

October 21, 2024

## Consumer Spatial Price Indices

Istat publishes the 2022 update of consumer spatial prices indices at regional level for the expenditure divisions Food and non-alcoholic beverages, Alcoholic beverages and tobacco, Clothing and footwear, of the Ecoicop classification (European Classification of Individual Consumption by Purpose), already published in 2023 for the year 2021. Moreover, new indices cover two further divisions: Furnishing, household equipment and routine household maintenance, and Restaurants and hotels. The process of progressive coverage of the expenditure aggregates continues within the experimental project aimed at providing an estimate of the consumer spatial prices indices at regional level (Sub National Spatial Price Indices or Regional Purchasing Power Parities), i.e. a synthetic measure of the relative price differential existing between one region and another.

Sub National Spatial Price Indices (SN-SPIs), in fact, measure the differences in the price level of a basket of products across regions within a country at a given point of time. They are therefore an important tool to have a more accurate reading of the inequalities and living household conditions across territories, due to the differences in purchasing power.

The SN-SPIs computation needs many detailed data at local level for a group of products that are representative of the consumer behavior in different areas. The basket of products must guarantee the requirements of representativeness and comparability. Representativeness relates to the importance of the product in consumer expenditures within a geographical area. Comparability, on the other hand, is guaranteed by the presence of products with the same or similar characteristics, so that any differences in the price levels are, in no way, attributable to the differences in quality.

The sources used for compiling these new indicators are mainly those of the consumer price survey complemented by surveys carried out for the specific purpose of calculating the regional spatial indices. In summary, the three data sources are:

- **Scanner data.** A unique identifier (bar code) characterizes each product, therefore the comparability in space is guaranteed. Information on turnover and quantity allows to calculate the unit value (average price) for each bar code and to weigh it, fully guaranteeing the principle of representativeness.
- **CPI (Consumer Price Index) data.** For some product categories (fresh fish, fruit, and vegetables, cleaning of clothing, domestic services by paid staff and cleaning services, some catering services and accommodation services), the definitions in the traditional CPI data collection are detailed enough to allow the use of these data in compliance with comparability. The products of these categories included in the consumer price basket are widely distributed throughout the country.

- **Ad hoc surveys** carried out in the regional capitals, with the addition of Padova and Bolzano, excluding L'Aquila<sup>1</sup> for products not covered by scanner data or with too generic definitions, which do not guarantee comparability, in the territorial CPI survey. For these products, ad hoc surveys were the only way to ensure comparability and representativeness. Even if the territorial coverage of these surveys does not reach the detailed level of the other sources, it is sufficient to guarantee reliable estimates. The surveys were conducted by the Municipal Statistical Offices of the municipalities involved, on a basket of products selected by Istat considering their share of household expenditure within Ecoicop division and the information on the importance of the single product provided by the municipal coordinator. The surveys are carried out using the CAPI technique (Computer assisted personal interview).

The methodology used to compute SN-SPIs is that recommended by the International Comparison Program (ICP) and used by the World Bank.

## Results

The disseminated results concern Food and non-alcoholic beverages, Alcoholic beverages and tobacco, Clothing and Footwear, Furnishing, household equipment and routine household maintenance and Restaurants and hotels divisions of the Ecoicop classification and represent a further step forward, compared to the 2023 publication, to arrive at an overall index of price differentials across the Italian regions.

For a correct reading of the data illustrated below, it is important to remember that when the price level index of a region is greater than 100 it means that this region is relatively more expensive than the Italian average (100) and vice versa. If the price level index of one region is higher than that of another region, it means that this region is relatively more expensive than the other for the product categories considered and vice versa. The colors used in the following cartograms are in shades of gray for regions that are relatively more expensive than the national average and more intense for the most expensive regions. The regions that are less expensive than the national average are in different shades of green, from the darkest for the least expensive to the lightest for the regions that are closest to the national average.

The indices calculated for 2022 highlight significant differences in consumer price levels between the various Italian regions. Overall, in the five divisions considered (Food products and non-alcoholic beverages, Alcoholic beverages and tobacco, Clothing and footwear, Furnishing, household equipment and routine household maintenance and Restaurants and hotels), the

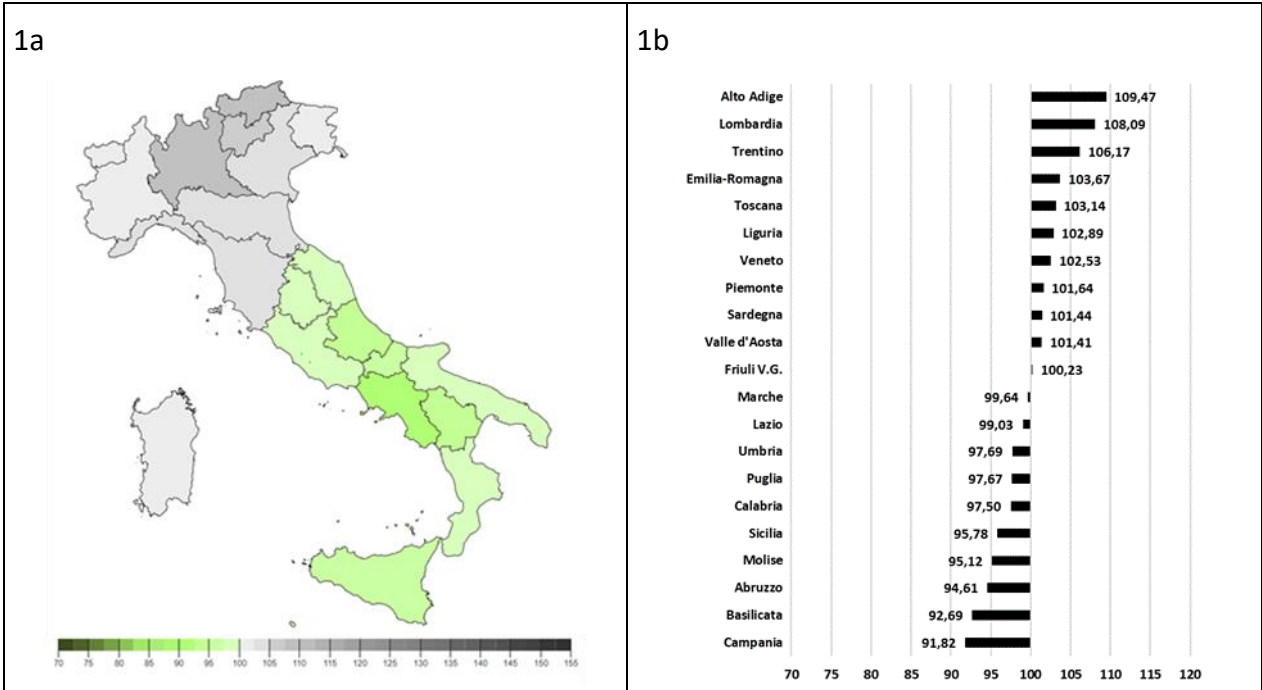
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<sup>1</sup> Due to the persistent difficulties in carrying out the CPI survey in the Municipality of L'Aquila, Pescara was preferred as the city in the Abruzzo region whereby to collect data in the ad hoc surveys for Clothing and Footwear, for some fresh food products and some catering services. For Furnishing, household equipment and routine household maintenance the ad hoc survey has been carried out in the Municipality of Teramo.

prices recorded in the northern regions are higher than those of the Center-South with the exception of Sardegna and Toscana which are in line with the northern regions (Fig. 1a).

