European Utilization-Adjusted Productivity Growth (EUROPROD-UA)

Version 1.0 - Handbook

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Abstract

This handbook describes Version 1.0 of the EUROPROD-UA database, hosted at https://doi.org/10.53479/DS-europrod-ua. The database contains utilization- and profit-adjusted TFP growth rates at the annual and quarterly frequency for the five largest Euro Area countries (Germany, France, Italy, Spain and the Netherlands). The methodology used to compute these series closely follows our prior work (Comin *et al.*, 2025), with some minor adjustments to ensure that our estimations can be updated and replicated more easily.

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1 Introduction

In Comin *et al.* (2025), we developed new measures of utilization-adjusted Total Factor Productivity (TFP) growth for European countries. Our work introduced three main novelties with respect to the literature.

1. We estimated unobserved fluctuations in factor utilization, relying on data from capacity utilization surveys. As we argued in our paper, these surveys provide a more reliable picture of utilization in Europe than hours per worker, which were established as the standard utilization proxy for the United States by Basu *et al.* (2006) and Fernald (2014).

2. We measured output elasticities as cost shares rather than sales shares, to account for positive profits. This avoids a bias from the conventional (and arguably counterfactual) zero-profit assumption in most of the growth accounting literature.

3. We constructed aggregate series on quarterly TFP growth. Prior to our work, there was no database providing quarterly TFP growth rates (utilization-adjusted or not) for Euro Area countries, and our paper therefore filled an important data gap.

The database on European Utilization-Adjusted Productivity Growth (EUROPROD-UA), hosted by the Bank of Spain at `https://doi.org/10.53479/DS-europrod-ua`, contains the latest update of our data. The current update, Version 1.0, covers the five largest Euro Area economies (Germany, France, Spain, Italy and the Netherlands), which jointly represented about 80% of Euro Area GDP in 2024.

This short paper is a guide for data users, and documents the construction of our series. We refer the reader to Comin *et al.* (2025) for an in-depth discussion of our methodological choices. Note that while EUROPROD-UA closely follows our original work, we do make a number of adjustments (fully described below). These adjustments do not affect any of the original insights, but make the series easier to update and more comparable to standard growth accounting data sources.

Coverage and future updates In Version 1.0 of EUROPROD-UA, annual data covers the period 1995-2020, while quarterly data covers the period 1998Q1-2024Q4. For each country, annual data is available at the industry and at the aggregate level, while quarterly data is only available at the aggregate level, due to data limitations.

We aim to update the quarterly data roughly every six months. The annual data, in turn, will be updated infrequently, depending on future releases of the EU KLEMS database (which is the main data source for our annual estimates).[1] We may also be able to include data for more countries in the future. For each new version, we will update the handbook accordingly.

The remainder of this handbook describes Version 1.0 of EUROPROD-UA, as well as the changes with respect to Version 0 (i.e., the database originally published with Comin *et al.*, 2025). Appendix A contains a full version history, listing all published versions of the database and briefly describing the changes from one version to another. All past versions of the data (and handbooks) can be downloaded on the EUROPROD-UA website. Appendix B contains a full list of the variables included in Version 1.0.

2 Annual TFP series

For each country, EUROPROD-UA contains annual utilization and profit-adjusted TFP growth rates for about 25 industries, as well as a growth rate of aggregate TFP. The focus is on the business economy, and we therefore exclude industries such as government, health care and education. The main raw data sources used for our series are growth accounting data from EU KLEMS and capacity utilization data from the European Commission's Business and Consumer Surveys.

2.1 Methodology

Our estimation is carried out independently for each country. To simplify notation, we omit country superscripts whenever this does not cause confusion.

Industry TFP We compute the growth rate of TFP for each industry i, denoted by $dZ_{i,t}$. To do so, we first compute a non-utilization-adjusted TFP growth rate, defined as

$$d\widetilde{Z}_{i,t} = dY_{i,t} - \left(\alpha_{Ki,t}dK_{i,t} + \alpha_{Li,t}dL_{i,t} + \alpha_{Mi,t}dM_{i,t}\right), \tag{1}$$

$$\text{where } dK_{i,t} \equiv \sum_{a=1}^{9} \frac{\alpha^a_{Ki,t}}{\alpha_{Ki,t}} dK^a_{i,t}, \quad dL_{i,t} \equiv \sum_{\ell=1}^{18} \frac{\alpha^\ell_{Li,t}}{\alpha_{Li,t}} dL^\ell_{i,t}$$

$$\text{and} \quad \alpha_{Ki,t} \equiv \sum_{a=1}^{9} \alpha^a_{Ki,t}, \qquad \alpha_{Li,t} \equiv \sum_{\ell=1}^{18} \alpha^\ell_{Li,t}.$$

[1] EU KLEMS is a long-standing European project for growth accounting at the industry level, coordinated by the European Commission and carried out by different institutes over the years. An overview can be found at https://www.rug.nl/ggdc/productivity/eu-klems/?lang=en.

In this equation, $dY_{i,t}$ stands for the growth rate (expressed in log changes) of real gross output of industry i from year $t-1$ to year t. Non-utilization-adjusted TFP growth is the difference between output growth and a weighted average of input growth rates. $dM_{i,t}$ is the growth rate of the industry's real spending on intermediate inputs, while $dK_{i,t}$ and $dL_{i,t}$ are the growth rates of capital and labour input. Capital and labour input, in turn, are aggregates across 9 different capital assets and 18 different types of workers (as in EU KLEMS).[2] Thus, capital input growth is a weighted average of the growth rates in the real capital stock of different assets a (denoted by $dK^a_{i,t}$), and labour input is a weighted average of the growth rates in the total hours worked of different worker types ℓ (denoted by $dL^\ell_{i,t}$).

