

EU KLEMS Growth and Productivity Accounts

2017 Release, Statistical Module¹

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Introduction

This document describes the new release of the [EU KLEMS Productivity and Growth Accounts](#) (2017) with data based on the NACE 2 industry classification and the new European System of National Accounts (ESA 2010) up to 2015 for all 28 member states of the European Union, as well as several EU aggregates (including the Euro Area), and the United States.

This release is the second in a series of two (2016 and 2017), which have been carried out with funding from the [European Commission, DG for Economic and Financial Affairs](#). The 2016 and 2017 EU KLEMS releases follow up on earlier rolling releases in 2012 which showed detailed growth accounts up to 2009-2012 depending on the country. The 2017 extends the 2016 release which included 10 major European economies (Austria, Belgium, Germany, Finland, France, Italy, Netherlands, Spain, Sweden, and United Kingdom) with growth accounts for two countries with full growth accounts (Czech Republic and Denmark). All growth accounts are based on the computations of capital and labour contribution to value added as well as total factor productivity², as well as output and labour productivity estimates for all 28 EU member states.

The 2017 EU KLEMS databases retains the standard EU KLEMS structure of previous rounds, where variables are broken down into values, prices, volumes, and additional variables. For more detailed

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² The full KLEMS approach, using gross output and all five major input factors (K-L-E-M-S) is only available for the United States with the 2017 release. The full KLEMS approach is currently not applicable for all European countries with gross output and intermediate input deflators by industry being the main bottleneck.

information on the general growth accounting methodology and construction of the database, see O'Mahony and Timmer (2009).

The difference between the statistical and analytical modules

The 2017 release has a number of features worth noting, which are explained in this document in more detail:

- Concepts and methodologies to calculate the various growth and productivity variables were adjusted to the new European System of National Accounts (ESA 2010).
- The time period coverage is 1995-2015 for most countries and industries.
- The data on output, value added and employment is nearly fully consistent with Eurostat at the corresponding industry levels - if not mentioned otherwise in the country notes.
- The data on gross fixed capital formation, prices, and capital stocks is consistent with Eurostat at the corresponding industry levels - if not mentioned otherwise in the country notes.
- The capital asset types were modified and extended according to the ESA 2010 requirements.
- One important deviation from previous EU KLEMS releases (prior to 2016) is that capital stock figures are mostly obtained from Eurostat and are thus consistent with national accounts assumptions on the measurement of capital stock - if not mentioned otherwise in the country notes.
- The computation of capital services, which are an essential part of a harmonized KLEMS database, require clarification of assumptions regarding depreciation rates and the calculation of the rates of return. As capital services are not part of the official System of National Accounts those assumptions are not harmonized in the official data. Our measure of capital services are based on geometric depreciation rates consistent with the previous EU KLEMS versions. Therefore, the measures of capital stock in the current release, which are obtained from official data, are not fully consistent with our applied measures of rates of return, rental prices and consequently capital services. While this adjustment is somewhat affecting the comparability of the series across countries, the results in this release (as well as the 2016 release) are more in line with the official national accounts estimates of underlying variables. Hence we refer to those releases as a “statistical module” of EU KLEMS, which are therefore not directly comparable to the “analytical module” as developed for earlier releases.
- Output files of the 2017 release comprise a further breakdown of capital services into ICT capital services and non-ICT capital services.
- For constructing labour services for the period 2008-2015, the micro-data underlying the European Labour Force Survey (LFS) has been used through the National Institute of Economic and Social Research (NIESR). Years prior 2008 have been extrapolated using the trend in labour services from former versions of EU KLEMS.

Availability of variables

Table A1 in the appendix lists all variables of the output and capital files, broken down into values, prices, volumes, and additional variables. Variables will be available to the extent possible as laid out in table A1 in O'Mahony and Timmer (2009) which largely correspond to the set of variables published in the first full release of the EUKLEMS database in March 2008. The 2017 release provides growth accounts across countries and industries where possible (see table 1). Contributions to growth rates of value added and labour productivity are calculated, with the latter measured in two ways – value added per hour worked and value added per person employed.

Table 1: Growth accounting approaches of the EU KLEMS release

| EU KLEMS Approaches: Contributions to... | | |
|--|----------|------------------|
| 1) LP2: Value Added / Person Employed | VA/EMP | Minimum approach |
| 2) LP1: Value Added / Hour worked | VA/H_EMP | ↕ |
| 3) Value Added and KL Inputs | VA | |
| 4) Gross Output and KLEMS Inputs (only US) | GO | Maximum approach |

Figure 1 shows the availability of growth accounting data for all the countries of the 2017 release. It was possible to calculate growth accounts for 12 of the 15 EU-15 countries, 4 of the EU-13 countries, the United States, and 2 EU aggregates within this release.

