Indicator Fiche

This fiche shows the investigation of upward convergence of Member States in the selected indicator using the methodological framework of Eurofound (2018). Where upward convergence is the process in which Member States improve their performance in relation to a particular outcome or policy objective together with a decrease in disparities among them. From a methodological point of view, there is no single measure capable of capturing all the relevant aspects of the convergence, it is therefore essential to consider more than one measure in order to obtain a more comprehensive idea of the convergence dynamics.

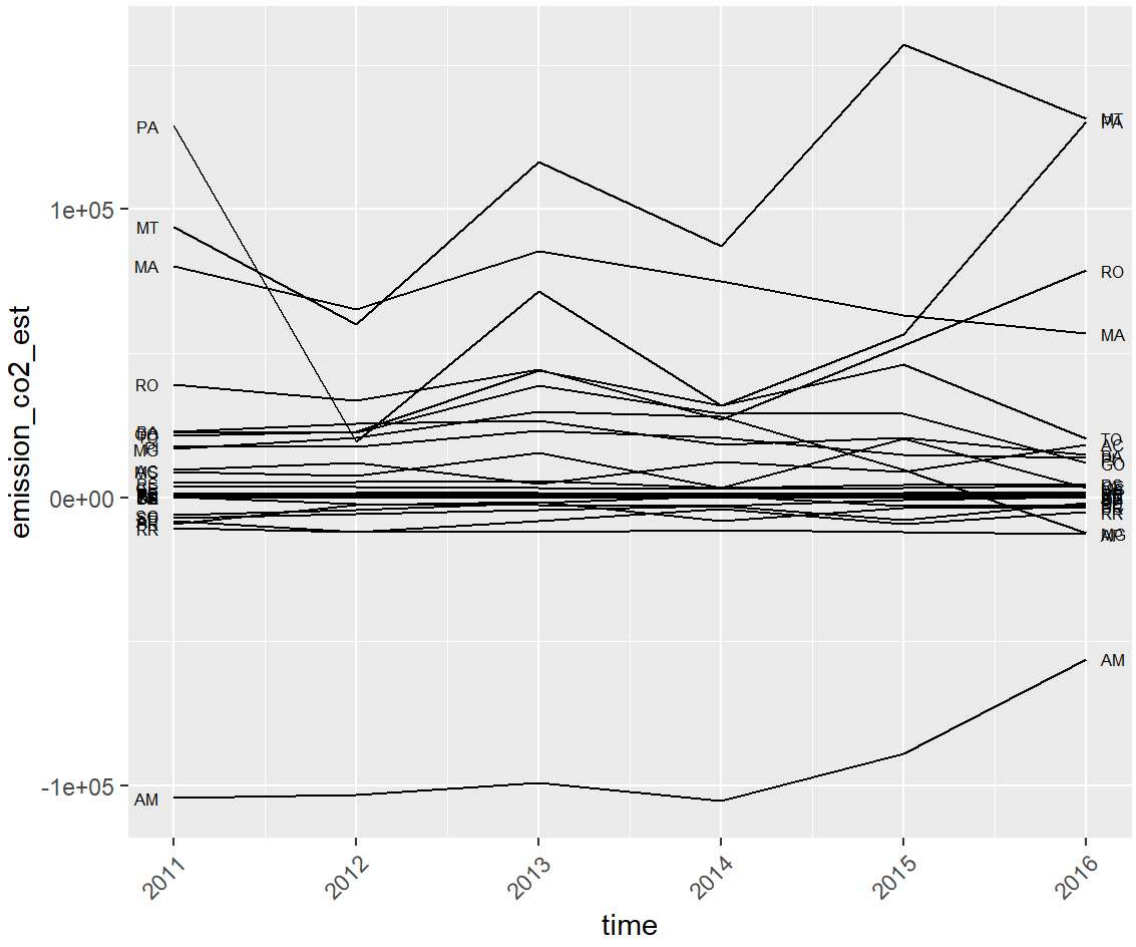
Fiche info

Today: 2024-06-20 09:08:47.086564
R Package: **convergEU** (https://cran.r-project.org/package=convergEU)
Indicator: *emission_co2_est*
Indicator type: *lowBest*
Measures of convergence: *all*
Aggregation: *custom*
Time window: *time* from *2011* to *2016*
Author: *Marcus*

