswirtschaftliche Gesamtrechnungen der Länder"*[38])

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✗	✗

Destatis produces **capital** and **labour productivity** estimates for the total economy and 10 industries. *The working group Regional Accounts* produces these estimates at a regional level; specifically:

Productivity Data Published

- **Real GDP/value added per hour worked/per person employed** as estimates of **labour productivity** (quarterly/annual) for the total economy and 10 industries in *National Accounts – Domestic product – quarterly results* (Fachserie 18, Reihe 1.2).

- **Capital and labour productivity** estimates (annual) for the total economy and 10 industries in *Inlandsproduktsberechnung – Detaillierte Jahresergebnisse* (Fachserie 18, Reihe 1.4).

- **GDP (real) per hour worked/per person employed** (annual) on regional level in *Gross domestic product, gross value added in Germany on NUTS3-Level* (Reihe 2, Band 1).

- **Capital productivity** (annual) on a regional level in *Stock of fixed assets in Germany by Bundesland 1991 to 2013* (Reihe 1, Band 4).

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[38] The *Regional Accounts* working group consists of Destatis (Statistisches Bundesamt), the statistical offices of the 16 federal states, and a representative of the German Association of Cities and Towns. Its purpose is to provide state level (or deeper) data with regard to the production, distribution and use of GDP. Information available at http://vgrdl.de/.

Table 33 Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity
Main / headline measure based on	Gross capital stock	Number of hours worked, number of employed persons
Other measures based on	Gross capital stock	Number of hours worked, number of employed persons
Periodicity	Annual	Annual/Quarterly
For annual, what is the period?	January - December	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	270 days	55 days quarterly, 14 days annual
Sectoral coverage	Total economy	Total economy
Published at sub-national level?[39]	yes	yes
If yes, at which levels?	Regional	Regional
Sub-national entities covered	16	16, 38, 402
Regional classification	NUTS 1	NUTS 1, 2, 3
Published at industry level?	Yes	yes
If yes, which?	ISIC 1-digit	ISIC 1-digit
Industries covered	10 (+ "of which manufacturing")	10 (+ "of which manufacturing")
Industry-level estimates published at sub-national level?	no	yes (at NUTS1 level)

Source: Destatis – Statistisches Bundesamt

Note: Industry-specific productivity estimates cover 10 separate industries, including the aggregate industrial sector (B-E). For the latter, there is an additional estimate for the sub aggregate manufacturing industry (C).

■ **Availability of Input-Output Tables:** yes

☐ **Frequency:** Annual

☐ **Price Base:** Purchasers prices, basic prices

☐ **Price(s) at which IO tables are published:** Current prices

■ **Production Speed:** 0

This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics. In the case of Destatis, productivity statistics are published as part of the national accounts data containing the output, labour and capital input data used for productivity calculation.

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[39] Productivity estimates on regional level are not published in the head productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as inputs to productivity calculations include: at sub-national level: value added/GDP (current/constant prices), number of persons employed, number of hours worked and capital stocks; at industry level: production values (current/constant prices), value added/GDP (current/constant prices), number of persons employed, number of hours worked and capital stocks; at national level: production values (current/constant prices), value added/GDP (current/constant prices), number of persons employed, number of hours worked and capital stocks.

Output

Destatis and *the Regional Accounts working group* define output for productivity estimates as GDP at constant prices for the whole economy and regional estimates. For industry level estimates, Destatis defines output as value added at constant prices. Moreover, the national accounts also contain statistics on GDP / value added at current prices on per hour worked/person employed basis. These are not labelled 'labour productivity' though.

Labour Input

Destatis neither constructs nor publishes quality-adjusted labour input data. With regard to productivity estimates based on hours worked per employee, Destatis relies on labour input data from another agency to produce productivity estimates. These data are provided by IAB (Institut für Arbeitsmarkt- und Berufsforschung), which is the research institute of the federal employment agency[40].

Capital Stocks and Capital Services

Destatis publishes capital stock data for the total economy and 64 industries, no capital services data. Capital stock data is published at current (replacement) cost/current prices and at year-to-year chained prices. Only gross capital stock data is used for productivity estimates.

Destatis uses the perpetual inventory method for calculating gross and net stocks of fixed assets. With regard to consumption of fixed capital, linear depreciation is assumed as well as a retirement function following Gamma distribution. Destatis does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

The capital stock includes information from surveys capturing self-produced and purchased intangible assets; Assets covered are R&D, mineral exploration and evaluation, software and databases. Destatis estimates data on intangibles if information from surveys is not available.[41,42]

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[40] Link for further information on IBA: http://iab.de/en/iab-aktuell.aspx .

[41] Link to metadata describing the method used for estimating/approximating missing data:
https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/GrossDomesticProduct6489030169004.pdf?__blob=publicationFile

[42] Links to metadata listing all types of assets included in the capital stock:

The statistical basis for actual service life of fixed assets is determined by estimations and/ or assumptions. Moreover, the average service life of different types of assets is estimated by industry.

Destatis does not rely on other agencies to provide capital data input. The capital stock estimates used for productivity calculations are identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Productivity is part of the comprehensive national accounts publications □ https://www.destatis.de/EN/PressServices/Press/pr/2017/02/PE17_062_811.html
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable datasets ■ Scientific Workshop □ https://www.destatis.de/EN/PressServices/Press/pr/2017/02/PE17_062_811.html
Recently introduced	■ Nothing was changed recently.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

Further Information

Capital productivity

■ Destatis (2016). *Inlandsproduktberechnung - Detaillierte Jahresergebnisse (vorläufige Ergebnisse) - Fachserie 18 Reihe 1.4 – 2016*. Retrieved 03/08/2017. Available at: https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/InlandsproduktsberechnungVorlaeufig.html

■ Other capital productivity estimates (German):
  □ Destatis (2014). *Anlagevermögen in den Ländern der Bundesrepublik Deutschland Revision 2014*. Retrieved 03/08/2017. Available at: http://www.vgrdl.de/VGRdL/tbls/R0B0.jsp?rev=RV2014&tbl=R1B4

94

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

Labour Productivity

■ Overview headline labour statistics:

Destatis (2017). *National Accounts - Domestic Product - Labour productivity, average wages and unit labour costs –Per hour Change on the previous year in %.* Retrieved 03/08/2017. Available at:

https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/NationalAccounts/DomesticProduct/Tables/LabourProductivityAverageWages_PerHour.html

■ Detailed headline labour statistic:

Destatis (2017). *National Accounts - Domestic Product - Quarterly results - Fachserie 18 Series 1.2 - 1st Quarter 2017.* Retrieved 03/08/2017. Available at:

https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/NationalAccountsQuarterlyResultsXLS_6480120

■ Other labour productivity estimates (German):

Destatis (2014). *Bruttoinlandsprodukt, Bruttowertschöpfung in den kreisfreien Städten und Landkreisen der Bundesrepublik Deutschland Revision 2014.* Retrieved 03/08/2017. Available at: http://www.vgrdl.de/VGRdL/tbls/R0B0.jsp?rev=RV2014&tbl=R2B1

Documentation/meta-data

■ Destatis (2012). *National accounts, domestic product.* Retrieved 08/08/2017. Available at:

https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/NationalAccounts.html

Press release

■ Destatis (2017). *Press releases - Current press releases*. Retrieved 03/08/2017. Available at: https://www.destatis.de/EN/PressServices/Press/pr/PressReleases.html

Key manuals/reference guides used:

Capital productivity

■ Schmalwasser, O. and Schidlowski, M. (n.d.). *Measuring Capital Stock in Germany*. Retrieved 03/08/2017. Available at:

https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/MeasuringCapitalStockWista1106.pdf?__blob=publicationFile

Labour productivity

■ Destatis (2010). *National Accounts - Domestic product and national income in accordance with ESA 2010 – Methods and sources.* Retrieved 03/08/2017. Available at:

https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/GrossDomesticProduct6489030169004.pdf?__blob=publicationFile

Annex: Published data that may serve to calculate productivity statistics

Table 34   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	X	X	X
Capital stocks	X	X	X
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Destatis –Statistisches Bundesamt

11.9   International Labour Organisation

Productivity Estimates Published by

International Labour Organisation (ILO)

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✔	✘	✘

The ILO publishes productivity statistics in the following area:

Productivity Data Published

■   **Output per worker**[43] as part of *ILO Estimates and Projections* (annual).

■   ILO used to publish **output per hour worked** as part of the *Key Indicators of the Labour Market* publication. The publication and the output per hour worked indicator have now been discontinued.

Table 35   Productivity Estimates Published

Productivity Measure	Labour Productivity
Main / headline measure based on	Number of employed persons
Other measures based on	-
Periodicity	Annual
For annual, what is the period?	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	30 days and 120 days[44]
Sectoral coverage	Total Economy
Published at sub-national level?	no
If yes, at which levels?	-
Sub-national entities covered	-
Regional classification	-
Published at industry level?	no
If yes, which?	-
Industries covered	-
Industry-level estimates published at sub-national level?	-

Source: ILO

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[43] GDP at constant 2005 US$ per worker and GDP in constant 2011 international $ in PPP per worker

[44] New estimates are released in January and July of each year.

- ■ **Definition of Private Business Economy:** -
- ■ **Availability of Input-Output Tables:** no
    - ☐ **Frequency:** -
    - ☐ **Price Base:** -
    - ☐ **Price(s) at which IO tables are published:** -
- ■ **Production Speed:** 0 days[45]

    This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: number of persons employed, and number of hours worked.

Output

ILO defines output for productivity estimates as GDP at constant prices (both in constant 2005 US$ and in constant 2011 international $ in PPP). GDP at PPP and GDP in constant US$ are obtained from the World Bank.

Labour Input

ILO does not construct quality-adjusted labour input data. ILO relies on national statistical offices to provide labour data inputs for its productivity statistics. When nationally reported employment data are unreliable, estimates are econometrically derived using the ILO Trends Econometric Models.

Capital Stocks and Capital Services

ILO does not publish capital stock or capital services data.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	■ Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ The labour productivity data were presented and discussed as part of the annual publication *Key Indicators of the Labour Market.* Now the data are available on-line at ILOSTAT, the ILO

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[45] Employment data (number of workers) used in the estimation of the productivity data are released at the same time as the productivity statistics.

	database of labour statistics, and in *World Employment and Social Outlook – Trends 2017*
Presentation	■ Data are provided in Excel tables on-line at http://www.ilo.org/ilostat/faces/oracle/webcenter/portalapp/pagehierarchy/Page3.jspx?MBI_ID=49&_afrLoop=76406742237266&_afrWindowMode=0&_afrWindowId=yl843hmnm_1#!%40%40%3F_afrWindowId%3Dyl843hmnm_1%26_afrLoop%3D76406742237266%26MBI_ID%3D49%26_afrWindowMode%3D0%26_adf.ctrl-state%3Dyl843hmnm_33 The latest data are discussed and analysed in the ILO publication *World Employment and Social Outlook – Trends 2017*
Recently introduced	■ No – but publication of *Key Indicators of the Labour Market* which presented and discussed the productivity data has been discontinued.
Announcement of new releases	■ None

Further Information

Labour Productivity

■ ILO (n.d.) *Labour Productivity Indicator Description*. Retrieved 23/01/2017. Available at:

http://www.ilo.org/ilostat-files/Documents/description_PRODY_EN.pdf

Contains concepts and definitions of labour productivity.

■ ILO (2017) *World Employment Social Outlook – Trends 2017*. Retrieved 23/01/2017. Available at:

http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_541211.pdf

Contains trends in employment.

■ ILO (2016) *Key Indicators of the Labour Market, Ninth Edition*. Retrieved 23/01/2017. Available at:

http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_498929.pdf

Contains information about labour market indicators.

Key manuals/reference guides used:

None

Annex: Published data that may serve to calculate productivity statistics

Table 36   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	°	°
Production values (constant prices)	°	°	°
Value added / GDP (current prices)	°	°	°
Value added / GDP (constant prices)	°	°	°
Number of persons employed	°	°	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	°	°	X
Capital stocks	°	°	°
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: ILO

11.10   Italy - Istat

Productivity Estimates Published by   Istat

	Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
	✓	✓	✓	✗

Productivity Data Published

Istat produces **capital, labour** and **multi-factor productivity** estimates for i) the total private economy, ii) 35 industries within the private economy and iii) on a regional level; specifically:

- **Capital, labour and multi-factor productivity** estimates (annual) for industries and the total private economy in *Productivity Statistics*.
- Labour productivity estimates (annual) on a regional level in *Noi Italia*.

Table 37   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital services	Number of hours worked	Labour and capital
Other measures based on	-	Number of employed persons, number of FTE employed persons, number of hours worked	-
Periodicity	Annual	Annual	Annual
For annual, what is the period?	January-December	January-December	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)[46]	90 and 300 days	90 and 300 days	90 and 300 days
Sectoral coverage	Total market economy or private economy	Total market economy or private economy	Total market economy or private economy
Published at sub-national level?	No	Yes	No
If yes, at which levels?	-	State, province, regional level	-
Sub-national entities covered	-	21	-
Regional classification	-	NUTS 2	-
Published at industry level?	Yes	Yes	Yes
If yes, which?	NACE Rev. 2 – A38 (excl. NACE 68, 97-98 and 99)	NACE Rev. 2 – A38 (excl. NACE 68, 97-98 and 99)	NACE Rev. 2 – A38 (excl. NACE 68, 97-98 and 99)
Industries covered	35	35	35

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[46] Productivity calculations are updated bi-annually in March and October each year. The periodicity of data is annual, nevertheless.

Industry-level estimates published at sub-national level?	No	No	No

- ■ **Definition of total market economy or private economy:** Total economy excluding activities referring to general government sector
- ■ **Availability of Input-Output Tables:** yes
  - □ **Frequency:** 5 years; supply and use tables annually
  - □ **Price Base:** Basic prices
  - □ **Price(s) at which IO tables are published:** Current and previous year prices
- ■ **Production Speed:** 30 days (one month)

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Productivity data that may serve as inputs to productivity calculations include: on sub-national level: value added, number of persons employed, number of persons employed FTE basis, number of hours worked; at industry level: value added (current / constant prices), number of hours worked, capital stocks and capital services.

Output

Istat defines output for productivity estimates as value added at constant and current prices.