Figure 1: Contributions to VA growth, LP1 growth, LP2 growth, and GO growth by country and year

| | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | | | |
|-------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|--|--|--|
| EU-15 (VA, LP1, LP2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Austria | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Belgium | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Denmark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Finland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| France | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Germany | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Italy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Luxembourg | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Netherlands | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spain | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sweden | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| United Kingdom | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EU-13 (VA, LP1, LP2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Czech Republic | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Latvia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Slovakia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Slovenia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EU Aggregates (VA, LP1, LP2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EU-12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EU-16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Non-EU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| US VA and LP1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| US LP2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| US GO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

No growth accounts EU-15: Greece, Ireland, Portugal

No growth accounts EU-13: Bulgaria, Croatia, Cyprus, Estonia, Hungary, Lithuania, Malta, Poland, Romania

Note: VA=value added, LP1= value added per hour worked, LP2= value added per person employed, GO=gross output

The remainder of this document details the structure of the 2017 EU KLEMS database and general methods applied to this release. The main differences between the former EU KLEMS releases and the 2016 and 2017 release are briefly highlighted. Additionally, this section covers the methods applied for the calculation of labour services.

Industry Classification

European National Statistical Institutes (NSIs) produce data based on the NACE 2 industry classification, which is consistent with the international standardized ISIC Revision 4 industry classification. We distinguish between 34 industries plus 8 aggregates as shown in table 2. The United States is also released in accordance with this industry classification (ISIC Rev. 4/NACE Rev 2) and is therefore not fully in accordance with the North American Industry Classification System (NAICS). The NACE 2 output and labour data used in this release are based on Eurostat insofar available. The National Accounts (NA) data in the new European System of National Accounts (ESA 2010) is provided for shorter time series than were previously available under ESA 1995. Unfortunately, the industry coverage of many capital variables is limited for Greece, Ireland, Portugal, Bulgaria, Cyprus, Estonia, Hungary, Latvia, Lithuania, Poland, and Romania. National Statistical Institutes of these countries, and therefore also Eurostat, often only release total economy capital data, or the main sections with alphabetical codes. Table A2 in the appendix lists the limitation of capital variables for these countries.

Table 2: EU KLEMS industries

| 34 industry list, based on NACE Rev.2 / ISIC Rev. 4 | | |
|---|--|-------|
| No | Description | Code |
| Agg | TOTAL INDUSTRIES | TOT |
| Agg | MARKET ECONOMY | MARKT |
| 1 | AGRICULTURE, FORESTRY AND FISHING | A |
| 2 | MINING AND QUARRYING | B |
| Agg | TOTAL MANUFACTURING | C |
| 3 | Food products, beverages and tobacco | 10-12 |
| 4 | Textiles, wearing apparel, leather and related products | 13-15 |
| 5 | Wood and paper products; printing and reproduction of recorded media | 16-18 |
| 6 | Coke and refined petroleum products | 19 |
| 7 | Chemicals and chemical products | 20-21 |
| 8 | Rubber and plastics products, and other non-metallic mineral products | 22-23 |
| 9 | Basic metals and fabricated metal products, except machinery and equipment | 24-25 |
| 10 | Electrical and optical equipment | 26-27 |
| 11 | Machinery and equipment n.e.c. | 28 |
| 12 | Transport equipment | 29-30 |
| 13 | Other manufacturing; repair and installation of machinery and equipment | 31-33 |
| 14 | ELECTRICITY, GAS AND WATER SUPPLY | D-E |
| 15 | CONSTRUCTION | F |
| Agg | WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES | G |
| 16 | Wholesale and retail trade and repair of motor vehicles and motorcycles | 45 |
| 17 | Wholesale trade, except of motor vehicles and motorcycles | 46 |
| 18 | Retail trade, except of motor vehicles and motorcycles | 47 |
| Agg | TRANSPORTATION AND STORAGE | H |
| 19 | Transport and storage | 49-52 |
| 20 | Postal and courier activities | 53 |
| 21 | ACCOMMODATION AND FOOD SERVICE ACTIVITIES | I |
| Agg | INFORMATION AND COMMUNICATION | J |
| 22 | Publishing, audiovisual and broadcasting activities | 58-60 |
| 23 | Telecommunications | 61 |
| 24 | IT and other information services | 62-63 |
| 25 | FINANCIAL AND INSURANCE ACTIVITIES | K |
| 26 | REAL ESTATE ACTIVITIES | L |
| 27 | PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES | M-N |
| Agg | COMMUNITY SOCIAL AND PERSONAL SERVICES | O-U |
| 28 | Public administration and defence; compulsory social security | O |
| 29 | Education | P |
| 30 | Health and social work | Q |
| Agg | ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICE ACTIVITIES | R-S |
| 31 | Arts, entertainment and recreation | R |
| 32 | Other service activities | S |
| 33 | Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use | T |

Aggregation

Not all industries and aggregates shown in table 2 are readily available from Eurostat and several aggregates have to be calculated (table 3). NACE 2 industries are aggregated by simple summation for nominal variables. Tornqvist aggregates are estimated from the corresponding child NACE 2 industries, using the corresponding nominal variable as weights. The following weights were used:

- Value added for variables listed under contributions to value added growth
- Value added for variables listed under contributions to value added per hour worked growth
- Value added for variables listed under contributions to value added per person employed growth
- Gross output for variables listed under contributions to gross output growth (US only)
- Labour compensation for labour services, 2010 = 100
- Capital compensation for capital services, 2010 = 100

All growth accounting related variables, namely growth rates of value added volumes (VA_Q), growth rates of value added per hour worked (LP1_Q), growth rates of value added per person employed (LP2_Q), their growth contributions, and TFP indexes exclude industries T and U from the aggregate economy, and O-U. This is because capital stocks and GFCF are usually not available for these industries. The market economy covers all industries minus L, O, P, Q, T, and U for all variables of the output files and capital files. Some series may not sum exactly to totals due to rounding, but any differences are well within the uncertainty of the estimates.

Table 3: EU KLEMS aggregates

| | Growth accounting variables* | All other variables |
|---|--|--|
| Total Economy | All industries excluding T and U | All industries including T and U |
| Market Economy | All industries excluding L, O, P, Q, T, and U | All industries excluding L, O, P, Q, T, and U |
| Chemicals and chemical products (20-21) | C20: Manufacture of chemicals and chemical products C21: Manufacture of basic pharmaceutical products and pharmaceutical preparations | |
| Electrical and optical equipment (26-27) | C26: Manufacture of computer, electronic and optical products C27: Manufacture of electrical equipment | |
| Electricity, Gas And Water Supply (D-E) | D: Electricity, gas, steam and air conditioning supply E: Water supply; sewerage, waste management and remediation activities | |
| Transport and storage (49-52) | H49: Land transport and transport via pipelines H50: Water transport H51: Air transport H52: Warehousing and support activities for transportation | |
| Community Social And Personal Services (O-U) | O-U excluding T and U | O-U including T and U |
| | O: Public administration and defence; compulsory social security P: Education Q: Health and social work R: Arts, entertainment and recreation S: Other service activities T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use U: Activities of extraterritorial organizations and bodies | |
| Arts, Entertainment, Recreation And Other Service Activities (R-S) | R: Arts, entertainment and recreation S: Other service activities | |

Note: * LAB_QI, CAP_QI, VA_Q, LP1_Q, LP2_Q, their growth contributions, and TFP indexes

Difference between LP_I and LP1_Q

Labour productivity growth rates for the so-called 'EU KLEMS' aggregates (see table 3) differ for variable names LP_I and LP1_Q. While both measure in principle the same thing (gross value added per hour worked), the difference for the EU KLEMS aggregates represents the reallocation effect for the underlying industries. LP_I is calculated by subtracting the growth of total hours worked (H_EMP) from the growth of real value added (VA_QI). On the other hand, LP1_Q is calculated from the bottom up, meaning the underlying contributions of LP1_Q, which are labour composition, ICT and non-ICT capital services and TFP, are calculated for each industry separately and then aggregated to LP1_Q as a simple sum. The same will hold for gross value added per worker, when calculated using variables VA_QI and EMP, compared to LP2_Q.

Output

Eurostat rounds chain linked volumes of gross value added volumes (2010=100) as well as the percentage change over previous period to one decimal place for some countries. Volumes of gross value added (VA_QI) are therefore denoted in 2010 prices instead of an index where 2010 is set to 100, to keep the detail needed for the growth accounting computations and other tasks. The growth rates of value added volumes (VA_Q) in the output files are calculated based on volumes of gross value added in 2010 prices because Eurostat is also rounding VA_Q to only decimal place and we refrain from decomposing rounded VA growth in the growth accounting exercise. The recalculated growth rates of value added volumes VA_Q may therefore differ slightly from the official VA_Q figures from Eurostat.

Asset types

Changes in the asset boundary under ESA 2010 do not only affect important figures throughout the national accounts, they also require a revision to the structure of the non-financial assets classification in EU KLEMS. More assets are included in the definition of gross fixed capital formation (GFCF) in ESA 2010 as compared to the previously used ESA 1995 system. In addition to the inclusion of new asset types, existing assets have been redefined, re-organised and re-numbered in the nomenclature.

The main changes of ESA 2010 that are relevant for EU KLEMS can be summarised as follows (Eurostat, 2014):