At the top of the ranking of the most expensive regions (Fig 1b) are Alto Adige with a price level 9,5 percent higher than the national average, Lombardia (plus 8 percent) and Trentino (plus 6,2 percent). Among the least expensive regions are Abruzzo (minus 5,4 percent), Basilicata (minus 7,3 percent), and finally Campania (with prices 8,2 percent lower than the average).

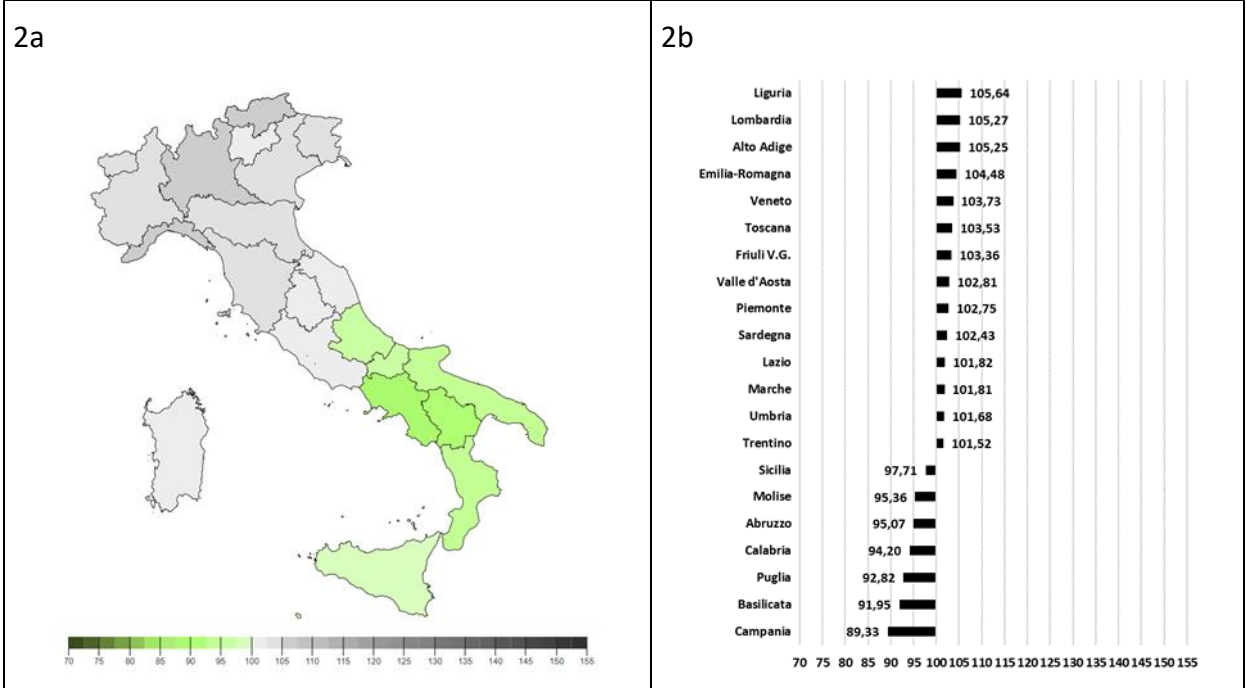
**Figure 1 - Consumer Spatial Price Index for five Ecoicop divisions, year 2022 - Italy=100**



Source: Istat

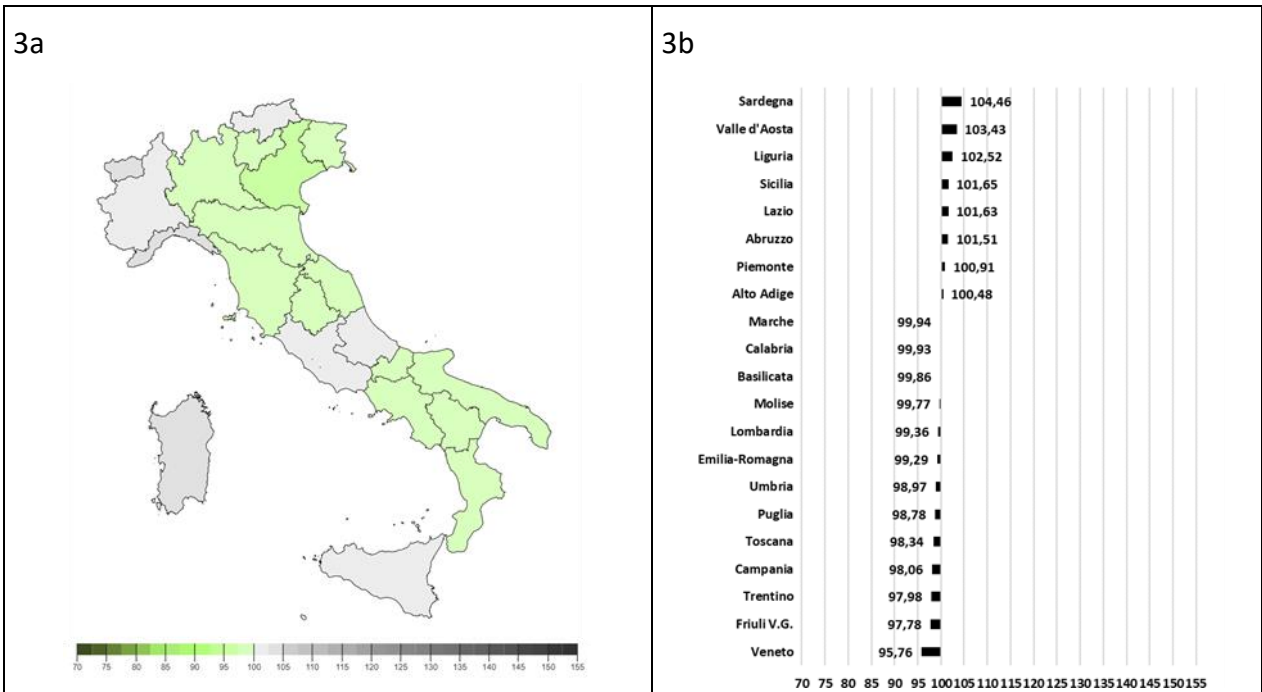
Analyzing the purchasing power parities calculated for the Food Products group, the price differentials highlight a clear polarization of the Italian regions: those with price levels above the national average are in central-northern Italy, while those with price levels systematically below the national average are in southern Italy (Fig 2a). Liguria, Lombardia and Alto Adige have price levels above the Italian average by more than 5 per cent, while Campania and Basilicata have price levels below the average by 11 and 8 per cent respectively (Fig 2b). In this case, the difference in price levels between Campania (the least expensive) and Liguria (the most expensive) is over 16 percentage points.

