July 2024

Methodological annex n°17: The national accounts retropolation for the 2020 benchmark

In a benchmark revision, it is not possible to compile all series anew from 1949 using the usual yearly compilation process. The usual process is used only to compile two recent years for both benchmarks so as to assess the impact of new estimation methods. Those two years are referred to as benchmark years. To compile historical series which are consistent with the new estimates for benchmark years, a process known as “retropolation”, or “backcasting”, is carried out. It uses different statistical methods, as well as newly compiled data for the most significant historical changes. Excluding conceptual innovations, backcasting must have limited impacts on major macroeconomic aggregates’ trends. From 2010 to 2019, the gross domestic product (GDP) chain-linked volume growth is slightly revised: +15.0% for the 2020 benchmark compared to +15.1% for the 2014 benchmark.

1. The retropolation method is meant to output accounts as close as possible to the previous benchmark’s trends

Retropolation allows for the availability of national accounts historical series which are consistent with both the new estimates for benchmark years (2019 and 2020 for the 2020 benchmark) and the previous benchmark’s trends (2014 benchmark). All national accounts tables are backcasted using one same retropolation method.

To initiate this process, accounts have to be available for both the new benchmark and the old benchmark for some given year(s) – two, in France’s case –. Among those years, the oldest one is referred to as the "link year". For the 2020 benchmark, 2019 is the link year. For the 2014 benchmark, 2019 finalized accounts were published in May 2023. For the 2020 benchmark, they were published in May 2024, after national accountants introduced new sources and methods in the compilation process.

Then, for each series, 2014 benchmark trends are used to derive a first draft for historical series. 2014 benchmark’s trend are applied from the 2020 benchmark’s 2019 value so the resulting first draft historical series have the same historical trends as for the 2014 benchmark. For some series, historical trends are then modified due to new statistical sources or methodological innovations. A second draft for the 2020 benchmark is compiled for such series by taking those innovations into account. Thus, those series which are subject to new sources or methods see their 2020 benchmark

trends deviate from their 2014 benchmark ones. For remaining series for which no new source or method is relevant, the second draft is identical to the first one.

Once the second draft is done for all series, it turns out that accounting relations are no longer verified. These include relations between operations which must balance each other (for example, gross value added must equal the difference between output and intermediate consumption), the equality between uses and resources for each product, and the equality between several breakdowns of one same series (for instance, the total gross value added computed from homogeneous branches gross values added must match the total gross value added computed from institutional sectors gross values added). To restore these accounting relations, successive rebalancing steps are carried out for each one to be restored. After a given relation gets adjusted, the involved series are fixed and not altered in subsequent rebalancing steps. Rebalancing steps are carried out in such an order that all accounting relations are ultimately verified.

The rebalancing method

To illustrate the rebalancing method, let's consider a simplified example involving a supply and use balance with four fictitious series: E_1, E_2, R_1, and R_2. These series must satisfy the accounting equality where the sum of uses equals the sum of resources, specifically, $E_1 + E_2 = R_1 + R_2$.

This accounting equality holds true for the data from 2018 and 2019 in the 2014 benchmark, as well as for the 2019 data in the 2020 benchmark revision. To estimate the 2018 data for the 2020 benchmark, we apply the trends observed in the 2014 benchmark revision to the 2020 benchmark's 2019 values.

	Uses				**Supply**			
2014 Benchmark								
	E_1	**E_2**	**E**	**Trend of E for 2019/2018 (%)**	**R_1**	**R_2**	**R**	**Trend of R for 2019/2018 (%)**
2019	60	40	100	+ 25 %	40	60	100	+ 25 %
2018	40	40	80		30	50	80	
2020 Benchmark								
2019	60	50	110		40	70	110	
2018	40 (*)	50 (*)	90	+ 22,2 %	30 (*)	58,3 (*)	88,3	+ 24,6 %

Reading Note: (*) Data estimated based on the trends from the 2014 benchmark, or adjusted if they are subject to methodological changes.

With this method, 2018 uses and resources are no longer equal for the 2020 benchmark. To solve this inconsistency, a rebalancing step is carried out. It involves finding the unique positive real number A such that:

$$AxR = \frac{E_1 + E_2}{A} \; i.e. \; A = \sqrt{\frac{E_1 + E_2}{R}}$$

The adjusted, and thus final, versions of backcasted series are: R_1*A and R_2*A for resources, E_1/A and E_2/A for uses. The supply and use equilibrium is thus verified.