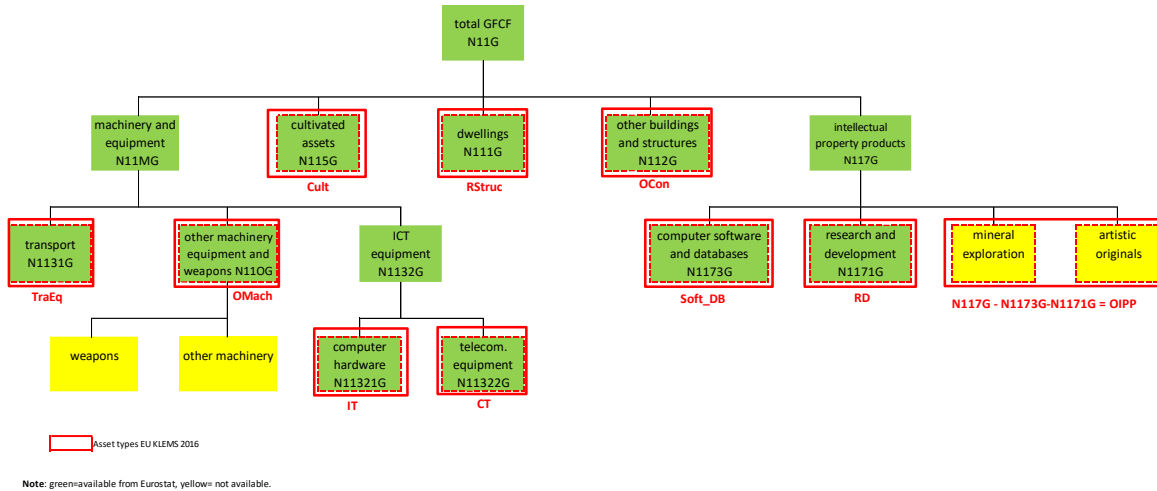
- Intangible assets were recognized as produced fixed assets (AN.112) and non-produced fixed assets (AN.22) in ESA 95³. The produced fixed assets come under the new heading of intellectual products in ESA 2010. The asset boundary under ESA 2010 was further expanded by including research and development as intellectual property under the heading of produced assets.
- Computer software has been modified to include databases, where software and databases are treated as two subcomponents.
- Only the acquisition of military structures and equipment that were considered to have a civilian purpose were recorded as capital formation under ESA 95. The boundary of military capital assets has been extended to include military weapons and supporting systems that do

³ Mineral exploration (AN.1121), computer software (AN.1122), entertainment, literary and artistic originals (AN.1123), and other intangible fixed assets (AN.1129) were recognized as (produced) intangible fixed assets in ESA95. Patented entities (AN.221) were part of non-produced intangible assets in ESA95.

not have an equivalent civilian purpose⁴. Weapons systems are classified separately and are recognized as produced assets under machinery and equipment.

Figure 2 shows the structure of the asset boundary under ESA 2010 and also indicates the current availability in the national accounts section on the Eurostat webpage.

Figure 2: Availability of gross fixed capital formation by assets, based on ESA 2010



For the purpose of the 2017 EU KLEMS release, we decompose total capital into ten asset types and label them as follows:

Table 4: EU KLEMS asset types, based on ESA 2010.

| Code | NA Asset Name | EU KLEMS Asset Name | Short |
|---------------------------|---|--|---------|
| N111G | Dwellings | Residential structures | RStruc |
| N112G | Other buildings and structures | Total non-residential investment | OCon |
| N1131G | Transport equipment | Transport equipment | TraEq |
| N11321G | Computer hardware | Computing equipment | IT |
| N11322G | Telecommunications equipment | Communications equipment | CT |
| N110G | Other machinery and equipment and weapons systems | Other machinery and equipment and weapon systems | OMach |
| N115G | Cultivated biological resources | Cultivated assets | Cult |
| N117G - N1173G- N1171G | Intellectual property products | Other Intellectual Property Products | OIPP |
| N1171G | Research and development | Research and development | RD |
| N1173G | Computer software and databases | Computer software and databases | Soft_DB |

⁴ ESA 2010 treats expenditures by the military as gross fixed capital formation that meet the definition of being used in production over a period in excess of one year. Examples are warships, submarines, military aircrafts, military vessels, tanks, missile carriers and launchers.

The new structure of asset types also has implications for the standard grouping of asset types in EU KLEMS into non-ICT and ICT. In previous versions, ICT capital was classified in three categories, namely computing equipment (IT), communication equipment (CT) and software. The changes in the current EU KLEMS release are as follows:

- Computer hardware which is equal to computing equipment (IT) and telecommunications equipment (CT) together equal ICT equipment and the series are comparable to what has been available under ESA 95.
- Computer software now includes databases and is therefore not entirely comparable to what was measured as software in the previous EU KLEMS datasets.
- In addition, computer software and databases are a subcomponent of intellectual property products, besides research and development and other IPP (OIPP) consisting of mineral exploration, and artistic originals (formerly known as other assets). Other IPP is not readily available from Eurostat and has therefore been calculated by deducting computer software and databases N1173G and research and development N1171G from intellectual property products N117G.
- Investment in cultivated assets accounts for only a minor share in total GFCF as they almost exclusively occurred in section A (agriculture, forestry and fishing). These were part of 'other assets' in former EU KLEMS and are treated as separate asset type in the 2016 release to keep as much detail as possible.

Investment, capital stocks and capital services⁵

ICT deflators

ICT investment in the previous versions of EU KLEMS was deflated using hedonic price deflators, based on U.S. constant quality price changes. However, in the current version, we rely on official ICT prices, which are assumed to reflect quality adjusted price declines. Recent evidence, however, suggests that the official quality adjusted deflators underestimate the true price decline even in the United States (see Byrne and Corrado, 2016, for the United States).

