**Flash estimates of income distribution indicators for the European Union: results 2016, methodology and quality assessment**

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**Abstract**

*Indicators on poverty and income inequality represent an essential tool to monitor progress towards the Europe 2020 poverty and social exclusion target and to prepare the European Semester. They are based on EU statistics on income and living conditions (EU-SILC) and are available for all countries around 18 months after the reference period. In order to better monitor the effectiveness of social policies at EU level, it is important to have more timely indicators. A new approach was therefore proposed, which consists in the development of flash estimates (FE). FE have currently a release date approximately one year earlier than the actual data. The main methodology used is based on microsimulation techniques further enhanced to take into account the evolution in employment, population structure and indexation factors. Developing flash estimates on poverty and income inequalities in the ESS involves that their methods, sources and output adhere to a common quality framework. This includes: 1) quality checks concerning input coherence and intermediate steps 2) the historical performance of the model is defined as the ability to predict accurately the past changes as captured by EU-SILC and 3) the plausibility of the estimated changes, mainly by linking these to evolutions in observed indicators (e.g. employment trends, total household income in national accounts, national data) and disentangling the impact of simulated policies via EUROMOD.*

*EUROSTAT has published for the first time FE 2016 as experimental statistics. While there are still limitations and we cannot expect the estimates to capture perfectly EU-SILC changes, the FE can provide useful information about the direction and magnitude of the change. The FE 2016 include several indicators, including the at-risk-of-poverty and interquartile share ratio. Deciles that measure changes at different points of the distribution seem to be important complements as early warnings for yearly changes*

**Keywords:** flash estimates, income, poverty, timeliness, microsimulation, policy effects

**1. General Framework**

Indicators on poverty and income inequality represent an essential tool to monitor progress towards the Europe 2020 poverty and social exclusion target and to prepare the European Semester (the annual cycle of economic policy coordination between EU countries). They are based on EU statistics on income and living conditions (EU-SILC) and are available for all countries around 18 months after the reference period, which is late for the EU’s policy agenda. Efforts for improving the timeliness of EU-SILC data are ongoing but the collection and processing of EU-SILC data based on both survey and administrative sources, will always have a certain time lag.

A new approach was therefore proposed, which consists in the development of flash estimates of year N if possible in June N+1, that would be available to prepare and to start the European Semester and provide data to MIP in autumn N+1. These will **complement** the EU-SILC data and can be used in preliminary discussions and analysis until the final EU-SILC data becomes available. In September 2017, flash estimates of income for 2016 (SILC 2017) were [published](http://ec.europa.eu/eurostat/documents/7894008/8256843/Flash-estimates-of-income-inequalities-and-poverty-indicators-experimental-results.pdf) for the first time as Experimental Statistics in Eurostat's website.

**2. Methodology**

*2.1. Overview*

The main methodology used for most countries is **Microsimulation.** It relies on EUROMOD, the European Union tax-benefit microsimulation model, managed, maintained and developed by the Institute for Social and Economic Research (ISER) at the University of Essex. The approach is based on previous work on nowcasting (Rastrigina, Leventi, Vujackov and Sutherland, 2016) and is being further developed by Eurostat and ISER, University of Essex in collaboration with the dedicated Task Force on “Flash estimates on income distribution” (Belgium, Italy, Portugal, Luxembourg, Germany, France, Sweden and the United Kingdom). In general, microsimulation is the preferred approach for both main users and the National Statistical Institutes (NSIs) given the use of microdata, the possibilities for further detailed analyses and the link with policy changes.

For few countries for which microsimulation results were not consistent enough with EU-SILC, a second methodology is used based on macro-economic time series modelling (**METS**). The current iteration of the model attempts to nowcast the indicators directly, based on linear regression, with time-serial extensions (autocorrelation, time lags).

The next section describes further the microsimulation methodology as it is the main methodology used for almost all countries. More information on the METS methodology and also further details on the microsimulation methodology can be found in the [Methodological report](http://ec.europa.eu/eurostat/documents/7894008/8256843/Methodological-note.pdf).