	Uses				Supply			
2014 Benchmark								
	E_1	**E_2**	**E**	**Trend of E for 2019/2018 (%)**	**R_1**	**R_2**	**R**	**Trend of R for 2019/2018 (%)**
2019	60	40	100	+ 25 %	40	60	100	+ 25 %
2018	40	40	80		30	50	80	
2020 Benchmark								
2019	60	50	110		40	70	110	
Non-adjusted 2018	40 (*)	50 (*)	90	+ 22,2 %	30 (*)	58,3 (*)	88,3	+ 24,6 %
Adjusted 2018	39,6	49,6	89,2	+ 23,3 %	30,3	58,9	89,2	+ 23,3 %

Reading Note: (*) Data estimated based on the trends from the 2014 benchmark, or adjusted if they are subject to methodological changes.

This method doesn't alter data which satisfy the supply and use balance from the beginning (when A=1). It also allows for each year to be rebalanced independently from the others; it is not necessary to have completed the rebalancing step for 2018 before estimating 2017 because it leads to the same result whether 2017 is estimated before or after rebalancing 2018. More specifically, there is some sort of commutativity between the application of 2014 benchmark trends and rebalancing steps. In our implementation, we estimated all years at once using the same method and then applied rebalancing to each individually.

Moreover, this rebalancing method is quite stable. The real number A gets closer to 1 (on a logarithmic scale) the smaller the discrepancy to be adjusted gets. So in most cases, there is very little rebalancing. Conversely, the rebalancing extent grows with the size of discrepancies arising from the reuse of the 2014 benchmark trends.

As a consequence of rebalancing, growth rates between 2019 and 2018 might get slightly revised: 2014 benchmark uses and resources increased by 25% in 2019 whereas, after rebalancing, 2020 benchmark ones increase by 23.3%.

2. The retropolation impacts on national accounts series

There are three reasons why the backcasting process could revise series trends between the old and new benchmarks: structural effects, methodological changes or new statistical sources, and the re-balancing step.

Structural effects

We consider the case of several atomic series which sum up to an aggregate series. When the benchmark year values – from 2019 in our case – for the atomic series are revised in heterogeneous proportions, the aggregate series's trend is revised for the new benchmark even when atomic series' trends remain unchanged compared to the previous benchmark. This is what we call a structural effect.

Let's look back at the tables from part 1. For both the 2020 and 2014 benchmarks, E1 increases by 50% between 2018 and 2019, while E2 remains stable. Total uses increased by 25% in the 2014 benchmark, whereas in the 2020 benchmark, they increase by 22.2% even before rebalancing. This gap comes from a distortion in the uses relative weights.

Accounting for new insights

For some series, national accountants were able to draw out new insights related to the new benchmark. In such cases, some bits of some new benchmark series are made available for the backcasting process and they are thus accounted for during the process. These new insights thus contribute to revise 2014 benchmark trends. These changes are easier to trace back because they are explicitly linked to the new benchmark new methods.

Rebalancing

Finally, rebalancing accounting relations – like supply and use balance – is a third source of trends revision. When reusing the 2014 benchmark trends results in a gap between total uses and total supplies, carrying out rebalancing revises trends as the rebalancing scale can differ across years.

Recap for macroeconomic aggregates

Regarding macroeconomic aggregates – and GDP in particular –, the three revisions sources discussed above may result in heterogeneous revisions across years. For example, an aggregate may be revised downward for 2018 values but upward for 2017 values due to the interaction between the three sources. Similarly, an aggregate trend may be revised downward between 2018 and 2019 but upward between 2017 and 2018. To conclude, it cannot be inferred from a downward revision in 2018 values, or in the trend between 2018 and 2019, that such a downward revision must also take place for 2017 values or for the trend between 2017 and 2018.

