Selective editing for the new Services Producer Price Indices (SPPIs) from indirect data sources

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Unece Expert Meeting on Statistical Data Editing
7-9 October 2024, Vienna, Austria

Outline

SPPIs - Services Producer Price Indices (1/5)

- **Target variable**: the business-to-business (BtoB) production price, which is the quarterly average price of the service sold.
- **Data sources**: direct quarterly survey on enterprises (Oros) and administrative data (INPS, and ISA models).
- **NACE groups**:
  - 741 - Specialized design activities
  - 742 - Photographic activities
  - 743 - Translation and interpretation activities
  - 749 - Other professional, scientific and technical activities n.e.c.
  - 821 - Office administrative and support activities
  - 829 - Business support service activities n.e.c.

SPPIs - Services Producer Price Indices (2/5)

Elementary chained-base indices:

$$I_{i,j,t} = \frac{clor_{i,j,t}}{clor_{i,j,0}} \ , \tag{1}$$

- $clor_{i,j,t}$ is the average hourly labour cost for the quarter t,
- i is the enterprise,
- j is the social security contributions unit,
- $clor_{i,j,0}$ is the average hourly labour cost for the base quarter, i.e. the fourth quarter of the previous year.

SPPIs - Services Producer Price Indices (3/5)

Indices at the enterprise level: a weighted geometrical mean over the n_i social security contributions unit belonging to a given enterprise:

$$I_{i,t} = \left(\prod_{j=1}^{n_i} I_{i,j,t}^{w_j} \right)^{\frac{1}{\sum w_j}} . \tag{2}$$

where the weights w_j are given by the quarterly paid hours for the j-th social security contributions unit.

SPPIs - Services Producer Price Indices (4/5)

Aggregate indices (at the level of economic activity): a weighted mean of the enterprise indices:

$$I_t^K = \sum_{i=1}^{n_K} I_{i,t}\omega_{i,0} \ , \tag{3}$$

the weighting coefficients $\omega_{i,0}$ are given by the share of revenues of the enterprise with respect to the total yearly revenues for a given offered service.

SPPIs - Services Producer Price Indices (5/5)

The aggregate indices can be re-written as:

$$I_t^K = \sum_{i=1}^{n_K} clor_{i,t}\pi_{i,0} = \sum_{i=1}^{n_K} clor_{i,t} \frac{1}{clor_{i,0}} \frac{ric_{i,0}}{\sum_{i=1}^{n_K} ric_{i,0}} \ , \tag{4}$$

This formula makes clearer the relationship with the hourly labour cost at the enterprise level and makes the use of SeleMix suitable. Indeed, $\boldsymbol{\pi_{i,0}}$ defines the **influence weight** to be used in the process of influential observations detection.

Outline

SeleMix - the method

- Approach based on **contamination normal models**.
- **Intermittent error mechanism**:
  - data can be represented by a latent class model, where the latent variable is a binary variable indicating the presence or absence of error for each unit.
- The observed data distribution can be derived by combining two regression models:
  - true data distribution
  - the error mechanism

$\Longrightarrow$ it is possible to estimate the **magnitude of the error**; thus, to identify errors that have high impact on target estimates (influential errors).

SeleMix - R package

Three key functions:

1. ***ml.est*** $\longrightarrow$ the estimation of model parameters
2. ***pred.y*** $\longrightarrow$ the prediction of variable values
3. ***sel.edit*** $\longrightarrow$ the selection of observations affected by potential influential errors

An additional function ***sel.pairs*** provides valuable graphical tools.

The editing strategy (1/2)

Two distinct models of the type were specified:

$$clor_t^{i,K} = A_t^K + B_t^K clor_{t-4}^{i,K} + \varepsilon^i \tag{5}$$

where i=enterprise, K=economic activity.