Time series overview of EU countries

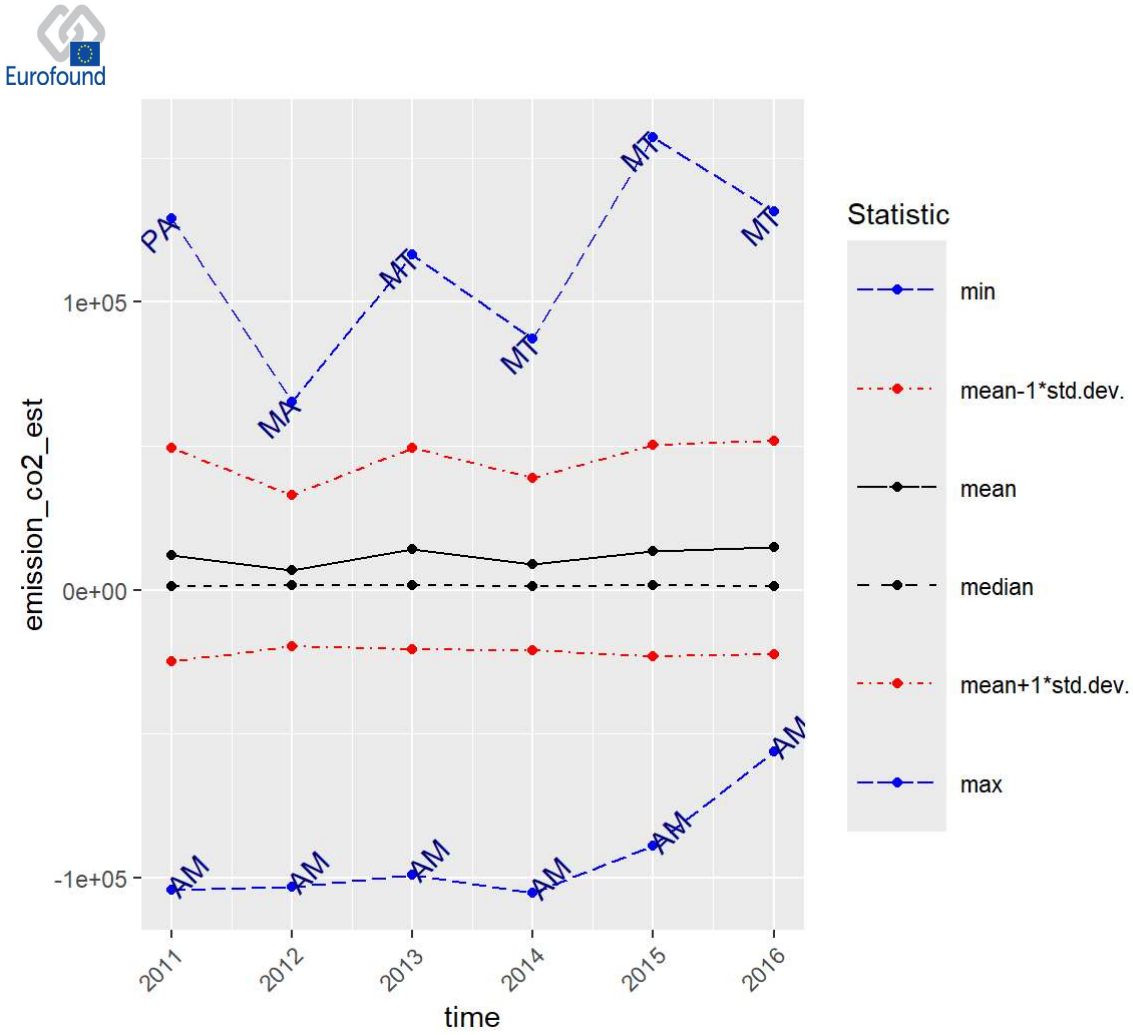
The graph shows the times series trend of each Member State giving an idea of the development of the countries across time.

Eurofound



Time series summary of EU countries

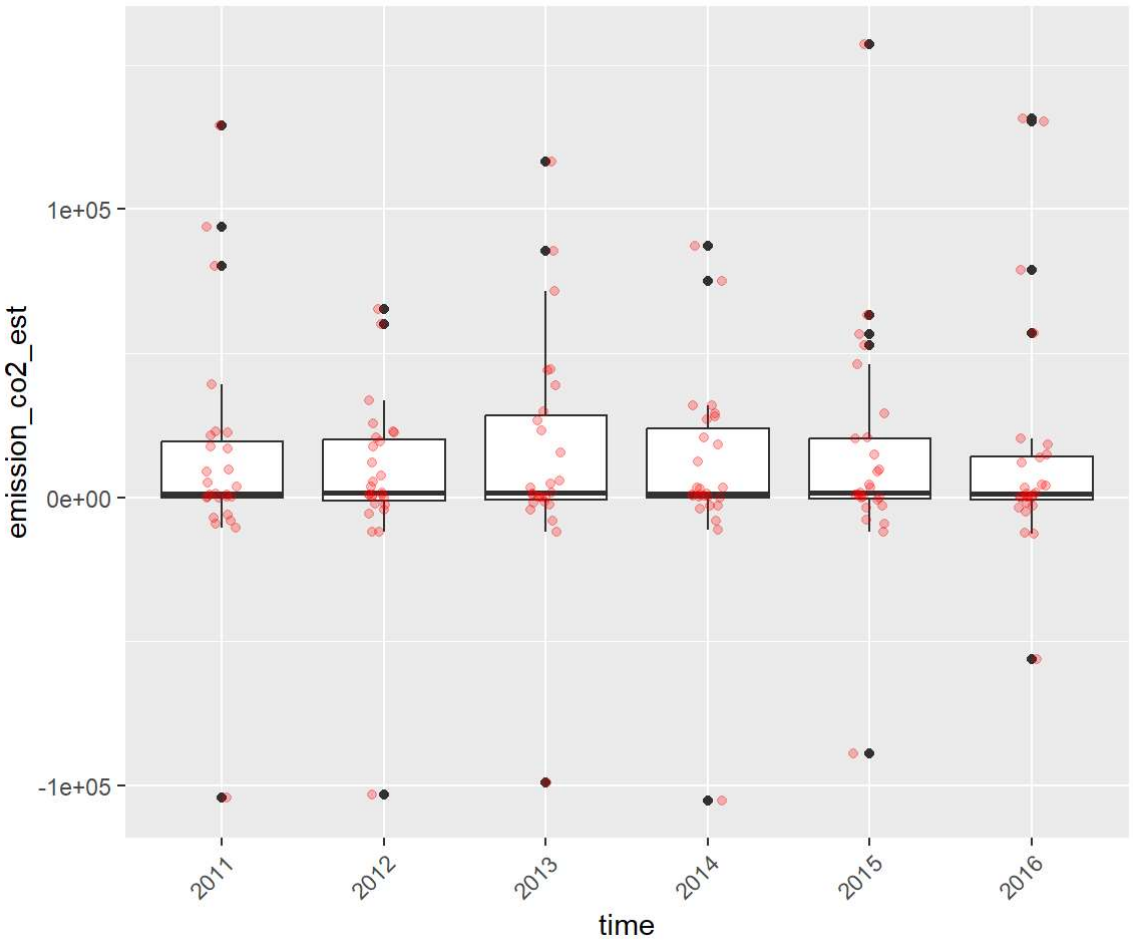
The graph gives an overview of the development in some basic descriptive statistics: unweighted average, median, the minimum and the maximum value in each year.