3. Some examples to illustrate the revisions sources

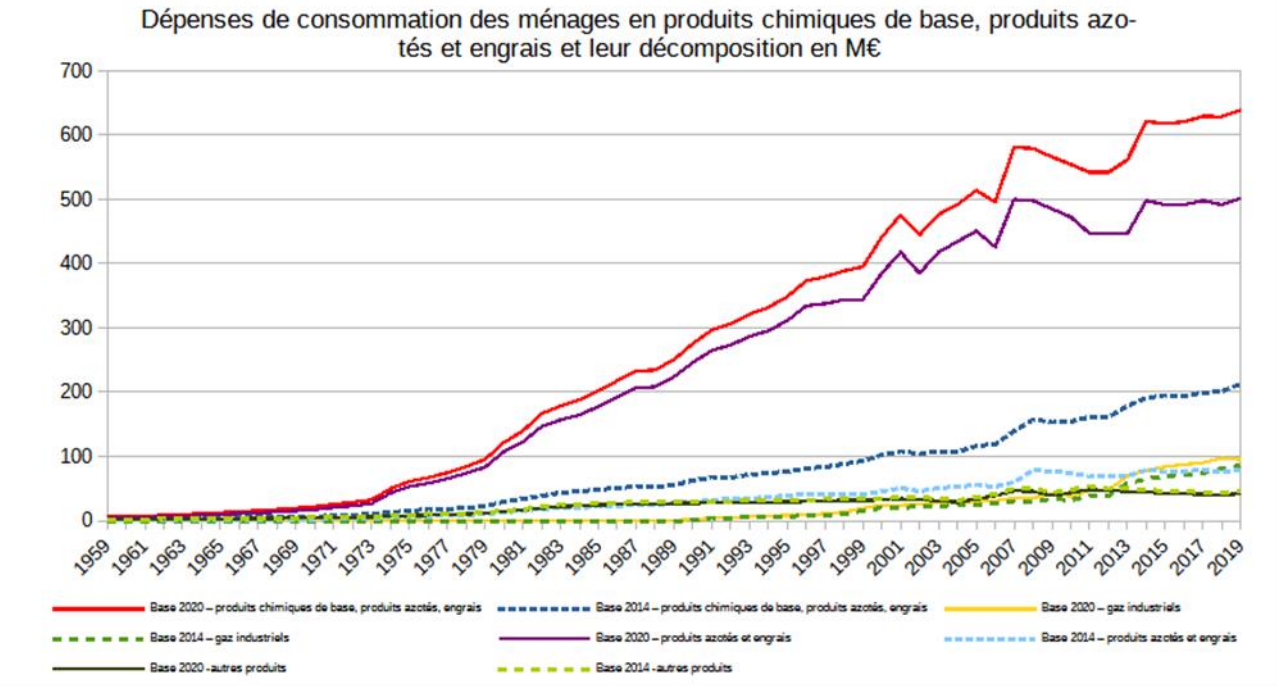
The retropolation output have been checked to ensure that the most significant revisions, compared to the 2014 benchmark, come from 2020 benchmark innovations. The following examples illustrate some typical revisions which were encountered while carrying out the backcasting process.

3.1 An example of structural effects

In 2019, household consumption expenditure on nitrogen products and fertilizers increased more than sixfold compared to the 2014 benchmark. Trends from 1960 onward were left unchanged between the 2014 and 2020 benchmark.

However, the graph below shows some strong revisions for the aggregate series including all basic chemicals, nitrogen products and fertilizers. These revisions come from changes in the breakdown of these products. For the 2014 benchmark, the breakdown was computed by applying fixed distribution key to a given basket of products. For the 2020 benchmark, a new statistical source, which measures the consumption levels directly, allowed for a better assessment of the consumption of nitrogen products and fertilizers.

