

EU KLEMS Growth and Productivity Accounts

2012 release

Description of methodology and country notes for the United States

Prepared by
Reitze Gouma and Marcel Timmer
(Groningen Growth and Development Centre)

Introduction

The 2012 EU KLEMS release follows up from the previous release in 2009 which showed detailed growth accounts up to 2007. Since last year many European NSIs started to produce data based on the new NACE 2 industry classification, which is consistent with the international standardized ISIC Revision 4 industry classification. Accordingly, we adjusted the industrial classification used in EU KLEMS. We distinguish between 34 industries covering the total economy. The United States are a special case in the EU KLEMS database since the native industry classification is the NAICS classification. Due to the switch to NACE 2 in EU KLEMS, new concordance tables have been developed to map the NAICS industries to the new NACE 2 EU KLEMS list.

A new dataset has become available from the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS) for the period 1998-2010, called 'A Prototype BEA/BLS Industry-Level Production Account for the United States'¹. The sources and methodology of the construction of this database are documented in the paper by Fleck et al, 2012². They provide a Gross Output based growth accounting decomposition following the same methodology as in the EU KLEMS database. For more detailed information on the general growth accounting methodology and construction of the EU KLEMS database, see O'Mahony, Mary and Marcel P. Timmer (2009)³.

Earlier releases of the EU KLEMS databases provide time series back to 1977. In order to produce estimations of TFP in the new industry classification prior to 1998, back-casts of the time series of output and labour, as well as the capital and labour services data have been made. These back-casts are based on data in the NACE 1 classification from the March 2008 (08I) release of the EU KLEMS database. Back-casted data is denoted in grey in the output file of this release.

Section 1 of this document describes the issues in mapping the NAICS industries from the BEA/BLS prototype Industry-Level Production Account to the new NACE 2 industries in the KLEMS output files, as well as the NACE 1 – NACE 2 concordances. Section 2 provides the methods applied for the estimation of back casts of the time series using the available KLEMS data in the NACE 1 industry

¹ The original the BEA/BLS prototype Industry-Level Production Account for the United States can be found on the website of the [BEA](#).

² Fleck, Susan, Steven Rosenthal, Matthew Russell, Erich H. Strassner, Lisa Usher, November, 2012. "[A Prototype BEA/BLS Industry-Level Production Account for the United States](#)"

³ O'Mahony, Mary and Marcel P. Timmer (2009), '[Output, Input and Productivity Measures at the Industry Level: the EU KLEMS Database](#)', *Economic Journal*, 119(538), pp. F374-F403

classification from the U.S. 08I NAICS output file⁴. Section 3 covers additional notes on the growth accounting variables and further notes on construction. The appendix shows the industry concordance tables that are used to map the BEA/BLS prototype Industry-Level Production Account industries in NAICS to the new EU KLEMS NACE 2 industry list. Additionally the NACE 1 to NACE 2 mapping table for the back-casts of output and labour variables and a separate, less detailed, table for back-casting capital and labour services indices are presented.

1 Mapping NAICS and NACE 1 to NACE 2

In this section the main issues in mapping the NAICS industries to the new NACE 2 classification are briefly highlighted. The same is done for the industry mapping between NACE 1 and NACE 2 industries.

Mapping NAICS to NACE 2

In general the new NACE 2 industry classification provides a better fit with the NAICS industry classification for many industries and sectors. Particularly the new 'Information and Communication' sector (J) is an improvement in matching corresponding NAICS industries. However, there are a number of industries that do not map directly to NACE 1 industries and therefore compromises have been made. To a large extent these issues were already present when mapping the NAICS industries to the NACE 1 industry list. Some of these mapping difficulties are specific to the U.S. like the case of U.S. postal services which is mostly a state owned enterprise, therefore output and labour for this industry are in state and local government which is now allocated to the 'Public Administration and Defence, compulsory social security' (O). The NAICS-NACE 2 concordance used for the U.S. is based on an OECD (many to one) mapping to a target NACE 2 industry list at the A38 level. The EU KLEMS 34 industries list deviates slightly from the official A38 list; hence the mapping table has been adjusted for these differences. The source NAICS industry list from the BEA/BLS prototype Industry-Level Production Account consists of 63 industries. No attempt was made to split NAICS industries. The full mapping table is given in **Appendix table 1**. The list below gives a brief overview of the most important mapping issues.

