

# The Choice between Bilateral and Multilateral Index for Scanner Data

Case Study on Austrian Grocery Scanner Data  
2022-2023

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Meeting of the Ottawa Group on Price Indices

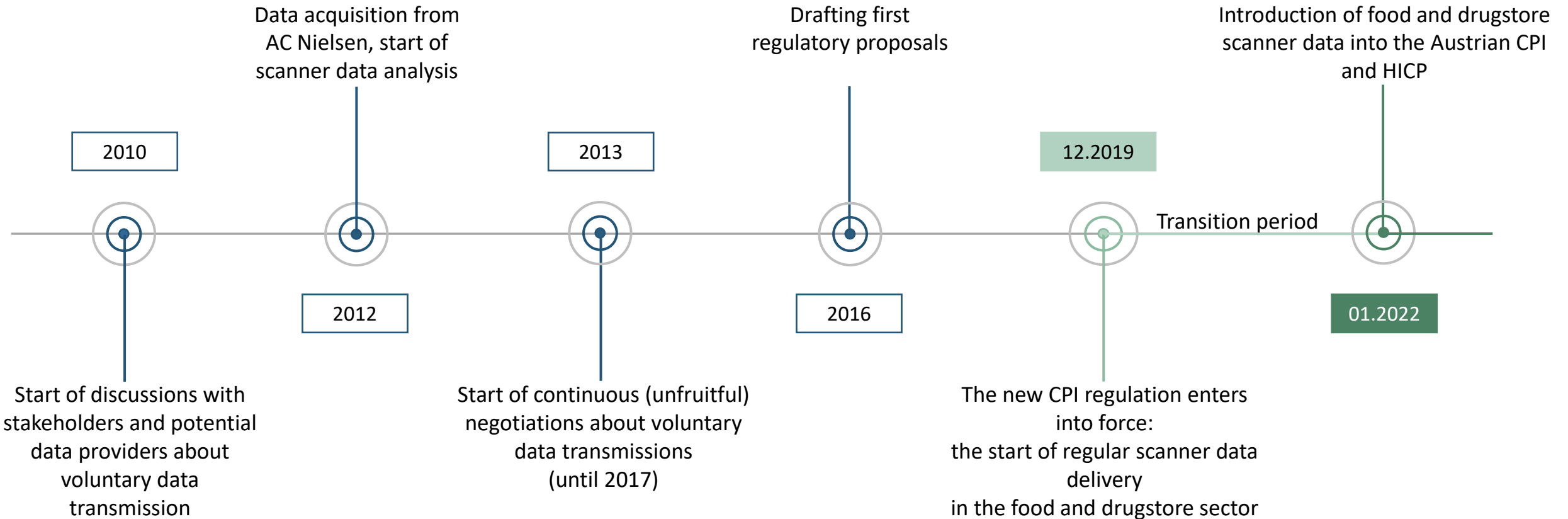
13. May 2024

[www.statistik.at](http://www.statistik.at)

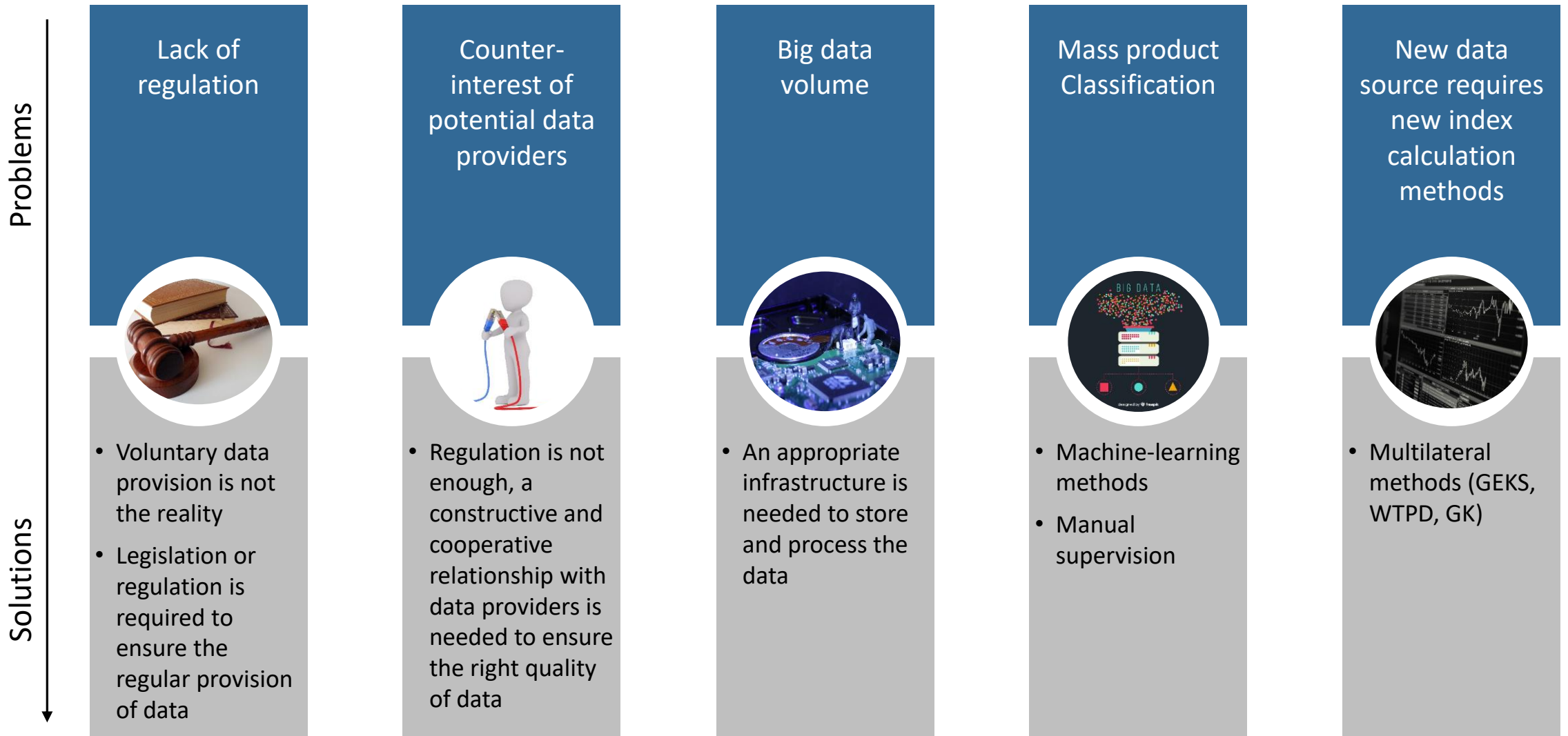
A photograph of a modern office building interior, featuring a multi-level atrium with glass railings and a blue overlay. The text 'Implementation of Scanner Data' is centered in white. The right side of the image shows a close-up of a window with a white frame and a view of another building.

# Implementation of Scanner Data

# Timeline of Austrian Scanner Data Project



# Challenges Faced when Implementing Scanner Data



# Regulation: National Compromise Was Reached between All Stakeholders.

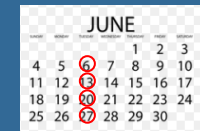
Since December 2019, the CPI regulation governs data collection by means of scanner data. This is not the best possible regulation, but it could win the cooperation of the companies.