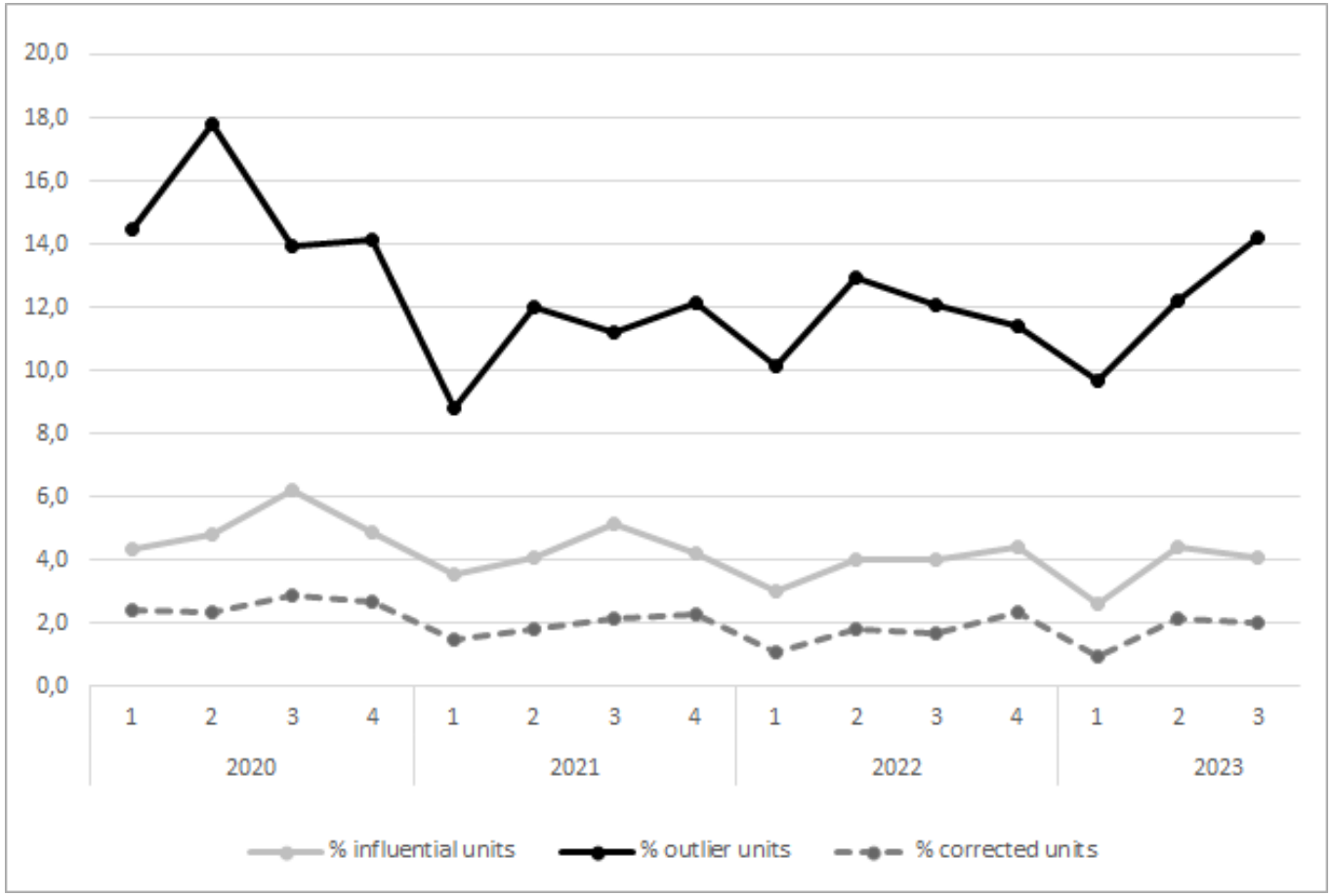
1. The **Model 1** with one covariate aims to identify influential units for the responding units (enterprises) for which the average labour cost at $t-4$ is available.
2. The **Model 2** with no covariates aims to identify influential units on all responding units.