Boxplots of EU countries over time

The graph gives an overall idea of the dispersion and some descriptive statistics of the Member States in each year.

Eurofound



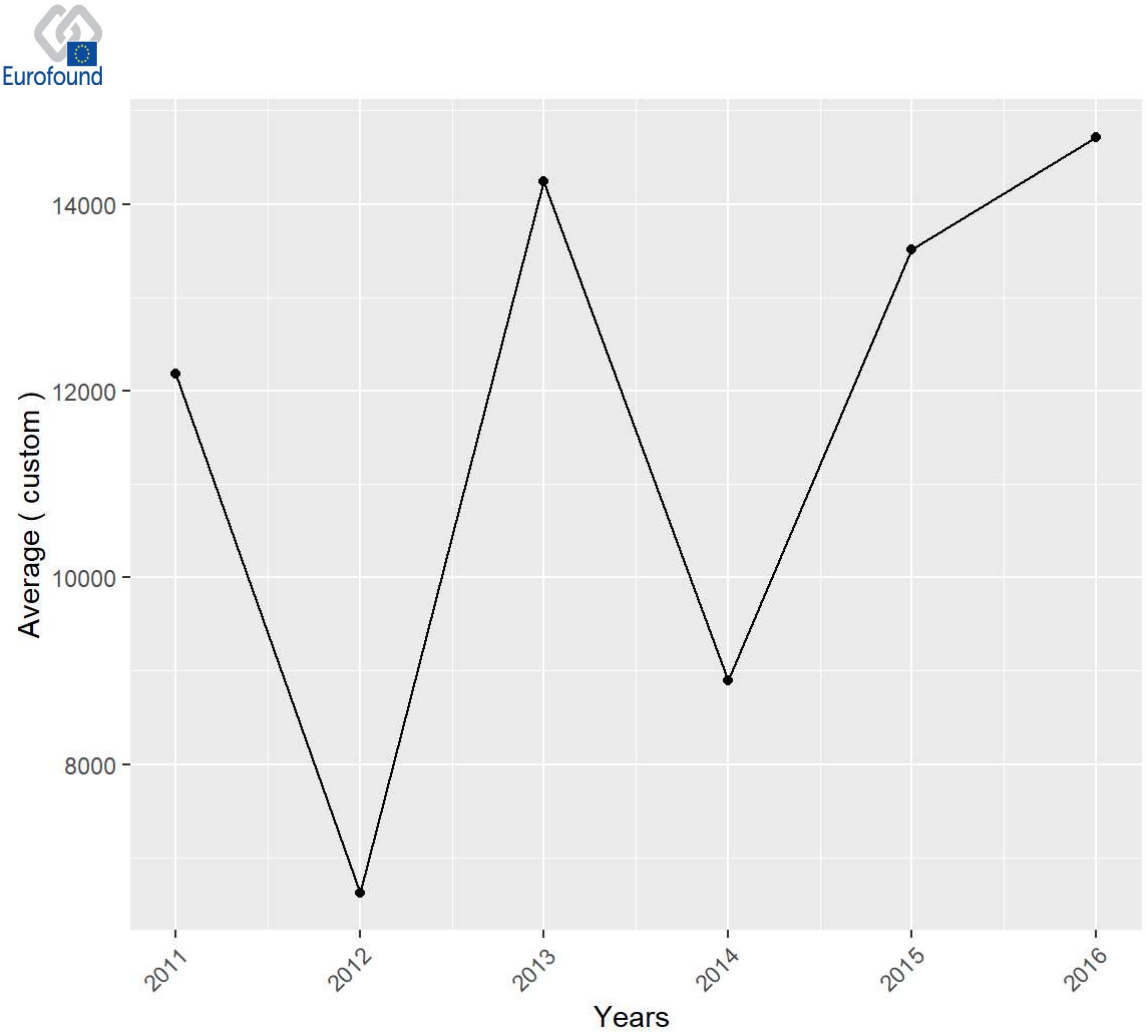
Legend:

- boxes height: first and third quartile (hinges)
- bold black horizontal segment: median
- upper whisker: $min(max(x), Q_3 + 1.5 * IQR)$
- lower whisker: $max(min(x), Q_1 - 1.5 * IQR)$

where $IQR = Q_3 - Q_1$ is the box length, that is the third quartile minus the first quartile. Overlaid jittered points are shown in red.

Unweighted average by year over selected countries

The graph presents the unweighted average calculated on the aggregation of Member States selected. Below the graph there are initial and final year values and the overall change in the period. The overall change can be upward or downward depending on the objective direction of the indicator and its interpretation.



- Change in average:
  - Year 2011, average: 1.2181637^{4}
  - Year 2016, average: 1.471693^{4}
  - Difference Δ between years: 2535.2925926

- Overall result (interpretation): **downward change**

- Member states with increment of mean in year 2016 with respect to year 2011:
  - AC; AL; AM; CE; MT; PA; PB; PE; PR; RN; RO; RR; SC; SE; SP
- Member states with decrement of means in year 2016 with respect to year 2011:
  - AP; BA; DF; ES; GO; MA; MG; MS; PI; RJ; RS; TO

Beta convergence

The calculation of beta convergence was not performed due to the presence of negative values.