Austrian regulation defines:

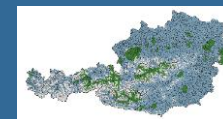
The size of enterprise obliged to provide data: cut-off sampling excluding Small and Medium Enterprises.



The periodicity of the delivery of scanner data: weekly



The survey regions for the scanner data deliveries: 346 postcodes were selected in such a way as to ensure representativeness at regional level. Around 43% of the Austrian population live in the selected areas



Each country will have to negotiate a compromise with stakeholders that is acceptable to all.

# Selected Sectors: Food, Beverages, and Cosmetic and Toiletry Articles

These sectors are highly concentrated in Austria, where the top 5 players have a market share of 80-90%, it is an ideal choice for the introduction of scanner data.



Relatively few data providers need to be involved, while these commodity groups have 15% weight in the CPI index basket.



There is a significant saving of resources, as in these areas regional price collection was carried out, involving a significant number of price collectors.



# Data Processing

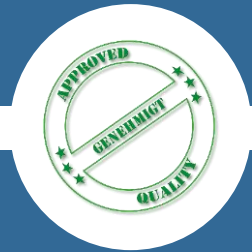
## Weekly tasks:

### Automated data transfer



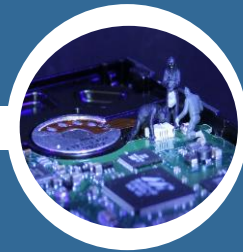
- Secure servers
- Storage privacy
- Data protection

### Data Import, Review, Quality control



- Check for completeness
- Search for anomalies
- Outlier check

### Database upload, synchronisation




- Verified data is loaded in database

## Monthly task:

### Classification



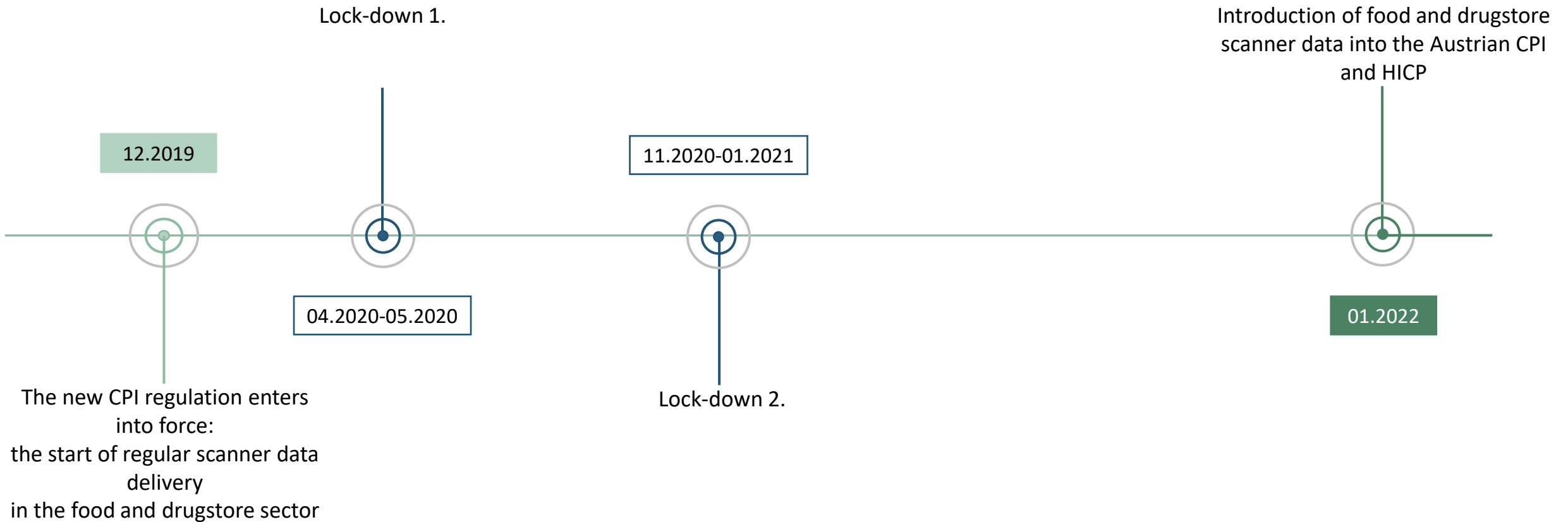
- Automated matching procedure
- Machine-learning methods
- Manual procedure



# Multilateral Index vs Bilateral Indices: an Overview of the Methodology Used During the Covid Lock-down Periods



# Transition Period Is Twice Interrupted by Lock-downs



Due to the lock-downs, it was unexpectedly necessary to compile indices based on scanner data, as the price collectors were prevented from visiting the shops.

# Bilateral Jevons Index Was Used in the Lock-down Months

## Why bilateral?

Lack of historical data, only three months of data available

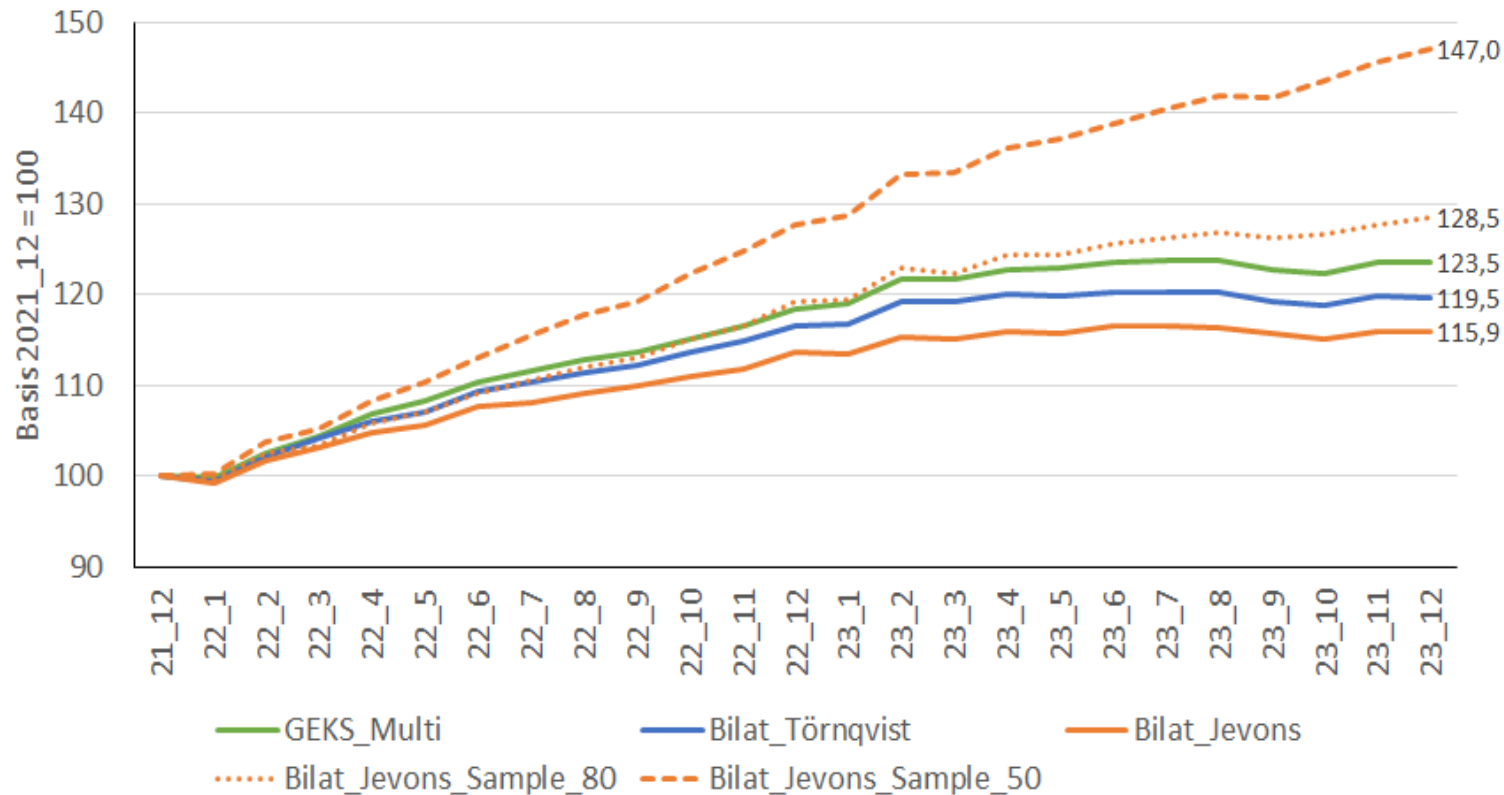
## Why Jevons instead of bilateral Törnqvist?