Labour Input

Istat does not construct quality-adjusted labour input data. Istat does not rely on other agencies to provide labour data input for productivity estimates.

Capital Stocks and Capital Services

Istat publishes capital stocks and capital services data for the total private economy and for 35 industries. Capital stocks data are published at current (replacement) costs / current prices, constant (replacement) costs / constant prices (base year) and year-to-year chained prices. Moreover, Istat publishes a capital services index and annual logarithmic change rates. Istat uses only capital services data for productivity estimates.

Istat uses the perpetual inventory method for calculating gross and net stocks of fixed assets. With regard to consumption of fixed capital, Istat assumes linear and geometric (for R&D) depreciation

models. Furthermore, retirement of fixed assets is assumed to follow a truncated normal distribution[47].

Istat does not adjust for capacity utilisation of capital. Transactions in used assets enter the capital stock only with regard to cars.

Capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. They cover self-produced and purchased R&D as well as software. Istat estimates data on intangibles if information from surveys is not available. For the estimation of gross fixed capital formation with regard to intangibles, Istat uses a mix of commodity flow methods, production costs based methods, and other model-based methods.

Average service lives of different types of assets are estimated by industry, based on actual statistics as well as assumptions.

The capital stock estimates used for productivity calculations differ from those published in the national accounts. The two estimates are not identical for two reasons:

■ Capital stocks used in productivity estimates are "productive" measures (i.e. they take into account efficiency decay) while capital stocks from national accounts are "wealth" measures (i.e. they take into account the price decay or depreciation).

■ Capital stocks used in Istat productivity measures refer only to the private sector component in each industry.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable datasets
Recently introduced	■ Nothing was changed recently.
Announcement of new	■ Via press conferences: no ■ Via press releases: yes

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[47] No retirement function is used for R&D capital stock (a geometric model is used instead).

releases
- □ Sent to news agencies, newspaper, television, radio
- ■ Via social media: yes
  - □ Twitter

Further Information

Capital productivity

- ■ Istat (n.d.). *Productivity measures.* Retrieved 03/08/2017. Available at:
  http://dati.istat.it/Index.aspx?DataSetCode=DCCN_PRODUTTIVITA

Labour Productivity

- ■ Istat (n.d.). *Productivity measures.* Retrieved 03/08/2017. Available at:
  http://dati.istat.it/Index.aspx?DataSetCode=DCCN_PRODUTTIVITA
- ■ Istat (n.d.). *Productivity measures : Contributions to growth of labour productivity by branch (NACE Rev. 2)*. Retrieved 07/08/2017. Available at:
  http://dati.istat.it/index.aspx?queryid=14650
- ■ Labour productivity estimates on regional level:
  Noi Italia (2015). *Labour productivity decreasing in Italy.* Retrieved 03/08/2017. Available at:
  http://noi-italia2015.istat.it/index.php?id=7&L=1&user_100ind_pi1%5Bid_pagina%5D=183&cHash=f998cea26c3cee9c794ca4b670a5e6f3

Total/multi-factor productivity

- ■ Istat (n.d.). *Productivity measures.* Retrieved 03/08/2017. Available at:
  http://dati.istat.it/Index.aspx?DataSetCode=DCCN_PRODUTTIVITA

Documentation / meta-data

- ■ Istat (n.d.). *Productivity measures.* Retrieved 03/08/2017. Available at:
  http://dati.istat.it/OECDStat_Metadata/ShowMetadata.ashx?Dataset=DCCN_PRODUTTIVITA&Lang=en

Press release

- ■ Istat (2016)*. Productivity statistics.* Retrieved 03/08/2017. Available at:
  http://www.istat.it/en/archive/192053

Key manuals/reference guides used:

Capital productivity

104

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

- OECD (2009). *Measuring Capital OECD Manual.* Second Edition. Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/43734711.pdf
- OECD (2010). *Handbook on Deriving Capital Measures of Intellectual Property Products*. Retrieved 03/08/2017. Available at: http://www.oecd.org/std/na/44312350.pdf

Labour productivity

- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf

Total/multi-factor productivity

- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf

Other productivity measures:

- Eurostat (2013). *European system of accounts – ESA 2010*. Retrieved 19/04/2017. Available at: http://ec.europa.eu/eurostat/cache/metadata/Annexes/nasa_10_f_esms_an1.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 38   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	°	°
Production values (constant prices)	°	°	°
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	X	X	X
Number of jobs	°	X	X
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	X	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Istat

11.11   Latvia - Central Statistical Bureau of Latvia

Productivity Estimates Published by   Central Statistical Bureau of Latvia

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✘	✘	✘	✘

Productivity Data Published

The Central Statistical Bureau of Latvia does **not produce any productivity estimates.**

Availability of Input-Output Tables: yes

- ☐ **Frequency:** Annual
- ☐ **Price Base:** Basic prices
- ☐ **Price(s) at which IO tables are published:** Current prices

Methodology

The Central Statistical Bureau of Latvia claims to publish no productivity estimates.

On their website, however, they provide figures for annual and quarterly GDP (nominal / real / chain-linked volumes) per person employed. Those are not labelled "labour productivity" estimates, though.

Annex: Published data that may serve to calculate productivity statistics

Table 39   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	X	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	°	°
Number of persons employed FTE basis	X	X	X
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	°	°

	At sub-national level	At industry-level	At national / whole economy level
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Central Statistical Bureau of Latvia

108

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

11.12   Netherlands – Statistics Netherlands / CBS

**Productivity Estimates
Published by**

Statistics Netherlands / CBS

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✗	✓	✓	✗

Statistics Netherlands produces **labour** and **multi-factor productivity** estimates for i) the total private economy and ii) total private business economy and iii) 38 industries; specifically:

**Productivity Data
Published**

■ **Value added/consolidated production per hour worked** as **labour productivity** estimates and **multi-factor productivity** estimates (annual) for the total economy and 38 industries in *Growth accounts; national accounts*.[48]

■ **Gross value added per full-time equivalent job** as estimates of **labour productivity** (annual) for 13 industries and the total private economy in *National Accounts of the Netherlands* (ISSN 1387-7461).

Table 40   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of hours worked	Labour, capital, energy, raw materials, services, land and others[49]
Other measures based on	Full-time equivalent jobs	-
Periodicity	Annual	Annual
For annual, what is the period?	January-December	January-December
Timeliness[50] (lag between end of reference period and publication of productivity statistics)	Preliminary figures 180 days / final figures 550 days	Preliminary figures 180 day / final figures 550 days
Sectoral coverage	Total Economy/ Total Private Business Economy	
Published at sub-national level?	no	no
If yes, at which levels?	-	-
Sub-national entities covered	-	-
Regional classification	-	-
Published at industry level?	yes	yes
If yes, which?	NACE 2 digit or aggregate of NACE 2 digit	
Industries covered	38	38
Industry-level estimates published at sub-national level?	no	no

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[48] Despite the otherwise very comprehensive productivity programme, *Growth Accounts* and *National Accounts* include only annual productivity estimates

[49] Others are specified as inventories, mineral and energy reserves. However, land, mineral reserves and inventories are not separately identified.

[50] 550 days relates to the final estimates, preliminary estimates are available earlier.

- ■ **Definition of Private Economy:** Total economy excluding the general government sector.
- ■ **Definition of Private Business Economy:** Total economy excluding general government, education, real estate and households as an employer (NACE 68).
- ■ **Availability of Input-Output Tables:** yes
  - □ **Frequency:** Annual
  - □ **Price Base:** Basic prices
  - □ **Price(s) at which IO tables are published:** Current and constant prices
- ■ **Production Speed:** 60 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: production values (current/constant prices), value added (current/constant prices), number of persons employed, number of hours worked, number of jobs, number of full-time equivalent jobs, capital stocks and capital services. All data are provided at industry and national level.

Output

Statistics Netherlands defines output for productivity estimates as value added and consolidated production at both current and constant prices.

Labour Input

There is no labour quality adjustment for labour productivity estimates. Statistics Netherlands constructs quality-adjusted labour input data, which is used for multi-factor productivity calculations. Labour quality adjustment takes into account age, gender, education, industries and collective wage agreements. Statistics Netherlands utilises register data on employees for labour quality adjustments.[51]

Capital Stocks and Capital Services

Statistics Netherlands publishes capital stocks data as well as capital services data at an ISIC 2-digit level including some aggregates of multiple 2-digit level industries. Capital stocks and services data is published at current (replacement) costs/current prices. Statistics Netherlands uses net and productive capital stock data for productivity estimates.

Statistics Netherlands uses the perpetual inventory method (PIM) for calculating gross and net stocks of fixed assets. Hyperbolic depreciation is assumed with regard to consumption of fixed capital. More precisely, Statistics Netherlands assumes retirement of gross stocks of fixed assets

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[51] Link to metadata on labour quality adjustment: https://www.cbs.nl/nl-nl/publicatie/2015/24/ict-and-economic-growth (chapter 2).

following a Weibull function, and depreciation according to a Winfrey function for net and productive stocks. Statistics Netherlands does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Both capital stock and capital services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, mineral exploration and evaluation, software and others. If information is not available from surveys, Statistics Netherlands estimates data on intangibles based on information from outside the statistical organisation, e.g. for the estimation of artistic originals.

The statistical basis for the actual service lives of fixed assets is determined by estimations and/or assumptions. The average service life of different types of assets is estimated by industry. If possible, expert information or data from other NSIs serve as a proxy when no estimates are available.

Statistics Netherlands does not rely on other agencies to provide capital data input. The capital stocks estimates used for productivity calculations are identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of the methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Interactive charts ■ Downloadable databases
Recently introduced	■ Annual publication "Dutch growth accounts" was introduced a few years ago but subsequently was discontinued due to budget constraints.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: yes, information about productivity releases is shared on Twitter.

Further Information

Labour Productivity

- Statistics Netherlands (2016). *Growth accounts; national accounts*. Retrieved 03/08/2017. Available at:
  http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83193ENG&D1=25-36&D2=0&D3=0-4,18-21,25,29-31,36,41&D4=1,8,l&LA=EN&VW=T (headline estimates)
- Additional labour productivity estimates:
  Statistics Netherlands (2016). *National accounts 2015.* Retrieved 03/08/2017. Available at: https://www.cbs.nl/en-gb/publication/2016/28/national-accounts-2015

Total/multi-factor productivity

- Statistics Netherlands (2016). *Growth accounts; national accounts*. Retrieved 03/08/2017. Available at:
  http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83193ENG&D1=25-36&D2=0&D3=0-4,18-21,25,29-31,36,41&D4=1,8,l&LA=EN&VW=T

Documentation/meta-data

- Statistics Netherlands (2008). *Productivity Measurement at Statistics Netherlands.* Retrieved 03/08/2017. Available at:
  https://www.cbs.nl/nl-nl/onze-diensten/methoden/onderzoeksomschrijvingen/aanvullende%20onderzoeksbeschrijvingen/productivity-measurement-at-statistics-netherlands

Key manuals/reference guides used:

Labour productivity

- Statistics Netherlands (2008). *Productivity Measurement at Statistics Netherlands.* Retrieved 03/08/2017. Available at:
  https://www.cbs.nl/nl-nl/onze-diensten/methoden/onderzoeksomschrijvingen/aanvullende%20onderzoeksbeschrijvingen/productivity-measurement-at-statistics-netherlands

Total/multi-factor productivity

- Statistics Netherlands (2008). *Productivity Measurement at Statistics Netherlands.* Retrieved 03/08/2017. Available at:
  https://www.cbs.nl/nl-nl/onze-diensten/methoden/onderzoeksomschrijvingen/aanvullende%20onderzoeksbeschrijvingen/productivity-measurement-at-statistics-netherlands

Annex: Published data that may serve to calculate productivity statistics

Table 41   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	°	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	X	X
Number of jobs	°	X	X
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	X	X
Other (outlined below)	°	X	X

Notes: X= data are published; ° = no data are published
Source: Statistics Netherlands

Other Sources: Full-time equivalent jobs are used to estimate other labour productivity estimates.

11.13   New Zealand - Stats NZ

Productivity Estimates Published by

Stats NZ - Statistics New Zealand

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✓	✗

Statistics New Zealand provides estimates of **capital**, **labour**, and **multi-factor productivity** for i) the measured sector and ii) sector and industry level estimates for all sectors in the measured sector and non-measured sector industries; specifically:

Productivity Data Published

■ Statistics New Zealand provides **GDP per capita** estimates (annual and quarterly) in the national accounts. In addition to national GDP per capita, they also provide regional estimates (annual).

■ **Prior to 2015** aggregate **capital, labour and multi-factor productivity** estimates (annual) for the measured sector were provided in the *Productivity Statistics* release and individual sector and industry specific estimates (annual) were provided in the *Industry Productivity Statistics* publication.

■ **From June 2015** onwards both publications have been published together in a combined release titled *Productivity Statistics* (annual)*. Productivity estimates are also available for the *former measured sector*[52].

■ **Labour productivity** statistics (reproduced from Productivity Statistics) are also available as part of the *NZ progress indicators* and *NZ social indicators* publications.

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[52] The former measured sector includes fewer industries than the measured sector, but provides a longer time series. Differences between the measured sector and former measured sector are provided in Statistics New Zealand (2014). *Productivity statistics: Sources and methods (10th edition).*

Table 42   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital services	Number of hours paid, number of persons employed (via hours paid)	Capital, labour
Other measures based on	-	-	-
Periodicity	Annual	Annual	Annual
For annual, what is the period?	March - February	March - February	March - February
Timeliness[53] (lag between end of reference period and publication of productivity statistics)	365 days	365 days	365 days
Sectoral coverage	Total market economy or private economy	Total market economy or private economy	Total market economy or private economy
Published at sub-national level?	no	no	no
If yes, at which levels?	-	-	-
Sub-national entities covered	-	-	-
Regional classification	-	-	-
Published at industry level?	yes	yes	yes
If yes, which?	ANZSIC 06	ANZSIC 06	ANZSIC 06
Industries covered[54]	27	27	27
Industry-level estimates published at sub-national level?	no	no	no

Source: Stats NZ

- ■ **Definition of total market economy or private economy:** This refers to the measured sector. The measured sector includes ANZSIC06 industries AA1–MN2, RS1, and RS2, but excludes government non-market industries (e.g. administration, health and education).