Sigma convergence

Sigma convergence is a reduction in disparities between Member States over time. It can be investigated with the standard deviation or with the coefficient of variation.

Standard Deviation

Standard deviation allows for the comparison across time periods and is preferable if no comparison across indicators is needed because the measure of dispersion will not be affected by changes in its average. Sigma convergence exists if the overall change is negative.

The key concept in sigma-convergence is variability with respect to the mean. Let $Y_{m,i,t}$ be the value of indicator i for member state m at time t, and $\overline{Y}_{A,i,t}$ the average over aggregation A, then:

- the average is

$$\overline{Y}_{A,i,t} = n(A)^{-1} \sum_{m \in A} Y_{m,i,t}$$

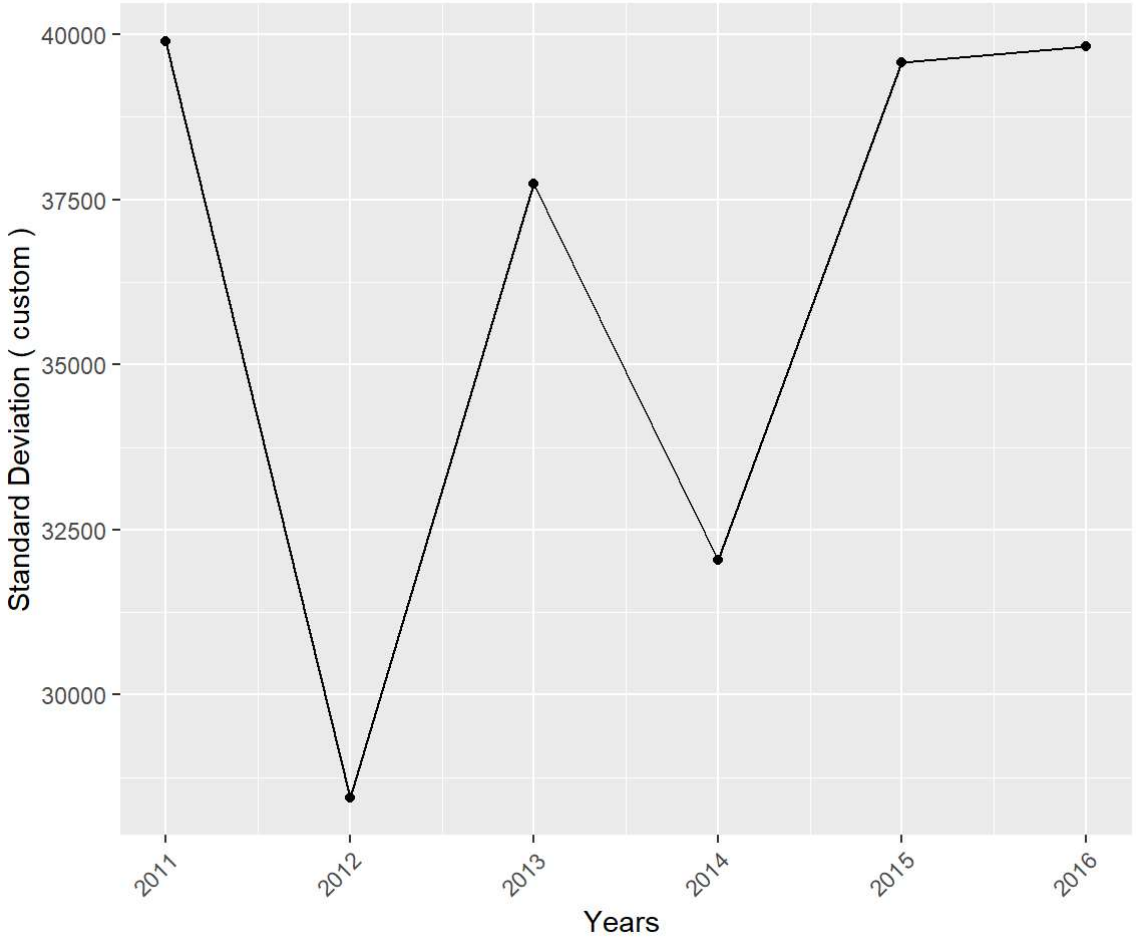
  where $n(A)$ is the number of member states within aggregation A;

- the standard deviation is

$$s_{A,i,t} = \sqrt{n(A)^{-1} \sum_{m \in A} (Y_{m,i,t} - \overline{Y}_{A,i,t})^2}$$

For each year, the above summaries are calculated to assess if a reduction in heterogeneity took place.

Eurofound



Coefficient of variation

The coefficient of variation allows for the comparison across time periods and since it is a scale invariant measure it allows the comparison among different indicators. Sigma convergence exists if the overall change is negative.