Alignment with traditional method: the Jevons Index was used in the price survey and we still planned to revert from scanner data to price survey in the transition period.

Flexibility and convenience: the Jevons index offered practical advantages by allowing the calculation of product-level rates of change and then their geometric means.

Limited experience with scanner data: the potential for chain drift associated with revenue-weighted bilateral indices, led us to adopt a cautious, unweighted approach

# Comparing Bilateral Jevons, Törnqvist, and Multilateral GEKS Approaches for Food and Non-Alcoholic Beverages



Unsampled bilateral indices, especially the unsampled Jevons index, show significantly lower values than the multilateral index over a two-year period.

Calculated on the basis of December 2021, the multilateral index stands at 123,5 in December 2023, the bilateral Törnqvist at 119,5 and the bilateral Jevons at 115,9.

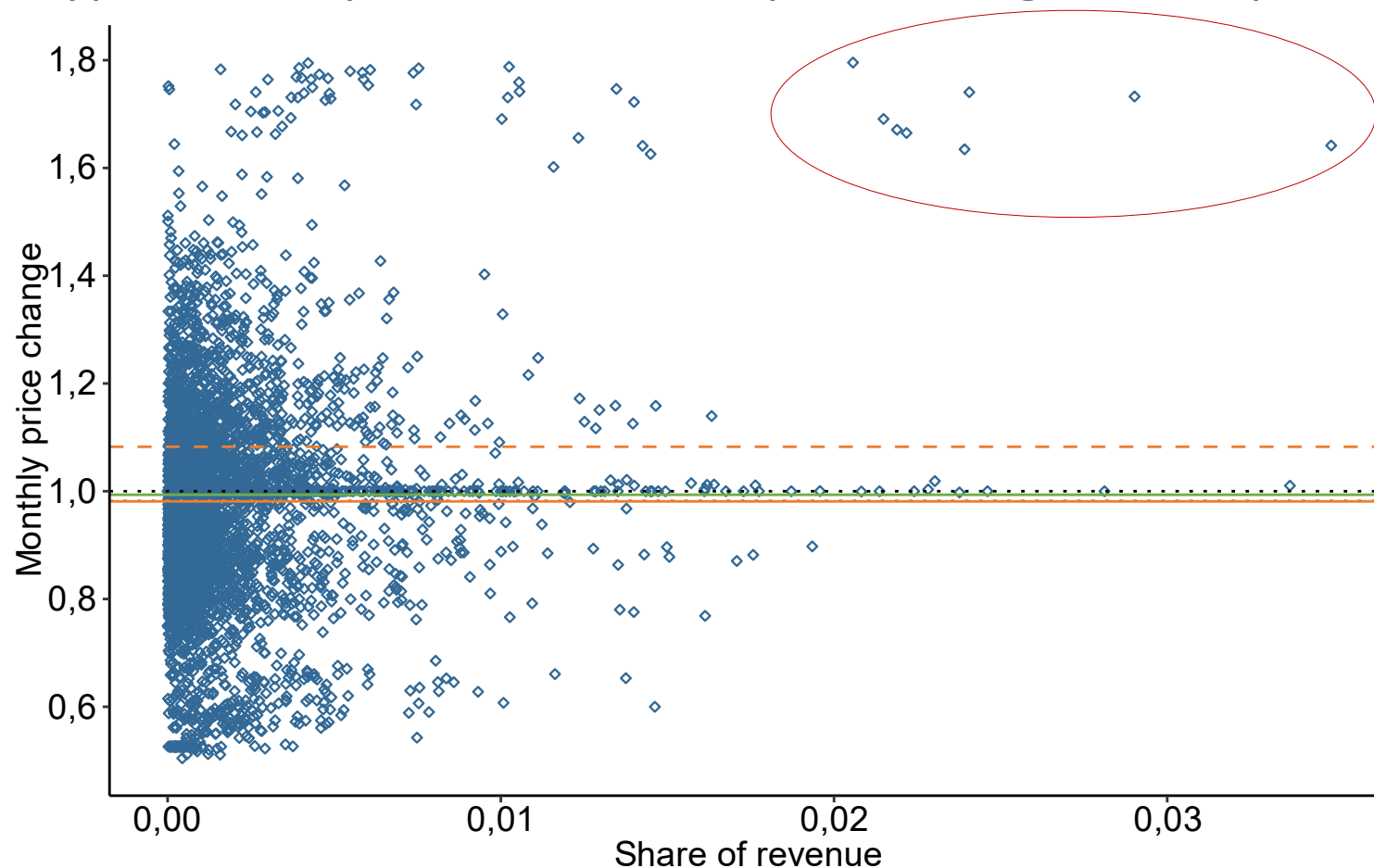
The lower value of the bilateral Törnqvist is due to a chain-drift effect. Similarly, chain drift affects the bilateral Jevons index, with additional distortions.

The scanner data contains a large number of products that have a negligible revenue in a given month. While weighted indices mitigate these problems, unweighted Jevons indices give these products an excessive influence.

Revenue-based sampling have lacked precision, resulting in a positive bias.

# How Revenue-Based Sampling Can Lead to a Positive Bias?

A typical example: coffee beans price change from April to May 2023 1.



The scatterplot shows the price change of more than 5.700 products (unit-values per chain and per region) of coffee beans.

On the y-axis, points greater than 1 represent products whose prices have increased and points less than 1 represent products whose prices have decreased.

The multilateral GEKS measure for this month is -0,65 price decrease (green line), with a value of 0,9935 on this y-scale.