- There is no separate data available of Postal and courier services, which is included in state and local government.
- The numbers reported for 'Education' pertain to private education only. Public education is included in government services.
- There is no split available of wholesale and retail of motor vehicles from total wholesale and retail trade, so the wholesale and retail trade and repair of motor vehicles is included in both wholesale and retail. Therefore only the totals for 'Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles' are shown.
- There is no separate NAICS total for Public administration and defence, hence the whole of Federal government and State and local government was allocated to public administration and defence. This sector also includes Public education and state owned enterprises such as U.S. Postal.

⁴ These data are available on the website of [EU KLEMS](#).

Mapping NACE 1 to NACE 2

When producing back-casts of time series, industry mappings between the old and the new classifications have to be made. For many industries the NACE 1 and NACE 2 industry classifications are a close or even one to one match. However, the new NACE 2 classification also features a number of industries which are completely new and are comprised of multiple activities at the 4-digit level spread across many NACE 1 2-digit industry aggregates. For these industries it is impossible to make a perfect match given the level of detail at which NACE 1 and NACE 2 data is currently available, hence compromises have been made. The full, many to one, mapping table used for back-casting the output and labour variables, is shown in **appendix table 2**. The short list below indicates the most problematic industries:

- Postal and courier activities are allocated to NACE 2 industry 53 whereas in NACE 1 these activities were part of Post and Telecommunications, combined in the 2-digit industry 64.
- The NACE 2 sector J, Information and communication, consists of Publishing, Audiovisual and broadcasting activities (58-60), Telecommunications (61), and IT and other information services (62-63). These activities consist of multiple NACE 1 industries belonging to several 2-digit sectors. Sector J is the sectors for which time series estimates will be most inaccurate. A split of NACE 1 industry 64 is not available in EU KLEMS so in general Postal and Courier activities are included in the estimation of the growth of J.

2 Back-casting time series in EU KLEMS

Since data on output and labour as well as labour and capital services inputs are only available from 1998 onwards in the BEA/BLS prototype Industry-Level Production Account, the EU KLEMS U.S. 08I NAICS file is used to back-cast these series to 1977. For output and labour the NACE 1 file includes data for 72 separate industries, excluding industry aggregates. Back-casting is done based on growth rates, using a many to one industry concordance, discussed in the previous section and shown in **appendix table 2**. The mapping is done in such a way that the combination of NACE 1 industries approximates the growth rate of the target NACE 2 industry as closely as possible. However, for the capital and labour services much less detail in the NACE 1 industry list is available from the 08I U.S. NAICS file. This section explains in more detail the methods applied to estimate the data series prior to 1998.

Back-casting output and labour variables

The **appendix table 2** shows which NACE 1 industry or combination of NACE 1 industries from the 09ii output file are used to calculate a growth rate, which is applied to the value of the NACE 2 industry in the following year. This is done only for the most detailed NACE 2 industries (lowest level). Industry aggregates of NACE 2 industries are calculated from the bottom up, following the same approach as in previous EU KLEMS releases. For nominal variables the NACE 1 industries are aggregated by simple summation in order to calculate the NACE 2 industry's growth rate. For volumes and price deflators a Tornqvist⁵ growth rate is calculated from the NACE 1 industries, using the corresponding nominal variable as weights. The intermediate inputs deflator (II_P) is estimated as a weighted average of the gross output and value added deflator using the following equation:

⁵ The Tornqvist aggregation approach uses annual moving weights based on averages of adjacent points in time. For more information on this procedure see the general EU KLEMS methodology [document](#).

$$dP_{II} = dP_{GO} \frac{\overline{GO}}{II} - dP_{VA} \frac{\overline{VA}}{II}$$

For the U.S. only a volume index of hours worked is available. Therefore the growth rate of hours worked of the NACE 1 industry, or industries, is used to estimate the growth in the NACE 2 volume index. For higher industry aggregates the volume index of hours worked is Tornqvist aggregated using labour compensation (LAB) as weights. LAB itself is estimated based on the share of LAB in value added (VA) from the NACE 1 industries.