Capital and labour compensation

Capital compensation (CAP) is derived using the standard EU KLEMS approach where it is defined as value added minus labour compensation (LAB). Labour compensation is obtained as the National Accounts reported employee compensation plus an imputed self-employed compensation. Labour compensation for the self-employed is imputed assuming the same hourly wages as employees.

Analytical approach to measure capital stock vs. official estimates of capital stock

Gross fixed capital formation by industry and asset type is mainly obtained from Eurostat for the EU KLEMS 2016 and 2017 releases. Data from NSIs are used to fill in gaps if any. In most cases, there are no revised ESA 2010 estimates available from Eurostat or NSIs before 1995 which explains why all growth accounting related variables are not available for the pre-1995 period for most countries.

The main difference of this release compared to former EU KLEMS releases concerns capital stocks. Time series of capital stocks in the previous releases of EU KLEMS were calculated using the perpetual

⁵ This section focuses mostly on the sources used to compute capital services and the differences with previous releases. For more details regarding the calculation of capital stocks and services, please refer to the manual of the 2007 release, available at:

http://euklems.net/data/EUKLEMS_Growth_and_Productivity_Accounts_Part_I_Methodology.pdf

inventory method (PIM) with assumed asset-wise geometric depreciation rates. Initial capital stocks were estimated based on capital-output ratios in a country dependent initial year, usually 1970.

The current release deviates from this analytical approach and follows a statistical module where capital stocks by industry and asset type are taken directly from Eurostat to ensure compatibility with official data. In general, for the countries covered in the current release, the PIM with a geometric depreciation rate is the preferred method of the national statistical offices. Belgium is an exception here, as the Belgian National Accounts assumes a straight line depreciation profile. Moreover, the previous EU KLEMS approach could still be different from the way PIM has been applied by NSIs, in terms of the depreciation rates used, asset composition considered, assumptions regarding initial stocks etc. We checked this by calculating the implicit depreciation rates based on volumes of investment and capital stocks in the official data. While, on average, those implicit depreciation rates are close to the standard EU KLEMS depreciation rates, we see substantial fluctuations from one year or industry to another and sometimes even resulting in negative depreciation rate. This may indicate that the practice followed by NSIs are not fully consistent with the previous EU KLEMS practice, and therefore, our capital stock and capital service (to be discussed below) are bound to be different from what has been reported in previous releases of EU KLEMS.

Capital services

Capital services are not part of the official System of National Accounts. Measurement of capital services requires data on capital stocks and rental prices⁶, which in turn are based on assumptions regarding depreciation rates and rates of return. Capital services (CAP_QI, CAPIT_QI, CAPNIT_QI) are calculated based on geometric depreciation rates by asset and industry largely obtained from previous EU KLEMS versions. Depreciation rates for computing equipment, communications equipment, software and databases, transport equipment, other machinery, total non-residential investment, other IPP (formerly known as other assets) are taken from former EU KLEMS releases. The depreciation rate for cultivated assets stems from Montinari et al. (2016) and the depreciation rate for research and development is taken from the [SPINTAN project](#). However, as our capital stock estimates are taken from official data, this assumption creates some internal inconsistencies. The depreciation rates assumed by the NSIs could be different from the depreciation rates we use in our calculations to derive capital services and therefore, the measures of capital stock are not fully consistent with our measures of rates of return, rental prices and consequently capital services. As mentioned before, we tried to impute the implicit depreciation rates from official capital stock data, the use of which would ensure a consistency between our capital stock and capital services. However, those estimates were highly volatile and often turning negative, and therefore, we decided not to use them.

Labour services⁷

In order to construct the labour composition indices, , sometimes referred to as labour quality, we draw on a number of micro-data sources. First of all, we rely on the European Labour Force Survey (EULFS) to provide us with the information on the employment structure of the workforce, such as age, gender, and educational attainment level. We extracted total numbers of people employed for each of the EU-28 countries on an industry basis (19 industries, in the NACE Rev. 2 Classification). We

⁶ We constrain the rental price to be non-negative, setting it to zero in rare cases where it is negative.

⁷ This section focuses mostly on the sources used to compute labour services. For more details regarding the calculation of labour services, please refer to the manual of the 2007 release, available at: http://euklems.net/data/EUKLEMS_Growth_and_Productivity_Accounts_Part_I_Methodology.pdf

do this on an annual basis by computing the averages of total people employed from the EULFS quarterly files, currently available up to 2015 (the averages are weighted up using population weights). In addition to the country and economic activity dimensions, we split the number of people employed according to a number of demographic characteristics. We distinguish a total of eighteen demographic groups within each country, industry and year cell. We consider two gender categories (male, female), three age categories (15-29 years; 30-49 years; 50 years and higher) and three educational qualifications levels (high, medium and low). A potential drawback of using such a fine split is that there is insufficient information on employment in some of the categories. This is likely to be more problematic in smaller industries in smaller countries, where there was no data or the sample sizes were low. To minimise the problem of large jumps in the data when sample sizes are small, we applied some additional adjustments to the employment series. We calculated growth rates and constrained these to be no more than 50% per annum.