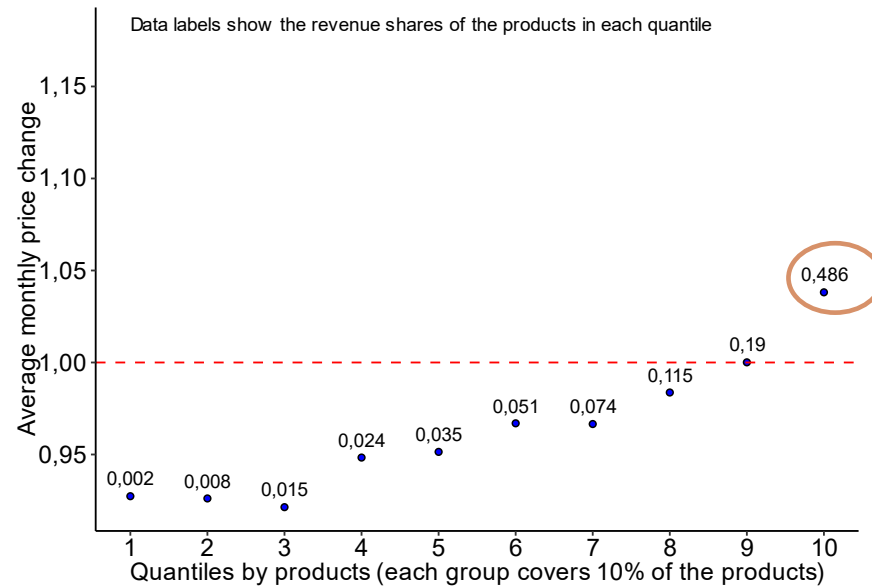
Unsampled Jevon index measures higher price decline of -1,9%, i.e. 0,9812 on the y-scale (orange line).

Sampled Jevon index including only the top products that generate 50 percent of the total turnover measures a price increase of 8,3 percent (1,083 - orange dotted line).

**Products within the red circle have a significant market share of 2-3%, accompanied by a significant increase in price, so the sample is biased upwards.**

# How Revenue-Based Sampling Can Lead to a Positive Bias?

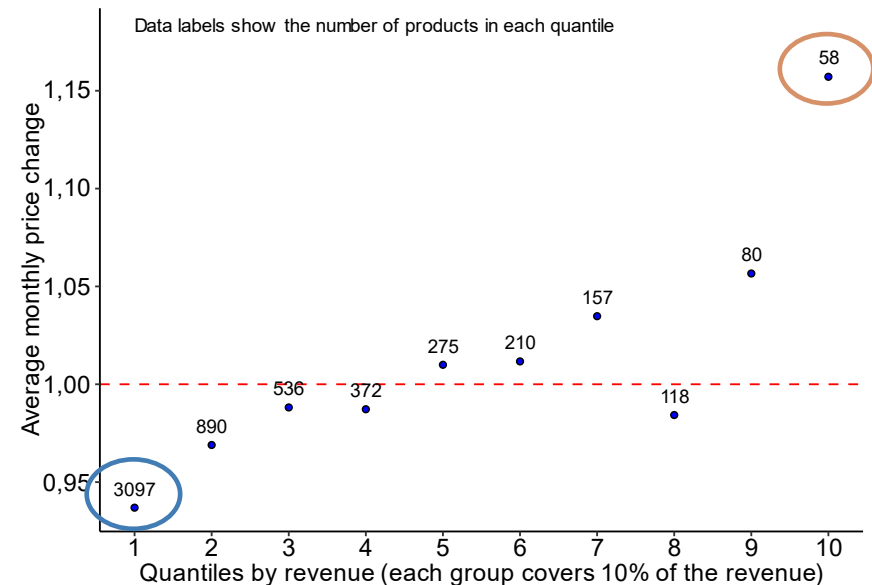
A typical example: coffee beans price change from April to May 2023 2.



Price change of more than 5.700 coffee products in quantiles.

Around 570 products, representing 1/10 of the total, contribute a massive 48,6% of total sales, while the most profitable 58 products alone account for 1/10 of sales.

Conversely, the least profitable products, numbering 3.097, contribute only 10% of revenue.



**There is a strong relationship between the price change of products and market share, as the prices of products with higher market shares tend to increase.**

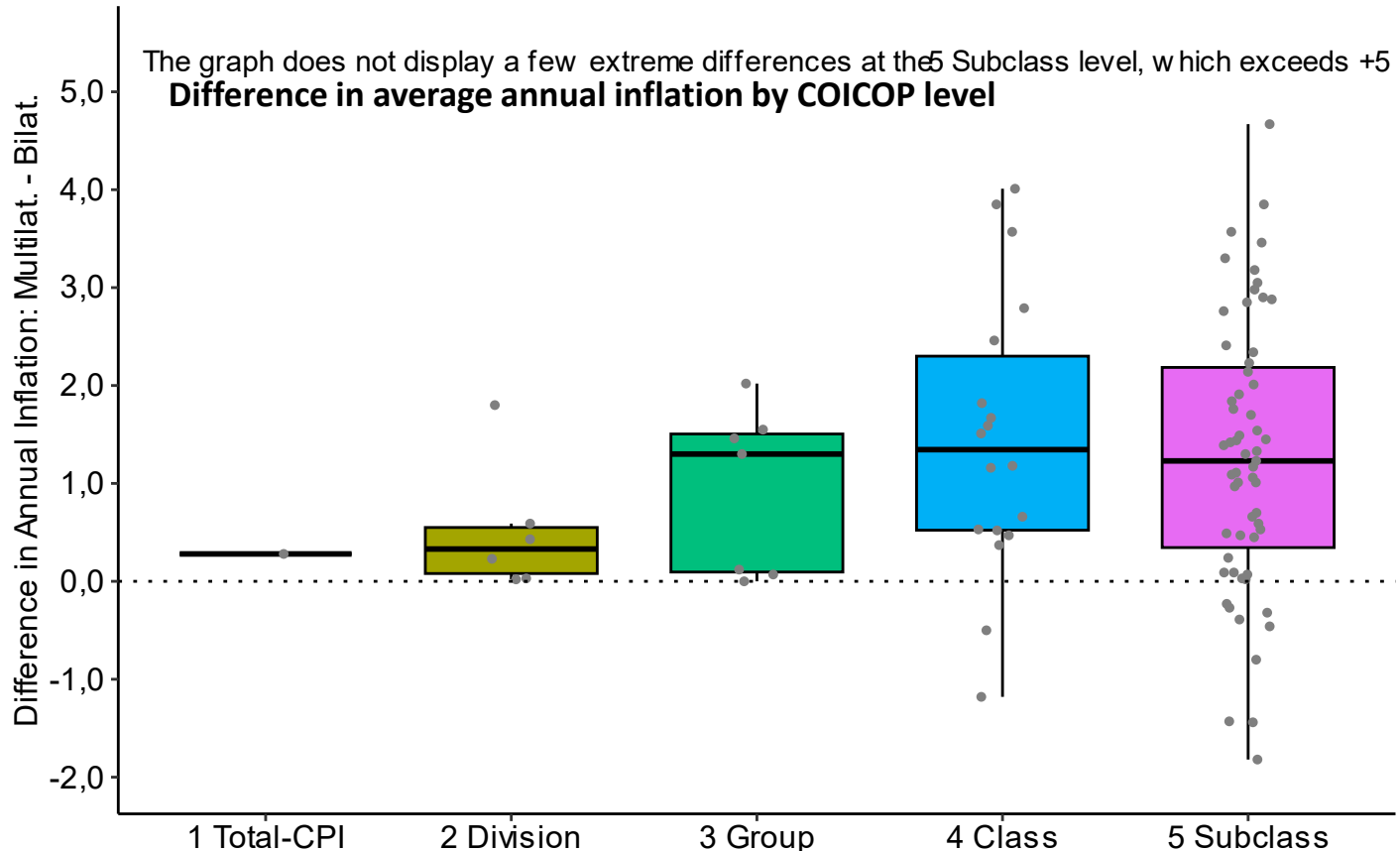
**Consequently, the sample is skewed upward, while the non-sample is biased downward.**

**Adopting a fixed sample over a longer period, similar to traditional price collection, could mitigate this bias, but has its own set of challenges: product churn and substitution, reduced product diversity.**

# Multilateral Index vs Bilateral Törnqvist

The background of the slide is a photograph of a modern building's interior, featuring a multi-level atrium with glass railings and potted plants. A semi-transparent blue overlay covers the left and central portions of the image. On the right side, there is a clear view through a window showing the exterior of a modern building with a grid-like facade and large glass panels.