Changes in inputs are weighted by their factor elasticities α. For each production factor X (i.e., for materials, asset types a or worker types ℓ), we compute the corresponding factor elasticity as a moving average of cost shares, so that

$$\alpha_{Xi,t} = \frac{1}{2}\left(cs_{Xi,t-1} + cs_{Xi,t}\right), \tag{2}$$

where $cs_{Xi,t}$ is the share of input X in the total costs of industry i in year t. Note that by definition, cost shares add up to 1, so that industry-level production has constant returns to scale. While EU KLEMS has data on labour and intermediate input costs, there is no data on the cost of capital. To determine this cost, we compute rental rates of capital, using data on investment good prices, depreciation rates and returns to bonds and equity.[3] Comin *et al.* (2025) contains further details on these computations and the data sources used.

To obtain industry-level TFP growth $dZ_{i,t}$, we then run an IV regression of the non-utilization-adjusted TFP growth rates on changes in capacity utilization. Intuitively, the residual from this regression captures all the changes in TFP which are not due to changes in factor utilization.

To increase statistical power, we assign each industry i to one of three broad sectors j (durable manufacturing, non-durable manufacturing, and non-manufacturing). We then estimate

$$d\widetilde{Z}^j_{i,t} = \kappa^j_i + \beta^j dCU^j_{i,t} + \varepsilon^j_{i,t}, \tag{3}$$

where κ^j_i is a dummy variable for industry i of sector j and the utilization adjustment coefficient β^j is the same for all industries within a sector. We instrument changes in capacity utilization with five instrumental variables: oil price shocks, monetary policy

[2]In particular, workers are differentiated by gender, age and education. The Online Appendix of Comin *et al.* (2025) contains further details on all data sources and definitions.

[3]In the absence of profits, no estimation of rental rates is needed, because capital shares can be obtained as residuals (as it is done e.g. in EU KLEMS). However, with non-zero profits, both methods are not equivalent.

shocks, economic policy uncertainty shocks, shocks to financial conditions and a dummy for the Covid 19 pandemic.[4]

For reference, Table 1 lists the estimated utilization adjustment coefficients for all countries and sectors.[5] All coefficients are positive, indicating that when capacity utilization falls, TFP growth $dZ_{i,t}$ is adjusted upwards with respect to the non-utilization-adjusted TFP growth $d\widetilde{Z}_{i,t}$.

Table 1: Utilization adjustment coefficients

	Germany	Spain	France	Italy	Netherlands
Non-durable manufacturing	0.420	0.100	0.096	0.402	0.214
Durable manufacturing	0.291	0.155	0.190	0.273	0.350
Non-manufacturing	0.199	0.334	0.503	0.136	0.791

Precisely, utilization-adjusted TFP growth at the industry-level is the difference between the unadjusted growth rate and the utilization adjustment:

$$dZ^j_{i,t} = d\widetilde{Z}^j_{i,t} - \beta^j dCU^j_{i,t}. \tag{4}$$

Aggregate TFP We compute aggregate TFP growth at the country level as

$$dZ_t = \sum_{i=1}^{I} \frac{1}{2} \left(\lambda_{i,t-1} + \lambda_{i,t}\right) dZ_{i,t}, \tag{5}$$

where $\lambda_{i,t}$ is industry i's cost-based Domar weight in year t, defined in Baqaee and Farhi (2019) and Comin *et al.* (2025). This method is a generalization of the usual Domar/Hulten aggregation (where each industry is weighted by the ratio of its gross output to aggregate GDP) and allows for positive profits, in line with our estimation assumptions.

Solow residuals For comparison purposes, EUROPROD-UA also provides a Solow residual measure of TFP growth at the industry and the aggregate levels. At the industry-level, the Solow residuals are given by an analogue of equation (1), with different factor elasticities.

[4]The instruments in this regression should be orthogonal to TFP shocks (which may themselves cause changes in factor utilization). The Online Appendix of Comin *et al.* (2025) contains further details on our instruments and the raw data sources used to compute them.

[5]Table A.5 in Appendix D contains the full IV estimation results.

To obtain the latter, we discard our estimates for capital costs and instead assume, as in EU KLEMS, that total capital costs are equal to the difference between value added and labour costs (so that there are zero profits). The aggregate Solow residual is obtained through an analogue of equation (5), replacing the cost-based Domar weights with the standard sales-based ones (i.e., the ratios of industry gross output to aggregate GDP).

Euro Area averages Our database also provides a series for aggregate annual TFP growth in the Euro Area. This is simply a weighted average of the TFP growth rates of the five Euro Area countries, computed as

$$dZ_t^{EA} = \sum_{c=1}^{5} \frac{1}{2} \left(v_{t-1}^c + v_t^c \right) dZ_t^c, \tag{6}$$

where v_t^c is the share of country c in total real value added in year t, and dZ_t^c is the growth rate of aggregate TFP in country c. In the same way, we obtain a Solow residual measure for the Euro Area.

2.2 Differences with respect to Version 0

The annual data in Version 1.0 of EUROPROD-UA slightly differ from the ones in Version 0, published with Comin *et al.* (2025). This is due to three modifications with respect to the original paper.