In the case of the UK we draw from the national Labour Force Survey (LFS) to extract employment figures.

The second source of key information in the calculation of labour composition is data on wages. We mainly draw from the Structure of Earning Survey (SES), which contains information on the wage structure of the EU countries in three years: 2002, 2006 and 2010. We extracted average gross hourly wages for an equivalent breakdown to the employment figures. The microdata underlying SES is not yet available for the most recent survey date, 2014. Instead we used the SES tabulations available from EUROSTAT to obtain wage figures for 2010 and 2014. Using growth rates between 2010 and 2014, we are able to bring the wage series forward to the year 2014 by applying linear interpolation. We do this by broad industry groups, that is, B-F, G-J, K-N, O and P-S to avoid data gaps in smaller industries. Whenever there was only one of the two years available for a particular group of industries, i.e. B-F or G-J, we assumed constant wages across all years. Whenever there were single gaps in the data (especially for young and less skilled male and females), we applied the growth rates of the closest sector – these imputations were rarely needed. There was no wage information on industry A, T and U in the SES tabulations. So while employment, technically covers the aggregate S&T&U (except for the UK where this is only S), growth rates of wages for S&T&U only refer to sector S.

We assume the same wage structure for 2015 as for 2014. The drawback of using these tabulations is that they are not available by age but only by industry, gender and qualification, so we assumed the same growth rate between 2010 and 2014 regardless of the age group. As for the UK employment series, we also extract the wage information from the national LFS. Extreme outliers were removed by applying interpolation techniques.

For Croatia the SES tabulation was not available for 2014 so we used SES tabulations for 2010 and assumed constant relative wages from 2008 to 2014. For Slovenia and Malta the SES tabulations were not available for 2010 or 2014. For these countries we used the age ratio of the EU-12 countries (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and the UK) by taking average wages across these 12 countries by sex, skill, industry and year and applied that to both countries to disaggregate the wage figures also by age.

Labour quality is calculated as the difference between the changes in labour services less the changes in hours worked. Both ingredients for labour services (H_shares and W_shares in the labour file) are calculated for the period 2008 to 2015 as described above. We applied the growth rate of labour service from EU KLEMS 2012 for the period prior to 2009.

Extending the time series

The current release is fully based on National Accounts data which conform to the ESA 2010 methodology. Most countries release ESA 2010-based data from 1995 onwards only, with a couple of notable exceptions such as France and Finland. Previous versions of the EU KLEMS provide data back to as far as 1970. Unfortunately, a direct comparability between the current EU KLEMS and previous releases is difficult because of differences in classification system used (NACE 1 as opposed to NACE 2) and the manual of system of national accounts used (ESA 1995 as opposed to ESA 2010). Therefore, we do not attempt to extend the series back to 1970 in the current release. However, using the methodology outlined (industry concordance) in the previous update of the analytical module of EU KLEMS, users may extend the series using the data from older releases.

Differences between labour input files across EU KLEMS releases

Labour input files with detailed industry data on the educational, age and gender distribution of employment and wages are not fully compatible across EU KLEMS releases. This is particularly true for the UK and Sweden, but also apparent for other countries. This is because definitions regarding what constitutes high, medium and low skilled workers change over time and between countries, which especially holds for the low- and medium-skilled categories.⁸ If users would however like to link up labour input files from different EU KLEMS releases to construct long timeseries, this can best be done by using the level data from the most recent release, and extending this further back in time using the growth rates from previous releases. For more information, for example with regards to overcoming differences in classification systems used, please refer to the above section on 'Extending the time series'.

⁸ More details about this can be found in the methodology document for the 2007 release of EU KLEMS (from page 28 onwards), available at http://euklems.net/data/EUKLEMS_Growth_and_Productivity_Accounts_Part_I_Methodology.pdf

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Appendix

Table A1: Variables of the EU KLEMS 2017 release.