- ■ **Availability of Input-Output Tables: yes**
  - ☐ **Frequency:** Annual
  - ☐ **Price Base:** Basic prices
  - ☐ **Price(s) at which IO tables are published:** Constant prices

- ■ **Production Speed:** 365 days

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[53] Productivity estimates for the measured sector are published with a one-year lag. Industry level productivity estimates are published with a two-year lag.

[54] The measured sector consists of 16 industries. In addition Stats NZ covers education and health. For agriculture Stats NZ covers 2 sub-industries and for manufacturing 9 sub-industries. For details about which sectors are covered see: Statistics New Zealand (2014). *Productivity statistics: Sources and methods (10th edition)*. Appendix A: ANZSIC06 divisions and published industries. p. 44.

This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry and national level production values (current/ constant prices), value added/GDP (current/ constant prices), number of persons employed, number of hours worked and capital stocks.

Output

Statistics New Zealand defines output for productivity estimates as value added at constant prices.

Labour Input

In addition to their standard labour input series, Statistics New Zealand also constructs quality-adjusted labour input data, which is used to provide additional quality adjusted labour and multi-factor productivity estimates for the measured sector. Labour quality adjustment takes into account gender, experience level, and education of workers[55]. Data used for quality adjustment is obtained from the New Zealand Income Survey[56]. Statistics New Zealand does not rely on other agencies to provide labour data input.

Capital Stocks and Capital Services

Statistics New Zealand publishes capital stocks data for the total economy and by industry (ANZSIC classification). Capital stocks data are published at current (replacement) costs/current prices and at year-to-year chained prices. Statistics New Zealand uses capital services calculated from productive capital stock for most assets[57] to calculate productivity estimates.

Statistics New Zealand uses the perpetual inventory method (PIM) for calculating net stocks of fixed assets. Hyperbolic depreciation is assumed with regard to the consumption of fixed capital. Furthermore, assets are assumed to retire following a Winfrey distribution. Specifically, residential and non-residential buildings are assumed to retire according to a Winfrey's R2 function, while all other assets are assumed to retire according to a Winfrey L4 function. Statistics New Zealand does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Capital stocks data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, mineral exploration and evaluation (self-produced and

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[55] Link to metadata on labour quality adjustment: http://datainfoplus.stats.govt.nz/Item/nz.govt.stats/d2d0ded2-dc45-4033-9b5b-3807c2b4edab/37#/nz.govt.stats/44e54412-79a6-4fd3-aaf1-1fccd312e57c Further details are available at: http://www.stats.govt.nz/browse_for_stats/income-and-work/employment_and_unemployment/accounting-changes-labour-composition-measurement-labour-productivity.aspx.

[56] Link to most recent New Zealand Income Survey (June 2015 quarter): http://www.stats.govt.nz/browse_for_stats/income-and-work/Income/NZIncomeSurvey_HOTPJun15qtr.aspx [retrieved 20/04/2017]

[57] For land government valuation data is used.

116

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

purchased), and software (purchased). Statistics New Zealand partly estimates or approximates data on intangibles, which is not available from surveys.[58]

The service lives of fixed assets are mainly based on information from a depreciation survey conducted by Statistics New Zealand in 1992 on behalf of Inland Revenue. Where the survey does not provide sufficient data, alternative sources, such as relevant New Zealand company reports, are used to estimate the average service lives.[59]

Statistics New Zealand does not rely on other agencies to provide capital data input. The capital stocks/services estimates used for productivity calculations differ from those published in the national accounts. Specifically, Statistics New Zealand publishes capital stocks data in the national accounts, while capital services data calculated from productive capital stock is used for productivity estimates.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Interactive charts ■ Downloadable datasets
Recently introduced	■ In 2015 the *Productivity Statistics* publication and the *Industry Productivity Statistics* publication were combined into a single publication titled *Productivity Statistics.* The reason for this change was to make it easier for users to find the complete set of productivity statistics in a single release.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: yes – online media: general ■ Via social media: no

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[58] Metadata listing all types of assets included in the capital stock and providing further details on the methodology used to construct capital stocks data can be found in Statistics New Zealand (2014). *Measuring capital stock in the New Zealand economy (4th edition).*

[59] Detailed information on the estimation of average service lives for each type of asset can be found in Statistics New Zealand (2014). *Measuring capital stock in the New Zealand economy (4th edition).*

Further Information

Capital, labour and total/multi-factor productivity

■ Statistics New Zealand (2017). *Productivity Statistics: 1978–2016*. Retrieved 19/04/2017. Available at:

http://www.stats.govt.nz/browse_for_stats/economic_indicators/productivity/ProductivityStatistics_HOTP78-16/Tables.aspx

Documentation/meta-data

■ Statistics New Zealand (2017). *Productivity Statistics: 1978-2016.* Retrieved 19/04/2017. Available at:

http://www.stats.govt.nz/browse_for_stats/economic_indicators/productivity/ProductivityStatistics_HOTP78-16/Related%20Links.aspx

Press release

■ Statistics New Zealand (n.d.). *Labour productivity falls on high input growth*. Retrieved 19/04/2017. Available at:

http://www.stats.govt.nz/browse_for_stats/economic_indicators/productivity/ProductivityStatistics_MR78-16.aspx

Key manuals/reference guides used:

Productivity statistics

■ Statistics New Zealand (2014). *Productivity statistics: Sources and methods (10th edition).* Available at:

http://www.stats.govt.nz/browse_for_stats/economic_indicators/productivity/productivity-stats-sources-methods-tenth-ed.aspx

Capital measurement

■ Statistics New Zealand (2014). *Measuring capital stock in the New Zealand economy (4th edition)*. Available at:

http://www.stats.govt.nz/~/media/Statistics/browse-categories/economic-indicators/national-accounts/measuring-capital-stock/measuring-capital-stock-4th.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 43   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	°	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Stats NZ

11.14   Norway – Statistics Norway

**Productivity Estimates
Published by**

Statistics Norway/Statistisk sentralbyrå

| Capital
Productivity | Labour
Productivity | Multi-factor
Productivity | Other |
|:---:|:---:|:---:|:---:|
| ✘ | ✔ | ✔ | ✘ |

**Productivity Data
Published**

Statistics Norway produces **labour** and **multi-factor productivity** estimates for i) the total economy, ii) the total private business economy and iii) 64 industries; specifically:

■ **Value added / output per hour worked** as **labour productivity** estimates (annual) in *National Accounts (Table 09174: wages and salaries, employment and productivity by industr*y).

■ **Multi-factor productivity** estimates (annual) for industries in *Produktivitetsberegninger for næringer* (in Norwegian only).

Table 44   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of hours worked	Labour, capital
Other measures based on	Number of hours worked	Labour, capital
Periodicity	Annual	Annual
For annual, what is the period?	January-December	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)	40 days	40 days
Sectoral coverage	Total economy, total private business economy	Total private business economy
Published at sub-national level?	no	no
If yes, at which levels?	-	-
Sub-national entities covered	-	-
Regional classification	-	-
Published at industry level?	yes	yes
If yes, which?	NACE Rev. 2 – A64	Agriculture, fisheries, mining, manufacturing, electricity, construction, trade, transport, ICT, finance
Industries covered	64	12
Industry-level estimates published at sub-national level?	No	No

Source: Statistics Norway

- ■ **Definition of Private Business Economy:** Market-oriented industries, except dwellings, oil and gas and international shipping
- ■ **Availability of Input-Output Tables:** yes
  - ☐ **Frequency:** Annual
  - ☐ **Price Base:** Basic prices
  - ☐ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** 2 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Output

Statistics Norway defines output for productivity estimates as value added at constant prices and production value at current prices.

Labour Input

Statistics Norway does not construct quality-adjusted labour input data.[60] Moreover, Statistics Norway does not rely on labour input data from other agencies to produce productivity estimates.

Capital Stocks and Capital Services

Statistics Norway publishes capital stock data at current (replacement) costs / current prices; for capital services data they only publish growth rates. Capital stock data cover 64 industries (NACE Rev. 2, A64). Capital services data are estimated for 12 industries. Statistics Norway uses capital services data for productivity calculations.

Statistics Norway uses the perpetual inventory method (PIM) for calculating net stocks of fixed assets. With regard to consumption of fixed capital, geometric depreciation is assumed. Statistics Norway does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Capital stock and capital service data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, mineral exploration and evaluation, software and databases. Statistics Norway estimates or approximates data on intangibles if information from surveys is not available. The statistical basis for the actual service lives of fixed assets is determined based on actual data and estimation/assumptions. Moreover, the average service life of different types of assets is estimated by industry.

Statistics Norway does not rely on other agencies to provide capital input data. The capital stocks used for productivity calculations are identical to those published in the national accounts.

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[60] However, Statistics Norway provides data on the compensation of employees per hour worked which is differentiated for industry, education level and gender in *National accounts – Table 10585: Compensation and employees, by industry, education and sex*.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Technical notes (e.g. description of methodology used)
Presentation	■ Tables ■ Downloadable datasets
Recently introduced	■ Nothing was changed recently.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

Further Information

Labour Productivity

Productivity

■ Statistics Norway (n.d.). *Quarterly national accounts.* Retrieved 03/08/2017. Available at: https://www.ssb.no/statistikkbanken/selectvarval/Define.asp?subjectcode=&ProductId=&MainTable=NRLonnSyssel&nvl=&PLanguage=1&nyTmpVar=true&CMSSubjectArea=nasjonalregnskap-og-konjunkturer&KortNavnWeb=knr&StatVariant

■ Statistics Norway (n.d.). *Value added at basic values per hour worked by kind of main activity. Annual percentage change in volume*. Retrieved 03/08/2017. Available at: https://www.ssb.no/294912/value-added-at-basic-values-per-hour-worked-by-kind-of-main-activity.annual-percentage-change-in-volume

Total / multi-factor productivity

■ Statistics Norway (2017). *NASJONALREGNSKAPET - Produktivitetsberegninger for næringer.* Retrieved 03/08/2017. Available at: https://www.ssb.no/nasjonalregnskap-og-konjunkturer/statistikker/nr/tilleggsinformasjon/produktivitetsendringer-for-naringer

Documentation / meta-data

- Statistics Norway (2012). *Concepts and definitions in national accounts.* Retrieved 07/08/2017. Available at:

  https://www.ssb.no/en/nasjonalregnskap-og-konjunkturer/concepts-and-definitions-in-national-accounts

- Statistics Norway (2017). NASJONALREGNSKAPET - Produktivitetsberegninger for næringer. Retrieved 07/08/2017. Available at: [Norwegian only]

  https://www.ssb.no/nasjonalregnskap-og-konjunkturer/statistikker/nr/tilleggsinformasjon/produktivitetsendringer-for-naringer

Key manuals/reference guides used:

Labour productivity

- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
  https://www.oecd.org/std/productivity-stats/2352458.pdf

Total/multi-factor productivity

- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
  https://www.oecd.org/std/productivity-stats/2352458.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 45   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	°	X	X
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	X	X
Capital services	°	°	°
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Statistics Norway

11.15   OECD

Productivity Estimates Published by

Organisation for Economic Co-operation and Development (OECD)

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✓	✗

The OECD publishes productivity statistics in the OECD.Stat online database on a rolling basis; specifically:

■ The OECD publishes annual estimates of **capital productivity**, **labour productivity** (GDP per head of population, per hour worked, and per person employed), and **multi-factor productivity** for the total economy as part of the *Productivity and ULC – Annual, Total Economy* table.

Productivity Data Published

■ The OECD also publishes early quarterly **labour productivity** estimates (GDP per person employed) for the total economy as part of the *Productivity and ULC, Total economy, quarterly early estimates* table.

■ The OECD also publishes annual estimates of **labour productivity** (Gross-Value-Added per hour worked and per person employed) at the industry level, as well as for all industries and the non-agricultural business sector excluding real estate as part of the *Productivity and ULC by industry, Annual table.*

■ Once a year the OECD also publishes a summary publication named *OECD Compendium of Productivity Indicators.*

Table 46   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital services	Number of hours worked	Labour, capital
Other measures based on	-	Number of employed persons	-
Periodicity	Annual	Annual, quarterly	Annual
For annual, what is the period?	January - December	January - December	January - December
Timeliness[61] (lag between end of reference period and publication of productivity statistics)	320 days	100 days quarterly, 300 days annual	320 days
Sectoral coverage	Total economy	Total economy, total private business economy	Total economy
Published at sub-national level?	no	no	no
If yes, at which levels?	-	-	-
Sub-national entities covered	-	-	-
Regional classification	-	-	-
Published at industry level?	no	yes	no
If yes, which?	-	ISIC 1-digit level	-
Industries covered	-	8	-
Industry-level estimates published at sub-national level?	-	no	-

Source: OECD

- **Definition of Private Business Economy:** Main economic activities at the level A10 according to the ISIC Rev. 4. This includes activities from B to N, excluding sector L (real estate activities). This sector is called "Non-agriculture business sector excluding real estate".

- **Availability of Input-Output Tables:** yes
  - **Frequency:** Annual
  - **Price Base:** Purchasers prices, basic prices
  - **Price(s) at which IO tables are published:** Current prices

- **Production Speed:** 300 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

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[61] The numbers provided are on average across all countries covered by the OECD. The publication dates differ across countries.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry and national level: value added/GDP (current/ constant prices), number of persons employed, number of hours worked. In addition, the OECD publishes capital stock and capital services at national level.

Output

The OECD defines output for productivity estimates as GDP (current/ constant prices) and value added (constant prices).

Labour Input

The OECD does not construct quality-adjusted labour input data. Labour input data are sourced either from the national accounts that NSIs transmit to the OECD and/or from NSIs' websites. For a small number of countries the OECD relies on labour input data published by institution other than NSIs; for example the Asian Productivity Organisation or The Conference Board.

Capital Stocks and Capital Services

The OECD publishes both capital stocks and capital services data for the total economy. Capital stocks / services data are published as growth rates and as indices. The OECD uses capital services data for productivity estimates.