The key concept in sigma-convergence is variability with respect to the mean. Let $Y_{m,i,t}$ be the value of indicator i for member state m at time t, and $\overline{Y}_{A,i,t}$ the average over aggregation A, then:

- the average is

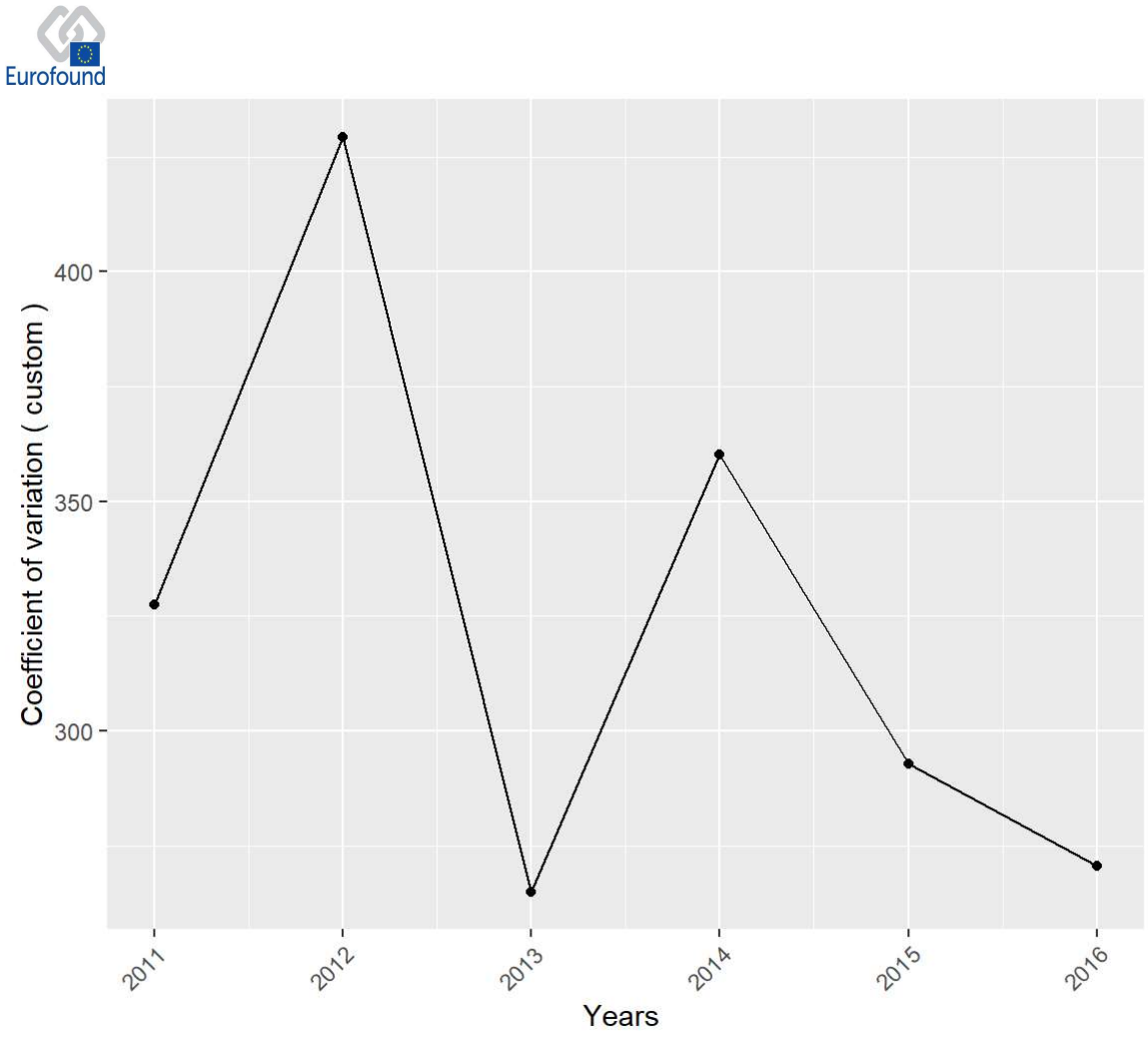
$$\overline{Y}_{A,i,t} = n(A)^{-1} \sum_{m \in A} Y_{m,i,t}$$

  where $n(A)$ is the number of member states within aggregation A;

- the coefficient of variation is

$$CV(A,i,t) = 100 \cdot \frac{s_{A,i,t}}{\overline{Y}_{A,i,t}}$$

For each year, the above summaries are calculated to assess if a reduction in heterogeneity took place.



Sigma summary list:

- Indicator type: lowBest

- Change in average:
  - Year 2011, average: 1.2181637^{4}
  - Year 2016, average: 1.471693^{4}
  - Difference Δ between years: 2535.2925926

- Change in Standard Deviation:
  - Year 2011, standard deviation: 3.9900035^{4}
  - Year 2016, standard deviation: 3.9826672^{4}
  - Difference between years: -73.3638154

    - Result: convergence

- Change in Coefficient of Variation (CV):
    - Year 2011, CV: 327.5424753
    - Year 2016, CV: 270.618075
    - Difference between years: -56.9244003
    - Result: convergence

- Results for year 2016 with reference year 2011:
    - Standard Deviation: **Weak downward Convergence**
    - Coefficient of Variation: **Weak downward Convergence**

Delta convergence

Delta convergence is a reduction of a country distance from the best performing Member State. There is convergence if there is a decrease in the period considered.

Let $y_{m,i,t}$ be the value of indicator i for member state m at time t, and $y_{i,t}^{(M)}$ the maximum value over member states in the reference set A:

$$y_{i,t}^{(M)} = max(\{y_{m,i,t} : m \in A\})$$

The distance of a member state m from the top performer at time i is:

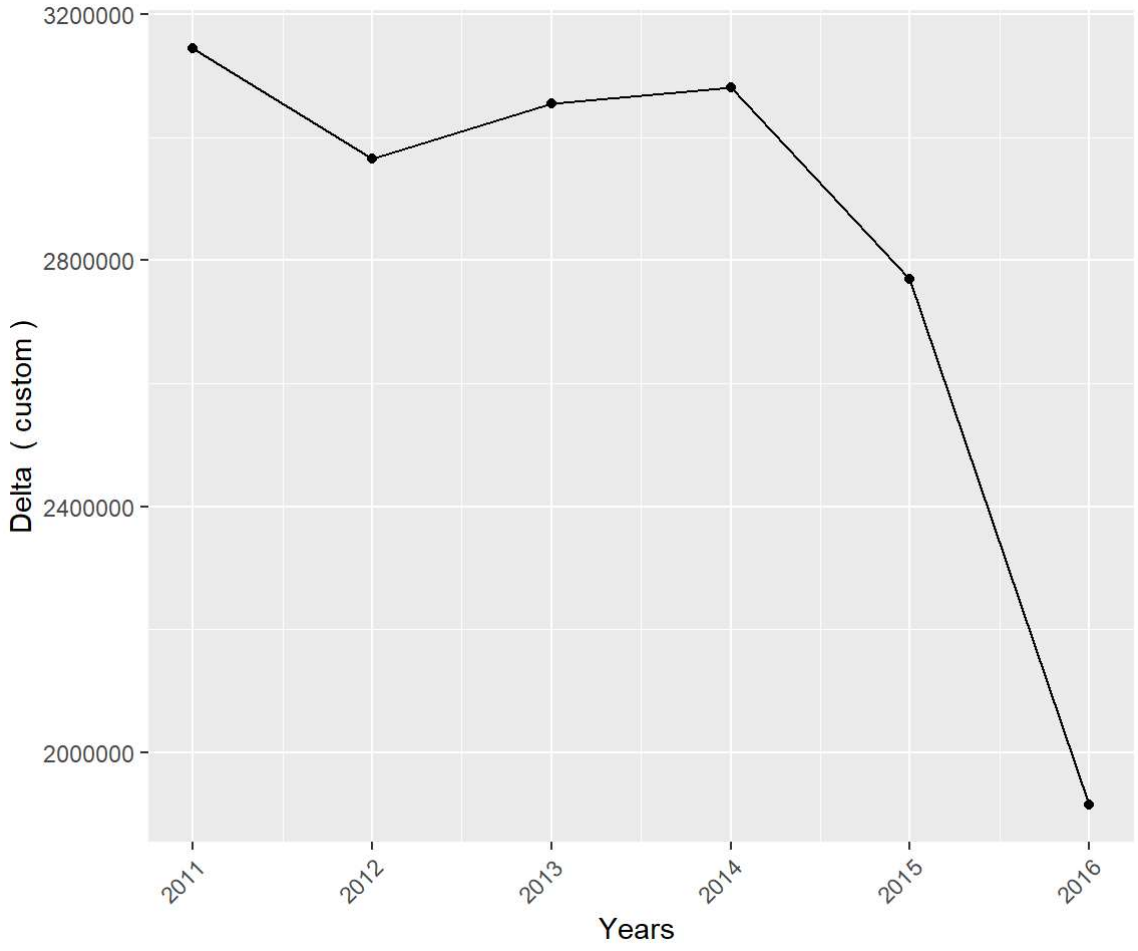
$$y_{i,t}^{(M)} - y_{m,i,t}$$

thus the overall distance at time t, called delta, is the sum of distances over the reference set A of MS:

$$\delta_{i,t} = \sum_{m \in A} (y_{i,t}^{(M)} - y_{m,i,t})$$

for the considered indicator i.

For each year, the above summaries are calculated to assess if a reduction in the amplitude on the took place.



Delta summary list:

- Indicator type: lowBest

- Change in average:
  - Year 2011, average: 1.2181637^{4}
  - Year 2016, average: 1.471693^{4}
  - Difference Δ between years: 2535.2925926

- Change in delta values:
  - Year 2011, delta: 3.1452796^{6}
  - Year 2016, delta: 1.9154186^{6}
  - Difference between years: -1.229861^{6}
  - **Overall: strict convergence**

Gamma convergence

Gamma convergence captures the movements of the Member States in the country ranking in different points in time. If countries in the first rank fall behind or catch up over time, convergence occurs. Changes in outcomes have been calculated with the Kendall Index (KI). The index can assume values between 0 and 1, where a low value implies that a high number of changes have occurred over time.

Gamma summary list:

- Indicator type: lowBest

- Change in average:
  - Year 2011, average: 1.2181637^{4}
  - Year 2016, average: 1.471693^{4}
  - Difference Δ between years: 2535.2925926

- Gamma value:
  - Year 2011: reference time
  - Year 2016: last time
  - KI value: 0.698313

Note: this measure should be complementary with the analysis of the others measures in order to check if the movements are towards an exemplary model.

Member States dynamics

The dynamics of Member States show the differences in the situation of single Member States which can be hidden under the use of a single indicator. Understanding the dynamics is also necessary to better identify possible drivers of convergence and divergence as well as structural deficiencies or sustainable recoveries.

id[1]	Cluster in year 2011	Cluster in year 2016	Change
AC	Cluster 2	Cluster 2	remained the same
AL	Cluster 4	Cluster 4	remained the same
AM	Cluster 5 (top performer)	Cluster 5 (top performer)	remained the same
AP	Cluster 5 (top performer)	Cluster 5 (top performer)	remained the same
BA	Cluster 1 (lagging behind)	Cluster 2	+1 cluster
CE	Cluster 3	Cluster 3	remained the same
DF	Cluster 4	Cluster 4	remained the same
ES	Cluster 4	Cluster 4	remained the same
GO	Cluster 2	Cluster 2	remained the same
MA	Cluster 1 (lagging behind)	Cluster 1 (lagging behind)	remained the same
MG	Cluster 2	Cluster 5 (top performer)	+2 clusters of move
MS	Cluster 3	Cluster 3	remained the same
MT	Cluster 1 (lagging behind)	Cluster 1 (lagging behind)	remained the same
PA	Cluster 1 (lagging behind)	Cluster 1 (lagging behind)	remained the same
PB	Cluster 3	Cluster 3	remained the same
PE	Cluster 3	Cluster 3	remained the same
PI	Cluster 2	Cluster 2	remained the same
PR	Cluster 5 (top performer)	Cluster 5 (top performer)	remained the same
RJ	Cluster 4	Cluster 4	remained the same
RN	Cluster 4	Cluster 3	-1 cluster