Back-casting capital and labour services

In the BEA/BLS prototype Industry-Level Production Account, data on capital and labour services is directly available, no investment data by asset type is provided. In order to do a full growth decomposition we need a back-cast of not only the output and labour data but also the factor inputs, capital and labour services, as well as their cost shares. Estimated back-casts of capital and labour services are being calculated based on growth rates, prior to 1998, in the same way as back casts are estimated for the output and labour variables. However, for the capital and labour services data from the 08I NAICS output file are available at the 32 industry level only. This means that an adjusted concordance table has to be used when mapping the NACE 1 industries to NACE 2 industries. This adjusted mapping table is presented in **appendix table 3**. This mapping is necessarily less detailed than the one based on the 72 NACE 1 industries. For some NACE 2 industries it is not possible to estimate a meaningful growth rate of capital and labour services based on the NACE 1 industries. In these cases no growth decomposition is done and the cells for these industries are left empty. This is the case for the following industries:

- Publishing, audiovisual and broadcasting activities (NACE 2 industry 58-60)
- Telecommunications (NACE 2 industry 61)
- IT and other information services (NACE 2 industry 62-63)
- Arts, entertainment and recreation (NACE 2 industry R)
- Other service activities (NACE 2 industry S)

For the total of industries 58 to 63, which is the Information and Communication sector (J), no estimates for the aggregate can be given. For the total of industries R and S (R-S), an accurate total can be estimate by taking the growth of the total of Other Community, Social and personal Services (NACE 1 industry O) as an estimator. Similarly for the Wholesale and Retail Trade sector (G) only the aggregate industry is estimated.

The BEA/BLS prototype Industry-Level Production Account does not provide a split of capital services into capital services for ICT and non-ICT assets, so only total capital services are used (CAP_QI). For labour services the growth rate of labour services per hour worked (LAB_QPH) are taken from the 08I NAICS file and added to the estimated growth rate of the volume index of hours worked, to arrive at a growth rate for labour services (LAB_QI).

3 Notes on growth accounting

In the BEA/BLS prototype Industry-Level Production Account dataset, a growth accounting decomposition is presented of Gross Output (GO) growth into the contributions of capital services (K), Labour services (L) and three types of intermediate inputs; Energy, Materials, Services (E, M, S), for the period 1998-2010. In the EU KLEMS NACE 2 file we provide a growth accounting decomposition based on Value Added (VA) growth into the contributions of the growth of Labour and Capital services for the period 1977-2010. The growth contribution of labour services is further split into the contribution of hours worked and the changes in the composition of the labour force. This decomposition is methodologically identical to the decomposition in the 08I NAICS output file.

As has been discussed, prior to 1998 the growth rates of the output and labour variables as well as capital and labour services for the NACE 2 industries are estimated based on the NACE 1 industries from the KLEMS 08I NAICS output file. The cost shares of labour compensation (LAB) and capital compensation (CAP) are also derived from the shares of LAB and CAP in VA from the 08I NAICS file. It follows that for industries where the NACE 1 to NACE 2 industry mapping is a perfect match, both for the output and labour data as well as capital and labour services, the result from the growth accounting decomposition are the same as in the 08I NAICS file. That is, the results for Total Factor Productivity (TFP) as well as the growth contributions of factor inputs are replicated for NACE 2 industries. This only holds for industries at the lowest level of aggregation, results for sector aggregates may deviate due to differences in the weights. Due to the fact that for some NACE 2 industries it was not possible to produce estimates on Labour and Capital services, no growth decomposition can be made for these industries. Therefore a bottom up estimation of TFP at the total economy level is not possible. For this reason the growth accounting results from the 08I NAICS are taken as given at the total economy level for the 1977-1997 period.

After 1998 the results for the contributions of TFP and factor inputs to Value Added growth have changed for all industries. The changes stem, for the most part, from revised estimates in the BEA/BLS prototype Industry-Level Production Account of capital services compared to earlier releases. The estimates of output growth have also been revised.