The OECD uses the perpetual inventory method (PIM) for calculating gross fixed assets. Hyperbolic depreciation is assumed with regards to consumption of fixed capital. Furthermore, assets are assumed to retire following a truncated normal distribution. The OECD does not adjust for capacity utilisation of capital, and does not take transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, mineral exploration and evaluation, software, databases, and entertainment, literary or artistic originals (all both self-produced and purchased). The OECD does not estimate or approximate any data on intangibles, which is not available from surveys.[62]

The OECD does not have a statistical basis for determining the actual service life of fixed assets. The capital services estimates used for productivity calculations are not identical to those published in the national accounts. Capital services used for OECD productivity statistics are constructed by the OECD using a common approach for all countries. Specifically, productive capital stock for all countries is estimated assuming the same service lives for assets across

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[62]   Link to metadata listing all types of assets included in the capital stock: http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9A. These can also be found in OECD (2016). *OECD Compendium of Productivity Indicators 2016. Annex C: Capital input measures at the OECD.*

countries.[63] To calculate capital services the OECD sources data on gross fixed capital formation by asset type at the total economy level mainly from national accounts submitted by NSIs.

Data Availability, Presentation and Communication

The OECD updates data in the online database on a rolling basis. In addition they produce an annual publication named *OECD Compendium of Productivity Indicators.* The information provided here refers to this annual publication.

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Charts/graphs ■ Downloadable databases
Recently introduced	■ For the most recent OECD Compendium of Productivity Indicators publication the OECD has added a new first chapter. This chapter serves as an introductory chapter that provides the OECD freedom to, for example, cover current relevant issues, and to provide an overarching story that ties the rest of the publication together.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: yes – in-house press-release published on the OECD website ■ Via social media: yes – Twitter, Facebook

Further Information

Capital Productivity

■   OECD (n.d.). *Growth in GDP per capita, productivity and ULC: Capital productivity.* Retrieved 19/04/2017. Available at:
http://stats.oecd.org/index.aspx?queryid=66345

Labour Productivity

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[63] For more details on the methodology used see: OECD (2016). *OECD Compendium of Productivity Indicators 2016. Annex C: Capital input measures at the OECD.*

■   OECD (n.d.). *Level of GDP per capita and productivity.* Retrieved 19/04/2017. Available at:

http://stats.oecd.org/Index.aspx?DataSetCode=PDB_LV

Total/multi-factor productivity

■   OECD (n.d.). *Growth in GDP per capita, productivity and ULC: Multifactor productivity.* Retrieved 19/04/2017. Available at:

http://stats.oecd.org/index.aspx?queryid=54566

Documentation / meta-data

■   OECD (n.d.). *Productivity statistics*. Retrieved 19/04/2017. Available at:

http://www.oecd.org/std/productivity-stats/

Press release

■   OECD (2016). *OECD Compendium of Productivity Indicators 2016.* Retrieved 19/04/2017. Available at:

http://dx.doi.org/10.1787/pdtvy-2016-en

Key manuals/reference guides used:

Capital Productivity

■   OECD (2009). *Measuring Capital OECD manual.* Retrieved 19/04/2017. Available at:

http://www.oecd.org/std/productivity-stats/measuring-capital-oecd-manual-2009-9789264068476-en.htm

Labour Productivity

■   OECD (2001). *Measuring Productivity OECD manual.* Retrieved 19/04/2017. Available at:

http://www.oecd.org/std/productivity-stats/2352458.pdf

Total/multi-factor productivity

■   OECD (2001). *Measuring Productivity OECD manual.* Retrieved 19/04/2017. Available at:

http://www.oecd.org/std/productivity-stats/2352458.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 47   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	°	°
Production values (constant prices)	°	°	°
Value added / GDP (current prices)	°	X	X
Value added / GDP (constant prices)	°	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	°	X	X
Capital stocks	°	°	X
Capital services	°	°	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: OECD

11.16   Sweden – Statistics Sweden

Productivity Estimates Published by

Statistics Sweden

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✖	✓	✓	✖

Productivity Data Published

Statistics Sweden produces **labour** and **multi-factor productivity** estimates for i) the total non-financial private business economy and ii) industries within the private business sector; specifically:

■ **Value added per hour worked** as **labour productivity** estimates (quarterly) for the total non-financial private business economy (and subgroups of private commodity producers and private service producers), in *Labour productivity by industrial classification* (Cat. No. NR0101BN).

■ **Multi-factor productivity** estimates (annual) for total non-financial private business economy and industry level in *Multifactor productivity* (Cat. No. NR0103AC).

Table 48   Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Number of hours worked	Labour, capital, energy, raw materials
Other measures based on	-	-
Periodicity	Annual / quarterly	Annual
For annual, what is the period?	Jan-Dec / Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)	60 days annual / 60 days quarterly	60 days
Sectoral coverage	Total non-financial private business economy	Total non-financial private business economy
Published at sub-national level?	No	No
If yes, at which levels?	-	-
Sub-national entities covered	-	-
Regional classification	-	-
Published at industry level?	Yes	Yes
If yes, which?	Total non-financial business economy, total non-financial business commodity producers, total non-financial service producers	ISIC 3-digit
Industries covered	3	52
Industry-level estimates published at sub-national level?	No	No

Source: Statistics Sweden

- ■ **Definition of Private Business Economy:** /
- ■ **Availability of Input-Output Tables:** yes
  - ☐ **Frequency:** Annual
  - ☐ **Price Base:** Market prices
  - ☐ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** 14 days

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

For multi-factor productivity estimates, Statistics Sweden makes a decomposition of capital services into ICT equipment, computer programs and databases, R&D capital, non-ICT and R&D capital. Labour input includes separate measures for hours worked and labour quality. Moreover, intermediate input of materials, energy and services are taken into account.

Data that may serve to calculate productivity

Published data that may serve as inputs to productivity calculations include: at sub-national level value added / GDP (current / constant prices), number of persons employed, number of hours worked; at industry-level: production values (current / constant prices) value added/ GDP (current / constant prices), number of persons employed, number of hours worked, capital stocks; at national level: production values (current / constant prices), value added/ GDP (current / constant prices), number of persons employed, number of hours worked, capital stocks and capital services.

Statistics Sweden publishes GDP per person employed on sub-national level, however, these estimates are not labelled "labour productivity" estimates,[64]

Output

Statistics Sweden defines output for labour productivity estimates as value added (current / constant prices). Production value and value added are used as output measures for multi-factor productivity calculations; both at current and constant prices.

Labour Input

There is no labour quality adjustment for labour productivity estimates. Statistics Sweden constructs quality-adjusted labour input data, which is used for multi-factor productivity calculations. Labour quality adjustment takes into account age, gender, education and industries. Statistics Sweden utilises data from the Swedish labour force survey for labour-quality adjustments. Statistics Sweden does not rely on other agencies to provide labour input data.

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[64] Statistics Sweden (n.d.). *Regional Accounts.*Retrieved 03/08/2017. Available at: http://www.scb.se/en/finding-statistics/statistics-by-subject-area/national-accounts/national-accounts/regional-accounts/

Capital Stocks and Capital Services

Statistics Sweden publishes capital stocks on ISIC 2-digit level, at year-to-year chained prices. Statistics Sweden uses only capital services for productivity estimates.

Statistics Sweden uses surveys to directly observe the stock of fixed assets, which is needed for calculating the net stock of fixed assets. Linear depreciation is assumed with regard to consumption of fixed capital. Moreover, Statistics Sweden does neither adjust for capacity utilisation of capital nor takes transactions in used assets into account for capital stock calculations.

Capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, software and databases. Statistics Sweden does not approximate or estimate missing data on intangibles.

Statistics Sweden does not rely on other agencies to provide capital data input. The capital stocks and services estimates used for productivity calculations are not identical to those published in the national accounts.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Factual information describing the data ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable datasets
Recently introduced	■ Nothing was changed recently.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: no

Further Information

Labour Productivity

- Statistics Sweden (n.d.). *Labour productivity by industrial classification SNI 2007, seasonally adjusted. Quarter 1993K1 - 2017K2*. Retrieved 03/08/2017. Available at: http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103B/NR0103ENS2010T13Kv/?rxid=3bce8abb-0fb7-49f1-997a-9977460c30e8#

Total/multi-factor productivity

- Statistics Sweden (n.d.). *Multifactor productivity, MFP (ESA2010). Subcomponents contribution to the yearly growth in Gross production/Value added by industrial classification SNI 2007. Year 1993 – 2016.* Retrieved 03/08/2017. Available at: http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103I/MFPdelkomp1/?rxid=dae5ee19-173d-4193-9768-df83a92445e1

Documentation / meta-data

- Statistics Sweden (2012). *Yearbook on Productivity 2012 - Contributions at the Saltsjöbaden Conference October 2012.* Retrieved 08/08/2017. Available at: http://www.scb.se/en_/Finding-statistics/Publishing-calendar/Show-detailed-information/?publobjid=20717

Press release

- Statistics Sweden (n.d.). *Previous statistical news.* Retrieved 04/08/2017. Available at: http://www.scb.se/en_/Finding-statistics/statistical-news/Press-archive/?Amne=NR&Year=9999&SortOrder=product#NR0103

Key manuals/reference guides used:

Labour productivity

- Eurostat (2013). *European system of accounts – ESA 2010*. Retrieved 19/04/2017. Available at: http://ec.europa.eu/eurostat/cache/metadata/Annexes/nasa_10_f_esms_an1.pdf

Total/multi-factor productivity

- Eurostat (2013). *European system of accounts – ESA 2010*. Retrieved 19/04/2017. Available at: http://ec.europa.eu/eurostat/cache/metadata/Annexes/nasa_10_f_esms_an1.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 49   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	°	°	°
Number of hours worked	X	X	X
Capital stocks	°	X	X
Capital services	°	°	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Statistics Sweden

134

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

11.17   Switzerland - Federal Statistical Office

Productivity Estimates Published by

Federal Statistical Office (FSO)

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✓	✗

The FSO produces **capital, labour** and **multi-factor productivity** estimates for i) the total economy ii) the total private business economy and iii) 48 industries, specifically:

Productivity Data Published

- **GDP per hour worked** as **labour productivity** estimates (annual) for the total economy and on sub-national level in *Labour productivity* (Cat. No. je-d-04.07.01.01, je-e-04.07.04.01, je-e-04.07.01.06, je-e-04.07.04.06).

- **Value added per full-time equivalent employed person** as **labour productivity** estimates (annual) for total business economy and industries in *Labour productivity* (Cat. No. je-e-04.07.01.02, je-e-04.07.01.03, je-e-04.07.01.04, je-e-04.07.04.02, je-e-04.07.04.03, je-e-04.07.04.04).

- **Capital productivity** estimates (annual) for the whole economy in *Kapitalproduktivität* (Cat. No. je-d-04.07.02.01).

- **Multi-factor productivity** (annual) for the whole economy in *Multifaktorproduktivität* (Cat. No. je-d-04.07.03.01).

Table 50   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital service	Number of hours worked	Capital and labour
Other measures based on	-	Number of FTE employed persons	-
Periodicity	Annual	Annual	Annual
For annual, what is the period?	January-December	January-December	January-December
Timeliness (lag between end of reference period and publication of productivity statistics)	260 days	240 days	260 days
Sectoral coverage	Total economy	Total economy, total private business economy	Total economy
Published at sub-national level?	No	Yes	No
If yes, at which levels?	-	National, province, regional	-
Sub-national entities covered	-	7	-
Regional classification	-	NUTS 2	-
Published at industry level?	No	Yes	No
If yes, which?	-	ISIC 1-digit, groupings of 2-digit level	-
Industries covered	-	48	-
Industry-level estimates published at sub-national level?	No	No	No

Source: Federal Statistical Office

- ■ **Definition of Private Business Economy:** Institutional sector according to SNA; financial corporations (S.11), non-financial corporations (S.12) and households (S.14) only
- ■ **Availability of Input-Output Tables:** yes
  - □ **Frequency:** /
  - □ **Price Base:** Basic prices
  - □ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** /

  This refers to the lag between the release of the final data used in estimating productivity statistics and the publication of productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at sub-national level: value added / GDP (current and constant prices), number of persons employed, number of persons employed FTE basis, number of jobs and number of hours worked; at industry level: production values (current and constant prices), value added / GDP (current and constant prices), number of persons employed, number of persons employed FTE basis, number of jobs and number of hours worked; at national level: production values (current and constant prices), value added / GDP (current and constant prices), number of persons employed, number of persons employed FTE basis, number of jobs, number of hours worked, capital stocks and capital services.

Output

The Federal Statistical Office uses value added and GDP for labour productivity estimates, both at constant and current prices. GDP at constant prices is defined as output for capital and multi-factor productivity calculations.

Labour Input

The FSO does not construct quality-adjusted labour input data. For the construction of labour input data, the FSO relies on social insurance contribution data by the compensation office for the compulsory old-age pension system.

Capital Stocks and Capital Services

The FSO publishes capital stocks and capital services data for the total economy, in year-to-year chained prices. Productivity estimates are based on capital services measures.

With regards to consumption of fixed capital, the FSO assumes geometric depreciation. Moreover, neither adjustments for capacity utilisation of capital nor transactions in used assets are taken into account.

Capital services data include information from surveys capturing intangible assets. The only intangible assets covered through specific surveys are self-produced and purchased R&D. The FSO estimates intangibles if information from surveys is not available.[65,66] The FSO does not have any statistical basis for determining the actual service life of fixed assets.

The FSO does not rely on other agencies to provide capital stocks data, but they use various interest rate series provided by the Swiss National Bank for the calculation of capital services. The

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[65] Link to metadata describing the method used for estimating/approximating the missing data:

https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.assetdetail.349131.html

[66] Links to metadata listing all types of assets included in capital stock data:

https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.assetdetail.349131.html
https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.assetdetail.350473.html

capital stocks and services estimates used for productivity calculations differ from those published in the national accounts.[67]

The principal data source for capital stocks and services estimates is the same (GFCF by type of asset, both at current and previous year prices). In addition, some macroeconomic data (interest rates, labour share in GDP etc.) are used for calculating capital services. The major distinction is that capital stocks in the national accounts are published for their own sake. In contrast, capital services are explicitly calculated and published alongside productivity series.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	No, not all data used to construct the productivity data are made available when productivity estimates are released.
Information included	■ Technical notes (e.g. description of methodology used)
Presentation	■ Tables ■ Downloadable datasets
Recently introduced	■ Nothing was changed recently.
Announcement of new releases	■ Via press conferences: no ■ Via press releases: no ■ Via social media: yes, information about productivity releases is shared on Twitter.