*2.2. Microsimulation*

Flash estimates based on microsimulation are based on an information set that includes the latest income data available from EU-SILC (income N-2) which is updated with more timely auxiliary information from the reference period (year N) such as EU-LFS and sources available at national level.

The three main stages of the microsimulation approach are: (1) adjustment for changes to the demographic structure of the population and for changes to the presence of income sources determined by labour market characteristics; (2) uprating the level of market income components; and (3) changes in taxes and benefits due to policy reforms (O'Donoghue and Loughrey, 2014).

*2.1.1. Changes in population characteristics including labour market*

Two approaches are considered to take into account changes in population characteristics: static and dynamic. The static approach is based on reweighting (or calibration). It consists of the derivation of a new vector of sample weights that brings the marginal distributions from the base year for a set of main socio-economic variables (e.g. age, labour, gender) to the level of the target year. In the dynamic process individual trajectories are modelled and individuals in the sample undergo transitions (Gasior and Rastrigina, 2017). The main auxiliary source of information used to obtain the population characteristics in the target year is the EU Labour Force Survey (EU-LFS) statistics. EU-LFS micro-level statistics for year N are usually available in April N+1.

*2.1.2. Updating non-simulated income sources*

After adjusting the input data for changes in the population characteristics, the next step is to update non-simulated income beyond the income data reference period. This approach applies uprating coefficients to market incomes[[1]](#footnote-1) and non-simulated social benefits (i.e. mainly benefits for which entitlement is based on previous contribution history (e.g. pensions) or unobserved characteristics (e.g. disability benefits). EUROMOD contains these uprating coefficients which are based on more timely data sources from the target year which reflect indexation rules or the change in the average income per recipient. (Rastrigina, Leventi, Vujackov and Sutherland, 2016)

*2.1.3. Simulating changes in tax-benefit policies*

After updating market income and other non-simulated income sources, we simulate tax-benefit policies for each year from the base year up to the target year with EUROMOD which is based mainly on EU-SILC data. (Sutherland and Figari, 2013). All simulations are carried out on the basis of the tax-benefit rules in place on the 30th June of the given policy year. To enhance the credibility of estimates, an effort has been made to address issues such as tax evasion (e.g. in Bulgaria, Greece, Italy and Romania) and benefit non-take-up (e.g. in Estonia, France, Greece, Latvia, Romania, and Finland). However, such adjustments are not possible to implement in all countries due to data limitations.[[2]](#footnote-2)

In order to account for the differences between EUROMOD and EU-SILC estimates of household income in the data reference year (here 2015, except for DE which is 2014), an alignment factor is calculated at individual level. The factor is equal to the absolute difference between the value of equivalised household disposable income in EU-SILC 2015 and the EUROMOD estimate for the same period and income concept. For consistency reasons, the same household specific factor is applied to all later policy years. (Rastrigina, Leventi, Vujackov and Sutherland, 2016)

**3. Flash estimates 2016**

In this section, flash estimates 2016 are presented. The key indicators they refer to and their communication format is discussed.

*3.1. Key indicators*

Flash estimates refer to the following key income indicators:

**Table 1. Definition of key income indicators**

|  |  |
| --- | --- |
| **Indicators** | **Definition** |
| At-risk-of-poverty rate (AROP) | Share of people with an [equivalised disposable income](http://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Equivalised_disposable_income)[[3]](#footnote-3) (after social transfer) below the at-risk-of-poverty threshold, which is set at 60 % of the national median equivalised disposable income after social transfers.  |
| Income quintile share ratio (QSR) | The ratio of total income received by the 20 % of the population with the highest income (the top quintile) to that received by the 20 % of the population with the lowest income (the bottom quintile). It is a measure of the inequality of income distribution. |
| Income deciles | Income deciles groups are computed on the basis of the total equivalised disposable income attributed to each member of the household. Nine cut-point values (the so-called deciles cut-off points) of income are identified, dividing the survey population into ten groups equally represented by 10 % of individuals each. Five representative income deciles have been selected in our analysis to show the evolution of the different parts of the national income distribution. |

*3.2. Communication*

Flash estimates denote the year-on-year (YoY) change rather than the actual levels and they are calculated as the difference between the model estimates for 2016 and 2015. The point estimate for the flash is calculated by adding the estimated YoY change to the last observed value in EU-SILC.

