

# Consumer price indices at IBGE: 40 years and counting

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## Abstract

The Brazilian Institute of Geography and Statistics (IBGE) is the entity responsible for providing official statistics and geographical information for Brazil. Among a plethora of products produced by IBGE, the National System of Consumer Price Indices (SNIPC) is certainly one of its most important, since one item of such system, the IPCA, is used to set the inflation target pursued by the Brazilian Central Bank. In 2019, IBGE celebrates the 40th anniversary of the implementation of the CPI system, which embodies four CPI indicators covering different population and geographical areas of Brazil. The goal of this work is twofold: first, describe the main characteristics of the SNIPC and the methodology employed in the CPIs. By doing so, we expect to increase the access and transparency of our methods to the international community, a gap caused due to a lack of - or scarce - documentation of such practices in English language. In second place, we present the main projects under development for the SNIPC in order to deal with current challenges of CPI compilation and to improve accuracy, representativeness and robustness of such system for the forthcoming years.

## 1. Introduction

Consumer price indices (CPIs) are among the economic statistics that most impact the economy of a country and the everyday life of its citizens. Since their first compilation dating back to more than 100 years ago [Stoevska, 2018], CPIs have experienced many methodological changes in order to promote accurate and broader measures of consumer habits and to portray the evolution of retail prices representative of those experienced by the population.

The origins of the CPIs are closely related to the advent of new classes of workers that emerged in the Industrial Revolution and the new labours' relations attached to it. In this regard, CPIs were originally designed as a measure of the evolution of the workers' "cost of living" and used for the adjustment of wages to compensate for the changes in their living costs. The original "target" population were the working-class families and the original CPI baskets comprehended only a reduced number of goods consumed by such families.

Throughout the years, anchored in methodological improvements based on robust theoretical developments in the fields of economics and statistics, the CPIs measurements experienced deep changes and the original goal and scope of the indices were extended to a much wider range. Nowadays, CPIs are compiled considering different target populations, covering a broader basket of goods and services. The "cost of living" notation was replaced by the broader definition of "consumer price index" and such measures have also been adopted as a macroeconomic indicator used for monetary policies and as a deflator for the system of national accounts. In Brazil, previous CPI measures were also related to the adjustment of workers' wages and their first compilation was in charge of the Brazilian Ministry of Labour (extinguished) with first results dating back to 70 years ago [IBGE, 2013].

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<sup>†</sup>The views expressed in this paper are those of the authors and do not necessarily reflect the views of IBGE.

Following the same global tendency, CPI measures in Brazil have also been changing to better reflect the consumption habits of the Brazilian society. According to this trend, an important mark was when the responsibility of compiling the CPI changed hands in 1978, from the Ministry of Labour to the Brazilian Institute of Geography and Statistics (IBGE, in Portuguese), the official Brazilian statistical agency [IBGE, 2013]. Within this context, IBGE created the National System of Consumer Price Indices (SNIPC), a framework established to provide a set of CPI measures reflecting the diversity of consumption habits in a country with continental dimensions and markedly social-demographic differences.

In 1979, the SNIPC released the first results of a CPI compiled by the IBGE.

Celebrating the 40th anniversary of the compilation of CPIs at IBGE, this paper aims at describing the main aspects and changes experienced by the SNIPC throughout these 40 years. Furthermore, we intend to present some future perspectives in order to keep the SNIPC indices accurate and representative measures in the digital era.

We here provide an overview over the past, present and future trends of the SNIPC. In Section 2, the paper presents the main methodological features of the SNIPC currently employed and the results produced by the system.

An overview of the results and changes presented by the SNIPC over the last 40 years is discussed in Section 3, in connection with the economic scenario experienced by the Brazilian society during this period.

The main challenges and opportunities faced by the SNIPC in order to remain as a provider of timely, accurate and representative CPIs are scrutinized in Section 4. We discuss some of the most important points where the system can be improved, present some actions in course and also future plans designed so that the SNIPC remains providing useful and necessary information for the Brazilian society, based on the most robust and modern methodological and probing techniques.

Finally, in Section 5, we summarize the main aspects of the paper and present our conclusions.

## **2. Main features of the CPIs produced at IBGE**

IBGE is the official compiler of CPIs in Brazil. The CPIs provided by the IBGE are structured in a framework called National System of Consumer Price Indices (SNIPC). The SNIPC is composed by different CPIs measures that account to different goals and user's needs according to differences in reference populations, frequency of compilation and publication, and geographical areas. The CPIs currently contained in the system are the IPCA, IPCA-15, IPCA-E, and the INPC. Such indicators are compiled at regional and national levels.