[1]Please refer to member_states_cluster.csv file for the complete dataset

Convergence and divergence patterns

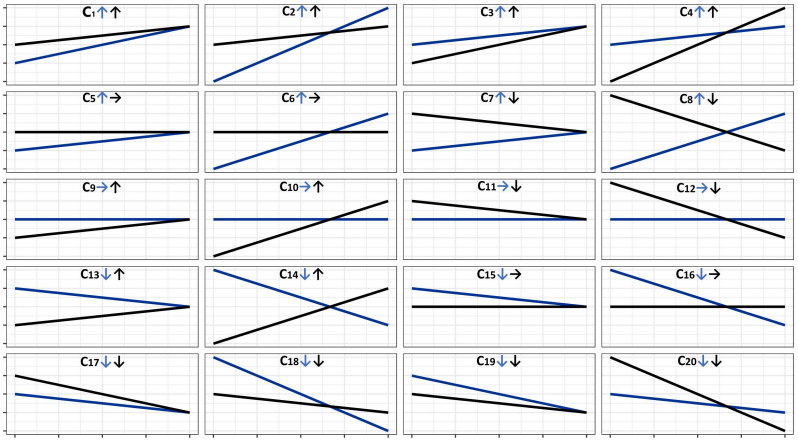
The table represents convergence patterns of the ‘aggregation’ countries in the chosen time frame. The values in the table refer to the patterns shown in the graphical legend below.

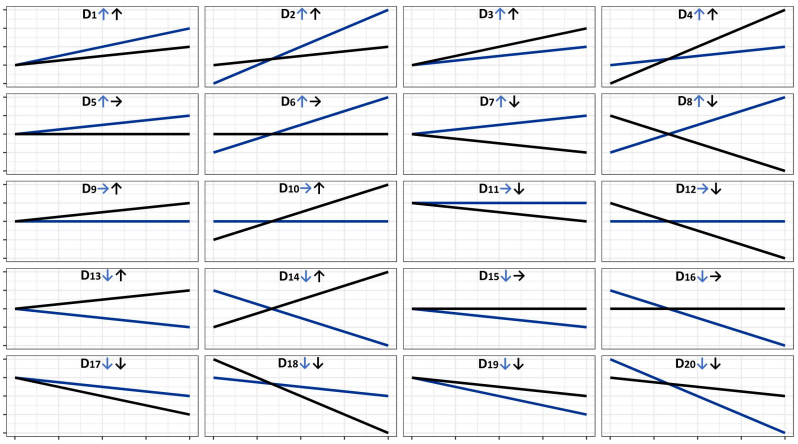
Eurofound

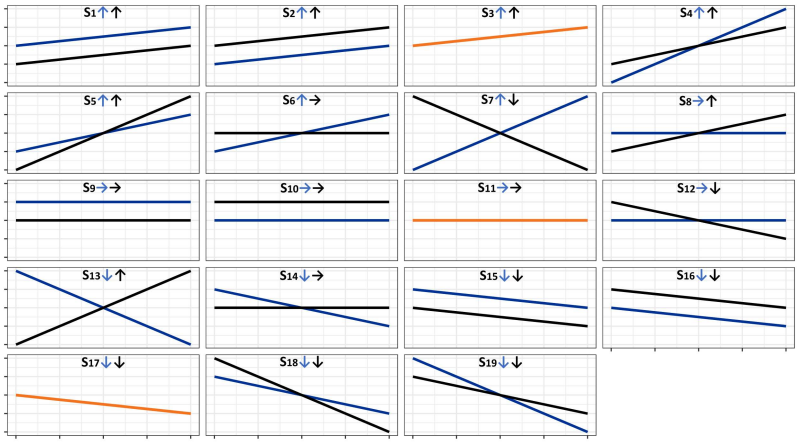
	Yearly Changes					
Country	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2011/2016
RO	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
AC	$D_{14}\downarrow\uparrow$	$D_{8}\uparrow\downarrow$	$C_{14}\downarrow\uparrow$	$D_{8}\uparrow\downarrow$	$C_{4}\uparrow\uparrow$	$D_{4}\uparrow\uparrow$
AM	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{17}\downarrow\downarrow$	$C_{3}\uparrow\uparrow$	$C_{3}\uparrow\uparrow$	$C_{3}\uparrow\uparrow$
RR	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{3}\uparrow\uparrow$	$C_{3}\uparrow\uparrow$
PA	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{1}\uparrow\uparrow$
AP	$C_{13}\downarrow\downarrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$
TO	$D_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{7}\uparrow\downarrow$	$C_{7}\uparrow\downarrow$
MA	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$C_{7}\uparrow\downarrow$	$C_{7}\uparrow\downarrow$	$C_{7}\uparrow\downarrow$
PI	$D_{19}\downarrow\downarrow$	$C_{1}\uparrow\uparrow$	$D_{19}\downarrow\downarrow$	$C_{7}\uparrow\downarrow$	$C_{8}\uparrow\downarrow$	$C_{8}\uparrow\downarrow$
CE	$C_{13}\downarrow\downarrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
RN	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
PB	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
PE	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
AL	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{7}\uparrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$
SE	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{7}\uparrow\downarrow$	$D_{1}\uparrow\uparrow$
BA	$D_{13}\downarrow\uparrow$	$C_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$C_{1}\uparrow\uparrow$	$C_{8}\uparrow\downarrow$	$C_{8}\uparrow\downarrow$
MG	$D_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{19}\downarrow\downarrow$	$C_{8}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$	$D_{8}\uparrow\downarrow$
ES	$C_{13}\downarrow\downarrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{7}\uparrow\downarrow$
RJ	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$
SP	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$C_{3}\uparrow\uparrow$	$C_{3}\uparrow\uparrow$
PR	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{3}\uparrow\uparrow$
SC	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$	$C_{3}\uparrow\uparrow$
RS	$C_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{1}\uparrow\uparrow$	$D_{7}\uparrow\downarrow$
MS	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{18}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$D_{8}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$
MT	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{7}\uparrow\downarrow$	$D_{7}\uparrow\uparrow$
GO	$D_{13}\downarrow\uparrow$	$D_{1}\uparrow\uparrow$	$C_{17}\downarrow\downarrow$	$C_{7}\uparrow\downarrow$	$C_{8}\uparrow\downarrow$	$C_{8}\uparrow\downarrow$
DF	$C_{13}\downarrow\downarrow$	$D_{1}\uparrow\uparrow$	$C_{13}\downarrow\uparrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$	$D_{7}\uparrow\downarrow$