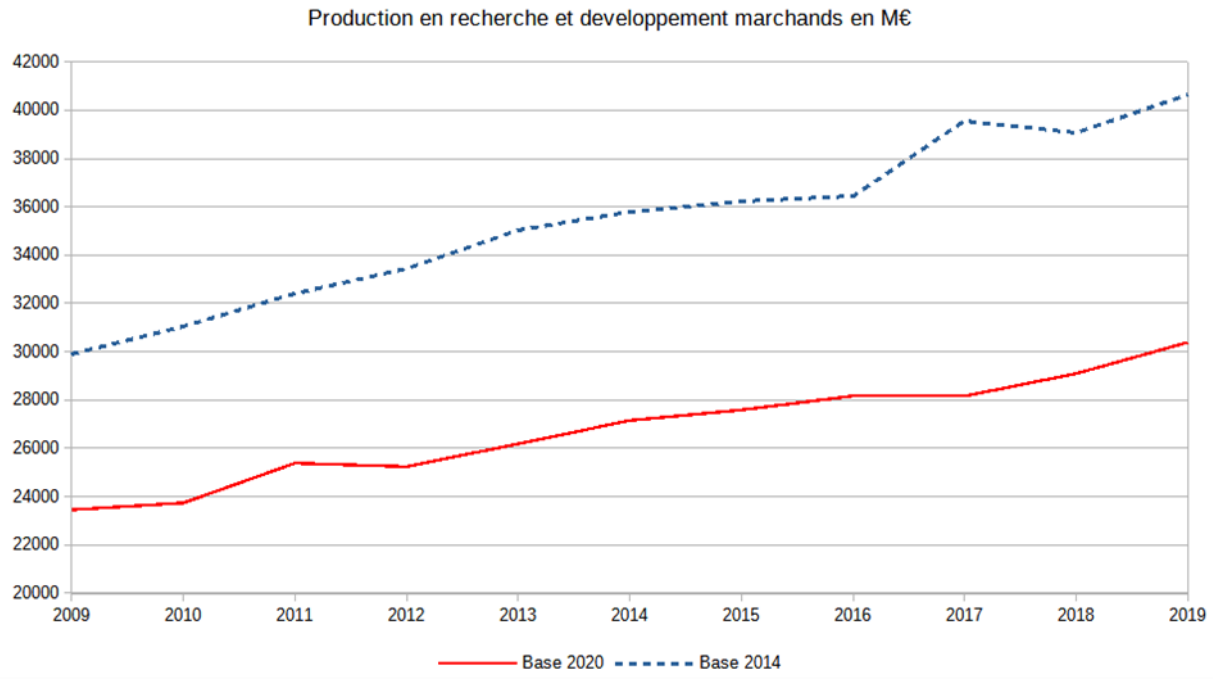
As a result, the trend of the aggregate series including all basic chemicals, nitrogen products and fertilizers now closely reflects the trend in consumption of nitrogen products and fertilizers. In 2019 for the 2020 benchmark, nitrogen products and fertilizers weighted 78.5% of consumption for the aggregate category, compared to only 37.3% for the 2014 benchmark, and this leads to significant revisions in the aggregate series trend.



Source : Insee, national accounts

3.2 A case where new insights were used

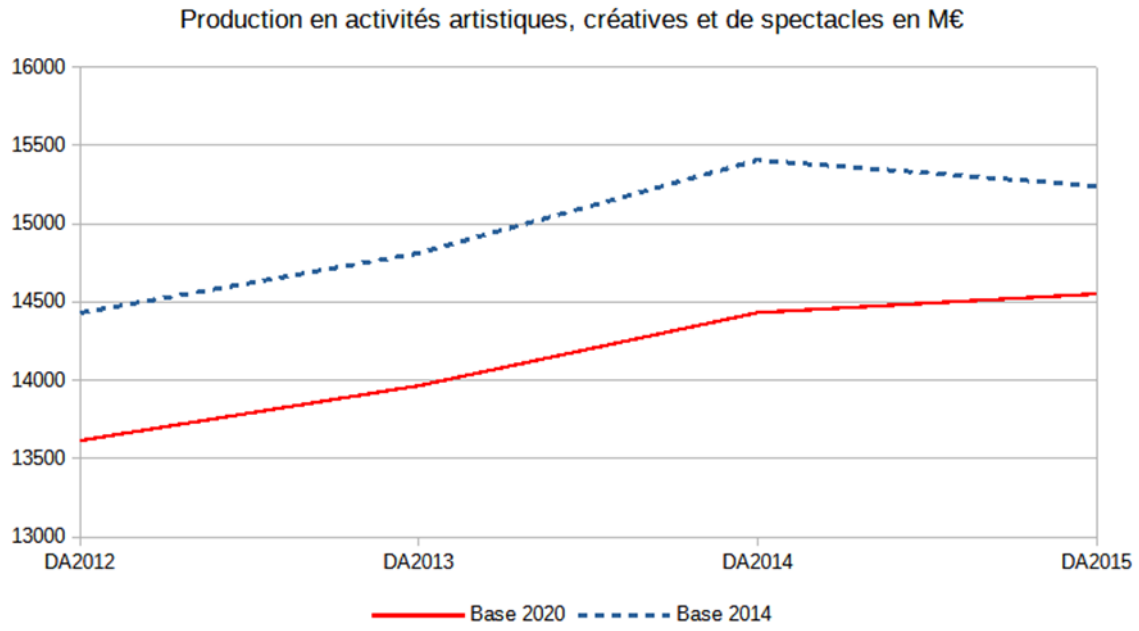
The R&D output has been substantially revised in terms of both level and trend by incorporating new data extending up to 2007, which was used to compile the benchmark year【► Fiche 14】. Prior to 2007, due to the lack of data, the standard backcasting method was carried out and the 2014 benchmark trend was thus used as a target for the new series trend.