Figure 2 - Consumer Spatial Price Index for Food group, year 2022 - Italy=100



Source: Istat

Figure 3 - Consumer Spatial Price Index for Non-alcoholic beverages group, year 2022 - Italy=100

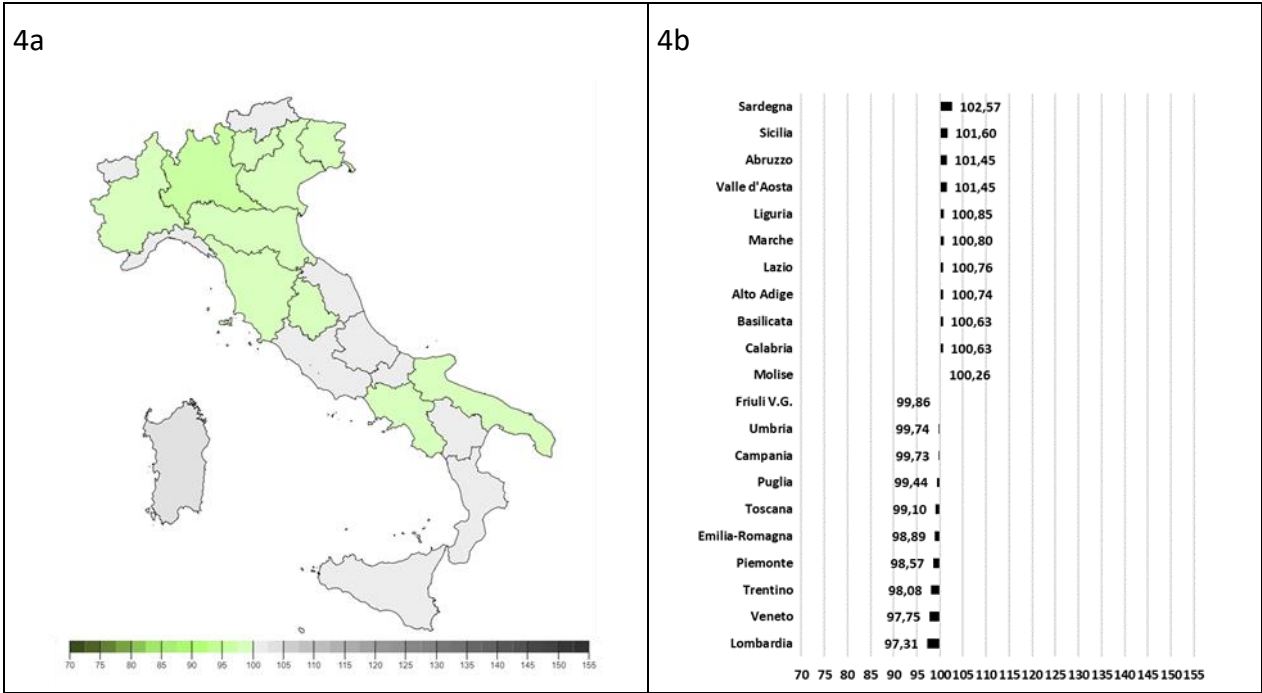


Source: Istat

Soft drinks (Fig. 3) and Alcoholic beverages (Fig. 4) show the least heterogeneity in consumer price levels between regions and low differences in price levels compared to the Italian average. There is not a territorial trend, which characterizes cluster of regions as in the other groupings examined. It should be noted, in fact, that in both cases a northern region is the least expensive,

Veneto for soft drinks, Lombardia for alcoholic ones. The most expensive region for both groups is Sardinia. This seems to highlight how for products with a longer supply chain, greater efficiency in logistics and infrastructure, it tends to change the traditional comparative geography of price levels between Italian regions.

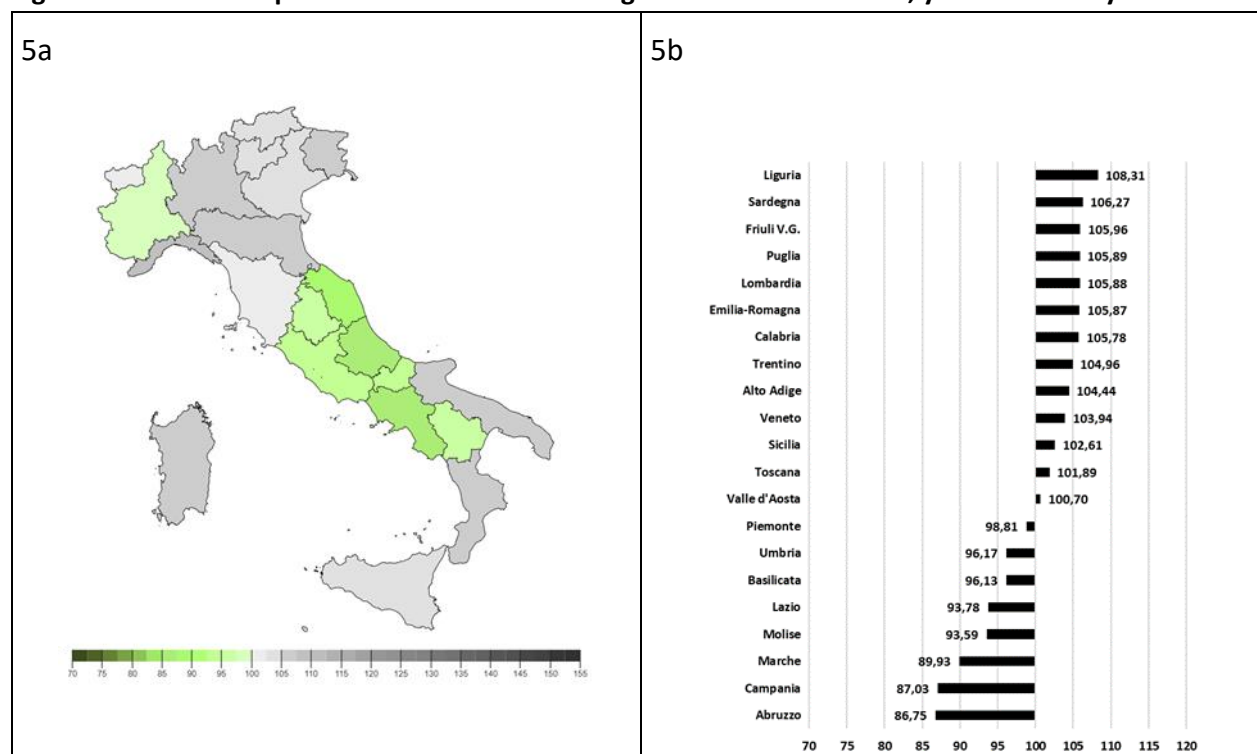
Figure 4 - Consumer Spatial Price Index for Alcoholic beverages group, year 2022 - Italy=100



Source: Istat

Even for the Clothing and Footwear division (Fig. 5a), no systematic differences are identified at the level of geographical distribution: some regions of Southern Italy (Sardegna, Puglia, Calabria, Sicilia) are more expensive than the national average, while Campania and Abruzzo are the least expensive, with parities lower by more than 13 percent compared to the Italian average. In this division, the gap between the most expensive region (Liguria) and the least expensive (Campania) is more than 21 percentage points. Likely, this highly accentuated dispersion of the results, relating to clothing and footwear, is due to the greater volatility in the elementary data, attributable to the limited number of price observations recorded (especially in Campania, Basilicata and Abruzzo).