1. **New growth accounting data.** Version 1.0 uses data from the 2023 EU KLEMS release, while Version 0 used the December 2021 release. For most countries, the 2023 release included two additional years of data.[6]

2. **Factor elasticities.** As shown in equation (2), factor elasticities are computed as moving averages in Version 1.0, whereas they were constant in Version 0. This change will ensure that in the future, new data does not retroactively alter past estimates. It also enhances comparability with EU KLEMS, which uses the same moving average method. It is worth noting that this change does not impact short and long-run patterns of TFP growth, as shown in Appendix C.1 of Comin *et al.* (2025) (which already considered moving averages for factor elasticities as a robustness check).

3. **Covid instrument.** Version 1.0 introduces one new instrument in the utilization adjustment regressions, capturing the Covid-19 pandemic. Given the time span of the

[6]The latest EU KLEMS releases are posted at `https://euklems-intanprod-llee.luiss.it/`.

annual data, this is simply a dummy for the year 2020.

3 Quarterly TFP series

EUROPROD-UA is currently, to the best of our knowledge, the only database containing quarterly TFP growth rates for Euro Area countries. Our series, which are adjusted for utilization and for non-zero profits, build on growth accounting data from Eurostat and on our annual estimation results.

3.1 Methodology

As in the annual estimation, our focus is on the business economy (and we therefore omit the public sector). However, due to a lack of sufficiently disaggregated data at the quarterly frequency, our quarterly series are not available at the industry level, but only for the aggregate business economy.

For each country, we define utilization-adjusted aggregate quarterly TFP growth as

$$dZ_t = dY_t - \left(\alpha_{K,t} dK_t + \alpha_{L,t} dL_t + dU_t\right). \tag{7}$$

In this equation, dY_t stands for the growth rate of real value added from quarter $t-1$ to quarter t, dL_t for the growth rate of labour input, dK_t for the growth rate of capital input, and dU_t for the growth rate of factor utilization.

Growth accounting The growth rates of real value added, labour and capital input (expressed again in log changes) are computed from Eurostat data, as described in detail in Appendix C. As in the annual data, our measures of capital and labour input are aggregates across different types of assets and workers, albeit at a lower level of disaggregation (due to data constraints). Precisely, we consider three different capital assets and six different types of workers, which are defined in Appendix C.

The factor elasticities $\alpha_{L,t}$ and $\alpha_{K,t}$ come from our annual data. To obtain them, we first define the annual aggregate cost share of the corresponding production factor (excluding costs for intermediate inputs). This gives

$$cs_{L,t}^{\text{Annual}} = \frac{\sum_{i=1}^{I} c_{Li,t}^{\text{Annual}}}{\sum_{i=1}^{I} \left(c_{Li,t}^{\text{Annual}} + c_{Ki,t}^{\text{Annual}}\right)} \quad \text{and} \quad cs_{K,t}^{\text{Annual}} = 1 - cs_{L,t}^{\text{Annual}}, \tag{8}$$

where $c^{\text{Annual}}_{Li,t}$ is the total cost of labour in industry i in year t (the sum across all worker types), and $c^{\text{Annual}}_{Ki,t}$ is the total cost of capital in industry i in year t (the sum across all asset types). We then linearly interpolate this annual series to derive a quarterly series,[7] and finally compute the factor elasticities as a moving average of the quarterly data, so that

$$\alpha_{L,t} = \frac{1}{2}\left(cs^{\text{Quarterly}}_{L,t-1} + cs^{\text{Quarterly}}_{L,t}\right), \quad \alpha_{K,t} = \frac{1}{2}\left(cs^{\text{Quarterly}}_{K,t-1} + cs^{\text{Quarterly}}_{K,t}\right).$$

As described above, our quarterly data covers a longer time horizon than our annual data. Thus, for the last years in the quarterly sample, we assume that factor elasticities remain constant and equal to their value in the last year with annual data.

Utilization adjustment The capacity utilization survey provides quarterly industry-level figures. Thus, for each industry i of broad sector j, the change in utilization is $\beta^j dCU^j_{i,t}$, where β^j is the utilization adjustment coefficient estimated with our annual data - shown in Table 1 - and $dCU^j_{i,t}$ denotes the quarterly change in capacity utilization for industry i.

To obtain the aggregate change in utilization dU_t, we aggregate industry-level changes using the cost-based Domar weights from our annual estimation, defined in equation (5). Again, we linearly interpolate annual Domar weights in order to get a quarterly series.

Solow residuals For comparison purposes, EUROPROD-UA also provides a quarterly Solow residual. The Solow residual is computed with an analogue of equation (7), with two modifications. First, we assume that there are no changes in utilization ($dU_t = 0$). Second, we compute factor elasticities under the assumption that total capital costs are equal to the difference between value added and labour costs, so that there are zero profits.

Euro Area series As in the annual data, the Euro Area series is a weighted average of the five country series, with

$$dZ^{EA}_t = \sum_{c=1}^{5} \frac{1}{2}\left(v^c_{t-1} + v^c_t\right) dZ^c_t, \tag{9}$$

where v^c_t is the share of country c in total real value added in quarter t. In the same way, we obtain a Solow residual measure for the Euro Area.

[7] Precisely, we use centered symmetric interpolation, ensuring that the average cost share of labour across the quarters of a year is equal to the annual value. We use the same method for all other instances in which we need to assign an annual data series to the quarterly frequency.

3.2 Differences with respect to Version 0

The quarterly data in Version 1 of EUROPROD-UA differ from the ones in Version 0, published with Comin *et al.* (2025), for four reasons.