Source : Insee, national accounts

3.3 An example where correcting an error from the 2014 benchmark leads to large rebalancing effects

For the 2014 benchmark, an amount of €324 million was mistakenly recorded as acquisitions less disposals of valuables (P.53) for the year 2014 for the arts, entertainment, and recreation activities. However, according to the ESA 2010, the operation of acquisitions less disposals of valuables does not apply to these service activities. Removing this amount in the 2020 benchmark directly affects the production trend for 2014 and 2015 by altering the balance between supplies and uses.



Source : Insee, national accounts

4. The retropolation process quality

For the 2020 benchmark, the backcasting process focused on achieving optimal quality in the resulting series. The approach included:

- **Maximum Automation**: The process was highly automated using R software.
- **Systematic and Stringent Handling of Accounting relations**: Accounting relations were managed rigorously.
- **Consistent Data Rounding**: Data were rounded consistently to ensure the quality of dissemination.
- **Optimized Adjustment Operations**: The sequence of adjustment operations was designed to ensure accounting consistency in the simplest possible manner, with a focus on atomic levels first.

Aggregate series were backcasted by aggregating atomic backcasted levels. This upward method allows for taking structural effects into account when changing the benchmark. However, it can lead to significant discrepancies at the aggregate level. Conversely to the upward method which was used, downward methods – which we didn't use – address this specific issue by backcasting aggregate series before breaking them down to more detailed levels. In this downward method, gaps between the backcast aggregate series and the sum of spontaneous backcasted atomic series is distributed proportionally among atomic series to ensure accounting consistency. However, the downward method tends to preserve aggregated series trends too much and to smooth out the changes introduced by the new benchmark.

The upward method we chose for the 2020 benchmark therefore required to look over all atomic and aggregate series. Nearly 30,000 series are disseminated, accounting for both atomic and aggregate series. This work was carried out on a large sample of those, and main macroeconomic aggregates were systematically checked.

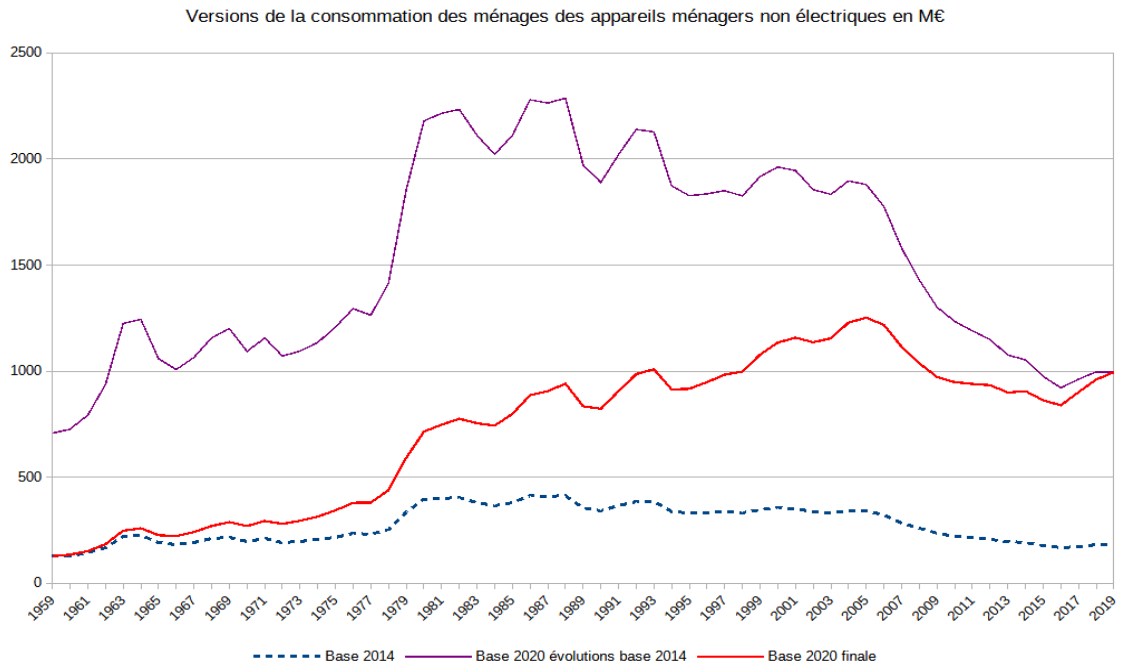
Additionally, various models from the quarterly accounts division were used to check the consistency of revisions on the main series [► Fiche 16]. New series from the 2020 benchmark were also tested using the Mésange model to ensure that macroeconomic interactions between series remained consistent.