| Basic File | |
|--|---|
| Values | |
| VA | Gross value added at current basic prices (in millions of national currency) |
| GO | Gross Output at current basic prices (in millions of national currency) |
| II | Intermediate inputs at current purchasers prices (in millions of national currency) |
| COMP | Compensation of employees (in millions of national currency) |
| EMP | Number of persons engaged (thousands) |
| EMPE | Number of employees (thousands) |
| H_EMP | Total hours worked by persons engaged (thousands) |
| H_EMPE | Total hours worked by employees (thousands) |
| Prices | |
| VA_P | Gross value added, price indices, 2010 = 100 |
| GO_P | Gross output, price indices, 2010 = 100 |
| II_P | Intermediate inputs, price indices, 2010 = 100 |
| Volumes | |
| VA_QI | Gross value added, volume (2010 prices) |
| GO_QI | Gross output, volume (2010 prices) |
| II_QI | Intermediate inputs, volume (2010 prices) |
| LP_I | Gross value added per hour worked, volume indices, 2010 = 100 |
| Growth accounting | |
| LAB | Labour compensation (in millions of national currency) |
| CAP | Capital compensation (in millions of national currency) |
| LAB_QI | Labour services, volume indices, 2010 = 100 |
| CAP_QI | Capital services, volume indices, 2010 = 100 |
| CAPIT_QI | ICT capital services, volume indices, 2010 = 100 |
| CAPNIT_QI | Non-ICT capital services, volume indices, 2010 = 100 |
| Contributions to value added growth | |
| VA_Q | Growth rate of value added volume (% per year) |
| VAConH | Contribution of hours worked to value added growth (percentage points) |
| VAConLC | Contribution of labour composition change to value added growth (percentage points) |
| VAConKIT | Contribution of ICT capital services to value added growth (percentage points) |
| VAConKNIT | Contribution of non-ICT capital services to value added growth (percentage points) |
| VAConTFP | Contribution of TFP to value added growth (percentage points) |
| TFPva_I | TFP (value added based) growth, 2010 = 100 |
| Contributions to value added per hour worked growth | |
| LP1_Q | Growth rate of value added per hour worked (% per year) |
| LP1ConLC | Contribution of labour composition change to value added per hour worked growth (percentage points) |
| LP1ConKIT | Contribution of ICT capital services to value added per hour worked (percentage points) |
| LP1ConKNIT | Contribution of non-ICT capital services to value added per hour worked (percentage points) |
| LP1ConTFP | Contribution of TFP to value added per hour worked growth (percentage points) |
| TFPp1_I | TFP (value added per hour worked based) growth, 2010=100 |
| Contributions to value added per person employed growth | |
| LP2_Q | Growth rate of value added per person employed (% per year) |
| LP2ConLC | Contribution of labour composition change to value added per person employed growth (percentage points) |
| LP2ConKIT | Contribution of ICT capital services to value added per person employed (percentage points) |
| LP2ConKNIT | Contribution of non-ICT capital services to value added per person employed (percentage points) |
| LP2ConTFP | Contribution of TFP to value added per person employed growth (percentage points) |
| TFPp2_I | TFP (value added per person employed based) growth, 2010=100 |

Capital Input File

Nominal gross fixed capital formation, in millions of national currency

| | |
|---------------------------|----------------------------------|
| I_IT | Computing equipment |
| I_CT | Communications equipment |
| I_Soft_DB | Computer software and databases |
| I_TraEq | Transport Equipment |
| I_OMach | Other Machinery and Equipment |
| I_OCon | Total Non-residential investment |
| I_RStruc | Residential structures |
| I_Cult | Cultivated assets |
| I_RD | Research and development |
| I_OIPP | Other IPP assets |
| I_GFCF | All assets |

Real gross fixed capital formation volume (2010 prices)

| | |
|----------------------------|----------------------------------|
| Iq_IT | Computing equipment |
| Iq_CT | Communications equipment |
| Iq_Soft_DB | Computer software and databases |
| Iq_TraEq | Transport Equipment |
| Iq_OMach | Other Machinery and Equipment |
| Iq_OCon | Total Non-residential investment |
| Iq_RStruc | Residential structures |
| Iq_Cult | Cultivated assets |
| Iq_RD | Research and development |
| Iq_OIPP | Other IPP assets |
| Iq_GFCF | All assets |

Gross fixed capital formation price index (2010=100.0)

| | |
|----------------------------|----------------------------------|
| Ip_IT | Computing equipment |
| Ip_CT | Communications equipment |
| Ip_Soft_DB | Computer software and databases |
| Ip_TraEq | Transport Equipment |
| Ip_OMach | Other Machinery and Equipment |
| Ip_OCon | Total Non-residential investment |
| Ip_RStruc | Residential structures |
| Ip_Cult | Cultivated assets |
| Ip_RD | Research and development |
| Ip_OIPP | Other IPP assets |
| Ip_GFCF | All assets |

Nominal capital stock, in millions of national currency

| | |
|---------------------------|----------------------------------|
| K_IT | Computing equipment |
| K_CT | Communications equipment |
| K_Soft_DB | Computer software and databases |
| K_TraEq | Transport Equipment |
| K_OMach | Other Machinery and Equipment |
| K_OCon | Total Non-residential investment |
| K_RStruc | Residential structures |
| K_Cult | Cultivated assets |
| K_RD | Research and development |
| K_OIPP | Other IPP assets |
| K_GFCF | All assets |

Real fixed capital stock (2010 prices)

| | |
|----------------------------|----------------------------------|
| Kq_IT | Computing equipment |
| Kq_CT | Communications equipment |
| Kq_Soft_DB | Computer software and databases |
| Kq_TraEq | Transport Equipment |
| Kq_OMach | Other Machinery and Equipment |
| Kq_OCon | Total Non-residential investment |
| Kq_RStruc | Residential structures |
| Kq_Cult | Cultivated assets |
| Kq_RD | Research and development |
| Kq_OIPP | Other IPP assets |
| Kq_GFCF | All assets |