The editing strategy (2/2)

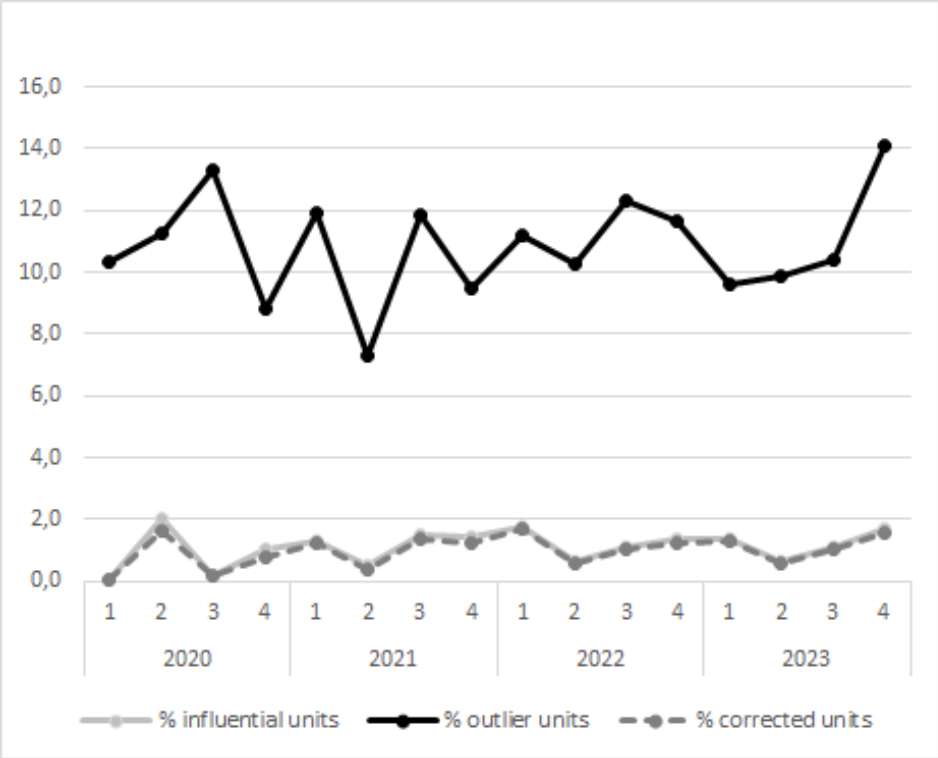
3. The entire data set was divided into two subsets based on the 99-th percentile of the distribution of the target variable ($clor_t$) and the share of per capita revenue.
4. Model 1 and Model 2 were applied to each of the two subsets, for $i = 1, 2, \ldots, n_K$.
5. The list of influential units is given by the union of the influential units identified by Model 1 and Model 2 (unless the influential units already identified by Model 1).

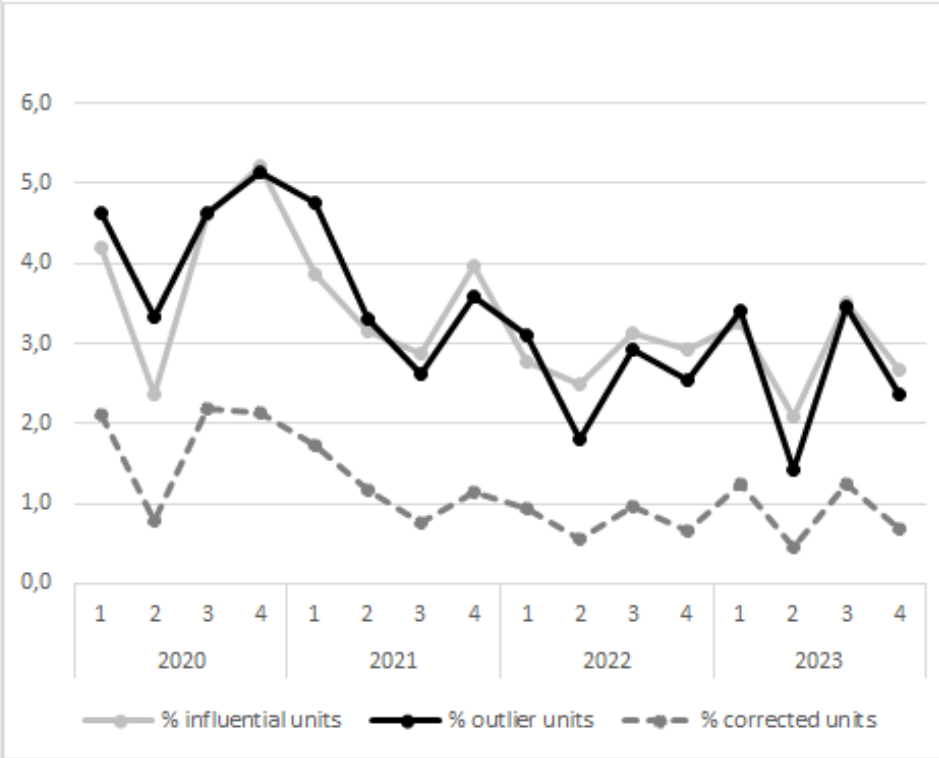
Outline

Percentage of outlier, influential and corrected units out of the total units, NACE groups as a whole - Figure 1