**Figure 5 - Consumer Spatial Price Index for Clothing and footwear division, year 2022 - Italy=100**

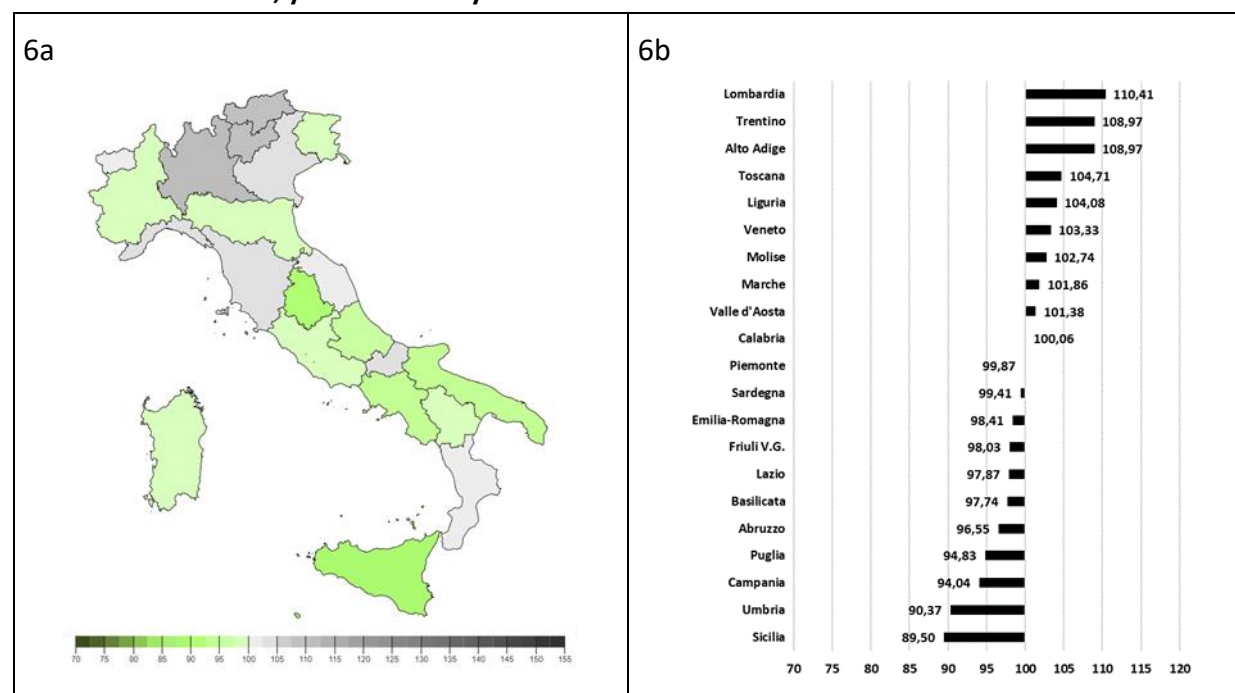


Note: Due to the low number of observations data in Basilicata, Campania and Abruzzo, the results of these regions are not reliable.

Source: Istat

A similar range of values (over 20 percentage points) is then recorded for the Furnishing, household equipment and routine household maintenance division (Fig. 6), whose prices in Lombardia, Trentino and Alto Adige show levels higher than the Italian average by 10 and almost 9 percentage points respectively. In Umbria and Sicilia, they are lower than the national average by about 10 percentage points. In this division, it is not possible to identify a clear territorial trend; there are regions with price levels higher than the national average both in the north and in the center-south.

**Figure 6 – Consumer Spatial Price Index for Furnishing, household equipment and routine household maintenance division, year 2022 - Italy=100**

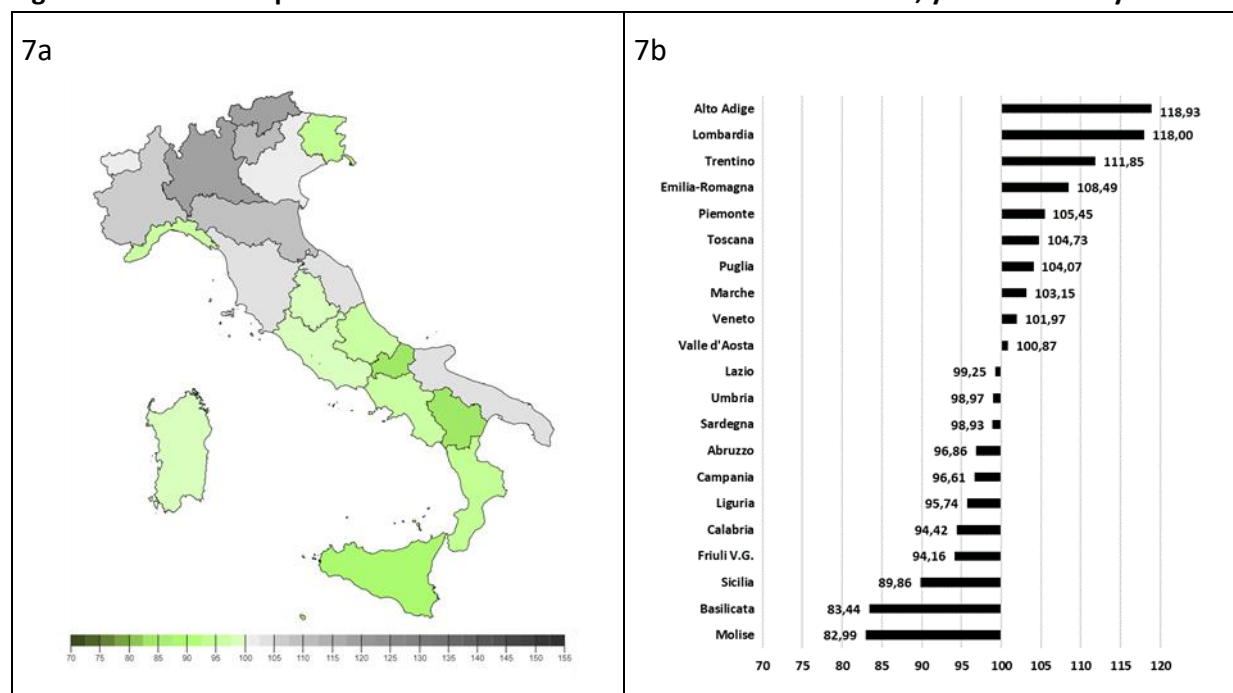


Note: Due to the low number of observations data, for Basilicata the data for Furniture and furnishing, carpets and other floor coverings, Household textiles, Glassware, tableware and household utensils, Tools and equipment for house have been imputed.  
Source: Istat

The Restaurants and hotels division (Fig. 7) is characterized by the greatest width of the gap between regions (almost 35 percentage points). Also in this case the most expensive regions are Alto Adige (118,9), Lombardia (118) and Trentino (111,8) and the least expensive Sicilia (86,9), Basilicata (83,4) and Molise (83). In particular, there is a great variability in the differentials between price levels in the Accommodation Services group, for which the first three regions (Alto Adige, Trentino and Valle D'Aosta), which are characterized by a high tourist vocation, have values much higher than the national average. On the other hand, the least expensive regions are Basilicata, Molise, Abruzzo and Calabria (Fig 8).