Additional variables

| | |
|-------------------------|---------------------------------------|
| Deprate | EU KLEMS Geometric depreciation rates |
|-------------------------|---------------------------------------|

Table A2: Reduced industry coverage of capital variables.

| Variable | EL | IE | PT | BG | CY | EE | HU | LV | LT | PL | RO |
|------------|----|----|----|----|----|----|----|----|----|----|----|
| I_IT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| I_CT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| I_Soft_DB | TE | TE | - | TE | TE | MS | MS | MS | NA | NA | TE |
| I_TraEq | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| I_OMach | TE | TE | - | TE | TE | MS | MS | MS | TE | MS | TE |
| I_OCon | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| I_RStruc | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| I_Cult | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| I_RD | TE | TE | - | TE | TE | MS | MS | TE | TE | TE | TE |
| I_OIPP | TE | TE | - | TE | TE | MS | MS | TE | TE | TE | TE |
| I_GFCF | - | TE | - | - | MS | MS | MS | TE | TE | MS | - |
| Iq_IT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| Iq_CT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| Iq_Soft_DB | TE | TE | - | TE | TE | MS | MS | MS | NA | NA | TE |
| Iq_TraEq | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| Iq_OMach | TE | TE | - | TE | TE | MS | MS | MS | TE | MS | TE |
| Iq_OCon | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| Iq_RStruc | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| Iq_Cult | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| Iq_RD | TE | TE | - | TE | TE | MS | MS | TE | TE | NA | TE |
| Iq_OIPP | TE | TE | - | TE | TE | MS | MS | TE | TE | TE | TE |
| Iq_GFCF | - | TE | - | - | MS | MS | MS | TE | TE | MS | - |
| Ip_IT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| Ip_CT | TE | TE | - | TE | TE | TE | NA | MS | TE | NA | NA |
| Ip_Soft_DB | TE | TE | - | TE | TE | MS | MS | MS | NA | NA | TE |
| Ip_TraEq | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| Ip_OMach | TE | TE | - | TE | TE | MS | MS | MS | TE | MS | TE |
| Ip_OCon | - | MS | - | - | MS | MS | MS | MS | MS | MS | TE |
| Ip_RStruc | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| Ip_Cult | - | MS | - | - | - | MS | MS | MS | MS | MS | TE |
| Ip_RD | TE | TE | - | TE | TE | MS | MS | TE | TE | NA | TE |
| Ip_OIPP | TE | TE | - | TE | TE | MS | MS | TE | TE | TE | TE |
| Ip_GFCF | - | TE | - | - | MS | MS | MS | TE | TE | MS | - |
| K_IT | TE | TE | TE | NA | MS | TE | NA | MS | MS | NA | NA |
| K_CT | TE | TE | TE | NA | TE | TE | NA | MS | MS | NA | NA |
| K_Soft_DB | TE | TE | TE | NA | TE | MS | MS | MS | TE | TE | NA |
| K_TraEq | - | MS | - | NA | MS | MS | MS | MS | MS | MS | NA |
| K_OMach | TE | TE | TE | NA | TE | MS | MS | MS | MS | NA | NA |
| K_OCon | - | MS | - | NA | MS | MS | MS | MS | MS | MS | NA |
| K_RStruc | - | MS | - | NA | - | MS | MS | MS | MS | MS | NA |
| K_Cult | - | MS | - | NA | - | MS | MS | MS | MS | MS | NA |
| K_RD | TE | TE | TE | NA | TE | MS | MS | TE | TE | TE | NA |
| K_OIPP | TE | TE | TE | NA | TE | MS | TE | TE | TE | TE | NA |
| K_GFCF | - | TE | TE | NA | TE | MS | MS | TE | MS | MS | NA |
| Kq_IT | TE | TE | TE | NA | MS | TE | NA | MS | MS | NA | NA |
| Kq_CT | TE | TE | TE | NA | TE | TE | NA | MS | MS | NA | NA |
| Kq_Soft_DB | TE | TE | TE | NA | TE | MS | MS | MS | TE | TE | NA |
| Kq_TraEq | - | MS | - | NA | MS | MS | MS | MS | MS | MS | NA |
| Kq_OMach | TE | TE | TE | NA | TE | MS | MS | MS | MS | NA | NA |
| Kq_OCon | - | MS | - | NA | MS | MS | MS | MS | MS | MS | NA |
| Kq_RStruc | - | MS | - | NA | - | MS | MS | MS | MS | MS | NA |
| Kq_Cult | - | MS | - | NA | - | MS | MS | MS | MS | MS | NA |
| Kq_RD | TE | TE | TE | NA | TE | MS | MS | TE | TE | NA | NA |
| Kq_OIPP | TE | TE | TE | NA | TE | MS | TE | TE | TE | TE | NA |
| Kq_GFCF | - | TE | TE | NA | TE | MS | MS | TE | MS | MS | NA |

- Full industry detail
TE Total Economy
MS Main sections
NA Asset not available