# Multilateral Method: +0,3 Percentage Points Higher Annual Inflation in 2023



The graph does not display a few extreme differences at the 5 Subclass level, which exceeds +5  
**Difference in average annual inflation by COICOP level**

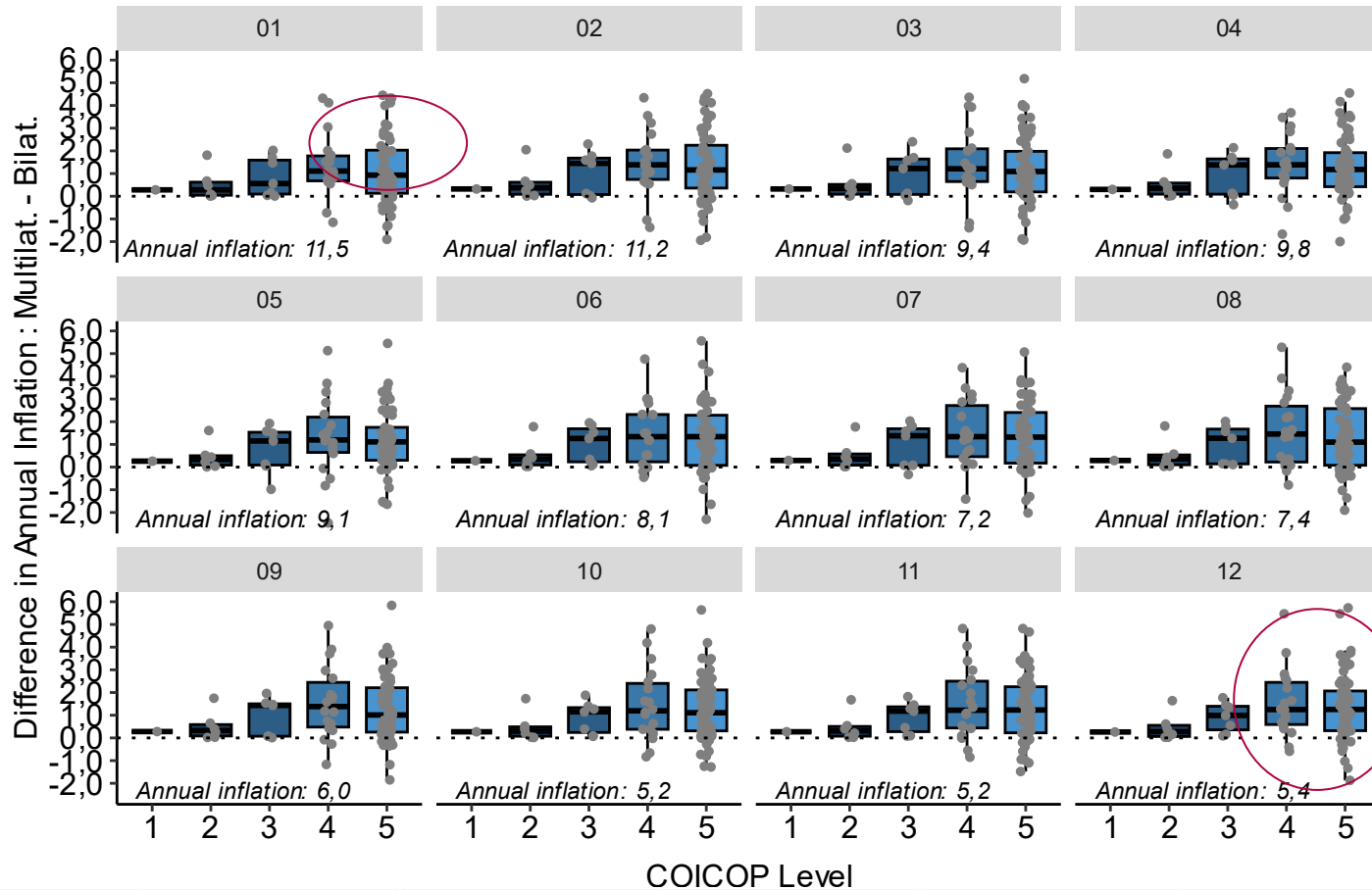
The average difference at COICOP level 5 is +1,8 percentage points.

Of the 62 COICOP 5 categories, 53 have positive differences and only 9 have negative differences.

Differences at COICOP 5 level range from -1,8 to +21,3 percentage points.

	1 Total-CPI	2 Division	3 Group	4 Class	5 Subclass
<b>Avg. M</b>	<b>8,0</b>	<b>7,6</b>	<b>9,3</b>	<b>10,1</b>	<b>12,3</b>
<b>Avg. B</b>	7,7	7,1	8,3	8,2	10,5
<b>Δ(M-B)</b>	<b>+0,3</b>	+0,5	+1,0	+1,9	+1,8

# Stable Monthly Inflation Differences Between the Methods Despite Significant Disinflationary Trend Throughout the Year



Annual inflation calculated using the multilateral method is consistently higher than that calculated using the bilateral method.