Further Information

Capital productivity

■   Federal Statistical Office (n.d.). *Productivity*. Retrieved 03/08/2017. Available at: https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.html

Labour Productivity

■   Federal Statistical Office (n.d.). *Productivity*. Retrieved 03/08/2017. Available at:

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[67] Links to metadata providing a description of any source database that is used to produce capital stocks that differ from national accounts:

https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.assetdetail.349131.html

https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.assetdetail.350473.html for details.

https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.html

Total/multi-factor productivity

■   Federal Statistical Office (n.d.). *Productivity*. Retrieved 03/08/2017. Available at:
     https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.html

Documentation / meta-data

■   Federal Statistical Office (n.d.). *Productivity*. Retrieved 03/08/2017. Available at:
     https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.html

Press release

■   Federal Statistical Office (n.d.). *Productivity*. Retrieved 03/08/2017. Available at:
     https://www.bfs.admin.ch/bfs/en/home/statistics/national-economy/productivity.html

Key manuals/reference guides used:

Capital productivity

■   OECD (2009). *Measuring Capital OECD Manual.* Second Edition. Retrieved 19/04/2017.
     Available at: https://www.oecd.org/std/productivity-stats/43734711.pdf

Labour productivity

■   OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
     https://www.oecd.org/std/productivity-stats/2352458.pdf

■   Eurostat (2013). *European system of accounts – ESA 2010*. Retrieved 19/04/2017.
     Available   at:
     http://ec.europa.eu/eurostat/cache/metadata/Annexes/nasa_10_f_esms_an1.pdf

Total/multi-factor productivity

■   OECD (2009). *Measuring Capital OECD Manual.* Second Edition. Retrieved 19/04/2017.
     Available at: https://www.oecd.org/std/productivity-stats/43734711.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 51   **Published data that may serve to calculate productivity statistics**

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	X	X	X
Number of persons employed FTE basis	X	X	X
Number of jobs	X	X	X
Number of hours worked	X	X	X
Capital stocks	°	°	X
Capital services	°	°	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Federal Statistical Office

140

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

11.18   United Kingdom – Office for National Statistics

Productivity Estimates Published by

Office for National Statistics

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✗	✓	✓	✓

The Office for National Statistics produces **labour and multi-factor productivity estimates** for the market sector and at industry level. Labour productivity estimates are also available for the whole economy, and at sub-national level. In addition the ONS also publishes other productivity estimates. Specifically the ONS publishes the following productivity estimates:

Productivity Data Published

■   **Output per worker, per filled job, and per hour worked** as estimates of **labour productivity** for the whole economy and at industry level as part of the *Labour Productivity* release (quarterly). Additional commentary and analysis of UK productivity is provided as part of the *UK productivity introduction* release (quarterly). A flash estimate of UK labour productivity is published 45 days after the end of the reference period.

■   **Regional and sub-regional labour productivity estimates** (GVA per hour worked, and per filled job) as part of the *Labour Productivity* bulletin (annual)*.*

■   A comparison of **labour productivity** (**GDP per hour worked, and per worker)** in the UK and the G7 nations as part of the *International comparisons of UK productivity* release (annual).

■   **Multi-factor productivity estimates** (experimental) for the UK market sector and 10 industry groups as part of the *Multi-factor productivity (experimental) estimates* release (annual).

■   Estimates of **public service productivity** for the whole of the UK and specific lines of government (e.g. healthcare) as part of the P*ublic service productivity estimates* release (Annual, experimental estimates available quarterly)

■   Experimental estimates of **region by industry labour productivity** were recently included as part of the quarterly publication.

Table 52 Productivity Estimates Published

Productivity Measure	Labour Productivity	Multi-factor Productivity	Other
Main / headline measure based on	Number of employed persons, number of jobs, number of hours worked	Labour, capital	Public service productivity
Other measures based on	Number of employed persons, number of jobs, number of hours worked	Labour, capital	-
Periodicity	Quarterly, Annual[68]	Annual	Annual[69]
For annual, what is the period?	January - December	January - December	January - December
Timeliness (lag between end of reference period and publication of productivity statistics)	97 days, although flash estimate available at 45 days	461 days	737 days, although experimental quarterly data available at 90 days
Sectoral coverage	Total economy, total market economy or private economy	Total market economy or private economy	Public services
Published at sub-national level?	yes	no	no
If yes, at which levels?	State, province, region level	-	-
Sub-national entities covered	221	-	-
Regional classification	NUTS1, NUTS2, NUTS3	-	-
Published at industry level?	yes	yes	no
If yes, which?	UK SIC 1 / 2 digit-level	UK SIC 1-digit level	-
Industries covered	26, although experimental estimates recently extended this to cover 50 industries.	10	-
Industry-level estimates published at sub-national level?	Experimental estimates for 16 industries, annual	-	-

Source: Office for National Statistics

- ■ **Definition of Private Business Economy:** -
- ■ **Availability of Input-Output Tables:** yes
  - □ **Frequency:** Annual
  - □ **Price Base:** Purchasers prices, basic prices
  - □ **Price(s) at which IO tables are published:** Current prices
- ■ **Production Speed:** 7 days

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[68] Labour productivity data are published on a quarterly basis, but annual estimates are also included in the publication.

[69] Experimental estimates are available quarterly.

Methodology

Data that may serve to calculate productivity

Published data that may serve as input to productivity calculations include: at industry, sub-national and national level value added/GDP (current/ constant prices), number of jobs, and number of hours worked. In addition the ONS publishes: at industry and national level production values (current prices), number of persons employed, capital stocks, and capital services.

Output

The Office for National Statistics defines output for productivity estimates as value added at current and at constant prices.

Labour Input

The ONS constructs quality-adjusted labour input data, which is used to produce quality adjusted labour and quality adjusted multi-factor productivity estimates. No quality adjustment is made for the main/headline measures. Labour quality adjustment takes into account age, gender, education and industries. The data used for quality adjustments are sourced from the Labour Force Survey and employment surveys.[70] The ONS does not rely on other agencies to provide labour data inputs for their productivity statistics.

Capital Stocks and Capital Services

The ONS publishes both capital stock and services data for the business economy and at the 1-digit industry level. Capital stocks and services are published at current (replacement) costs / current prices, constant (replacement) costs at specific base year / constant prices (base year), and year-to-year chained prices. The Office for National Statistics uses capital services for productivity estimates.

The ONS uses the perpetual inventory method for calculating gross and net stocks of fixed assets. Linear and geometric depreciation is assumed with regard to consumption of fixed capital, 'one hoss shay' is used for cultivated assets. Furthermore, assets are assumed to retire following a Normal / Weibull distribution. The ONS does not adjust for capacity utilisation of capital, and does not take transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered[71] are R&D, software, and databases (self-produced and purchased); and mineral exploration and evaluation, entertainment, literary or

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[70] Metadata about adjustment of labour quality:

https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/qualityadjustedlabourinput/estimatesto2015

[71] Metadata listing all the types of assets included in the capital stock data:
https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/qmis/capitalstocksandcapitalconsumptionqmi
and
https://www.ons.gov.uk/economy/economicoutputandproductivity/output/articles/volumeindexofukcapitalservicesexperimental/estimatesto2015

artistic originals, and architectural plans and designs (purchased only). The ONS estimates or approximates any data on intangibles which is not available from surveys.[72]

The ONS does not have a statistical basis to determine the actual service life of fixed assets. The ONS does not rely on other agencies to provide capital data inputs for their productivity statistics.

The capital stock estimates used for productivity calculations differ to those published in the national accounts. Specifically, the ONS capital stock estimates are consistent with the national accounts and are the source for estimates of consumption of fixed capital for the national accounts. However, capital services estimates are experimental estimates, which are specifically compiled for use for productivity calculations. These differ in methodology in the following way: i) geometric depreciation not straight line depreciation is assumed, and ii) aggregation across components uses user cost weights not asset price weights.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates	Yes, all data used to construct the productivity data are made available when productivity estimates are released
Information included	■ Factual information describing the data ■ Commentary explaining changes in productivity ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Downloadable databases
Recently introduced	■ Publication of productivity related material was aligned on quarterly "theme days" ■ More overarching commentary
Announcement of new releases	■ Via press conferences: no ■ Via press releases: yes - print media: general and financial/business, broadcast media (TV and Radio): general and financial/business, online media: general and financial/business ■ Via social media: yes - Twitter

Further Information

Labour Productivity

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[72] Link to metadata describing the method used for estimating/approximating the missing data:
https://www.ons.gov.uk/economy/grossdomesticproductgdp/qmis/investmentinartisticoriginalassetsqmi

144

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

- Office for National Statistics (n.d.). *Labour Productivity*. Retrieved 03/05/2017. Available at:

  https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity

Total/multi-factor productivity

- Office for National Statistics (2017). *Dataset: Multi-factor Productivity (experimental): Estimates*. Retrieved 03/05/2017. Available at:

  https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/datasets/multifactorproductivityexperimentalestimatesreferencetables

Documentation / meta-data

- Office for National Statistics (2017). *Quality and Methodology Information (QMI): Labour Productivity QMI*. Retrieved 03/05/2017. Available at:

  https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/qmis/labourproductivityqmi

Key manuals/reference guides used:

Capital and Total/multi-factor productivity

- OECD (2009). *Measuring Capital OECD Manual.* Second Edition. Retrieved 19/04/2017. Available at:
  https://www.oecd.org/std/productivity-stats/43734711.pdf
- OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
  https://www.oecd.org/std/productivity-stats/2352458.pdf

Labour Productivity

- None[73]

Other productivity measures:

- Office for National Statistics (2007). *The ONS Productivity Handbook. A Statistical Overview and Guide*. Retrieved 03/05/2017. Available at:
  https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/methodologies/productivityhandbook

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[73] Internal desk notes are the main reference guide for labour productivity.

Annex: Published data that may serve to calculate productivity statistics

Table 53   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	°	°
Value added / GDP (current prices)	X	X	X
Value added / GDP (constant prices)	X	X	X
Number of persons employed	°	X	X
Number of persons employed FTE basis	°	°	°
Number of jobs	X	X	X
Number of hours worked	X	X	X
Capital stocks	°	X	X
Capital services	°	X	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Office for National Statistics

11.19   United States – Bureau of Labor Statistics

Productivity Estimates Published by

Bureau of Labor Statistics

Capital Productivity	Labour Productivity	Multi-factor Productivity	Other
✓	✓	✓	✗

Productivity Data Published

The Bureau of Labor Statistics (BLS) publishes **labour productivity** for major sectors and at the industry level as part of two *Labour Productivity and Costs* programs (the *Major Sector Productivity and Costs* program (quarterly) and the *Industry productivity* program (annual)); and **capital, labour** and **multi-factor productivity** estimates for major sectors and (detailed) industries as part of two *Multifactor Productivity* programs (Major Sector Productivity Program (annual) and *Industry Productivity Program* (annual)); specifically:

■   BLS publishes **labour productivity** estimates for the business sector, the nonfarm business sector, and the manufacturing sector (incl. 2 sub-sectors), and for non-financial corporations as part of the *Productivity and Costs News Release* (quarterly).

■   BLS publishes **industry-level labour productivity** statistics in the manufacturing, mining, utilities, wholesale and retail trade, and services sectors (annual) as part of the *Productivity and Costs by Industry News Release*. This news release is split into three separate releases: i) Wholesale Trade, Retail Trade, and Food Services and Drinking Places; ii) Selected Service-Providing Industries; and ii) Manufacturing and Mining Industries.

■   The Bureau of Labor Statistics publishes **labour** (output per hour worked), **capital** (output per unit of capital services), and **multi-factor productivity** estimates for the U.S. private business sector and the private nonfarm business sector as part of the *Multifactor Productivity Trends News Release* (annual).

■   BLS also publishes **KLEMS multi-factor productivity estimates** for the manufacturing sector and 18 groups of manufacturing industries, as part of the *Multifactor Productivity Trends in Manufacturing News Release* (annual), as well as for 86 detailed manufacturing industries as part of the *Multifactor Productivity Trends for Detailed Industries News Release* (annual).

■   **Labour**, **capital** and **KLEMS multi-factor productivity estimates** are also available for the total economy and the detailed non-manufacturing industries on the BLS MFP website l**abour productivity** is also available down to the 6-digit industry level on the BLS Labour Productivity and Costs (LPC) website.

■   The Bureau of Labor Statistics used to publish international comparisons of GDP per capita and GDP per hour

worked across a range of countries as part of the International
Labor Comparisons program (now discontinued).

In addition to the BLS statistics outlined above, the BLS and **the Bureau of Economic Analysis
(BEA)** collaborate to provide an **integrated production account** for industries within GDP. These
tables integrate the BEA output measures with estimates of labour and capital inputs provided by
the BLS to construct a production account consistent with the national income and product
accounts (NIPAs) at BEA.[74]

Table 54   Productivity Estimates Published

Productivity Measure	Capital Productivity	Labour Productivity	Multi-factor Productivity
Main / headline measure based on	Capital services	Number of jobs, number of hours worked	Labour, capital
Other measures based on	-	-	Labour, capital, energy, raw materials, services, land
Periodicity	Annual	Annual, quarterly	Annual
For annual, what is the period?	January - December	January - December	January - December
Timeliness[75] (lag between end of reference period and publication of productivity statistics)	90 days	35 days (quarterly)	90 days
Sectoral coverage	Total economy, private business sector, private nonfarm business sector, and manufacturing (total manufacturing, durable manufacturing and non-durable manufacturing)	Total economy[76], (private) business sector, (private) nonfarm business sector, non-financial corporations, and manufacturing sector (total manufacturing, durable manufacturing and non-durable manufacturing)	Total economy, private business sector, private nonfarm business sector, and manufacturing sector (total manufacturing, durable manufacturing and non-durable manufacturing)
Published at sub-national level?	no	no	no
If yes, at which levels?	-	-	-
Sub-national entities covered	-	-	-
Regional classification	-	-	-

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[74] For more information see Lydaker, A. et. al. (2016). *Integrated BEA/BLS Industry-Level Production Account, Initial Statistics for 2014
and Revised Statistics for 1998–2013.* Retrieved 17/01/2017. Available at:
https://www.bea.gov/scb/pdf/2016/07%20July/0716_integrated_industry_level_production_account.pdf

[75] These statistics refer to the main major sector publications. Industry level estimates are published at a later date. Moreover,
productivity statistics are first released as preliminary estimates, revised estimates are published at a later date. For labour productivity,
annual averages are published together with the fourth quarter estimates. For capital and multifactor productivity, 90 days was the lag
of the most recent publication for 2016, between 2010 and 2015 the lag was between 126 and 190 days.