Legend:

- Indicator type: lowBest
- solid black lines: Member States
- solid blue lines: EU average





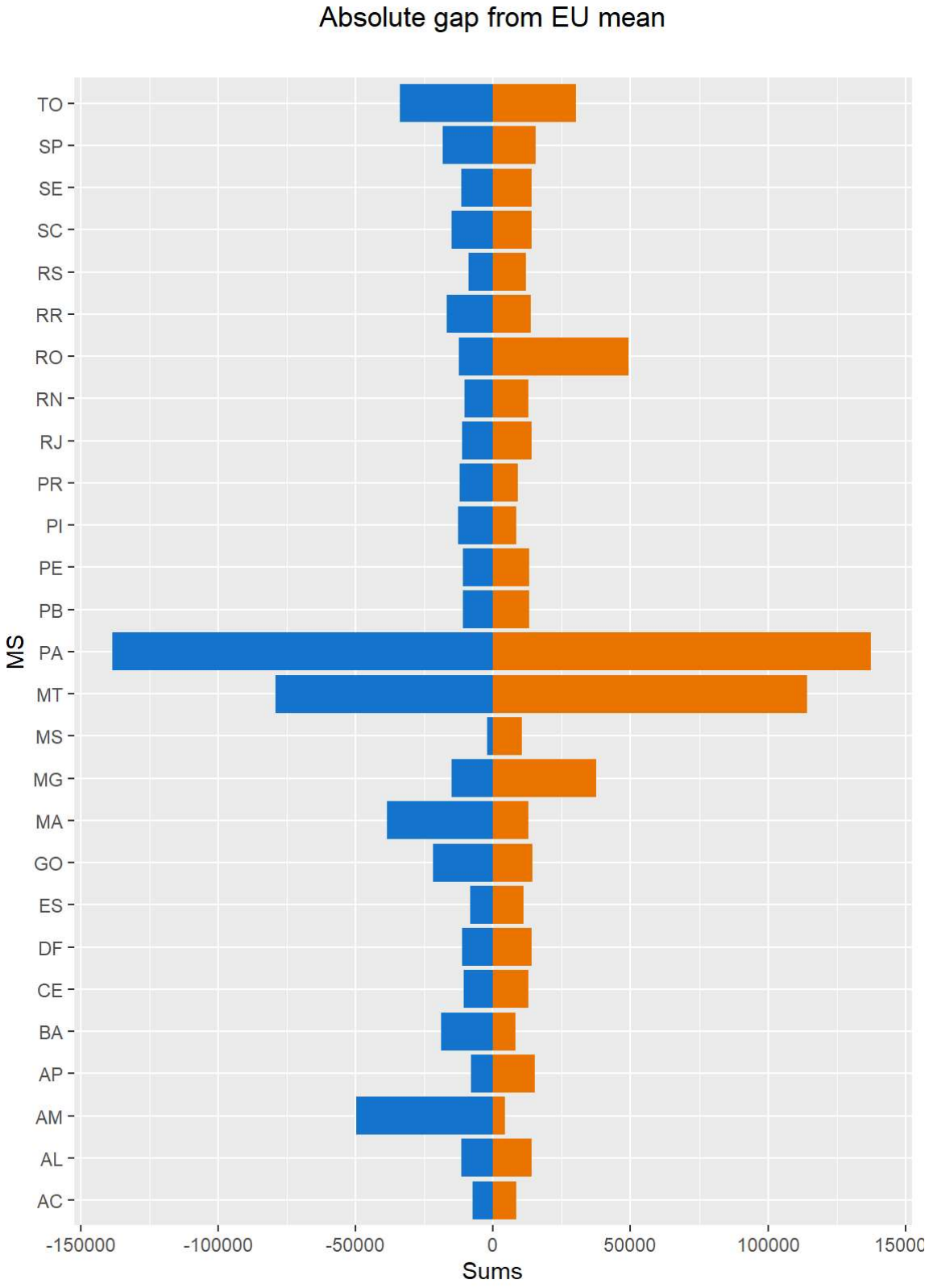


Legend:

- Indicator type: lowBest
- solid black lines: Member States
- solid blue lines: EU average

Total decrease and increase in the gap with the mean

The graph shows the sum of the yearly deviations from European average in each country.



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