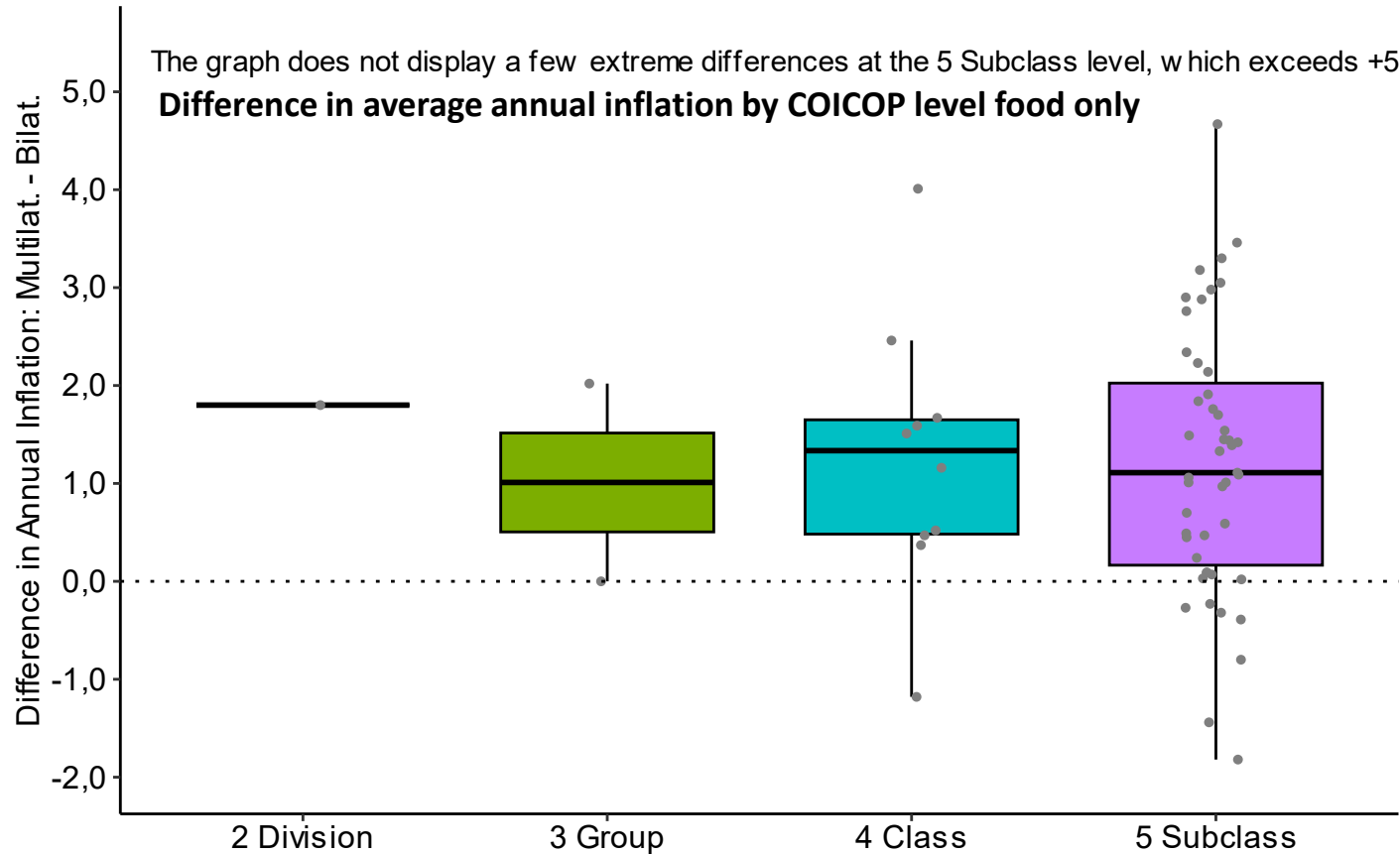
The annual inflation in the COICOP 5 categories involved was 17,4 percent in January, while at the end of the year it was 5,6 percent.

The size of the difference between the two methods is almost the same for all COICOP aggregations in the different months.

	1	2	3	4	5
<b>January 2023</b>					
<b>Avg. M</b>	11,5	8,8	11,1	14,4	17,4
<b>Avg. B</b>	11,2	8,3	10,2	12,5	15,7
<b>Δ(M-B)</b>	+0,3	+0,5	+0,9	+1,9	+1,7
<b>December 2023</b>					
<b>Avg. M</b>	5,4	5,4	5,9	4,9	5,6
<b>Avg. B</b>	5,2	4,9	5,0	2,9	3,9
<b>Δ(M-B)</b>	+0,2	+0,5	+0,9	+2,0	+1,7



# Multilateral Method: +1,8 Percentage Points Higher Annual Inflation for Food in 2023

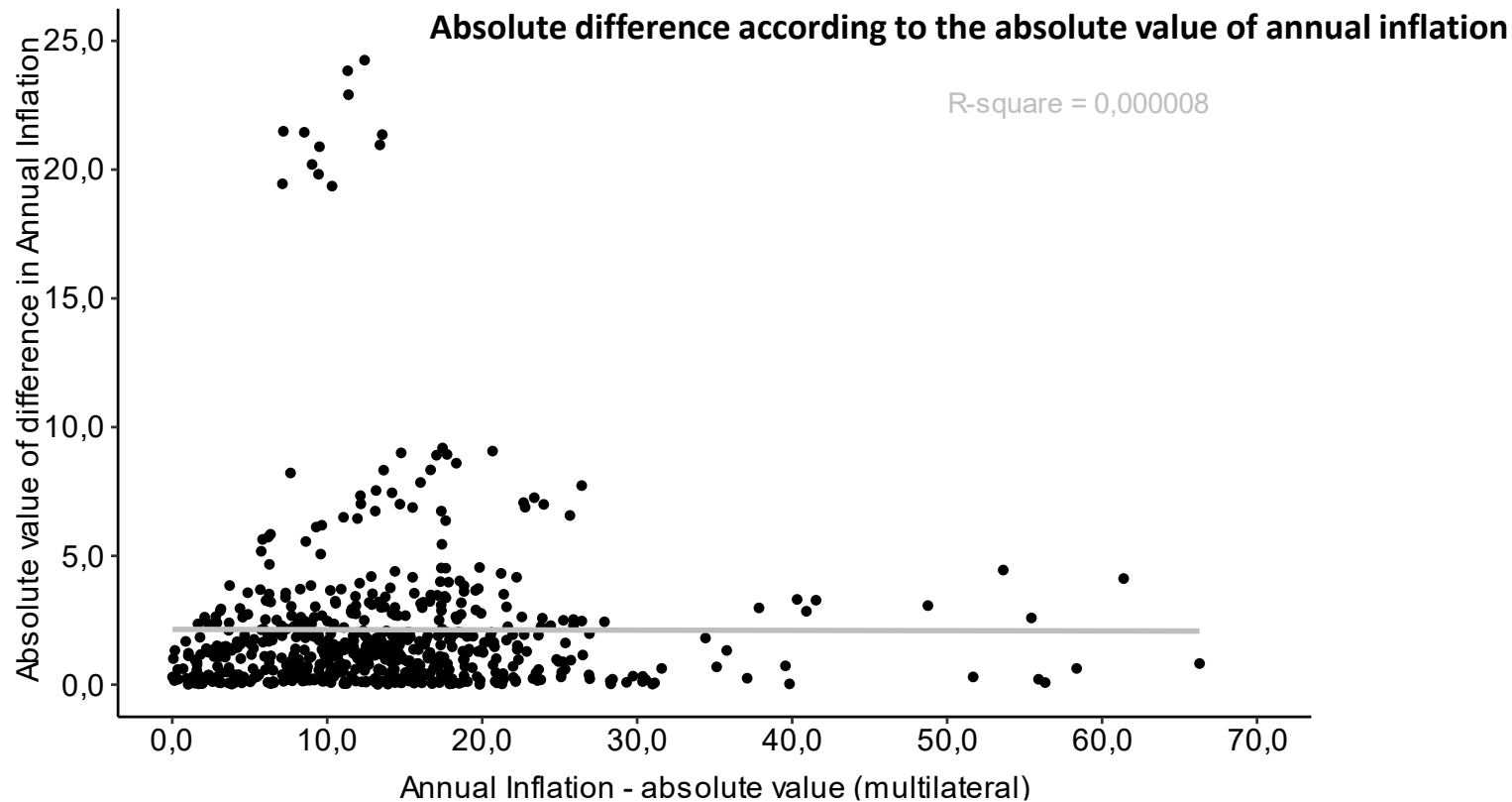


This chart represents fewer categories, but they are all fully covered with scanner data.

At COICOP Level 5, the average difference between the results of the methods is +1,9 percentage points, but again the results for each category show a relatively larger difference of between -1,8 and +21,3 percentage points.