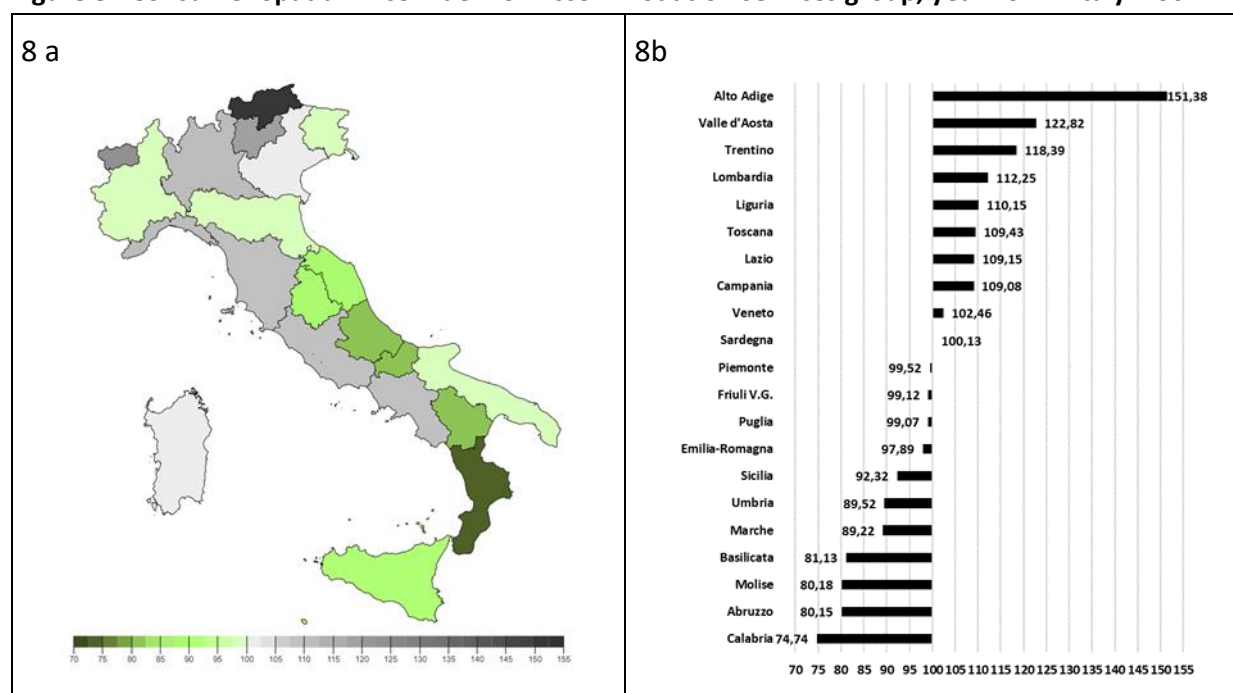


**Figure 7 - Consumer Spatial Price Index for Restaurants and hotels division, year 2022 - Italy=100**



Note: Campania data for catering services have been imputed due to the lack of detection

**Figure 8 - Consumer Spatial Price Index for Accommodation services group, year 2022 - Italy=100**



Source: Istat

## Methodological Note

The production of consumer spatial price indices or regional purchasing power parities is part of the National Statistical Program (PSN code IST-01905), which contains statistics of national interest.



The classification adopted for the consumer spatial price indices is the European Classification of Individual Consumption by Purpose (Ecoicop). According to this classification, the hierarchical structure has four levels of disaggregation: Divisions, Groups, Classes, and Subclasses.

For the purposes of calculating both spatial and temporal consumer price indices, the Subclasses are further broken down into Consumption Segments and then into Product aggregates, called Basic Heading<sup>2</sup> (BH). Within each Basic Heading, individual product definitions are specified.

Based on the classification structure, regional purchasing power parity indices are published at the division and group level in this study. Data of four expenditure divisions<sup>3</sup> of the Ecoicop classification for the year 2022 were considered, using a multi-source and multi-technique approach like for the consumer price survey, which estimates their changes over time. The data sources used are:

- Scanner data
- CPI data
- Ad hoc surveys

The tobacco products whose prices have no variability across the Italian territory (but have different weights in the regions) have been included in the calculation with parity equal to 100.

## **Data sources**

### *Scanner data*

Scanner data, employed for several years to estimate inflation, has been used for all the BH for which they are available, starting from the elementary data that pass the quality checks implemented in the consumer price process. Nielsen, according to an agreement between Istat and the Association of large-scale retail trade distribution (ADM), provides turnover and quantities sold for each bar code and outlet, included in the outlets sample, on a weekly basis for all 107 Italian provinces. The overall outlets sample is approximately 4,000 units, extracted with probabilistic sampling stratified by province and outlet type (supermarket, hypermarket, self-service, discount, specialist drug). The extraction probability is proportional to turnover. The scanner data use for the construction of spatial price indices has been the subject of numerous research projects (Laureti, Polidoro; 2017; 2022; Pratesi et al., 2021; Biggeri, Pratesi, 2022).

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<sup>2</sup> The Basic Heading is the lowest level of aggregation at which expenditure share data are available and the lowest level at which consumer spatial price indices are calculated.

<sup>3</sup> 01 Food and non-alcoholic beverages, 02 Alcoholic beverages and tobacco, 03 Clothing and Footwear, 05 Furnishing, household equipment and routine household maintenance and 11 Restaurants and hotels

The data used to estimate consumer spatial price indices is the average annual price for bar code and province. For each barcode and outlet, annual unit value is obtained by dividing the sum of the barcode turnover by the sum of the barcode quantities sold in the outlet.

The annual average price by barcode and province is calculated as a weighted average of the barcode annual unit value in the outlets (obtained in the previous step), by using the sampling weight.

Only barcodes sold in at least two provinces were selected for the analysis: 160.105 barcodes for division 01, 28.748 for division 02 and 34.295 for division 05.

In the food products group, scanner data were used for 50 BHs, whereas data from the territorial CPI survey and ad hoc surveys were used for the other BHs. On average, the number of barcodes per BH was over 2.900, but with a minimum of 58 barcodes for Margarine, other vegetable fats, and a maximum of 14.400 for Packaged pastry products (Table 1)

**Table 1 - Descriptive statistics by product group. Scanner data (Nielsen)**

Group Code	Group Description	Nr. of. BH	Bar code by BH			Standard deviation	Coefficient of variation
			Mean number	Min number	Max number		
<b>01.1</b>	Food product	50	2.912	58	14.400	2.784	96
<b>01.2</b>	Non- alcoholic beverages	7	2.073	258	3.701	982	47
<b>02.1</b>	Alcoholic beverages	9	3.194	70	11.070	3.432	107
<b>05.6</b>	Household maintenance	6	5.716	1.743	14.940	4.514	79

Source: Istat

Soft drinks group products are entirely processed by using scanner data. The average number of barcodes per BH is 2.073 and is more homogeneous than the other groups, with a minimum number of 258 and a maximum of 3.701.

For the alcoholic beverages group, all BHs are recorded by using scanner data, too. Compared to the group of non-alcoholic beverages, there is greater variability between the BH: the minimum number of barcodes present is 70 (Low-alcohol and non-alcoholic beers) and the maximum 11.070 (Quality wines).

The average number of bar codes per BH in the Household maintenance group is high, over 5.700. In the 6 BHs covered by scanner data in this group, the minimum number of bar codes is recorded in Dishwashing detergents (1.743), while the maximum concerns Other non-durable household items (14.940).

A relevant issue in using scanner data for spatial price indices calculation is the presence of direct connections (products shared between two territories) or indirect connections (two territories do not have products in common, but another territory has at least one product in common with

both). The number of barcodes present in each pair of regions was considered, for each aggregate, and the average number for all pairs of regions was analyzed, as well as the minimum and maximum value.

**Table 2 - Descriptive statistics of the barcodes for aggregate present in each pair of regions by product groups**

Group Code	Group Description	Mean Number	Min Number.	Max Number.	Standard Deviation	Coefficient of Variation
01.1	Food product	609	1	7.792	608	99,76
01.2	Non- alcoholic beverages	525	28	2.003	253	48,17
02.1	Alcoholic beverages	408	13	4.799	309	75,78
05.6	Household maintenance	1.491	247	8.019	845	56,71

Source: Istat

For the food products group, in each BH the average number of barcodes available simultaneously in two regions is 609 (Table 2). The minimum direct connection occurs for Whole milk where for two regions the number of barcodes in common is only one. Soft drinks do not present overlapping problems, with an average of 525 and a minimum of 28 barcodes. The aggregate of Low-alcohol and non-alcoholic beers is the one with the least overlap (13) in the group of alcoholic beverages, while the maximum is found for Quality wines. The household maintenance's BHs are those with the highest number of bar codes present simultaneously in two regions.

Overall, the number of bar codes per BH and the diffusion at territorial level is good. However, there are differences when considering the individual BHs. The BH that presents the most problems is Whole milk, the direct overlap is guaranteed only by a bar code. The problem arises between Alto Adige and Sicilia. However, there are several common bar codes between Trentino and Sicilia and common bar codes between Trentino and Alto Adige that guarantee the connection between the two regions: for this reason, the BH was not excluded from the analysis.