Point estimates are subject to several sources of uncertainty: e.g. model bias and variance, the sampling error in EU-SILC, inconsistencies between the different data sources entering the estimation. This raises not only a question of quality, but also of communication of the results. Following in-depth discussions with both users and producers, it was agreed that results for this first release of the flash estimates are disseminated according to a magnitude direction scale (MDS) for the expected change. This dissemination format takes into account that estimated changes cover a possible range of values, associated with uncertainty[[4]](#footnote-4). Therefore, the FE will give an indication on the type of change expected in terms of intervals, but not the point estimates.

Table 2 below shows the MDS classes chosen by indicator and common across countries. It includes a condition for checking if the change is statistically significant from zero: at this stage, only the sampling error is considered for the significance of the change. Changes not statistically significant from zero are not communicated.

**Table 2. Bounds MDS by indicators**

|  |  |  |  |
| --- | --- | --- | --- |
| **MDC** | **AROP(pp)** | **QSR** | **Deciles (%)** |
|  | Decrease in inequality indicators=green[[5]](#footnote-5) | Increase in positional indicators = green |
| [---] | <-2 | <-0.6 | <-5 |
| [--] | [-2,-1[ | [-0.6,-0.3[ | [-5,-2[ |
| [-] | [-1,0] | [-0.3,0] | [-2,0] |
| [+] | ]0, 1] | ]0, 0.3] | ]0, 2] |
| [++] | ]1,2] | ]0.3,0.6] | ]2,5] |
| [+++] | >2 | >0.6 | >5 |

|  |
| --- |
| ***MDC (change class)*** ***communicated only if the estimated change is significant***  |

*3.3. Results*

Eurostat has produced flash estimates for 25 countries (see table 3). They are based on microsimulation except for Belgium, the Czech Republic and Ireland which are based on macroeconomics time series modelling.

**Table 3. Flash estimates of the nominal change 2015-16**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Country** | **Income Year** | **AROP** | **QSR** | **D1** | **D3** | **MEDIAN** | **D7** | **D9** |
| BE | 2016 | u | ]0,0.3] | ns | u | ]2,5] | u | ]2,5] |
| BG | 2016 | ns | ns | >5 | >5 | >5 | >5 | >5 |
| CZ | 2016 | ns | ns | >5 | >5 | >5 | >5 | u |
| DK\* | 2016 | ns | ns | ns | ns | ns | ns | ns |
| EE | 2016 | ns | ns | >5 | >5 | >5 | >5 | >5 |
| IE | 2016 | ns | [-0,6,-0,3[ | >5 | ]2,5] | u | >5 | ]2,5] |
| EL | 2016 | ns | ns | ]2,5] | u | ns | u | u |
| ES | 2016 | ns | ns | u | ]2,5] | ]2,5] | ]2,5] | ]2,5] |
| HR | 2016 | ns | ns | ns | ]2,5] | ]2,5] | ]2,5] | ]0,2] |
| LV | 2016 | ns | ns | ]2,5] | ]2,5] | ]2,5] | ]2,5] | ]2,5] |
| LT | 2016 | u | ns | >5 | >5 | >5 | >5 | >5 |
| LU | 2016 | ns | ns | ns | ns | ns | ns | ns |
| HU | 2016 | ns | ns | >5 | >5 | >5 | >5 | >5 |
| NL\* | 2016 | ns | ns | ]0,2] | ]2,5] | ]2,5] | ]2,5] | ]2,5] |
| AT | 2016 | ns | ns | ns | ]2,5] | ]2,5] | ]2,5] | u |
| PL | 2016 | <-2 | <-0.6 | >5 | >5 | >5 | >5 | >5 |
| PT | 2016 | [-1,0] | ns | >5 | ]2,5] | ]2,5] | ]2,5] | ]2,5] |
| RO | 2016 | ]0,1] | ns | ns | >5 | >5 | >5 | >5 |
| SI | 2016 | [-1,0] | ns | ]2,5] | u | ]0,2] | u | u |
| SK | 2016 | ns | ns | u | u | ]2,5] | u | u |
| FI | 2016 | ns | ns | ns | ]0,2] | ]0,2] | ]0,2] | ns |
| SE | 2016 | u | u | u | u | ]2,5] | ]2,5] | ]2,5] |
| UK\*\* | 2016 | [-1,0] | ns | ns | ]2,5] | ]2,5] | ]0,2] | ]0,2] |
| *DE* | *2016* | [-1,0] | u | u | ]0,2] | ns | ns | ns |
| FR | 2016 | ns | ns | ns | ns | ]0,2] | ]0,2] | ns |
| *IT* | *2016* | ns | ns | ]2,5] | ]0,2] | ]0,2] | ]0,2] | ns |
| CY | 2016 | u | ns | ns | ns | ns | ns | ns |
| *MT* | *2016* | ns | ns | ]2,5] | ns | ns | ns | ns |