1. **Industry coverage.** Our estimation focuses on the business economy. However, Eurostat does not directly publish growth accounting data consistent with the EU KLEMS definition of the business economy. In Version 0, we therefore used Eurostat data for output in the entire economy (including the public sector), and multiplied this data with the annual ratio of business output to total output taken from EU KLEMS. We proceeded similarly with employment or investment. In Version 1.0, instead, we only use Eurostat quarterly data on private industries. As a result, the industry coverage of the quarterly data is slightly different from the annual one (see Appendix C for details). However, the advantage of this approach is that we can now rely almost exclusively on Eurostat data, making updates more straightforward and independent of future releases of the EU KLEMS database.

2. **Factor elasticities.** As in the annual estimation, Version 1.0 uses time-varying factor elasticities, while Version 0 had fixed factor elasticities.

3. **Disaggregated capital data.** In Version 0, we constructed data on quarterly capital input by only using data on the aggregate capital stock. In Version 1.0, we instead construct a more sophisticated measure, using disaggregated data for three different asset categories. Appendix C contains further details on this point.

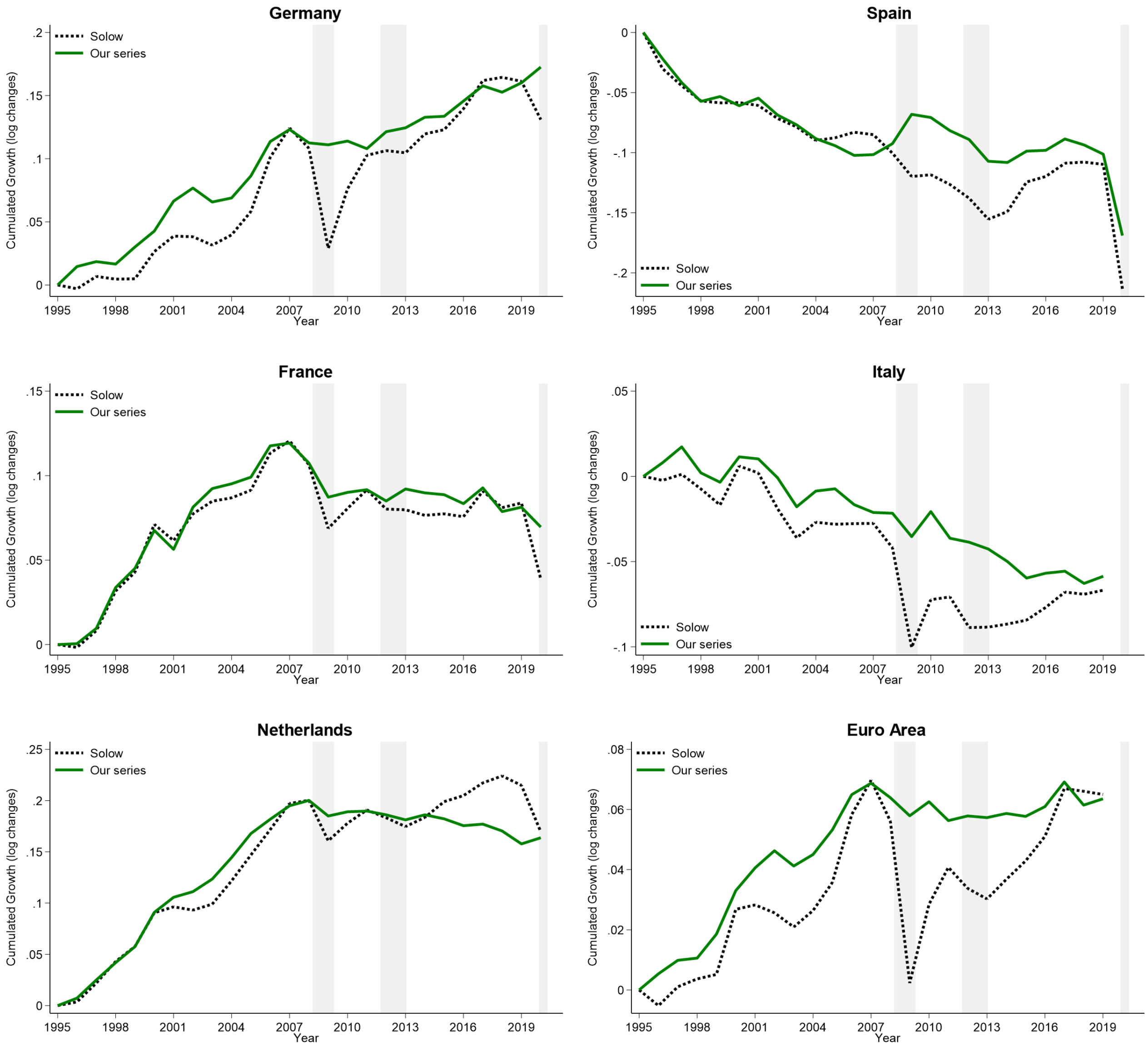
4. **Change in annual estimates**. Finally, the updates in the annual estimation obviously imply (small) changes in the estimates for factor elasticities and utilization adjustment coefficients, which feed into the quarterly data.

4 Figures

This section briefly illustrates the most important data series in EUROPROD-UA.

Annual TFP data Figure 1 shows annual cumulated aggregate TFP growth rates for the five countries and the Euro Area. Dotted black lines refer to a standard Solow residual and solid green lines refer to our TFP measure.