The parities of Household appliances have been estimated using scanner data provided by GfK Italia S.r.l., a company that collects and analyses quantitative market information relating to purchases in the Consumer Technology sector. The information is collected in a sample of over 6,000 stores distributed throughout the country (traditional stores, large specialized retail chains, large-scale general distribution, specialists in durable consumer goods). These data have been used for several years to calculate inflation and 2020 was the last year in which they were provided disaggregated for 10 macro-areas<sup>4</sup>. These data, inflated to 2022 by the IPCA (Harmonized Consumer Price Index) index, were used to estimate the parities for the aggregates

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<sup>4</sup> Valle d'Aosta, Piemonte e Liguria --Lombardia -- Friuli Venezia Giulia, Trentino, Alto Adige e Veneto -- Emilia Romagna-- Marche, Toscana, Umbria -- Lazio -- Campania -- Abruzzo, Molise, Basilicata, Calabria, Sardegna -- Puglia -- Sicilia.

of the Household appliances group, considering the prices of the macro-area for each region belonging to the macro-area. Despite the strong limitations deriving from not having the detail of all the regions, this is currently the best source available for the group of products under examination. In the future, the acquisition of scanner data with greater territorial detail will improve the quality of the estimates.

The data refer to the average monthly price recorded in the macro-areas for the 10, for some products 20, best-selling models of the brands selected for the consumer price survey. The average annual price was calculated as a simple average of the monthly prices, obtaining 1.947 annual quotations referring to different models/brands. The average number of prices per aggregate is 389 (Table 3), with a minimum of 171 for Heating and air conditioning appliances and a maximum of 949 for Washing machines, dryers and dishwashers.

**Table 3 - Descriptive statistics by product group. Scanner data (GfK)**

Group Code	Group Description	Nr of. BH	Bar code by BH			Standard deviation	Coefficient of variation
			Mean number	Min number	Max number		
05.3	Household appliances	5	389	171	949	284	73

Source: Istat

### *CPI data*

The data from the traditional consumer prices survey have been used for products whose definitions are sufficiently detailed to satisfy the comparability requirement. These are fruit, vegetables, fresh fish, accommodation services, some catering services, domestic and laundry services. The prices collected for all months by all 80 provinces participating in the territorial survey of consumer prices in 2022 were included in the calculation. Only the prices actually recorded were included, excluding the estimates. Furthermore, for each product, particularly high or particularly low prices, included in the tails of the distribution (considering the percentiles 1-99 or 5-95), were excluded from the calculation. The incidence of outliers on the initial number of quotations depends on the characteristics of the products based on which a different threshold was chosen. The lowest value was found in the catering sector where they were less than 2% overall, up to 9% for accommodation services<sup>5</sup>. Products that did not satisfy the requirement of comparability between the different geographical areas were excluded from the analysis.

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<sup>5</sup> For other product types, the outliers were approximately 2.9% of the fruit and vegetable BHs prices, approximately 6% of the fish BHs, approximately 7% for laundry services and domestic services and home care services.

The average price per product at the provincial level is calculated as a simple mean of the monthly data, which in turn were calculated as the geometric mean of the individual observations. For these data, there are no values available on the quantities sold or the turnover.

**Table 4 - Descriptive statistics by product class. CPI data**

Class Code	Class description	Nr. Of BH	References by BH			Standard deviation	Coefficient of Variation
			Mean number	Min number	Max number		
01.1.3	Fish and fish products	6	2.706	1.345	6.420	1.776	66
01.1.6	Fruits	20	1.507	598	5.038	1.042	69
01.1.7	Vegetables	28	1.331	540	3.558	833	63
03.1.4	Cleaning of clothing	1	1.318	1.318	1.318	0	0
05.6.2	Household services	2	307	187	427	120	39
11.1.1	Restaurants, cafés	4	1.152	544	2.675	884	77
11.1.2	Accommodation services	2	1.026	382	1.670	644	63

Source: Istat

The total number of references<sup>6</sup> after the elimination of outliers was 92,236. The data from the territorial survey do not present problems (Table 4). The average number of references per BH is high in all the classes considered. Even the BH with the minimum value (187) has enough observations for the analyses.

### *Ad hoc surveys*

The ad hoc surveys are carried out for product categories for which the use of other types of sources has comparability problems that are difficult to overcome. A specific basket of products is defined as a subset of that used for international parities, which allows solving this problem.

The municipalities involved in the survey are the regional capitals, with the exception for L'Aquila replaced by Pescara for the 2021 and 2022 surveys and by Teramo for 2023. The municipality of Bolzano has also participated starting in 2021, and from 2023 the municipality of Padova. The outlet sampling design in each municipality is the one defined for the local consumer prices survey.

The ad hoc price surveys are based on a cyclical system of surveys coinciding with those of international purchasing power parities. Overall, there are 6 surveys, each on a specific basket of goods and services, which take place over a 3-year cycle.

To guarantee an overall coherence framework, a basket of products highly comparable between

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<sup>6</sup> A reference is the combination of product and store in which the survey was made. Each reference is collected several times during the year

the municipalities was defined for each survey. The basket of food products included in the index calculation is made up of 36 items, 82 items for clothing and footwear, 68 for furnishings and 62 for catering services.

The number of quotations entered in the calculation of the indices for food products was 8.311. Compared to the analysis carried out on the 2021 data, the BH of hard cheeses has been replaced by scanner data. In clothing and footwear, 8.246 prices were used, in the furnishing and household equipment division 6.553 and 7.346 in catering services. The trimming of invalid quotations had an impact above all on furnishing and household equipment and clothing and footwear, where approximately 18% and 16% of those recorded were eliminated, but also on catering services with 12% of quotations, while for food products, have been eliminated 5,5% of quotations.

Food BHs have an average of 1.039 quotations. Among the different BHs, there is a wide variability: the minimum value is presented for edible entrails and offal with only 152 values, while the quotations for adult bovine meat are 1.618 (Table 5). Overall, the fresh food data does not have many problems.

The clothing and footwear BHs on average have 218 and 243 quotations respectively. The lower number of quotations for clothing and footwear than food can be attributed to the intrinsic differences of the product types, which make collection particularly difficult. In general, ad hoc surveys employ a considerable effort by the Municipalities involved in terms of organization, time for the survey and dedicated human resources. It was not always possible to collect an adequate number of price quotations. The collected and validated quotations for the municipalities of Napoli, Pescara, and Potenza, in clothing and footwear, is small for some products. Therefore, the results for Campania, Abruzzo and Basilicata regions must be read by taking into consideration this limit and require significant further study. Despite these difficulties, the BHs with the greatest weight are overall well represented.

In the furnishing and household equipment division groups, the average number of quotations per BH varies from 315 to 394. The minimum number of quotations is recorded in Bathroom furniture with 144 observations. The furniture survey is also particularly difficult due to the number of characteristics that the product whose price is recorded must respect for the purposes of comparability between the different areas.

Regarding the municipality of Potenza, it was decided to impute the data from the ad hoc survey relating to the Furnishings, household equipment and routine household maintenance division, as the number of validated quotations was not sufficient to allow robust estimates. In particular, the Potenza data were imputed using the price quotations recorded in the other municipalities of the Southern division (excluding islands).

The average number of quotations per aggregate in the catering sector is greater than 800, thus ensuring good coverage.

The municipality of Napoli did not participate in the catering survey; also, in this case the data were imputed using the price quotations recorded in the other municipalities of the Southern division (excluding islands). However, unlike the case of Potenza, the quotations used for the imputation were corrected taking into account the parities, calculated for the division of Food and non-alcoholic beverages, of each donor municipality with respect to Naples. We chose to use the parity of the first Ecoicop division, since the type of products it represents appears to some extent related to that of catering products and, secondly, for the robustness of these estimates.