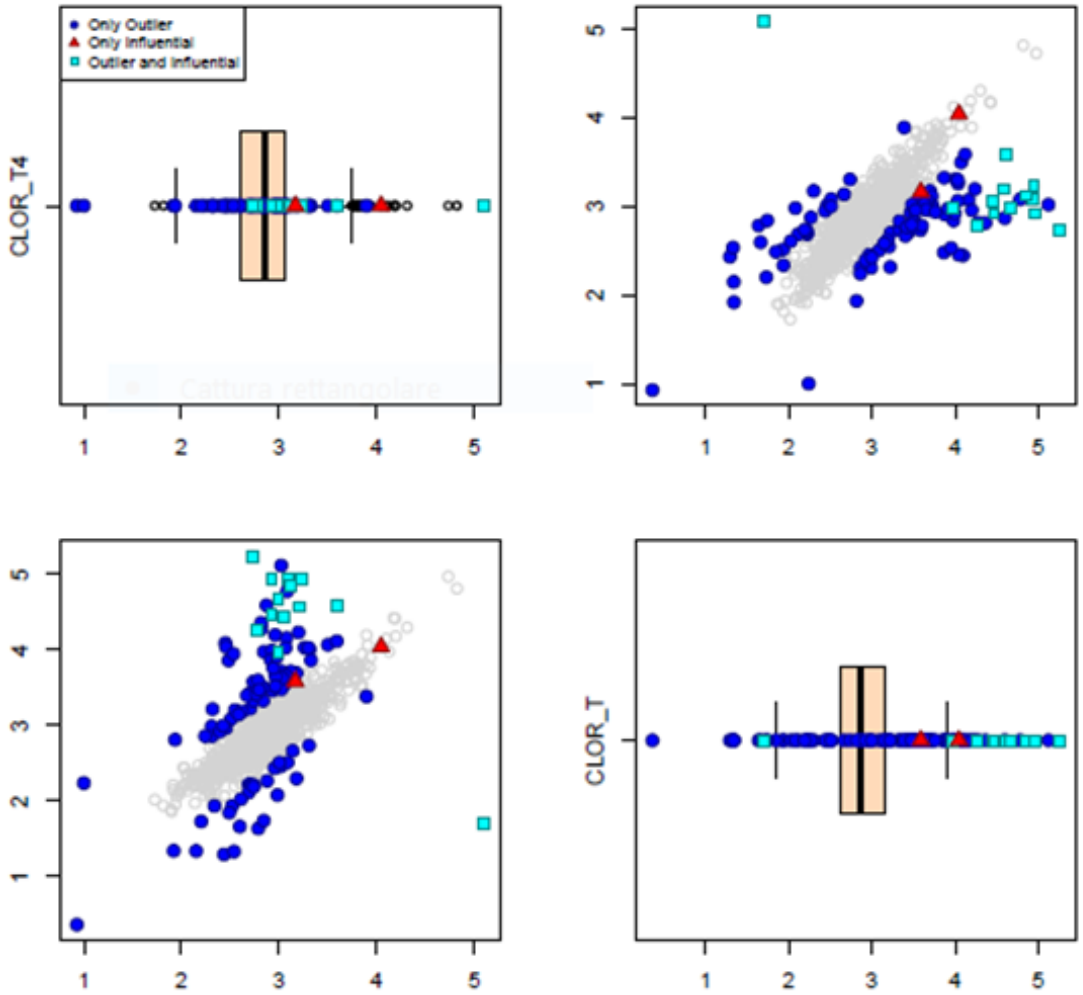


Percentage of outlier, influential and corrected units out of the total units, NACE groups as a whole - Model 1 and Model 2