In this section we present the main features of the indicators provided by the SNIPC. We start discussing the common basis of the system related with the sources and methods used to derive the indicators. In the end of the section we present the details and peculiarities of each measure.

### **2.1. SNIPC Classification System**

In the compilation of a CPI a fundamental pillar is given by the classification system used to “organize” the elements contained in the CPI basket according to similarities criteria and set the

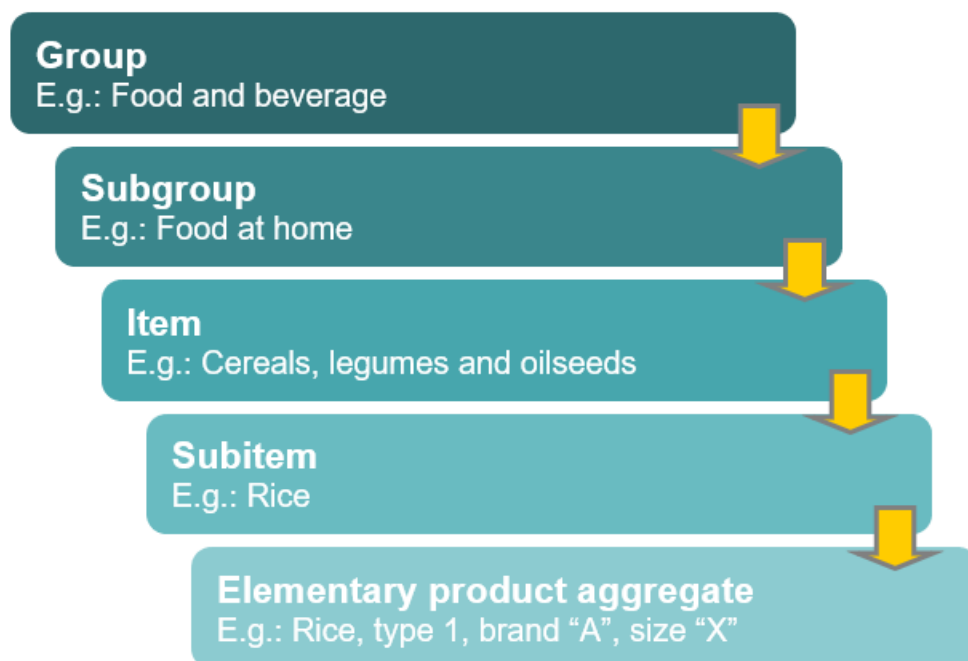


Figure 1: Classification structure of the SNIPC.

aggregation structure for the derivation of indicators in different levels of interest.

The SNIPC adopts its own system of classification. The SNIPC classification has a four-level breakdown structure, from top-down defined as: **Groups**, **subgroups**, **items** and **subitems**, as presented in Figure 1. The subitems are the lowest level with explicit weights derived from the *household budget survey* (HBS), corresponding to the *elementary aggregates* of the SNIPC. Below the subitems are the homogeneous groups of products whose prices are collected for the indexes compilation.

Currently the SNIPC classification is composed of 9 groups, 19 subgroups, 52 items. The number of subitems may vary according to the CPI indicator and the geographical area considered [IBGE, 2014]. Figure 2 presents the groups and subgroups of the SNIPC.

## 2.2. Weights source: Household Budget Survey

The main source used to construct the baskets of goods and services for the SNIPC indices is the Household Budget Survey (HBS) of the IBGE (POF, in Portuguese) [IBGE, 2011, 2014, 2013]. Household budget surveys were previously conducted five times by IBGE in 1974 – 1975, 1987 – 1988, 1995 – 1996, 2002 – 2003<sup>1</sup>. Currently, there is a HBS being conducted corresponding to the period 2017 – 2018 that will provide information necessary for implementation of new baskets to be adopted in the SNIPC.

Since its first realization the HBS has suffered many changes in its scope and methods adopted.

<sup>1</sup>The HBS are intended to be performed every five years in agreement with the maximum interval recommended between HBSs for updating the CPI basket. However, due budget constraints such periodicity is not being followed properly.

Groups	Subgroups			
Clothing	Clothes	Footwear and accessories	Jewelry and bijouterie	Fabrics and haberdashery
Communication	Communication			
Education	Courses, reading and stationery items			
Food and Beverage	Food away from home	Food at home		
Health and Personal care	Pharmaceutical and optical products	Health related services	Personal care	
Household goods	Furniture and utensils	Electrical home appliances	Repair and maintenance	
Housing	Charges and maintenance	Fuels and energy		
Personal Expenses	Personal services	Recreational activities, tobacco and photography		
Transport	Transport			

Figure 2: Groups and subgroups of the SNIPC.