In the analysis of the average number of quotations per aggregate, the quotations imputed for Naples and Potenza were not considered.

The search for alternative sources and/or the inclusion in the surveys of other municipalities will be the basis to sort out the problem of the limited number of quotations collected for some products. In this way, wider database on which to carry out analyses will be available.

**Table 5 - Descriptive statistics by product group. Ad hoc survey.**

Group code	Group description	Nr. of BH	Quotations by BH			Standard deviation	Coefficient of variation
			Mean number	Min number	Max number		
01.1	Food Products	8	1.039	152	1.618	513	49
03.1	Clothing	30	218	56	724	166	76
03.2	Footwear	7	243	67	460	119	49
05.1	Furniture and furnishing	7	394	144	734	204	52
05.2	Household textiles	4	315	148	621	181	58
05.4	Household appliances	4	342	178	594	173	51
05.5	Equipment for house and garden	3	389	217	615	167	43
11.1	Catering services	9	816	105	4.044	1.176	144

Source: Istat

Given that the prices collected through *ad hoc* surveys refer to the two months in which each survey was conducted, the monthly data were made representative of the year, by considering the inflation recorded in the Municipality in the other months of the year. Temporal Adjustment Factors (TAFs) were calculated based on HICP (Harmonized Index of Consumer Price) data.

If the reporting month is generically 'month', the TAF is calculated with the following formula:

$$TAF = \frac{(I_{(gen)} + I_{(feb)} + \dots I_{(may)} + \dots I_{(dic)})}{12 * I_{(month)}}$$

Where  $I$  is HICP with base December (t-1).

While the annual price  $P_{year}$  is calculated as:



$$P_{year} = P_{month} * TAF$$

The data presented in this analysis refer to the year 2022. For this reason, the prices recorded during the 2021 (Fresh food products, Clothing and Footwear) and 2023 (Furniture and furnishings, Home textiles) surveys are reported to the reference year using the average annual variations calculated on the basis of the HICP index.

#### *Data sources relevance*

The five divisions of the Ecoicop classification considered correspond to approximately 48% of household expenditure based on the HICP 2022 basket. The first division (19.5% of the overall weight of the basket) is affected by all three data sources, although with different importance: 56% scanner data, 22% ad hoc surveys and 22% data from the territorial survey of consumer prices. The second division represents approximately 3.6% of Italian consumption and in this analysis, for the beverage part, it is entirely covered by scanner data. The data of the third division (approximately 7.3%) come from ad hoc surveys with the exception of the aggregate Cleaning of clothing for which the data from the territorial survey of consumer prices were used. The fifth division represents approximately 8.5% of household consumption and is covered by all data sources: 51% ad hoc survey, 23% territorial consumer price survey, 25% scanner data, which also includes data provided by GfK for the estimate of household appliances (8%). The eleventh division (9.9% of consumption) is covered by ad hoc survey (69%) and territorial consumer price survey (31%).

### **Methodological Approach**

Purchasing power parity indicators are calculated by using recognized methodological tools and used in numerous international studies and in empirical experiences conducted in various countries (USA, Brazil, India, Indonesia, China, Australia, and Great Britain). The ICP (International Comparison Program) in 2021 published a guideline (ICP, 2021), to which Italy contributed, for the calculation of regional purchasing power parities. In accordance with these guidelines, the methods used are:

- **RPD (Regional product dummy)** model at BH level
- **GEKS (Gini - Èltetö-Köves-Szulc)** method to aggregate RPPP calculated at BH level (using household expenditure as weights).

### Regional Product Dummy (RPD)

The idea behind this method<sup>7</sup> is that the price  $p_{nr}$  of an item ( $n=1...N$ ,  $N$  items belonging to the BH) in an area  $r$  ( $r=1...R$ ) is function of a specific area factor  $PPP_r$  (parity or general price level of the area considered with respect to other areas), of the average price of the  $n$ -th product or item  $P_n$  and of a random error  $u_{nr}$ :

$$p_{nr} = P_n * PPP_r * u_{nr} \quad (1)$$

Considering the logarithms, the previous expression can be written as:

$$\ln p_{nr} = \sum_{r=1}^R a_r D_r + \sum_{n=1}^N b_n D_n^* + v_{nr} \quad (2)$$

Where:

$D_r$  is the dummy variable that takes value equal to 1 if the price quotation is from area  $r$  and 0 otherwise,

$D_n^*$  is the dummy variable for product  $n$  which takes value equal to 1 when item considered is  $n$  and 0 otherwise,

$a_r$  e  $b_n$  are, the differences in the effects associated with the areas and the product type, respectively,

$v_{nr}$  are random error normally distributed with a zero mean and variance  $\sigma^2$ .

Parameters of this model can be estimated using ordinary least squares, imposing a restriction, that a coefficient corresponding to a specific area is set equal to zero ( $a_1=0$ ) or equivalently  $PPP_1=1$  thus considering it as reference area to which the coefficient estimates are referred.

The purchasing power parity between an area  $r$  and the reference area is  $\widehat{PPP}_r = \exp(\widehat{a_r})$ . The parities thus estimated satisfy the property of transitivity and invariance of the basis.

Having weights in terms of value or quantity for each product, the model can be written as:

$$\sqrt{w_{nr}} \ln p_{nr} = \sum_{r=1}^R a_r \sqrt{w_{nr}} D_r + \sum_{n=1}^N b_n \sqrt{w_{nr}} D_n^* + \sqrt{w_{nr}} v_{nr} \quad (3)$$

where:

$w_{nr}$  are the weights in terms of value or quantity that reflect the economic importance of the different product consumed in the area.

The model was estimated for each BH, making the most of the information available depending

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<sup>7</sup>For more information: Rao (2013), Rao e Hajargasht (2016)

on the data source used. Within each BH, only one of the three considered source was used.

In the case of *scanner data*, they provide information on turnover and quantities sold for each bar code, in all 107 Italian provinces. The turnover-weighted model was then used to obtain the estimates. Furthermore, a two-step procedure was adopted (Laureti, Polidoro, 2022) for each BH:

- Step 1: In each region, a model (eq. 3) was estimated to obtain provincial purchasing power parities. These indicators have been used to 'deflate' the initial prices and the turnover of each barcode within each region.
- Step 2: Models (eq. 3) were estimated to obtain regional purchasing power parities, using the 'deflated' prices and turnover as indicated in step1.

The data from the consumer prices survey do not allow the use of the weighted model, as the quantities sold are not available. For all the 80 provinces participating in the survey, the annual provincial average price was calculated for each product as the simple mean of the individual quotations. The regional average price per product was calculated as a weighted average of mean provincial prices, using population as weights, in line with what occurs in inflation calculating.

The data from the *ad hoc survey*, carried out in 21 Municipalities, do not present data relating to the quantities sold, therefore, as with the data from the traditional consumer prices survey, it is not possible to use the weighted model. The data, collected in two months of the year, were corrected with the TAFs to obtain the annual prices. The model was applied to annual individual data.

The Regional Product Dummy has been adopted to estimate regional parities at BH level.