[76] Available as part of a collaboration between the BLS and the BEA. Published as part of the multifactor productivity program, not the
labour productivity program.

Published at industry level?	yes	yes	yes (KLEMS)
If yes, which?	NAICS 3-digit level, selected industries at 4 digit level	NAICS 3-digit level, selected industries at 4 and 6 digit level	NAICS 3-digit level, selected industries at 4 digit level
Industries covered	145	380[77]	145
Industry-level estimates published at sub-national level?	no	no	no

Source: Bureau of Labor Statistics

- ■ **Definition of (private) business sector:**
  - □ For labour productivity the BLS produces two measures:
    - – Business excluding non-profit institutions, households, and general government.
    - – Private business excluding non-profit institutions, households, and total government.
  - □ For capital productivity and MFP the BLS produces only one measure:
    - – Private business excluding non-profit institutions, households, and total government.
- ■ **Definition of (private) nonfarm business sector:** (Private) business sector excluding the farm sector.
- ■ **Availability of Input-Output Tables:** no – available from the Bureau of Economic Analysis
  - □ **Frequency:** -
  - □ **Price Base:** -
  - □ **Price(s) at which IO tables are published:** -
- ■ **Production Speed:** 1 week

  This refers to the lag between the release of the final data (GDP release) used in estimating quarterly labour productivity statistics and the publication of official productivity statistics.

Methodology

Data that may serve to calculate productivity

Published data that may serve as inputs to productivity calculations include: at industry / national level production values (current/constant prices), number of jobs, number of hours worked, capital stocks, and capital services. In addition, the BLS publishes value added/GDP (current/constant prices) at national level.

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[77] This number refers to the total unique industries for which the BLS publishes labour productivity estimates across their two production divisions. It includes the quarterly labour productivity series as well as the detailed (down to the 6-digit NAICS level) industry series.

Output

The BLS defines output for productivity estimates as value added at current/constant prices. Output for the manufacturing sector and NAICS 3- and 4-digit manufacturing industries is defined as sectoral output. Sectoral output is constructed by using the deflated value of industry shipments from the U.S. Census Bureau, adjusted to remove transactions occurring within the industry[78].

Labour Input

The BLS constructs quality-adjusted labour input data, which is used for total economy and industry level multi-factor productivity measures. Quality-adjusted labour input data is not used in the construction of labour productivity estimates or in the construction of (KLEMS) multi-factor productivity estimates for 4-digit NAICS industries.

Labour quality adjustment takes into account age, gender, education and industries. The BLS utilises data from the Current Employment Statistics Survey and the Current Population Survey (Ongoing Rotation Group) for labour quality adjustment.[79]

The BLS does not rely on labour input data from other agencies for total economy and most industry level data. However, the BLS does rely on labour input data from other agencies for some detailed industries. For example, the BLS relies on employment data from the Department of Transportation for the air transportation industry, and on employment data from the Department of Transportation and Association of American Railroads for the line-haul railroads industry.

Capital Stocks and Capital Services

The BLS publishes both capital stock and services data for the total economy and on industry level (NAICS 3-digit level and selected 4-digit industries). Capital stocks and capital services data are published at year-to-year chained prices. The BLS uses net capital stock and capital services for productivity estimates.

The BLS uses the perpetual inventory method for calculating net stocks of fixed assets. Hyperbolic depreciation is assumed with regard to consumption of fixed capital. Furthermore, assets are assumed to retire following a truncated normal distribution. The BLS does not adjust for capacity utilisation of capital, but takes transactions of used assets into account for capital stock calculations.

Both capital stocks and services data include information from surveys capturing self-produced and purchased intangible assets. Assets covered are R&D, software, and entertainment, literary or artistic originals (all self-produced and purchased). Missing data on software investments for detailed manufacturing industries is estimated using ratios of software-to-equipment from more aggregate industries[80].

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[78] See Bureau of Labor Statistics (2014). *Overview of Output Measures used by BLS to construct Productivity Statistics for Major Sectors of the Us Economy.* Retrieved 20/04/2017. Available at: https://www.bls.gov/mfp/outputnote.pdf

[79] Link to metadata on labour quality adjustment: https://www.bls.gov/mfp/mprlabor.htm

[80] Aggregate investment data is obtained from the Bureau of Economic Analysis.

The statistical basis for actual service life of fixed assets is determined by estimations and/or assumptions.[81] Moreover, the average service life of different types of assets is estimated by industry.

The BLS relies on capital data inputs from the Bureau of Economic Analysis (investment in equipment, structures, and stock of inventories), the Department of Agriculture (farmland), the Bureau of the Census (investment in equipment, structures, and stock of inventories for detailed manufacturing industries), the Bureau of Transportation Statistics (capital stocks of airframes and engines for air transportation), and the Surface Transportation Board and AMTRAK (investment in equipment, structures, and land for railroad transportation).

The capital stock estimates used for productivity calculations differ in the deprecation method used to those published in the national accounts. Specifically, national accounts use a geometric depreciation function, while the Office of Productivity and Technology uses a hyperbolic depreciation function.

Other Data Inputs

In addition to labour and capital, the BLS uses intermediate purchases as an input for detailed industry multi-factor (KLEMS) productivity estimates.

Intermediate inputs consist of energy, materials, and purchased business services. Data on intermediate inputs are obtained from BEA annual input-output tables. Tornqvist indexes of each of these three input classes are derived at the three-digit NAICS level and then aggregated to the manufacturing sectors. Materials inputs are adjusted to exclude transactions between establishments within the same sector.

For 4-digit NAICS manufacturing industries, intermediate purchases are constructed as a Tornqvist index of raw materials, services, fuels and energy consumed by each industry. Direct quantity and price data are available for electricity consumed by manufacturing industries. All other quantities are estimated by a weighted price deflator[82].

The BLS relies on energy, material, purchased services, and nominal compensation and profits data from the Bureau of Economic Analysis; materials, fuels, and electricity from the Bureau of the Census for detailed manufacturing industries; materials, services, fuels, and electricity from the Bureau of Transportation Statistics for air transportation; and energy, materials, and services from Surface Transportation Board, Association of American Railroads, AMTRAK, Energy Information Administration, and the Edison Electric Institute for railroad transportation.

Data Availability, Presentation and Communication

Availability of data used in construction of productivity estimates

Yes, all data used to construct the productivity data are made

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[81] Link to metadata listing all types of assets included in the capital stock and their assumed/estimated service lives: https://www.bls.gov/mfp/mprcaptl.pdf

[82] Price deflators for materials are constructed by combining BLS producer price indices and import price indices with weights derived from input-output tables provided by the Bureau of Economic Analysis. More details can be found in: *Bureau of Labor Statistics (n.d.). Handbook of Methods: Chapter 11. Industry Productivity Measures.*

available when productivity estimates are released.

Information included	■ Factual information describing the data ■ Technical notes (e.g. description of methodology used)
Presentation	■ Text ■ Tables ■ Charts/graphs ■ Interactive charts ■ Downloadable databases
Recently introduced	■ Added all data in Excel format ■ Added interactive charts
Announcement of new releases	■ Via press conferences: no ■ Via press releases: yes – print media: general and financial/business, broadcast media (TV and Radio): general and financial/business, online media: general and financial/business ■ Via social media: yes - Twitter

Further Information

Capital Productivity

■ Bureau of Labor Statistics (n.d.). *Multifactor Productivity.* Retrieved 19/04/2017. Available at: https://www.bls.gov/mfp/

Labour Productivity

■ Bureau of Labor Statistics (n.d.). *Labor Productivity and Costs.* Retrieved 19/04/2017. Available at: https://www.bls.gov/lpc/

Total/multi-factor productivity

■ Bureau of Labor Statistics (n.d.). *Multifactor Productivity.* Retrieved 19/04/2017. Available at: https://www.bls.gov/mfp/

Documentation / meta-data

■ Bureau of Labor Statistics (n.d.). *Multifactor Productivity. Download Tables of Multifactor Productivity Measures for Major Sectors and Manufacturing.* Retrieved 19/04/2017. Available at: https://www.bls.gov/mfp/mprdload.htm

■ Bureau of Labor Statistics (2008). *Technical Information About the BLS Major Sector Productivity and Costs Measures.* Retrieved 20/04/2017. Available at: https://www.bls.gov/lpc/lpcmethods.pdf

- ■ Bureau of Labor Statistics (n.d.). *Technical Information About the BLS Multifactor Productivity Measures.* Retrieved 20/04/2017. Available at: https://www.bls.gov/mfp/mprtech.pdf

Press release

- ■ Posted on the main BLS website: https://www.bls.gov/

Key manuals/reference guides used:

Capital Productivity

- ■ Bureau of Labor Statistics (1983). *Trends in Multifactor Productivity, 1948-81.* Retrieved 19/04/2017. Available at:
  https://www.bls.gov/mfp/trends_in_multifactor_productivity.pdf

Labour Productivity

- ■ OECD (2001). *Measuring Productivity OECD Manual.* Retrieved 19/04/2017. Available at:
  http://www.oecd.org/std/productivity-stats/2352458.pdf

Total/multi-factor productivity

- ■ Bureau of Labor Statistics (1983). *Trends in Multifactor Productivity, 1948-81.* Retrieved 19/04/2017. Available at:
  https://www.bls.gov/mfp/trends_in_multifactor_productivity.pdf

Annex: Published data that may serve to calculate productivity statistics

Table 55   Published data that may serve to calculate productivity statistics

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	°	X	X
Production values (constant prices)	°	X	X
Value added / GDP (current prices)	°	°	X
Value added / GDP (constant prices)	°	°	X
Number of persons employed	°	°	°
Number of persons employed FTE basis	°	°	°
Number of jobs	°	X	X
Number of hours worked	°	X	X

	At sub-national level	At industry-level	At national / whole economy level
Capital stocks	°	X	X
Capital services	°	X	X
Other (outlined below)	°	°	°

Notes: X= data are published; ° = no data are published
Source: Bureau of Labor Statistics

Index of Tables and Figures

Tables

Figures

ANNEXES

Annex 1 References

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Baldwin, J., Gellatly, G., Tanguay, M., & Patry, A. (2005). Estimating depreciation rates for the productivity accounts. In OECD Workshop on Productivity Measurement, Madrid Spain, October (pp. 17-19).

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Weibull, W. (1951). A statistical distribution function of wide applicability. Journal of applied mechanics, 18(3), 293-297.

Annex 2   Published datasets that may serve as a basis for productivity calculations

Table 56   Publication of production values and GDP/value

Statistical organisation	Production value						GDP / value added					
	Current prices			Constant prices			Current prices			Constant prices		
	SN	I	N	SN	I	N	SN	I	N	SN	I	N
Office for National Statistics		√	√				√	√	√	√	√	√
Australian Bureau of Statistics	√	√	√	√	√	√	√	√	√	√	√	√
BLS-Office of Productivity and Technology		√	√		√	√			√			√
Central Statistical Bureau of Latvia	√	√	√		√	√	√	√	√		√	√
Destatis (DE)		√	√		√	√	√	√	√	√	√	√
Eurostat		√	√		√	√	√	√	√		√	√
Federal Statistical Office (CH)		√	√		√	√	√	√	√	√	√	√
Insee (FR)		√	√		√	√		√	√		√	√
International Labour Organization												
Istat (IT)							√	√	√	√	√	√
OECD								√	√		√	√
Statistics Canada	√	√	√	√	√	√	√	√	√	√	√	√
Statistics Denmark	√	√	√	√	√	√	√	√	√	√	√	√
Statistics Estonia		√					√	√	√			√
Statistics Finland					√	√					√	√
Statistics Netherlands / CBS		√	√		√	√		√	√		√	√
Statistics New Zealand		√	√		√	√		√	√		√	√
Statistics Norway		√	√		√	√	√	√	√		√	√
Statistics Sweden		√	√		√	√	√	√	√	√	√	√
Total number of NISOs (excluding the ONS)	4	14	13	3	14	14	11	15	16	7	15	17

Source: Survey of NISOs. Number of respondents = 18 (excluding the ONS)
Notes: N = national level, SN = sub-national level, I = industry level

Table 57   Publication of employment data

Statistical organisation	Number. persons employed			Number of persons employed FTE basis			Number of jobs			Number of hours worked		
	SN	I	N	SN	I	N	SN	I	N	SN	I	N
Office for National Statistics		√	√				√	√	√	√	√	√
Australian Bureau of Statistics	√	√	√	√	√	√				√	√	√
BLS-Office of Productivity and Technology								√	√		√	√
Central Statistical Bureau of Latvia				√	√	√					√	√
Destatis (DE)	√	√	√							√	√	√
Eurostat	√	√	√	√	√	√					√	√
Federal Statistical Office (CH)	√	√	√	√	√	√	√	√	√	√	√	√
Insee (FR)		√	√		√	√					√	√
International Labour Organization			√									√
Istat (IT)	√	√	√	√	√	√		√	√		√	√
OECD		√	√								√	√
Statistics Canada							√	√	√	√	√	√
Statistics Denmark	√	√	√							√	√	√
Statistics Estonia	√	√	√		√					√	√	√
Statistics Finland		√	√								√	√
Statistics Netherlands / CBS		√	√		√	√		√	√		√	√
Statistics New Zealand		√	√								√	√
Statistics Norway	√	√	√		√	√					√	√
Statistics Sweden	√	√	√							√	√	√
Total number of NISOs (excluding the ONS)	9	14	15	5	9	8	2	5	5	7	17	18

Source: Survey of NISOs. Number of respondents = 18 (excluding the ONS)

Table 58   Publication of capital stock and capital services data

Statistical organisation	Capital stock			Capital services		
	SN	I	N	SN	I	N
Office for National Statistics		√	√		√	√
Australian Bureau of Statistics	√	√	√		√	√
BLS-Office of Productivity and Technology		√	√		√	√
Central Statistical Bureau of Latvia						
Destatis (DE)	√	√	√			
Eurostat						
Federal Statistical Office (CH)			√			√
Insee (FR)		√	√			
International Labour Organization						
Istat (IT)		√	√		√	√
OECD			√			√
Statistics Canada	√	√	√	√	√	√
Statistics Denmark		√	√			
Statistics Estonia						
Statistics Finland		√	√			
Statistics Netherlands / CBS		√	√		√	√
Statistics New Zealand		√	√			
Statistics Norway		√	√			
Statistics Sweden		√	√			√
Total number of NISOs (excluding the ONS)	3	12	14	1	5	8

Source: Survey of NISOs. Number of respondents = 18 (excluding the ONS)
Notes: N = national level, SN = sub-national level, I = industry level

Annex 3   Characteristics of the different retirement functions

In general, the functional forms of different retirement patterns are quite similar to each other and one cannot state that a specific pattern should be preferred. While one describes more precisely the characteristics of a specific type of asset, another can be more suitable for another type of asset. Aside from the truncated normal distribution, most distributions show a right-skewness of different degrees. This degree of skewness usually depends upon the chosen parameters of the respective retirement function. A common feature of the distribution functions chosen to model asset retirements is that they are to some degree supported by empirical observations on specific retirement patterns. For example, retirements of motor vehicles follow closely the gamma distribution (Schmalwasser and Schidlowski, 2006).