\*National preliminary data is used; \*\*SILC data; u: unreliable, ns: not significant

Source: Eurostat calculations based on EUROMOD H0.25+ and Eurostat data sources (EU-SILC, EU-LFS, Sector Accounts)

For Denmark and the Netherlands, provisional national register data were used. For the United Kingdom, EU-SILC 2016 is used because for the UK the data collection and income reference period are the same.

The figures for flash estimates 2016 are in terms of absolute change for AROP and QSR and change in percent for the deciles. We can observe that AROP and QSR for the majority of countries have not significantly changed. This is in line with previous developments of these indicators in EU-SILC when most of the yearly changes are not significant. It becomes thus relevant to assess the trends across several years and to check the relative movement of the deciles. It should be noted that only those estimates indicated as fit-for-purpose, meaning passing the quality assessment framework, are disseminated.

Flash estimates are [published](http://ec.europa.eu/eurostat/documents/7894008/8256843/Flash-estimates-of-income-inequalities-and-poverty-indicators-experimental-results.pdf) as Experimental Statistics in Eurostat's website.

**4. Quality assessment**

Developing flash estimates on poverty and income inequalities in the ESS involves that their methods, sources and output adhere to a common quality framework:

a) Quality Assurance: to make sure that our way of producing the FE is correct and robust with quality checks concerning input coherence and intermediate steps; an important component being our actively seeking the feedback and input from stakeholders (users and national statistical institutes) and the academic community.

b) Quality Assessment in order to ensure a comparable way to assess results stemming from different methods and national estimates within this ESS exercise. This includes: 1) the historical performance of the model and 2) the plausibility of the estimated changes.

This section is focused on part b) Quality assessment in the context of assessing the reliability of flash estimates 2016 before the SILC 2017 (income 2016) arrives.

*4.1. Historical performance of the model*

The historical performance of the model is defined as the ability to retropredict accurately changes in the main target indicators as captured by EU-SILC. Flash estimates were simulated from 2012 to 2015 and compared with EU-SILC indicators. Performance is mainly assessed for with the Mean Absolute Error (MAE), as an expression of a linear[[6]](#footnote-6), symmetric[[7]](#footnote-7) loss function:

$$Mean Absolute Error (MAE)= mean\left(\left|e\_{y}\right|\right)$$

The nowcasting error $e\_{y}$ compares the observed percentage change of SILC (YoY.OBS), respectively with the nowcasting estimate (YoY.EST) of the percentage change[[8]](#footnote-8) in the target indicator:

$$e\_{y}=YoY.OBS\_{y}-YoY.EST\_{y}=\frac{OBS\_{y}}{OBS\_{y-1}}-\frac{EST\_{y}}{EST\_{y-1}}$$

where $OBS\_{y}$ is the observed (SILC) value of the indicator in income year y, and $EST\_{y}$is the out-of-sample nowcasting estimate of $OBS\_{y}$.

The best model by country is selected on the basis of its average out-of-sample past performance.

*4.2. Plausibility of the estimated change*

Plausibility is defined as "reinforcement through external validation". It can be used as a complement to reliability measured as the historical performance, in particular when the latter is based on a short time series.