*GEKS (Gini - Èltetö-Köves-Szulc)*

Parities at the upper level of the BH are calculated using the GEKS method aggregating RPPP estimated at BH level. The weights, based on household expenditure, are the same used for the calculation of the Hicp. The index compiled by the GEKS method satisfies the properties of transitivity and invariance of the basis. Furthermore, it is as close as possible to the corresponding binary indices<sup>8</sup>. Aggregate regional purchasing power parities (RPPPs) are obtained from as follows:

$$RPPP_{jk}^{GEKS} = \prod_{l=1}^R (F_{jl} \cdot F_{lk})^{1/R}$$

The parity for region k with reference to region j chosen as the base is given by the geometric

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<sup>8</sup> For more information: Diewert (2013)

mean of the Fisher type indices of all direct comparisons between region  $j$  and region  $k$ , and indirect across all possible links between the  $R$  regions ( $l, k, j \in R$ ).

Fisher type ( $F_{jl}$ ) indices are obtained as the geometric mean of the corresponding Laspeyres type and Paasche type indices, calculated based on the parities for BH weighted respectively by the expenses of the base region (Laspeyres) and of the partner region (Paasche).

These first results lack data on some BHs<sup>9</sup>, because of difficulties in data collection. The weights of these BHs were distributed among the BHs of the same consumption segment or at a higher level if it was the only BH of the segment.

To express the parities referring to the national average, each parity is divided by the geometric mean of the price level indices of the participating regions, and conventionally, multiplied by 100.

## References

Aten B. (2017) "Regional Price Parities and Real Regional Income for the United States" Social Indicators Research

Bernardini A., Casciano M.C., De Vitiis C., Guandalini A., Inglese F., Seri G., Terribili M.D., Tiero F. (2019) "Re-design project of the Istat consumer price survey: use of probability samples of scanner data for the calculus of price indices" *Rivista di Statistica Ufficiale* N.2-3, 67-141

Biggeri L., Laureti, T. and Polidoro, F. (2017) "Computing Sub-national PPPs with CPI Data: An Empirical Analysis on Italian Data Using Country Product Dummy Models" *Social Indicators Research*, 131(1):93-121.

Biggeri L., Pratesi M. (2022) "Estimation of local Spatial Price Indices using scanner data: methods and experiments applied also for assessing poor-specific indices" *Rivista di Statistica Ufficiale* N.2/2022

Cannari L., Iuzzolino L. (2009) "Le differenze nel livello dei prezzi al consumo tra Nord e sud" *Questioni di Economia e Finanza*, Bank of Italy, Rome

Diewert W.E. (2013) "Methods of Aggregation above the Basic Heading Level within Regions",

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<sup>9</sup> Relevance of not available BH on the division: 01 Food products and non-alcoholic beverages: 4,2%, 03 Clothing and footwear. 7,4%, 05 Furnishing, household equipment and routine household maintenance 6,3% and Restaurants and hotels 6,5%

Chapter 5 in Measuring the Real Size of the World Economy, World Bank, Washington D.C.

Diewert W.E. (2005) "Weighted country product dummy variable regressions and index number formulae". *Review of Income and Wealth*, 51(4): 561–570

Diewert W.E. (2004) "On the Stochastic Approach to Linking the Regions in the ICP" Department of Economics, University of British Columbia

Diewert W.E. (1976) "Exact and superlative index numbers". *Journal of econometrics*, 4(2): 115–145

Eurostat (2017) Practical Guide for Processing Supermarket Scanner Data, European Commission, Directorate C: National Accounts; prices and key indicators. Unit C-4: Price statistics; Purchasing power parities; Housing statistics. Luxembourg

Eurostat- OECD (2012) "Methodological manual on purchasing power parities" Luxembourg: Publications Office of the European Union

Geary R.C. (1958) "A Note on the Comparison of Exchange Rates and Purchasing Power between Countries", *Journal of the Royal Statistical Society, Series A (General)*, 121(1): 97–99.

Heravi S., Heston A., Silver M. (2003) "Using scanner data to estimate country price parities: A hedonic regression approach" *Review of Income and Wealth*, 49(1), 1-21.

ICP (2021), "A Guide to the Compilation of Subnational Purchasing Power Parities (PPPs)" World Bank.

Istat (2023) "Indici spaziali dei prezzi al consumo – anno 2021", *Statistica sperimentale*, 3 agosto 2023.

Istat (2022) "Gli indici dei prezzi al consumo: Aggiornamenti del paniere, della struttura di ponderazione e dell'indagine", 2 febbraio 2022

Istat (2010) "La differenza nel livello dei prezzi al consumo tra i capoluoghi delle regioni italiane". Comunicato Stampa. Roma, Italy.

Ivancic L., Diewert W. E., Fox, K. J. (2011) "Scanner data, time aggregation and the construction of price indexes" *Journal of Econometrics*, 161(1), 24-35.

Laureti T., Ferrante C., Dramis B. (2017), "Using scanner and CPI data to estimate Italian sub-national PPPs". In Proceedings of 49th Scientific Meeting of the Italian Statistical Society – SIS 2018: 581–588. Palermo, Italy, 20th – 22nd June 2018

Laureti T., Polidoro F. (2022) "Using Scanner Data for Computing Consumer Spatial Price Indexes at Regional Level: An Empirical Application for Grocery Products in Italy." *Journal of Official Statistics*, Vol. 38, No 1, 2022, pp. 23-56.

Laureti T., Polidoro F. (2017) "Testing the use of scanner data for computing sub-national Purchasing Power Parities in Italy". In Proceedings of 61st World Statistics Congress – ISI 2017. Marrakech, Morocco, 17th – 21st July 2017.

Laureti T., Rao D.S.P. (2018) "Measuring spatial price level differences within a country: Current status and future developments". *Estudios de Economía Aplicada*, Volume 36, N. 1: 119–148.

Léonard I., Sillard P., Varlet G., and. Zoyem J.P. (2019) "Spatial differences in price levels between French regions and cities with scanner data". *Economie et Statistique*, 5091: 69–82.

Menon M., Perali F., Ray R., and Tommasi N. (2019) *The Tale of the Two Italies: Regional Price Parities Accounting for Differences in the Quality of Services*, Working Paper Series Department of Economics University of Verona, No. 20/2019: 2036–4679.

Pratesi M., Giusti C., Marchetti S., Biggeri L., Bertarelli G., Schirripa Spagnolo F., Laureti T., Benedetti I., Polidoro F., Di Leo F., Fedeli M. (2021) "Estimations of local spatial price indices using scanner data and their impact on the measure of poverty incidence". *MAKSWELL Project*, Deliverable 3.2.

Rao D.S.P, Hajargasht G. (2016) "Stochastic approach to computation of purchasing power parities in the International Comparison Program (ICP)." *Journal of Econometrics*, 191(2), 414-425.

Rao D.S.P (2013) "Computation of Basic Heading PPPs for Comparisons within and between Regions", Chapter 4 in *Measuring the Real Size of the World Economy*, World Bank, Washington D.C.

Rao D.S.P. (2001) "Weighted EKS and generalized CPD methods for aggregation at basic heading level and above basic heading level". In Joint World Bank-OECD seminar on Purchasing Power Parities, 30 January 2 February 2001, Washington D.C.

Rao D.S.P. (2009) "Generalized Elteto-Koves-Szulc EKS and Country-Product-Dummy CPD

Methods for International Comparisons” In Purchasing Power Parities: Recent Advances in Methods and Applications, edited by Prasada D.S. Rao: 86–120. Edward Elgar Publishing Company.

World Bank (2013) “Measuring the Real Size of the World Economy: The Framework, Methodology, and Results of the International Comparison Program (ICP).” The World Bank. Available at: <https://openknowledge.worldbank.org/handle/10986/13329>.

World Bank (2020) “Purchasing Power Parities and the Real Size of the World Economies Results from the 2017 International Comparison Program”, Washington D.C. Available at: <https://openknowledge.worldbank.org/handle/10986/33623>.

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