Figure 1: Cumulative aggregate TFP growth (annual data)

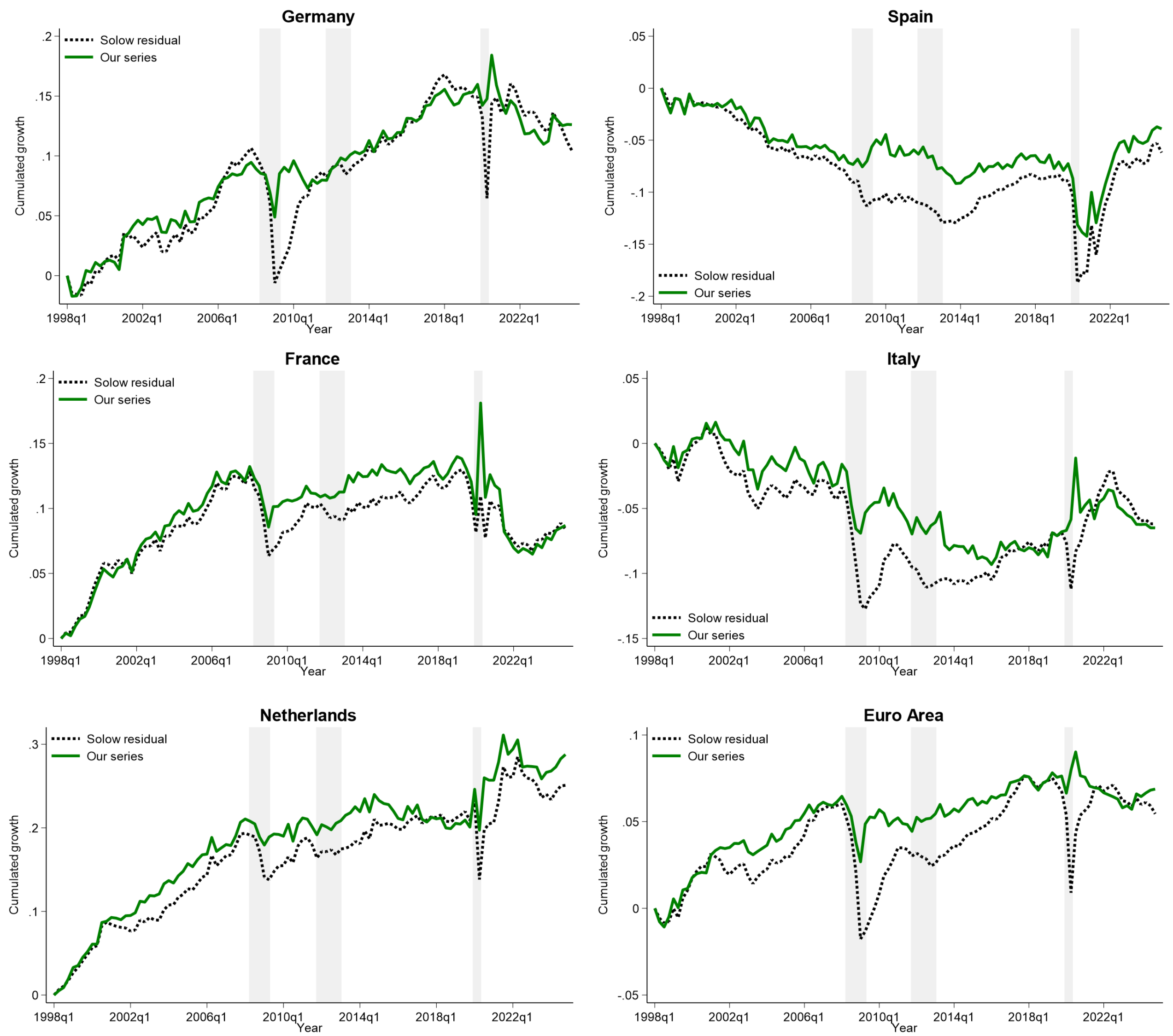


Notes: All series are normalized to 0 in 1995.

Quarterly TFP data Figure 2 plots the quarterly series for the five countries in the database and the Euro Area. Again, dotted black lines refer to a standard Solow residual and solid green lines refer to our TFP measure.

Due to the fact that annual and quarterly growth rates use different data sources, they are not exactly consistent (that is, cumulative TFP growth over a given period is different in the annual and in the quarterly dataset). However, both data frequencies do show the same trends and very similar cumulative growth rates for each country.

Figure 2: Cumulative aggregate TFP growth (quarterly data)



Notes: All series are normalized to 0 in 1998Q1.