What follows is a short introduction to the different characteristics of the most commonly used functional forms in modelling retirement patterns that the NISOs use for estimating the capital stocks. The chosen parameterization of the asset life length in the graphical examples is only done so for the sake of illustration. For the sake of comparison, all graphs include the normal distribution as a black line.

The Weibull Distribution:
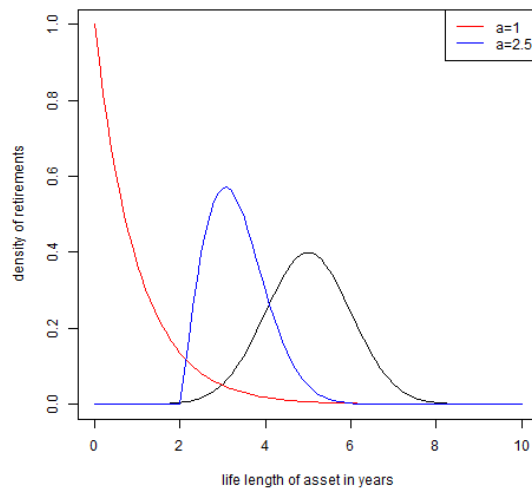
source: DIW Econ

The Weibull distribution is frequently used for reliability analysis and, for example, for measuring the fatigue life of steel (Weibull, 1951). "Statistics Netherlands has used data from surveys of discards to estimate Weibull discard patterns for a wide range of assets", such as buildings, machinery, passenger cars as well as other road transport equipment and computers (OECD, 2009). In general, the Weibull distribution is a right-skewed distribution and can describe systems with falling, constant or increasing failure rates. a is the shape parameter that determines the skewness of the distribution and "can be interpreted as a measure of changes in the risk of an asset being discarded" (OECD, 2009). Retirements due to fatigue / attrition can be described with $a > 1$ (the blue retirement pattern), while surprise retirements or random failures[83] during the operation phase of an asset can be described with $a = 1$ (the red

---

[83] See: https://en.wikipedia.org/wiki/Weibull_distribution, last access: 27.04.2017

retirement pattern). Depending on the shape parameter a, the hazard function (i.e. the probability of an asset's retirement or failure in the next period, conditional on the asset not having retired until then) will either rise monotonically with time (when $a > 1$, i.e. the retirements due to fatigue) or will be constant over time (for $a = 1$, i.e. for surprise retirements / random failures caused by external events).
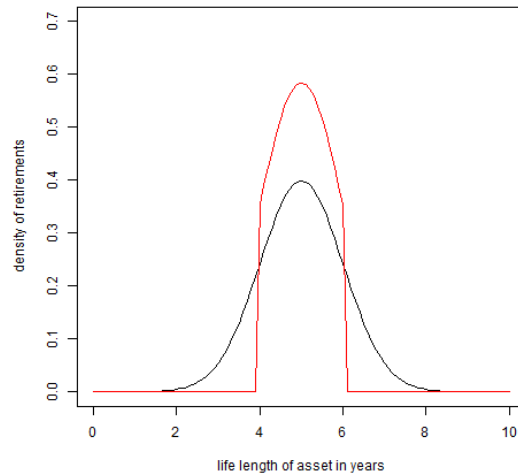
The Log-normal Distribution:
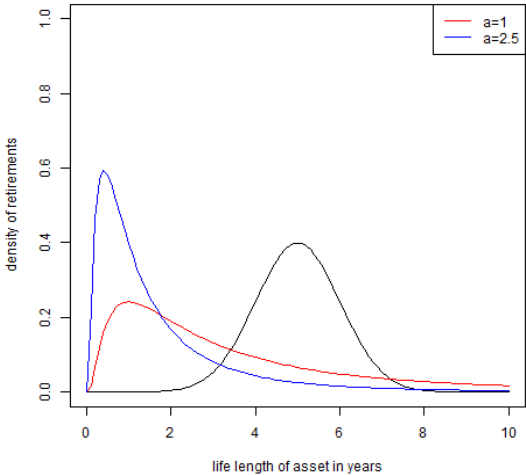
source: DIW Econ

The lognormal distribution likewise possesses the property of describing the lives of assets showing fatigue failure. Thus, it is widely used as a distribution modelling failure / asset retirement (e.g. for the PIM) and is based on some empirical support regarding mortality patterns (OECD, 2009). The distribution puts zero probability of retirement on an asset's first year of life. It is characterised by a right-skewed retirement pattern which depends on the shape parameter a, which in the case of the lognormal is the estimate of an asset's mean life length. The coefficient for the standard deviation of the asset's life length in the lognormal is used to normally distribute asset retirements around their average length of service life (Rincon-Aznar et al, 2017).

The Truncated-normal Distribution:

source: DIW Econ

The truncated normal distribution shows a symmetric retirement pattern. The main difference to the normal distribution lies in the feature that the truncated normal distribution is cut off at particular values for the service life of the asset, ensuring that retirement only appears between these limits. Therefore, the hazard rate describing the asset's failure probability conditional on the asset having not retired from the capital stock until the time of interest, is zero until the lower limit, increases sharply between the chosen truncations and equals one at the upper limit.
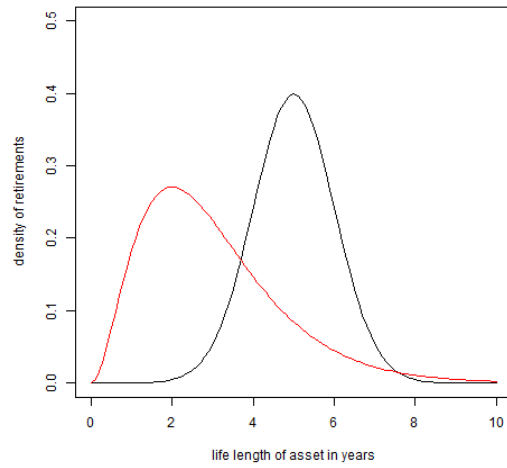
The Winfrey Curves:
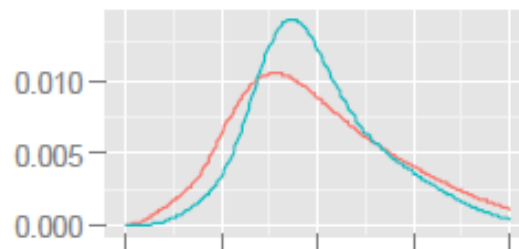
source: ONS, 2015

The Winfrey curves are based on information about retirement patterns for 176 groups of industrial assets that Robley Winfrey collected during his research at the IOWA Engineering Experimentation Station in the 1930s(ONS, 2015). They comprise 18 "type" curves including seven symmetrical, six left-skewed and five right-skewed curves, depending on the observed retirement patterns, which makes the Winfrey curves a flexible function form in modelling retirement patterns for assets of different failure rates.

The Gamma Distribution:

166

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

density of retirements / life length of asset in years

source: DIW Econ

The Gamma function is also right-skewed with the degree of skewness depending on the shape and scale parameter. Destatis uses the Gamma distribution for estimating capital stocks.

The "foundation for choosing this function was the registration and deregistration rates of motor vehicles. The gamma function is closest to the actual retirements of vehicles that distribute around the average service life." (Schmalwasser and Schidlowski, 2006).

ONS Best Practice Survey

Contact Information

1. Please note: if you intend to complete this survey as a team, please provide details for the primary contact in your organisation.

Your Name	
Your Organisation	
Email	
Phone	

Published Productivity Data (Labour)

2. Do you publish labour productivity statistics?

☐ Yes

☐ No

3. On which of the following labour measures are the labour productivity statistics based? Please select all that apply.

	Main / headline labour productivity estimate	Other labour productivity estimates
Number of employed persons	☐	☐
Number of FTE employed persons	☐	☐
Number of jobs	☐	☐
Number of hours worked	☐	☐
Other (please specify below)	☐	☐

Other (please specify)

Labour Productivity Statistics

4. For which of the following sectors does your organisation publish labour productivity data? Please select all that apply.

☐ Total economy

☐ Total private economy (i.e. excluding the general government sector)

☐ Total private business economy

☐ Total non-financial private business economy (i.e. private business economy excluding finance and insurance)

If you selected 'private business economy' please provide a definition

```
```

5. Do you publish labour productivity estimates at an industry level?

☐ Yes

☐ No

6. At what industry level(s) do you publish labour productivity estimates?

☐ ISIC or equivalent 1-digit level

☐ ISIC or equivalent 2-digit level

☐ ISIC or equivalent 3-digit level

☐ Other (please specify):

```
```

7. Please provide the maximum number of different industries (at the most granular level) that you cover according to ISIC classification.

```
```

8. Do you publish labour productivity estimates at a sub-national level?

☐ Yes

☐ No

9. Please select the relevant sub-national level(s) at which you publish labour productivity estimates. Please select all that apply.

☐ State, province, region level

☐ Urban/non-urban level

☐ Other (please specify):

10. Please provide the maximum number of sub-national entities (at the most granular level) for which you publish labour productivity statistics.

11. If you are a European statistical agency, please state which level(s) of regional classification apply/applies e.g. NUTS 1, NUTS 2, NUTS 3, etc,

12. Do you publish industry-level labour productivity statistics at sub-national level?

☐ Yes

☐ No

☐ Do not publish industry-level productivity statistics

13. At what periodicity do you publish your main / headline labour productivity statistics? Please select all that apply.

☐ monthly

☐ quarterly

☐ annual

☐ Other (please specify):

14. If you selected 'annual' for the previous question, please select the starting month for the annual period.

☐ January

☐ February

☐ March

☐ April

- [ ] May
- [ ] June
- [ ] July
- [ ] August
- [ ] September
- [ ] October
- [ ] November
- [ ] December

15. What is the time delay in publishing your main/headline labour productivity releases? (i.e. how many days elapse between the end of the reporting period and the actual publication date?) Please select the time delay for each of the relevant categories below.

	Time delay (days)
Monthly basis	
Quarterly basis	
Annual basis	
Other basis	

If you selected 'other basis' please specify

Total or Multi-Factor Productivity

16. Do you publish total or multi-factor productivity statistics?

- [ ] Yes
- [ ] No

17. Please select the factors of production which are taken into account in the estimation of multi-factor productivity. Please select all that apply.

	Main / headline estimate of multi-factor productivity	Other estimates of multi-factor productivity
Labour	[ ]	[ ]
Capital	[ ]	[ ]
Energy	[ ]	[ ]

	Main / headline estimate of multi-factor productivity	Other estimates of multi-factor productivity
Raw Materials	☐	☐
Services	☐	☐
Land	☐	☐
Other	☐	☐

If you selected 'other' please specify

[ ]

18. For which of the following sectors does your organisation publish total or multi-factor productivity data? Please select all that apply.

☐ Total economy

☐ Total private economy (i.e. excluding the general government sector)

☐ Total private business economy

☐ Total non-financial private business economy (i.e. private business economy excluding finance and insurance)

If you selected 'private business economy' please provide a definition

[ ]

19. Do you publish total or multi-factor productivity estimates at an industry level?

☐ Yes
☐ No

20. At what industry level(s) do you publish total or multi-factor productivity estimates? Please select all that apply.

☐ ISIC or equivalent 1-digit level
☐ ISIC or equivalent 2-digit level
☐ ISIC or equivalent 3-digit level
☐ Other (please specify):

[ ]

21. Please provide the maximum number of different industries (at the most granular level) that you cover according to ISIC classification.

22. Do you publish total or multi-factor productivity estimates on a sub-national level?

- [ ] Yes
- [ ] No

23. Please select the relevant sub-national level(s) at which you publish total or multi-factor productivity estimates. Please select all that apply.

- [ ] State, province, region level
- [ ] Urban/non-urban level
- [ ] Other (please specify):

24. Please provide the maximum number of sub-national entities (at the most granular level) for which you publish total or multi-factor productivity statistics.

[ ]

25. If you are a European statistical agency, please state which level(s) of regional classification apply/applies e.g. NUTS 1, NUTS 2, NUTS 3, etc,

[ ]

26. Do you publish industry-level total or multi-factor productivity statistics at sub-national level?

- [ ] Yes
- [ ] No
- [ ] Do not publish industry-level total or multi-factor productivity statistics at sub-national level

27. At what periodicity do you publish the main / headline total or multi-factor productivity statistics? Please select all that apply.

- [ ] monthly
- [ ] quarterly
- [ ] annual

☐ Other (please specify):

[   ]

28. If you selected 'annual' for the previous question, please select the starting month for the annual period.

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

☐ October

☐ November

☐ December

29. What is the time delay in publishing your main / headline total or multi-factor productivity releases? (i.e. how many days elapse between the end of the reporting period and the actual publication date?) Please select the time delay in days for each of the relevant categories below.