Unlike forecasting, for flash estimates we have several auxiliary sources in the target year which are used either in the estimation process or for plausibility assessment. A highly plausible estimate is one with many different sources of corroboration. Plausibility of the estimated change is mainly assessed along the following lines:

* Consistency with trends in National Accounts for the household disposable income (or gross disposable income) and at income component level
* In microsimulation, more detailed estimates can be assessed: a) estimates of the change in market incomes and simulated policies via EUROMOD (keeping labour characteristics constant) and b) estimates of the change in labour market (keeping policies and market incomes constant). (See table 4)

a) The change in market incomes and simulated policies via EUROMOD (FE\_P) is linked by experts in national tax-benefit systems in ISER, University of Essex (EUROMOD (2017)) with concrete polices implemented.

b) The change in the labour update (FE\_L) can be compared with the observed evolution in SILC (N-1), if available, given that it is SILC (N-2) that is currently used for flash estimates.

**Table 4. Disentangling the change of flash estimates 2015-16 for the left part of distribution (Selection of countries with majority of no 'unreliable' or 'not significant' for FE)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **D1** | **D3** | **MEDIAN** |
| FE | FE\_L | FE\_P | FE | FE\_L | FE\_P | FE | FE\_L | FE\_P |
| HR | ]2,5] | ns | ns | ]2,5] | ]0,2] | ns | ]2,5] | ns | ns |
| IT | ]2,5] | ns | ns | ]0,2] | ]0,2] | ns | ]0,2] | ns | ns |
| LV | ]2,5] | ns | ns | ]2,5] | ns | ]2,5] | ]2,5] | ns | ]2,5] |
| BG | >5 | ns | ns | >5 | ns | >5 | >5 | ns | >5 |
| EE | >5 | ns | >5 | >5 | ns | >5 | >5 | ns | >5 |
| LT | >5 | ]0,2] | ]2,5] | >5 | ]2,5] | >5 | >5 | ]0,2] | >5 |
| HU | >5 | ]2,5] | >5 | >5 | ]2,5] | ]2,5] | >5 | ]2,5] | ]2,5] |
| PL | >5 | ]2,5] | >5 | >5 | ]0,2] | >5 | >5 | ]0,2] | >5 |
| PT | >5 | ]2,5] | ns | ]2,5] | ns | ns | ]2,5] | ]0,2] | ]0,2] |
| AT | ns | ns | ]2,5] | ]2,5] | ns | ]2,5] | ]2,5] | ns | ]2,5] |
| RO | ns | ns | ns | >5 | ns | ]2,5] | >5 | ns | >5 |

Source: Eurostat calculations based on EUROMOD H0.25+ and Eurostat data sources (EU-SILC, EU-LFS, Sector Accounts)

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1. Market incomes are wages and salaries, self-employment income, property income, income from capital, etc. [↑](#footnote-ref-1)
2. Detailed information on the scope of simulations, updating factors, non-take-up and tax evasion adjustments is provided in the EUROMOD Country Reports (see: <https://www.iser.essex.ac.uk/euromod/resources-for-euromod-users/country-reports>). [↑](#footnote-ref-2)
3. The equivalised takes into account the structure of the household. The income is calculated by dividing the total household income by its size determined after applying the following weights: 1.0 to the first adult, 0.5 to each other household members aged 14 or over and 0.3 to each household member aged less than 14 years old. [↑](#footnote-ref-3)
4. [UNSD - Handbook on Rapid Estimates (Draft for Global Consultation, 28 October 2016)](https://unstats.un.org/UNSD/nationalaccount/consultationDocs/Handbook_RE.pdf) [↑](#footnote-ref-4)
5. The colour coding used for the QSR is there for readability purpose and does not imply judgements about the desirable level of inequality over the whole distribution. [↑](#footnote-ref-5)
6. An error double the size is twice as bad. [↑](#footnote-ref-6)
7. A positive error is equally good (or bad) as a negative error of the same size. [↑](#footnote-ref-7)
8. By using *percentage* change in the indicator, we are able to combine the performance measures for estimates of indicators measured on vastly different scales, e.g. AROP (usual values between 5%÷30%), QSR (3÷9), median income (1 000÷50 000). [↑](#footnote-ref-8)