Appendix Table 1

U.S. NAICS-NACE2 many to one industry concordance

NAICS list	NACE 2	NAICS Description	Comments on NAICS industries
111, 112	A	Farms	
113, 114, 115	A	Forestry, fishing, and related activities	
211	B	Oil and gas extraction	
212	B	Mining, except oil and gas	
213	B	Support activities for mining	
22	D-E	Utilities	
23	F	Construction	
321	16-18	Wood products	
327	22-23	Nonmetallic mineral products	
331	24-25	Primary metals	
332	24-25	Fabricated metal products	
333	28	Machinery	
334	26-27	Computer and electronic products	
335	26-27	Electrical equipment, appliances, and components	
3361, 3362, 3363	29-30	Motor vehicles, bodies and trailers, and parts	
3364, 3365, 3366, 3369	29-30	Other transportation equipment	
337	31-33	Furniture and related products	
339	31-33	Miscellaneous manufacturing	
311, 312	10-12	Food and beverage and tobacco products	
313, 314	13-15	Textile mills and textile product mills	
315, 316	13-15	Apparel and leather and allied products	
322	16-18	Paper products	
323	16-18	Printing and related support activities	
324	19	Petroleum and coal products	
325	20-21	Chemical products	
326	22-23	Plastics and rubber products	
42	46	Wholesale trade	Includes Wholesale of motor vehicles
44, 45	47	Retail trade	Includes Retail of motor vehicles
481	49-52	Air transportation	
482	49-52	Rail transportation	
483	49-52	Water transportation	
484	49-52	Truck transportation	
485	49-52	Transit and ground passenger transportation	
486	49-52	Pipeline transportation	
487, 488, 492	49-52	Other transportation and support activities	Includes parts of postal and courier services (NAICS 492; Couriers and messengers)
493	49-52	Warehousing and storage	
511, 516	58-60	Publishing industries (includes software)	
512	58-60	Motion picture and sound recording industries	
515, 517	61	Broadcasting and telecommunications	Includes broadcasting
518, 519	62-63	Information and data processing services	
521, 522	K	Federal Reserve banks, credit intermediation, and related activities	
523	K	Securities, commodity contracts, and investments	
524	K	Insurance carriers and related activities	
525	K	Funds, trusts, and other financial vehicles	
531	L	Real estate	
532, 533	L	Rental and leasing services and lessors of intangible assets	
5411	M-N	Legal services	
5415	62-63	Computer systems design and related services	
5412-5414, 5416-5419	M-N	Miscellaneous professional, scientific, and technical services	
55	M-N	Management of companies and enterprises	
561	M-N	Administrative and support services	

U.S. NAICS-NACE2 many to one industry concordance (continued)

NAICS list	NACE 2	NAICS Description	Comments on NAICS industries
562	D-E	Waste management and remediation services	
61	P	Educational services	Excludes public education
621	Q	Ambulatory health care services	Excludes public health care
622, 623	Q	Hospitals and nursing and residential care facilities	Excludes public health care
624	Q	Social assistance	Excludes public health care
711, 712	R	Performing arts, spectator sports, museums, and related activities	
713	R	Amusements, gambling, and recreation industries	
721	I	Accommodation	
722	I	Food services and drinking places	
81	S	Other services, except government	Includes T (Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use)
NA	O	Federal government	
NA	O	State and local government	Includes the public part of education as well as state owned companies