	Time delay (days)
Monthly basis	[ ]
Quarterly basis	[ ]
Annual basis	[ ]
Other basis	[ ]

If you selected 'other basis' please specify

[   ]

Capital Productivity

30. Do you publish capital productivity statistics?

☐ Yes

☐ No

Capital Productivity Statistics

31. For which of the following sectors does your organisation publish capital productivity data? Please select all that apply.

☐ Total economy

☐ Total private economy (i.e. excluding the general government sector)

☐ Total private business economy

☐ Total non-financial private business economy (i.e. private business economy excluding finance and insurance)

If you selected 'private business economy' please provide a definition

[   ]

32. Do you publish capital productivity estimates at an industry level?

☐ Yes
☐ No

33. At what industry level(s) do you publish capital productivity estimates? Please select all that apply.

☐ ISIC or equivalent 1-digit level
☐ ISIC or equivalent 2-digit level
☐ ISIC or equivalent 3-digit level
☐ Other (please specify):
[   ]

34. Please provide the maximum number of different industries (at the most granular level) that you cover according to ISIC classification.

[   ]

35. Do you publish capital productivity estimates at a sub-national level?

☐ Yes

☐ No

36. Please select the relevant sub-national level(s) at which you publish capital productivity estimates. Please select all that apply.

☐ State, province, region level

☐ Urban/non-urban level

☐ Other (please specify):

[ ]

37. Please provide the maximum number of sub-national entities (at the most granular level) for which you publish capital productivity statistics.

[ ]

38. If you are a European statistical agency, please state which level(s) of regional classification apply/applies e.g. NUTS 1, NUTS 2, NUTS 3, etc,

[ ]

39. Do you publish industry-level capital productivity statistics at a sub-national level?

☐ Yes

☐ No

☐ Do not publish industry-level capital productivity statistics at a sub-national level

40. At what periodicity do you publish the main / headline capital productivity statistics? Please select all that apply.

☐ monthly

☐ quarterly

☐ annual

☐ Other (please specify):

[ ]

41. If you selected 'annual' for the previous question, please select the starting month for the annual period.

☐ January

- [ ] February
- [ ] March
- [ ] April
- [ ] May
- [ ] June
- [ ] July
- [ ] August
- [ ] September
- [ ] October
- [ ] November
- [ ] December

42. What is the time delay in publishing your main / headline capital productivity releases? (i.e. how many days elapse between the end of the reporting period and the actual publication date?) Please select the time delay in days for each of the relevant categories below.

Time delay (days)

Monthly basis

Quarterly basis

Annual basis

Other basis

If you selected 'other basis' please specify

Other Published Productivity Data

43. Do you produce other productivity statistics?

- [ ] Yes
- [ ] No

Other Productivity Statistics

44. Please state the 'other' type of productivity statistics you produce. NOTE: if you produce more than one 'other' type please list all the 'other' productivity statistics which your organisation produces, along with a brief description.

	Name of the 'other' productivity statistics	Brief description/explanation
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

45. For which of the following sectors does your organisation publish the main 'other' productivity data? Please select all that apply.

☐ Total economy

☐ Total private economy (i.e. excluding the general government sector)

☐ Total private business economy

☐ Total non-financial private business economy (i.e. private business economy excluding finance and insurance)

If you selected 'private business economy' please provide a definition

46. Do you publish the main 'other' productivity estimates at an industry level?

☐ Yes

☐ No

178

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

47. At what industry level(s) do you publish the main 'other' productivity estimates? Please select all that apply.

☐ ISIC or equivalent 1-digit level

☐ ISIC or equivalent 2-digit level

☐ ISIC or equivalent 3-digit level

☐ Other (please specify):

    [_____]

48. Please provide the maximum number of different industries (at the most granular level) that you cover according to ISIC classification.

[_____]

49. Do you publish the main 'other' productivity estimates at a sub-national level?

☐ Yes

☐ No

50. Please select the relevant sub-national level(s) at which you publish the main 'other' productivity estimates. Please select all that apply.

☐ State, province, region level

☐ Urban/non-urban level

☐ Other (please specify):

    [_____]

51. Please provide the maximum number of sub-national entities (at the most granular level) for which you publish the main 'other' productivity statistics.

[_____]

52. If you are a European statistical agency, please state which level(s) of regional classification apply/applies e.g. NUTS 1, NUTS 2, NUTS 3, etc,

[_____]

53. Do you publish industry-level main 'other' productivity statistics at a sub-national level?

☐ Yes

☐ No

☐ Do not publish industry-level 'other' productivity statistics at a sub-national level

54. At what periodicity do you publish your main / headline 'other' productivity statistics? Please select all that apply.

☐ monthly

☐ quarterly

☐ annual

☐ Other (please specify):

[ ]

55. If you selected 'annual' for the previous question, please select the starting month for the annual period.

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

☐ October

☐ November

☐ December

56. What is the time delay in publishing your main / headline 'other' productivity releases? (i.e. how many days elapse between the end of the reporting period and the actual publication date?)Please select the time delay in days for each of the relevant categories below.

	Time delay (days)
Monthly basis	[ ]
Quarterly basis	[ ]
Annual basis	[ ]
Other basis	[ ]

Time delay (days)

If you selected 'other basis' please specify

Data used to calculate productivity

57. Which datasets do you publish that may serve as basis for productivity calculations?

	At sub-national level	At industry-level	At national / whole economy level
Production values (current prices)	☐	☐	☐
Production values (constant prices)	☐	☐	☐
Value added / GDP (current prices)	☐	☐	☐
Value added / GDP (constant prices)	☐	☐	☐
Number of persons employed	☐	☐	☐
Number of persons employed FTE basis	☐	☐	☐
Number of jobs	☐	☐	☐
Number of hours worked	☐	☐	☐
Capital stocks	☐	☐	☐
Capital services	☐	☐	☐
Other	☐	☐	☐

If you selected 'other' please specify

58. Does your organisation publish input / output tables?

☐ Yes

☐ No

59. Please select the frequency of the input-output tables that your organisation publishes.

☐ Quarterly only

☐ Annual only

☐ Quarterly and annual

60. Please select at which base price the input-output tables are published. Please select all that apply.

☐ Purchasers prices

☐ Basic prices

☐ Market prices

61. Please select the specific price(s) at which the input-output tables are published.

☐ Current prices only

☐ Constant prices only

☐ Current and constant prices

62. What is the time delay (in days) between the publication date of the last available data input used to calculate the main / headline productivity estimate, and the publication of the main / headline productivity statistics for the same period?

[   ]

63. Please provide web links to the relevant page(s) on your website for the following productivity data and publications which you produce.

Labour productivity	[ ]
Total/multi-factor productivity	[ ]
Capital productivity	[ ]
Documentation / meta-data	[ ]
Press release	[ ]

Methodology and inputs

64. How do you define output used for productivity measurement? Please select all that apply.

☐ GDP (current prices)

☐ GDP (constant prices)

☐ Value added (current prices)

☐ Value added (constant prices)

☐ Production value (current prices)

☐ Production value (current prices)

☐ Other (please specify):

Labour Input

65. Do you construct and/or publish quality-adjusted labour input data?

☐ Yes

☐ No

66. Is quality adjusted labour input data used for calculating published labour productivity?

	Yes	No
Main / headline labour productivity data	☐	☐
Other labour productivity data	☐	☐

67. If you produce multi-factor productivity estimates, do you use quality adjusted labour input data?

	Yes	No	Not applicable
Main / headline labour productivity data	☐	☐	☐
Other labour productivity data	☐	☐	☐

68. Which of the following factors do you take into account when you construct quality adjusted labour data? Please select all that apply.

☐ Age

☐ Gender

☐ Education

☐ Industries

☐ Occupations

☐ Regions

☐ Other (please specify):

_____

69. Please list the data sources which you use for quality adjustments (e.g. labour force survey for occupations, etc).

_____

70. Please provide link(s) to any metadata about your adjustment of labour quality.

_____

Capital Stocks and Capital Services

71. Please select the type of capital data which your organisation publishes.

☐ Only capital stock data

☐ Only capital services data

☐ Both capital stock and services data

☐ Neither capital stock nor capital services data

72. Which of the following measures of capital do you use for your productivity estimates? Please select all that apply.

☐ Gross Capital Stock

☐ Net Capital Stock

☐ Capital Services

184

London Economics and DIW Econ
Review of international best practice in the production of productivity statistics

☐ None

☐ Other (please specify):

[   ]

73. At what industry level do you publish data on capital stocks or services?

☐ Total economy

☐ Business economy

☐ ISIC or equivalent 1-digit level

☐ ISIC or equivalent 2-digit level

☐ ISIC or equivalent 3-digit level

☐ Other (please specify):

[   ]

74. At what prices do you publish data on capital stocks or services?

☐ Current (replacement) costs / current prices

☐ Acquisition prices / historic cost value

☐ Constant (replacement) costs at specific base year / constant prices (base year)

☐ Year-to-year chained prices

☐ Other (please specify):

[   ]

75. What general method is used for calculating the stock of gross fixed assets / stock of net fixed assets?

	Gross Fixed Assets	Net Fixed Assets
Perpetual Inventory Method (PIM)	☐	☐
Direct observation of stock of fixed asset by survey	☐	☐
Other	☐	☐
If you selected 'other' please specify		

[   ]

76. Which depreciation method(s) do you use for calculating consumption of fixed capital? Please select all that apply.

☐ Linear

☐ Geometric

☐ Hyperbolic

☐ Other/mixture (please specify):

[ ]

77. Do you use a retirement function in the estimation of capital stocks?

☐ Yes

☐ No

78. Which retirement function do you use? Please select all that apply.

☐ Normal

☐ Truncated normal

☐ Log-normal

☐ Wiebull

☐ Other (please specify):

[ ]

79. Do you make any adjustment for capacity utilisation of capital?

☐ Yes

☐ No

80. Do you take into account transactions in used assets in capital stock calculation?

☐ Yes

☐ No

81. Do you include intangible assets in your capital estimates?

☐ Only in capital stock data

☐ Only in capital services data

☐ In both capital stock and services data

☐ Neither in capital stock nor in capital services data

82. Please select the intangible assets for which you have observations from surveys. NOTE: please distinguish between self-produced and purchased assets and select all that apply.

	Self-produced	Purchased
R&D	☐	☐
Mineral exploration and evaluation	☐	☐
Software	☐	☐
Databases	☐	☐
Entertainment, literary or artistic originals	☐	☐
Other intellectual property products	☐	☐

If you selected 'other intellectual property products' please specify

[ ]

83. When you have no survey data on intangibles, do you estimate/approximate the missing data?

☐ Yes

☐ No

☐ Partly

84. Please provide a web link to metadata describing the method used for estimating/approximating the missing data.

[ ]

85. Please provide link(s) to any metadata listing ALL the types of assets that your organisation includes in the capital stock data.

[ ]

86. With regard to the actual service life of each type of fixed asset (e.g machinery, IT, etc) do you have a statistical basis for determining the actual service life of the fixed asset?

☐ Yes

☐ No

87. How are the service lives of each type of asset determined?

- [ ] Actual data
- [ ] Estimations/assumptions
- [ ] Combination of both

88. Are average service lives of different types of asset estimated by industry?

- [ ] Yes
- [ ] No

89. Are the capital stock / services estimates used for productivity estimates identical with the capital stock / services estimates published in your national accounts?

- [ ] Yes
- [ ] No
- [ ] Do not publish capital stock estimates

90. Please provide a brief description of any other source databases which are used to produce your capital stock estimates and how they differ from the National Accounts.

Other Agencies

91. Do you rely on other agencies to provide labour data inputs for your productivity statistics?

- [ ] Yes
- [ ] No

92. Please list the labour data inputs you require from other agencies.

93. Do you rely on other agencies to provide capital data inputs for your productivity statistics?

☐ Yes

☐ No

94. Please list the capital data inputs you require from other agencies.

95. Do you rely on other agencies to provide any other data inputs for your productivity statistics?

☐ Yes

☐ No

96. Please specify the other data inputs you require from other agencies.

Dissemination and communication

97. Does your organisation hold a press conference when the main / headline productivity data are released/published?

- [ ] Yes
- [ ] No

98. Does your organisation send press releases when the productivity data are released/published?

- [ ] Yes
- [ ] No

99. Please select the types of media organisations to whom your press releases are sent.

- [ ] Print Media: Financial/business
- [ ] Print Media: General
- [ ] Broadcast Media (TV) : Financial/business
- [ ] Broadcast Media (TV): General
- [ ] Broadcast Media (Radio): Financial/business
- [ ] Broadcast Media (Radio): General
- [ ] Online Media: Financial/Business
- [ ] Online Media: General
- [ ] Other (please specify):

100. Does your organisation use social media (Twitter, Facebook, LinkedIn, etc.) to share information about the release/publication of productivity data?

- [ ] Yes
- [ ] No

101. Please list all the specific social media you use to share information about the release/publication of productivity data.

Data Availability And Presentation

102. Are all the data which are used to construct the productivity data made available at the same time as the productivity data are released?

☐ Yes

☐ No

103. Which of the following does the productivity data release include? Please select all that apply.

☐ Factual information describing the data

☐ Commentary explaining changes in productivity

☐ Technical notes (e.g. description of methodology used)

☐ Other (please specify):

104. Please select from the following list ALL of the ways that you present productivity information.

☐ Text

☐ Tables

☐ Charts/graphs

☐ Infographics

☐ Interactive charts

☐ Downloadable databases

☐ Other (please specify):

105. Have you changed the way you disseminate or present productivity statistics in recent years?

☐ Yes

☐ No

106. Please briefly describe the changes / key innovations your have made in disseminating productivity information.

International Best Practice

107. For each of the categories below, please enter the name of one specific statistical institution (worldwide, excluding your own institution), which, in your opinion, is the best at each of the following:

	Name of Organisation
Range and scope of productivity statistics	
Underlying methodologies for labour productivity	
Underlying methodologies for MFP	
Underlying methodologies for capital productivity	
Documentation and transparency of productivity statistics	
Presentation, dissemination and communication of productivity statistics	
Timeliness of productivity publications	

108. Please list below any key manuals and reference guides which you use to inform and guide the construction of the organisation's main / headline productivity data.

	Key manuals / reference guides
Labour productivity	

Key manuals / reference guides

Multi-factor productivity

Capital productivity

Other measure(s) of
productivity

Any Other Comments

109. If you have any further comments you would like to add about any aspect of this study, please do so here.