<b>Avg. M</b>	<b>11,7</b>	<b>12,2</b>	<b>11,4</b>	<b>13,1</b>
<b>Avg. B</b>	9,9	11,2	9,3	11,2
<b><math>\Delta(M-B)</math></b>	<b>+1,8</b>	+1,0	+1,9	+1,9

# Absence of Correlation: Inflation Level and Methodological Differences

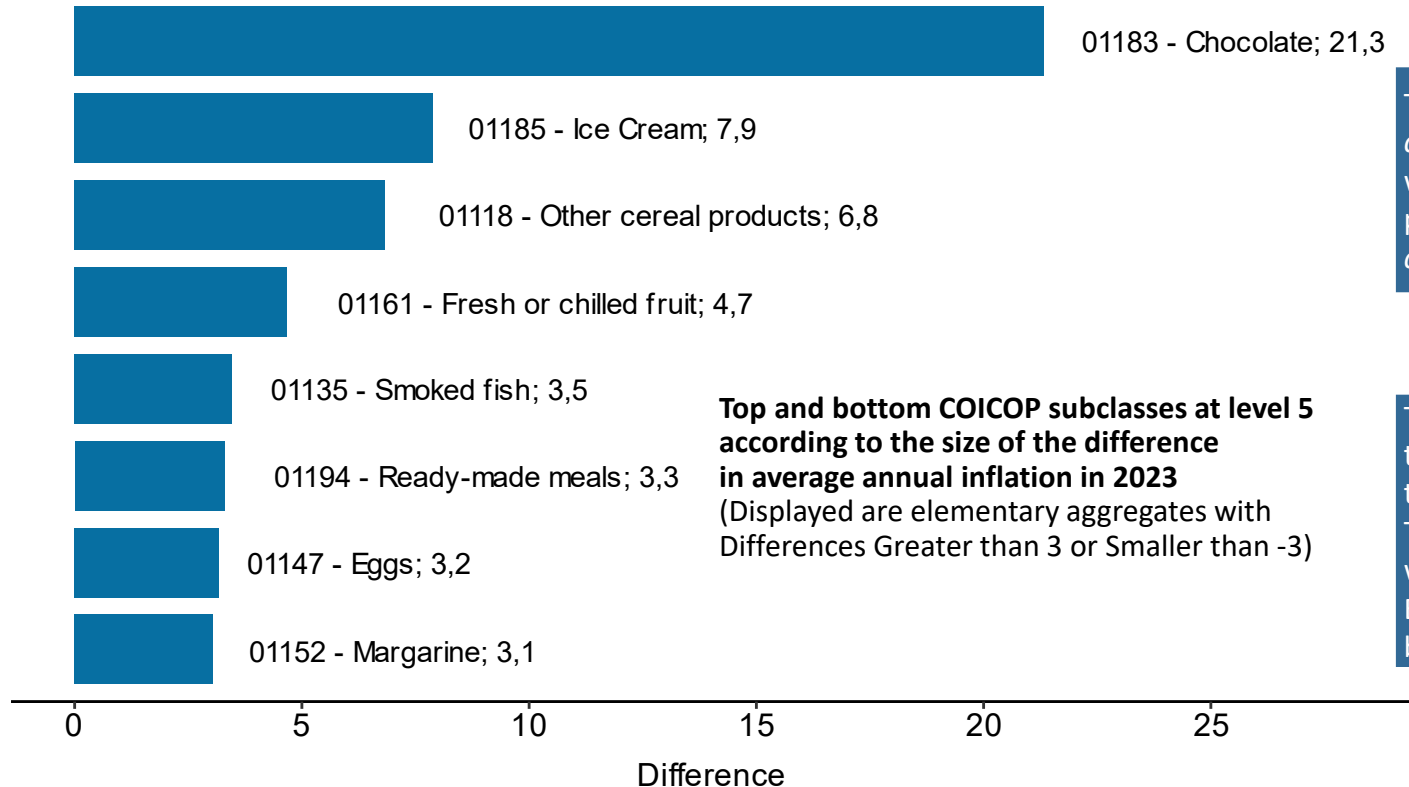


Annual inflation (absolute value of change)	Absolute value of difference
0-5	1,1
5-10	2,7
10-20	2,3
20-40	1,7
40+	2,1

The hypothesis that the large difference between the methods is due to high inflation in 2023 is rejected.

Given that the bilateral method consistently measures lower inflation than the multilateral method, this implies that even in a moderate inflation environment, the bilateral method can underestimate inflation by a relatively large margin.

# The Largest Differences at COICOP 5 Level: Mainly Seasonal Products



The largest positive difference in the average inflation is for *chocolate*, where annual inflation is 21,3 percentage points higher with multilateral index than with bilateral index. The second largest positive difference is for *ice cream* and the third largest is for *other cereal products*.\*

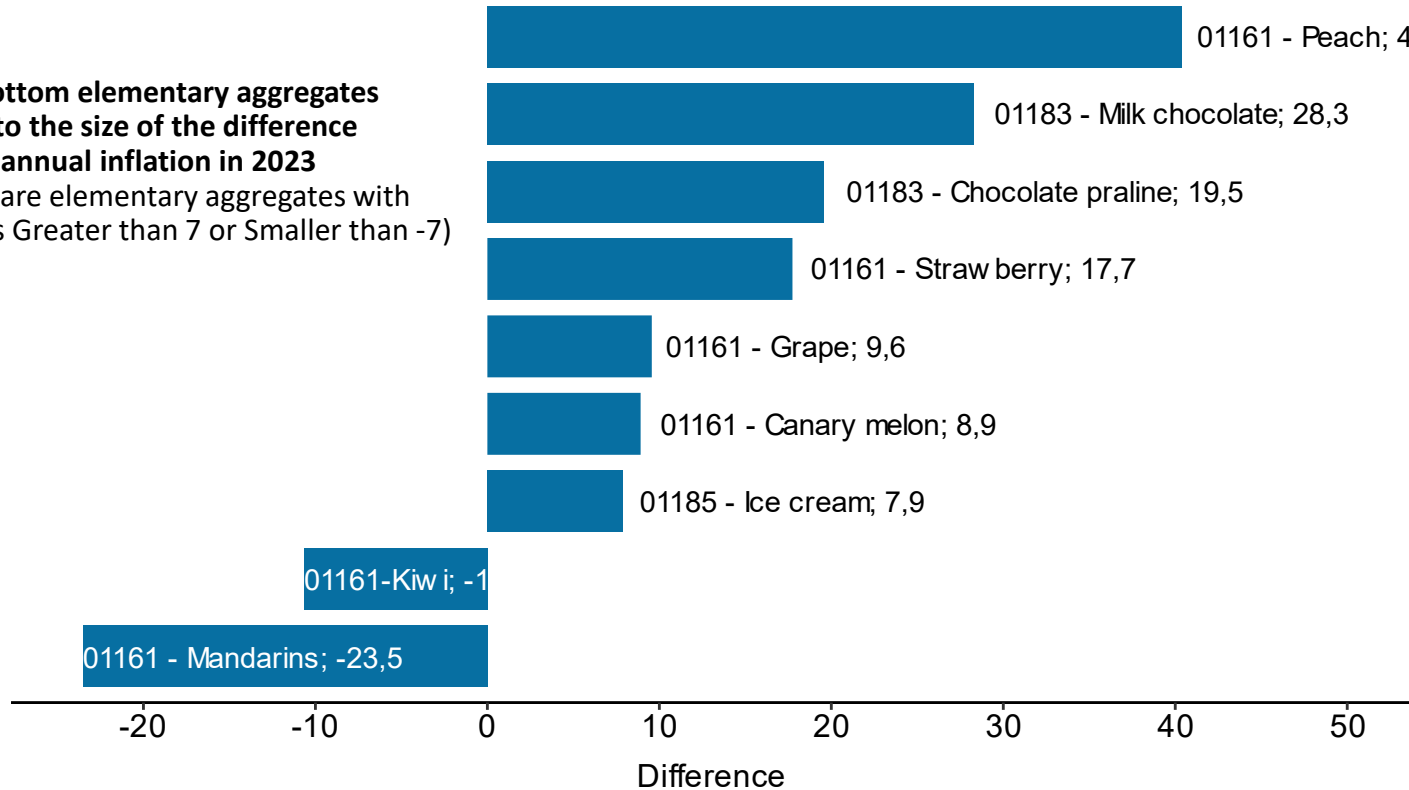
The contrast is particularly marked for chocolate: the bilateral method shows an annual fall in inflation of 11%, while the multilateral method shows a price increase of 10,3%. This is due to the seasonal nature of many chocolate products, which are often only available around holidays such as Christmas or Easter, resulting in inaccurate price fluctuations captured by the bilateral index.