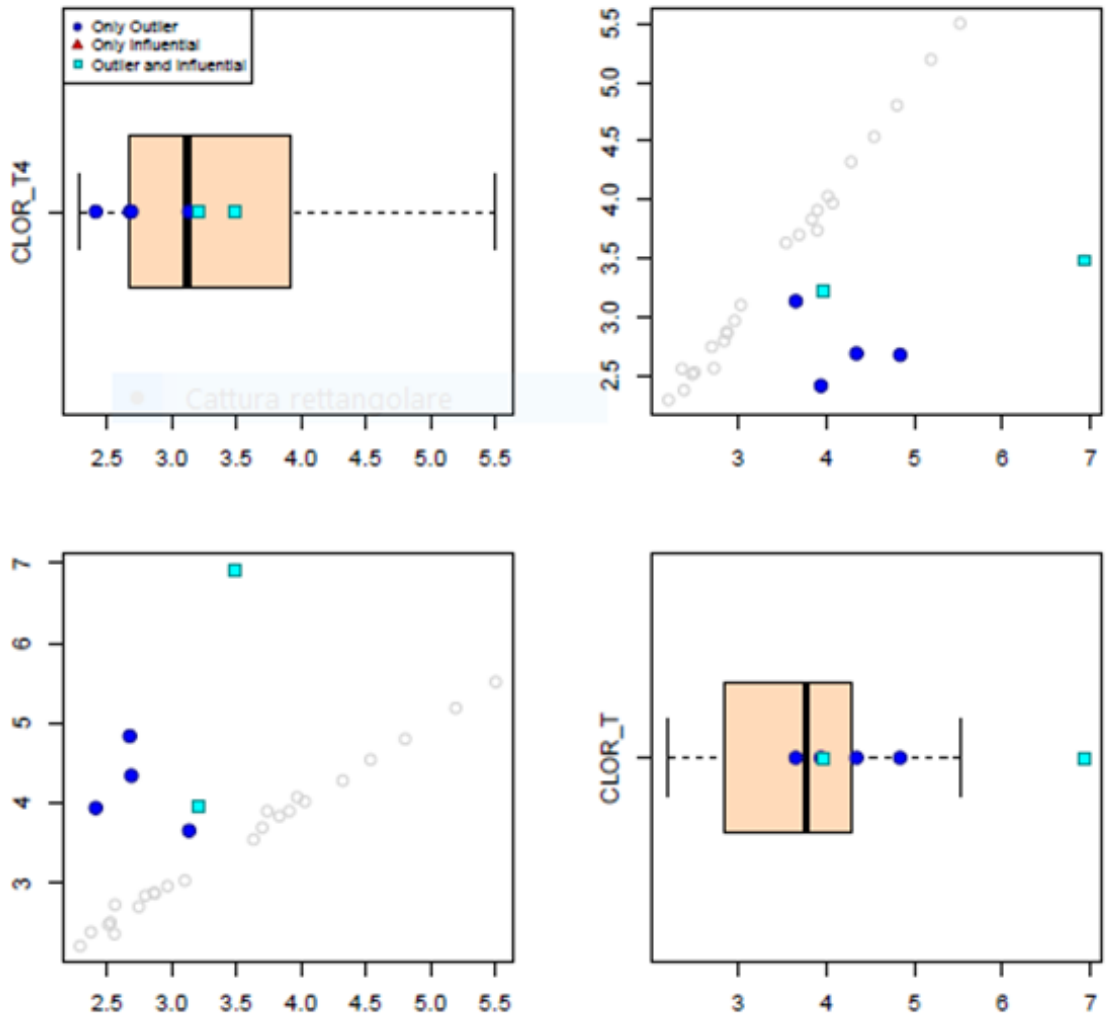




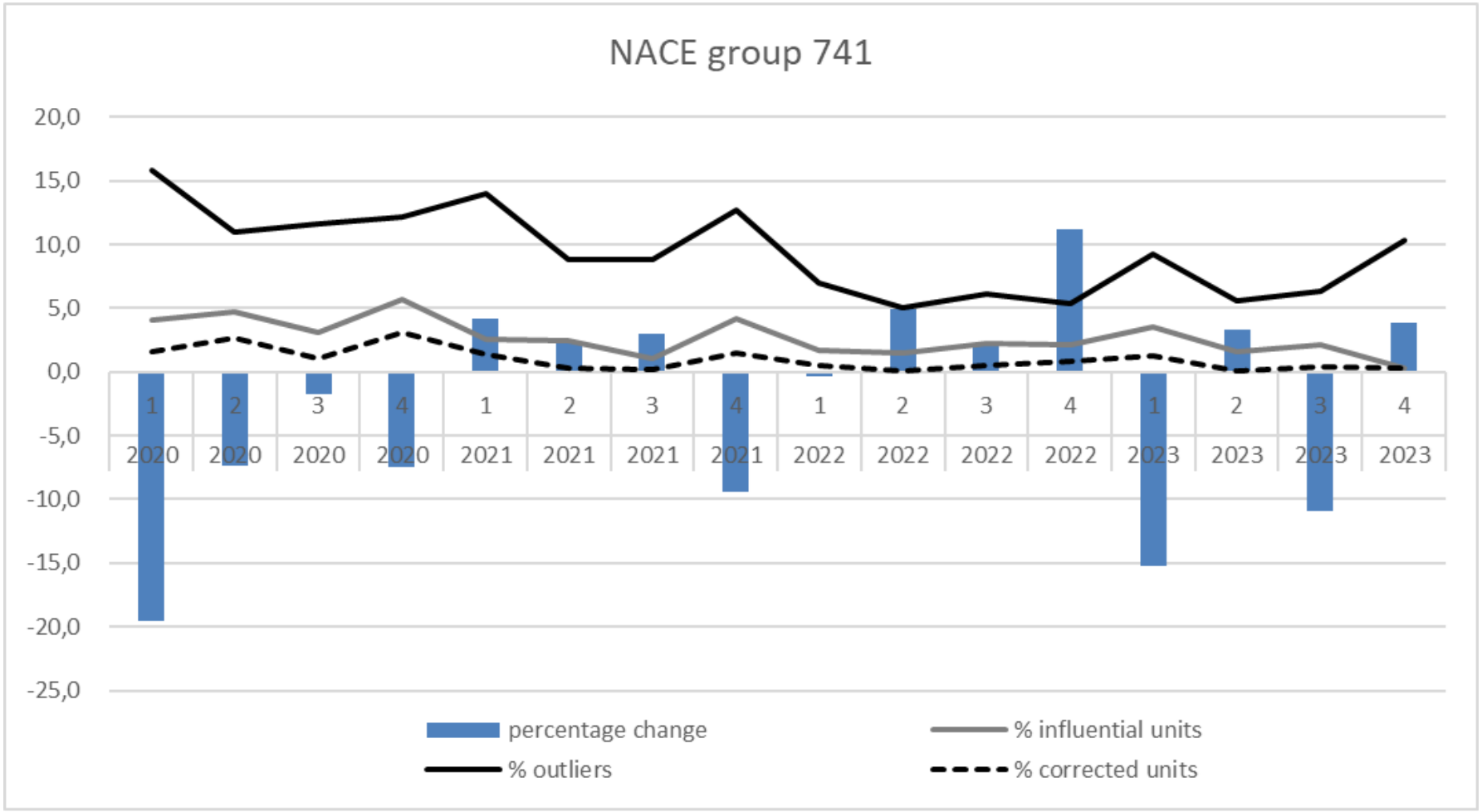
NACE group 741, Q1 2020, units below the 99-th percentile. Outliers and influential errors highlighted.



NACE group 741, Q1 2020, units exceeding the 99-th percentile. Outliers and influential errors highlighted.



NACE group 741: Percentage changes, and percentage of outliers, influential and corrected units out of the total



Outline

Conclusions and future work

- Different performance for Model 1 when focused on units above the 99-th percentile versus the same model on the rest of units: only by setting a high threshold were potential influential units identified.
  - Possible cause: strong relationship between the dependent variable and its covariate.
  - Possible solution: discarding highly similar observations between time (t) and $(t-4)$ may be better.
- Different methods should be found for subsets of units above the 99-th percentile for which SeleMix did not converge.
- All identified influential units should be manually reviewed by experts; it is reasonable to expect that fewer units will need to be corrected.

Questions, comments, suggestions?

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