Appendix Table 2

Industry concordance for back casts of nominal output and labour data		
NACE 1 list (many to 1 mapping)	NACE 2	NACE 2 Description
Aggregate	TOT	TOTAL INDUSTRIES
AtB	A	AGRICULTURE, FORESTRY AND FISHING
C	B	MINING AND QUARRYING
Aggregate	C	TOTAL MANUFACTURING
15t16	10-12	Food products, beverages and tobacco
17t19	13-15	Textiles, wearing apparel, leather and related products
20	16-18	
21	16-18	Wood and paper products; printing and reproduction of recorded media
22x	16-18	
23	19	Coke and refined petroleum products
24	20-21	Chemicals and chemical products
25	22-23	
26	22-23	Rubber and plastics products, and other non-metallic mineral products
27t28	24-25	Basic metals and fabricated metal products, except machinery and equipment
30t33	26-27	Electrical and optical equipment
29	28	Machinery and equipment n.e.c.
34t35	29-30	Transport equipment
36t37	31-33	Other manufacturing; repair and installation of machinery and equipment
E	D-E	ELECTRICITY, GAS AND WATER SUPPLY
90	D-E	
F	F	CONSTRUCTION
G	G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
na*	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
na*	46	Wholesale trade, except of motor vehicles and motorcycles
na*	47	Retail trade, except of motor vehicles and motorcycles
Aggregate	H	TRANSPORTATION AND STORAGE
60t63	49-52	Transport and storage
64	53	Postal and courier activities
H	I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES
Aggregate	J	INFORMATION AND COMMUNICATION
221	58-60	Publishing, audiovisual and broadcasting activities
921t2	58-60	Publishing, audiovisual and broadcasting activities
64	61	Telecommunications
72	62-63	IT and other information services
J	K	FINANCIAL AND INSURANCE ACTIVITIES
70	L	REAL ESTATE ACTIVITIES
71	M-N	PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
73	M-N	
74	M-N	
Aggregate	O-U	COMMUNITY SOCIAL AND PERSONAL SERVICES
L	O	Public administration and defence; compulsory social security
M	P	Education
N	Q	Health and social work
Aggregate	R-S	ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICE ACTIVITIES
923t7	R	Arts, entertainment and recreation
91	S	Other service activities
93	S	
P	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
Q	U	Activities of extraterritorial organizations and bodies

***No back-casted series are estimated for this NACE 2 industry.**

Appendix Table 3

U.S. Industry concordance for back casts of capital and labour services			
NACE 1 list	NACE 2	NACE 2 Description	Comments
TOT	TOT	TOTAL INDUSTRIES	Taken directly from the 08I file, no bottom up approach
AtB	A	AGRICULTURE, FORESTRY AND FISHING	
C	B	MINING AND QUARRYING	
	C	TOTAL MANUFACTURING	Aggregate industry, estimated bottom up
15t16	10-12	Food products, beverages and tobacco	
17t19	13-15	Textiles, wearing apparel, leather and related products	
20+21t22	16-18	Wood and paper products; printing and reproduction of recorded media	Used combination of NACE 1 industries
23	19	Coke and refined petroleum products	
24	20-21	Chemicals and chemical products	
25+26	22-23	Rubber and plastics products, and other non-metallic mineral products	Used combination of NACE 1 industries
27t28	24-25	Basic metals and fabricated metal products, except machinery and equipment	
30t33	26-27	Electrical and optical equipment	
29	28	Machinery and equipment n.e.c.	
34t35	29-30	Transport equipment	
36t37	31-33	Other manufacturing; repair and installation of machinery and equipment	
E	D-E	ELECTRICITY, GAS AND WATER SUPPLY	
F	F	CONSTRUCTION	
G	G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	
na*	45	Wholesale and retail trade and repair of motor vehicles and motorcycles	
na*	46	Wholesale trade, except of motor vehicles and motorcycles	
na*	47	Retail trade, except of motor vehicles and motorcycles	
	H	TRANSPORTATION AND STORAGE	Aggregate industry, estimated bottom up
60t63	49-52	Transport and storage	
64	53	Postal and courier activities	
H	I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES	
na*	J	INFORMATION AND COMMUNICATION	
na*	58-60	Publishing, audiovisual and broadcasting activities	
na*	61	Telecommunications	
na*	62-63	IT and other information services	
J	K	FINANCIAL AND INSURANCE ACTIVITIES	
70	L	REAL ESTATE ACTIVITIES	
71t74	M-N	PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	
	O-U	COMMUNITY SOCIAL AND PERSONAL SERVICES	Aggregate industry, estimated bottom up
L	O	Public administration and defence; compulsory social security	
M	P	Education	
N	Q	Health and social work	
O	R-S	SERVICE ACTIVITIES	
na*	R	Arts, entertainment and recreation	
na*	S	Other service activities	
P	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	
Q	U	Activities of extraterritorial organizations and bodies	

***No back-casted series are estimated for this NACE 2 industry.**