Although COICOP level 5 is not the lowest elementary level for index calculation, significant differences can be observed, especially for seasonal products. This is even more evident when comparing at the elementary aggregate level where the index calculation takes place.

\*The category *other cereal products* includes mixes and doughs for the preparation of bakery, which are highly seasonal linked to holidays.

# The Largest Differences at Elementary Aggregate Level: Only Seasonal Products

**Top and bottom elementary aggregates according to the size of the difference in average annual inflation in 2023**  
(Displayed are elementary aggregates with Differences Greater than 7 or Smaller than -7)



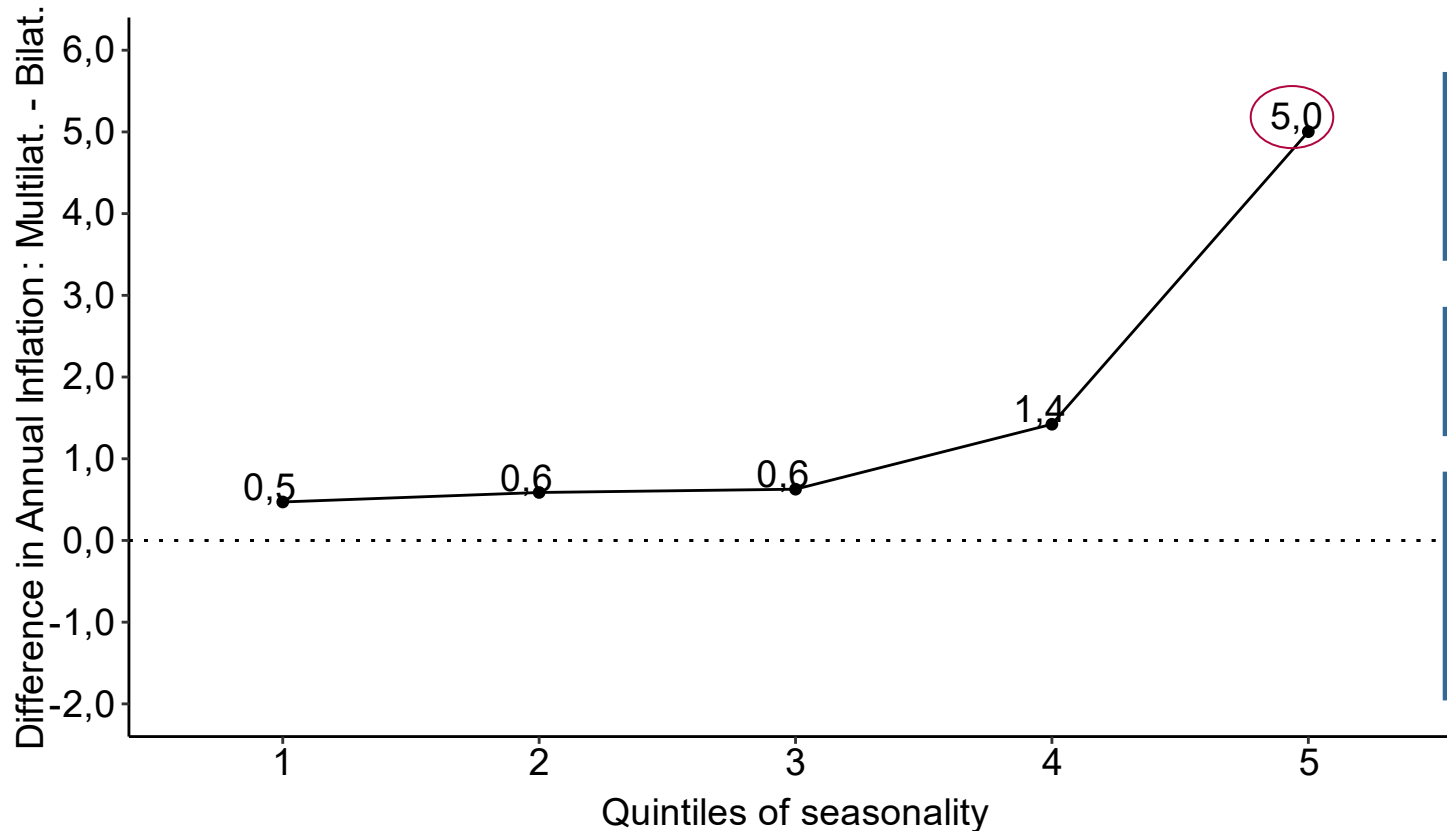
At the elementary aggregate level, six out of the nine top categories presented showing large differences between the methods relate to different types of fruit.

In addition to fruit, ice cream and chocolate are also seasonal.

In some rare cases the bilateral method can measure higher inflation rates for seasonal products compared to the multilateral method.

The frequent appearance of seasonal elementary aggregates is in line with the literature which emphasizes the increased importance of multilateral index calculation, especially for seasonal products.

# Underestimation of Inflation by the Bilateral Method Increases with Product Seasonality



Seasonality was expressed in terms of some quantifiable indicator: this indicator takes into account both the relative standard deviation of revenues and the number of months in which products are on sale in the window.

130 elementary aggregates calculated based on scanner data were divided into quintiles along this new seasonality variable.

**Quintile 5** includes a wide range of items, including fruit, chocolate, ice cream, vegetables and fish.

**Quintile 1** consists of items such as bread, milk, cheese, canned goods, chips, soft drinks and bananas.

Overall, the multilateral method, although dependent on elementary aggregates, tends to register higher inflation rates, with the difference being particularly pronounced for seasonal products.

# Conclusion

- Jevons index is vulnerable to chain drift and additional biases. Scanner data often include products with minimal turnover, which disproportionately affect the unweighted Jevons indices.
- Attempts to mitigate this bias through monthly adjusted revenue-based sampling have lacked precision, resulting in a transition to positive bias when sampled. This confirms that scanner data and the unweighted Jevons index are difficult to reconcile.
- When bilateral Törnqvist and GEKS methods are compared significant differences between the two methods were observed at all the aggregation level of the HICP. The hypothesis that the large difference between the methods is due to high inflation in 2023 is rejected.
- We also found that when an elementary aggregate is seasonal, the difference between the two methods becomes larger and the multilateral method usually measures higher inflation than bilateral.
- The significant differences we have found strongly argue against the use of the bilateral method with scanner data, as it consistently shows a tendency to underestimate inflation, especially for seasonal products.

# Questions and Discussion

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