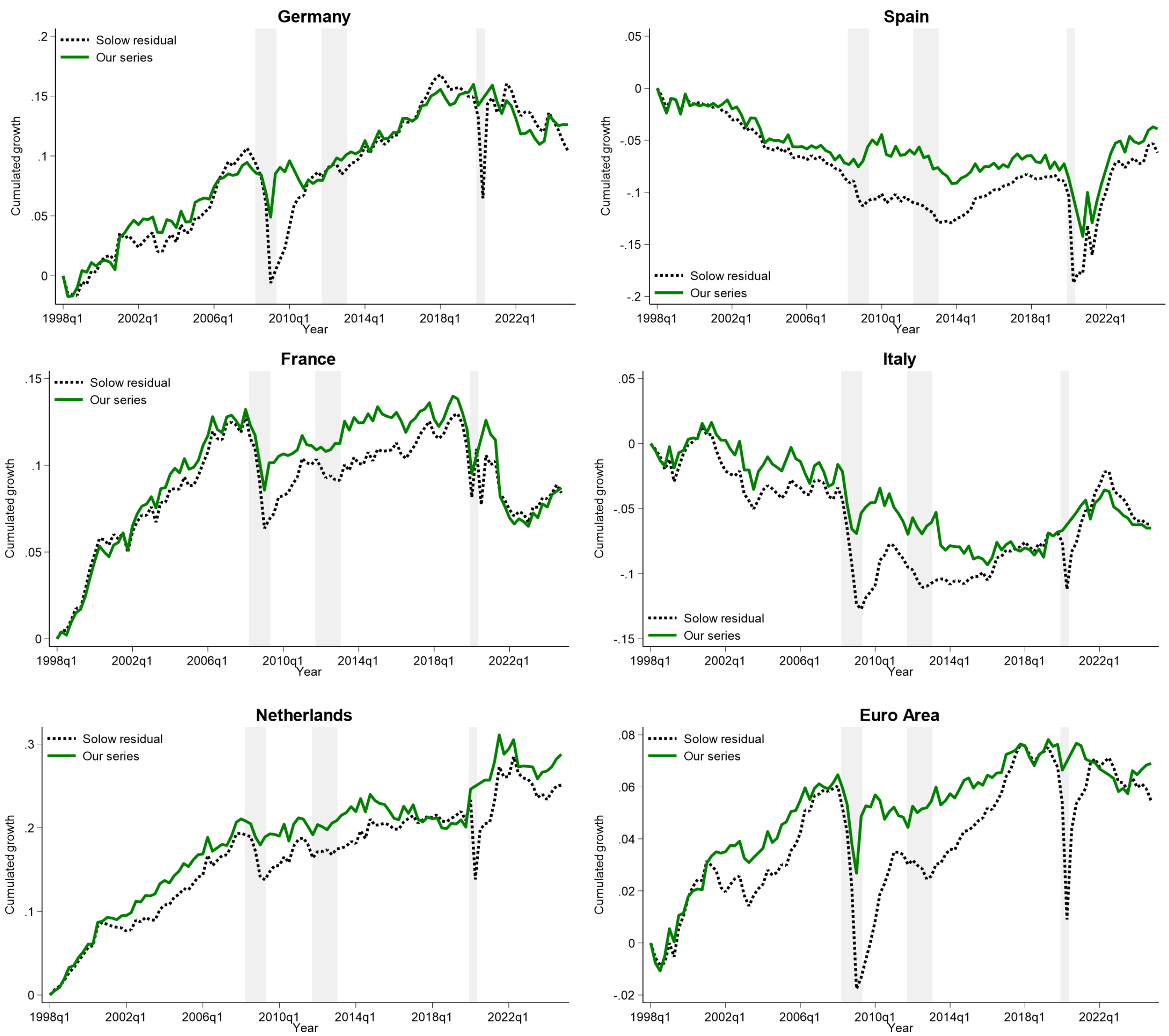
Quarterly TFP data, interpolated during the Covid-19 pandemic Finally, as is immediately apparent in Figure 2, there are large discontinuities in the TFP series during the initial period of the Covid-19 pandemic, in the second to fourth quarters of 2020.

These movements probably reflect at least in part some mismeasurement of output and inputs (in particular, of hours worked) rather than true changes in TFP. Therefore, we also provide an interpolated version of our series, which assumes that TFP growth was smooth during this period.[8] Figure 3 plots this interpolated series. EUROPROD-UA provides both

[8]That is, the interpolated series replaces TFP growth in each quarter between 2020Q2 and 2020Q4 by one third of the cumulated TFP growth during this period.

the interpolated and the raw series, so that researchers can choose the one that is more appropriate for their purpose.

Figure 3: Cumulative aggregate TFP growth (quarterly data, interpolated during the Covid-19 pandemic)



Notes: All series are normalized to 0 in 1998Q1.

5 Conclusion

EUROPROD-UA provides regularly updated data on utilization and profit-adjusted TFP growth for the five largest Euro Area economies. Annual data is available at the industry and the aggregate level and will be updated occasionally, depending on new releases of EU KLEMS. Quarterly data is available at the aggregate level only, and will be updated roughly every six months. Future updates will include data for more recent periods, and potentially more countries. We hope that these series can be a useful resource for researchers interested in European productivity dynamics.

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Appendix

A Version history

Table A.1 lists the version history for EUROPROD-UA. The data corresponding to each version can be downloaded from https://doi.org/10.53479/DS-europrod-ua.

Table A.1: EUROPROD-UA Version History

Version	Publication	Notes/Changes
0	October 2024	• Original data published with Comin *et al.* (2025).
1.0	May 2025	• Methodological changes described in the handbook. • Longer time horizon. • Added the Netherlands. • Added Euro Area averages. • Published quarterly data includes more growth accounting variables.