Here are a few examples illustrating the necessity of improving spontaneously backcasted series:

- *The standard backcasting method might not be suitable due to very specific long-term historical trends*

In some cases, the using trends from the previous benchmark does not yield credible results. For example, the household consumption expenditure on non-electrical household appliances was significantly revised for 2019 due to better monitoring of the product scope. For the 2014 benchmark, the series level had shown no notable evolution over sixty years despite inflation. When the 2014 benchmark trends were applied to the new and much higher level for 2019, resulting series became much more volatile. Noticeably, the series' level in the early years was excessively high. In the early years for the 2014 benchmark, this series accounted around 0.03% of the GDP level in value but with the spontaneous result of backcasting this share would have increased to 1.7% for the 2020 benchmark.

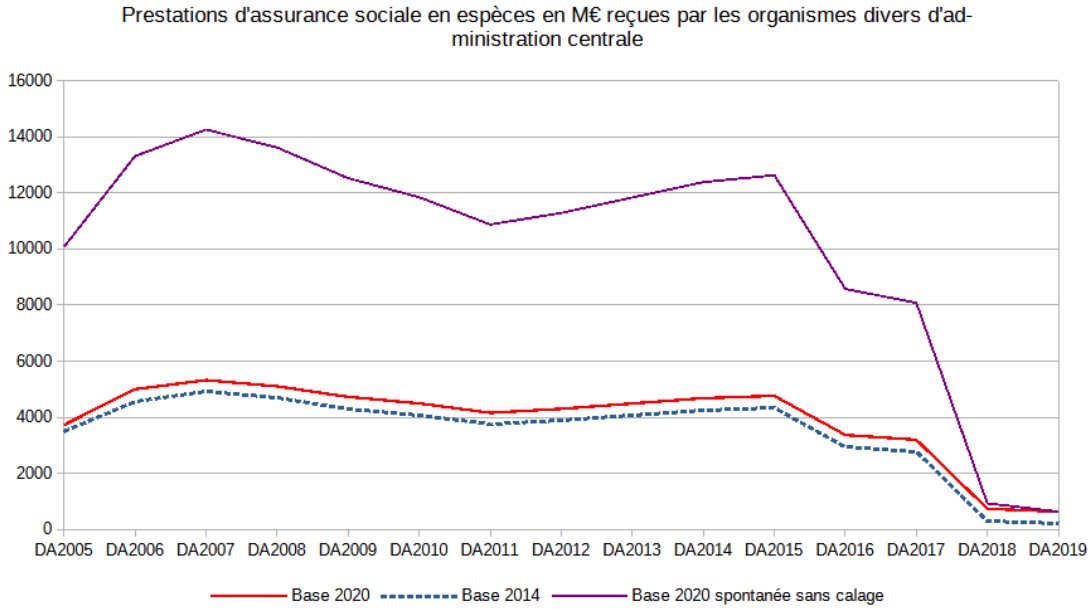
The chosen solution was to smooth trends to match the 2014 base level in 1959. This approach ensured more stability and realism in the historical data, preventing massive discrepancies which could mislead economic analysis.



Source : Insee, national accounts

- *The standard backcasting method is not suitable when a time series experienced a sudden drop in the past*

If a time series is significantly revised upward for 2019 in proportion, and it has much higher values in some previous years, backcasting it with its trend can produce very high values for those previous years. Such high values end up not being credible from an economic perspective. For example, consider the cash social insurance benefits received by various central administrative bodies (S1314). These were worth €221 million for the year 2019 and the 2014 benchmark, but it reaches €662 million for the same year and the 2020 benchmark. Applying trends to backcast this series means multiplying it by 3 on all the past. But between 2006 and 2017, this series's values fluctuated between €2.5 billion and €5 billion. The backcasting method spontaneously provided implausible values ranging from €8 billion to €14 billion for this period. To solve this issue, an ad hoc backcasting was carried out by carrying backward the 2019 gap between the two benchmark in absolute terms rather than proportionally as the standard backcasting method does.



Source : Insee, national accounts

5. Link

Reference	Link
Mésange model	https://www.insee.fr/fr/information/3605738