B Variable list

Table A.2: List of variables provided in EUROPROD-UA

Frequency	Variable name	Description
Annual	country	Country code (DE = Germany, ES = Spain, FR = France, IT = Italy, NL = Netherlands)
Annual	year	Year
Annual	code	Industry code (NACE Rev. 2)
Annual	dZ_Solow_ind	Growth in the industry-level Solow residual
Annual	dZ_ind	Growth in utilization and profit-adjusted industry TFP
Annual	dZ_Solow	Growth in the aggregate Solow residual
Annual	dZ	Growth in utilization and profit-adjusted aggregate TFP
Annual	dZ_Solow_EA	Growth rate of the Euro Area Solow residual (weighted average of dZ_Solow)
Annual	dZ_EA	Growth rate of utilization and profit-adjusted Euro Area TFP (weighted average of dZ)
Quarterly	country	Country code (DE = Germany, ES = Spain, FR = France, IT = Italy, NL = Netherlands)
Quarterly	year	Year
Quarterly	quarter	Quarter
Quarterly	dZ_Solow	Growth in the aggregate Solow residual
Quarterly	dZ	Growth in utilization and profit-adjusted aggregate TFP
Quarterly	dY	Aggregate output growth
Quarterly	dL	Aggregate labour input growth
Quarterly	dtotal_hours	Aggregate growth rate of total hours worked. Differences between dL and d_totalhours reflect labour composition changes
Quarterly	dK	Aggregate capital input growth
Quarterly	alpha_L	Output elasticity of labour
Quarterly	alpha_K	Output elasticity of capital
Quarterly	dU	Aggregate factor utilization growth
Quarterly	dZ_Solow_EA	Growth rate of the Euro Area Solow residual (weighted average of dZ_Solow)
Quarterly	dZ_EA	Growth rate of utilization and profit-adjusted Euro Area TFP (weighted average of dZ)
Quarterly	dZ_interp	Aggregate utilization-adjusted and profit-adjusted TFP growth, interpolated in 2020Q2-2020Q4 to adjust for the Covid-19 pandemic
Quarterly	dZ_interp_EA	Growth rate of utilization and profit-adjusted Euro Area TFP (weighted average of dZ_interp)

C Quarterly growth accounting data

Industry coverage To construct our quarterly series, we use Eurostat data at the finest possible level of disaggregation. As noted in the main text, our objective is to cover the same industries as in our annual estimation. However, this is not exactly possible, as Eurostat's quarterly data sometimes groups together several NACE 1-digit industries in a way that is different from EU KLEMS. Table A.3 lists the industries included in our quarterly data, highlighting in the third column the sectors that are included in our quarterly data, but excluded in our annual data. As the table shows, there are only three such industries, which are relatively small with respect to the aggregate economy.

Table A.3: Industries used for quarterly series

Eurostat code	Eurostat name	Not included in annual data
B-E	Industry	B - Mining and Quarrying
F	Construction	
G-I	Wholesale, retail trade, transport, accommodation, food	
J	Information and communication	
K	Financial and insurance activities	
M-N	Professional, scientific, technical; administrative services	
R-U	Arts, entertainment, other services	T - Activities of extraterritorial organizations and bodies, U - Repair of computers and personal and household goods

Value Added Our data on real value added growth at the quarterly frequency come from Eurostat's quarterly national accounts database (series namq_10_a10). The data are seasonally and calendar-adjusted, and expressed in chain-linked volumes (base year 2015).

Labor Input As in Comin *et al.* (2025) and in the EU KLEMS database, our measure of labour input is computed as a weighted average of total hours worked across different types of workers.

To construct this measure, we use Eurostat data on total hours worked in the market economy (series namq_10_a10_e, seasonally and calendar year adjusted). We then split this number into total hours for six different categories (by gender and three age groups), using data on the share of different workers in total hours from the EU Labour Force Survey.[9]

[9] To compute the share of the different categories, we use data on their employment (series lfsq1_egaed) and their average number of actual weekly hours of work (series lfsq_ewhais). As the series from the EU Labour Force Survey are not seasonally adjusted, we adjust them using the X-13ARIMA-SEATS algorithm. The three age groups considered are 15-29 years, 30 to 49 years, and 50 to 74 years.

With this, we compute changes in labour input as

$$dL_t = \sum_{\ell=1}^{6} \frac{1}{2}(v_{t-1}^{\ell} + v_t^{\ell}) dL_t^{\ell},$$

where dL_t^{ℓ} stands for the growth rate of total hours worked for workers of type ℓ. The weights are defined at the annual frequency as

$$v_t^{\text{Annual},\ell} = \frac{E_t^{\text{Annual},\ell} L_t^{\text{Annual},\ell}}{\sum_{\ell'=1}^{6} E_t^{\text{Annual},\ell'} L_t^{\text{Annual},\ell'}}.$$

In this expression, $E_t^{\text{Annual},\ell}$ stands for mean gross hourly earnings for a worker of type ℓ in year t, and $L_t^{\text{Annual},\ell}$ for the total hours worked of a worker of type ℓ in this year. Mean gross hourly earnings are taken from the EU Structure of Earnings Survey.[10] To obtain quarterly data for the weights, we linearly interpolate the annual series.

Capital Input In Comin *et al.* (2025), we computed capital input by only using data on aggregate investment. Here, we take a more sophisticated approach, using disaggregated data for investment in three different categories of capital goods. Table A.4 lists the three asset categories (in the third column), and matches them to the relevant EU KLEMS asset codes.

Table A.4: EUKLEMS and Eurostat Codes for Asset Types

EUKLEMS Code	KLEMS Label	Eurostat Code	Eurostat Label
IT	Computing equipment	N11MG	Machinery and equipment and weapons systems (gross)
CT	Communications equipment	N11MG	Machinery and equipment and weapons systems (gross)
TraEq	Transport Equipment	N11MG	Machinery and equipment and weapons systems (gross)
OMach	Other Machinery and Equipment	N11MG	Machinery and equipment and weapons systems (gross)
OCon	Non-residential investment (structures)	N112G	Other buildings and structures (gross)
Soft_DB	Computer software and databases	N117G	Intellectual property products (gross)
RD	Research and development	N117G	Intellectual property products (gross)
OIPP	Other IPP assets	N117G	Intellectual property products (gross)

Overall capital input is then calculated as in our annual estimation, and holds

$$dK_t = \sum_{a=1}^{3} \frac{1}{2} \left(s_{K,t-1}^{a} + s_{K,t}^{a} \right) dK_t^{a}$$

where dK_t^a is the growth rate of the real capital stock of asset a between quarter t and quarter $t-1$. $s_{K,t}^{a}$ is the share of asset a in total capital compensation in quarter t. These shares are computed in our annual estimation, as described in Comin *et al.* (2025), and interpolated to the quarterly frequency in the way described in footnote 7 in the main text.

[10] We use the series for mean hourly earnings by sex, age and occupation for the years 2002 (earn_ses_agt14), 2006 (earn_ses06_14), 2010 (earn_ses10_14), 2014 (earn_ses14_14), 2018 (earn_ses18_14) and 2022 (earn_ses22_14). This data is only available every four years, and we interpolate data for intermediate years.

We use Table A.4 to match the more disaggregated asset categories in EU KLEMS to the more aggregated ones in Eurostat.

The capital stock of asset a evolves according to the equation:

$$K_t^a = (1 - \delta^a) K_{t-1}^a + I_t^a.$$

To measure investment, we use quarterly data on investment by asset from Eurostat (series name: namq_10_an6), which are seasonally adjusted and in chain-linked volumes. Importantly, these series cover the entire economy, and not just the market economy. However, there is annual data on investment by asset for the market economy (series nama_10_a64_p5). Using this data, we compute quarterly investment for the market economy as

$$I_t^{a,mkt} = \frac{I_t^{a,mkt}}{I_t^{a,tot}} \cdot I_t^{a,tot},$$

where $I_t^{a,mkt}$ is market economy real investment in asset a in quarter t, and $I_t^{a,tot}$ is the entire economy's real investment in asset a in quarter t. Again, these two quarterly series are linearly interpolated from the original annual series.

To construct a capital series with this data, we need an initial value for the capital stock and a depreciation rate. As in Comin *et al.* (2025), we assume that the initial value of the capital stock (in the first quarter of 1998) is the value of the real capital stock of the corresponding asset observed in our annual EU KLEMS data. Furthermore, we use implicit depreciation rates, taken as well from EU KLEMS.[11]

Note on investment data for the Netherlands In the Netherlands, the data on investment in intellectual property products has two abnormal spikes in 2007Q4 and in 2015Q1-Q2. To correct for these, we linearly interpolate the investment data for these quarters. We do the same for the annual data in EU KLEMS, where these spikes appear only in industry M-N (Professional, scientific, technical and administrative services).

Capacity utilization Capacity utilization data is taken from the European Commission's Harmonised Business and Consumer Surveys. We aggregate the industry-level data to the industries used in our annual analysis using value-added weights, and backcast missing data for service industries by projecting the existing data onto the average capacity utilization in manufacturing.

Utilities (NACE codes D-E), Construction (F), and Wholesale and Retail Trade (G) are not covered by the survey. For Wholesale and Retail, we apply the average capacity utilization across all service industries, while for Utilities and Construction, we use the manufacturing average. Our results remain robust when using the services average for these sectors instead. For further details on all of these issues, see Comin *et al.* (2025).

[11] EU KLEMS provides annual time series on the aggregate real capital stock $K_t^{\text{Annual},a}$ and investment $I_t^{\text{Annual},a}$ up to 2020. We compute an implicit annual depreciation rate as $1 - \delta_{K,t}^a = \left(K_{t+1}^{\text{Annual},a} - I_t^{\text{Annual},a}\right) / K_t^{\text{Annual},a}$. For years beyond 2020, we assume that the implicit depreciation rate remains at its 2020 value.

Finally, note that Italy did not run a capacity utilization survey in the first quarter of 2020, due to the Covid-19 pandemic. Therefore, Italian capacity utilization for this quarter is a linear interpolation of the values for the last quarter of 2019 and the second quarter of 2020.

D Additional results

Table A.5 lists the estimates for the utilization adjustment coefficients β^j, as specified in equation (3).

Table A.5: Utilization adjustment regression results

	Germany	Spain	France	Italy	Netherlands
Non-durable manufacturing					
$\hat{\beta}$	0.420***	0.100**	0.096***	0.402***	0.214***
	(0.065)	(0.047)	(0.030)	(0.111)	(0.049)
Observations	150	125	150	144	125
First-stage F-statistic	8.1	11.5	14.6	5.3	9.3
Durable manufacturing					
$\hat{\beta}$	0.291***	0.155***	0.190***	0.273***	0.350***
	(0.030)	(0.037)	(0.041)	(0.031)	(0.085)
Observations	150	125	150	144	125
First-stage F-statistic	31.0	13.5	27.2	30.2	17.3
Non-manufacturing					
$\hat{\beta}$	0.199***	0.334***	0.503*	0.136**	0.791***
	(0.063)	(0.125)	(0.262)	(0.065)	(0.268)
Observations	325	325	325	312	325
First-stage F-statistic	61.7	27.7	7.1	13.3	15.0

Notes: Utilization adjustment coefficients β are estimated using 2SLS. Instruments for capacity utilization are oil, monetary policy, uncertainty, financial and pandemic shocks. The table reports Kleibergen-Paap rk Wald F statistics. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.