While the original version of the HBS was mainly designed to reveal aspects related to the incomes and expenditures of the population used for the composition of the CPIs baskets, the newer versions (after the 2000's) encompasses, besides a much larger geographical area, a much wider range of information of the households such as [IBGE, 2011]: living conditions, poverty and feeding habits of the population.

Currently, the HBS is part of the Integrated System of Households Surveys of IBGE [IBGE, 2011, Quinstlr and Hypólito, 2009, Freitas and Antonaci, 2014] (SIPD, in Portuguese) which is a robust framework whose goal is to optimize and integrate the planning and methodologies of all the household surveys conducted by the IBGE. This architecture have deep impacts on the sampling design of all the household surveys of the system since all the survey's samples are derived from a single *master sample*. The *master sample* derives from a *master frame* given by a combination of sources such as the Brazilian Census, the Operational Geographical Base and the CNEFE [Freitas and Antonaci, 2014]. The primary sample units (PSU) of the master sample are given by *census sectors* which a "geographical partition" containing a set of households. The PSU are constituted by the *census sectors* with more than 60 households. For those *census sectors* with less than 60 households, a PSU is generated by aggregating contiguous census sectors until the aggregated areas exceed 60 households (making sure that certain geographical and administrative constraints are respected) [Freitas and Antonaci, 2014, IBGE, 2018].

The *master sample* for which the sample of the HBS 2017 – 2018 was extracted covers over 15.000 PSUs spread among urban and rural areas all over the country (see the spots in Figure 2a) accounting to over 210.000 households [IBGE, 2018]. For the HBS 2017 – 2018 the (sub)sample selected amounts to  $\approx 40\%$  of the *master sample* leading to a selection of  $\approx 75.000$  households from over 1.900 Brazilian municipalities (out of a total of  $\approx 5.500$ ) represented in the map displayed in Figure 2b.

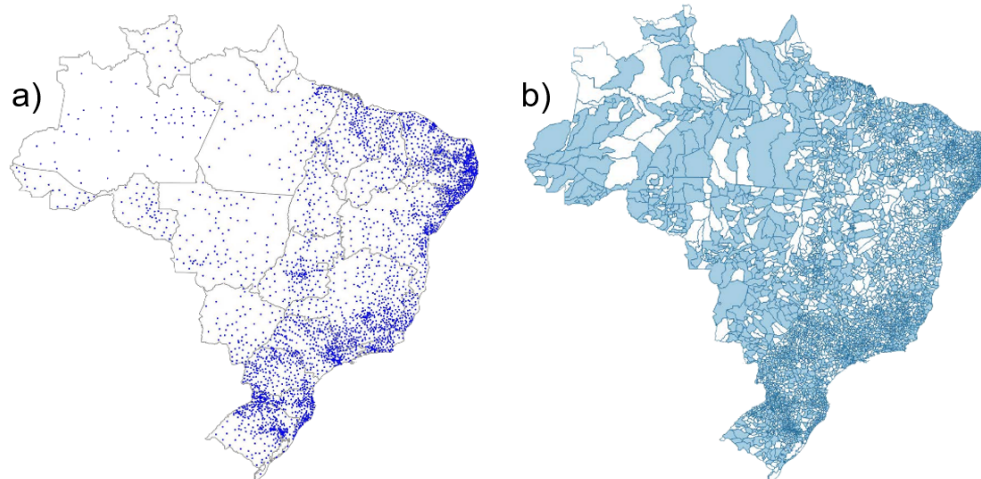


Figure 3: a) Full Master sample of the SIPD. The spots represent the places where the PSUs were selected. b) Sample of the HBS 2017 – 2018, a subsample of the *master sample*, covering over 1900 Brazilian municipalities.

In order to capture seasonal practices and to reflect stable economic conditions of the population the HBS is spread over 12 months (from June 2017 to July 2018 in the current HBS) along 52 weeks. The information is collected by personal visits of the interviewers to the selected households. Each visit lasts a period of 7 days.

The sample design guarantees the derivation of robust estimates in a detailed geographical level such as the urban areas of the capital cities of the Brazilian states. Such scope is way beyond the domains currently necessary for the SNIPC whose scope are the metropolitan areas of the Brazilian states<sup>2</sup> [IBGE, 2013].

For the derivation of the weights for adoption in the CPIs the plutocratic approach has been employed which attributes more weight to households that consume more [ILO, 2004, IBGE, 2013, 2014]. Also, since the domestic approach is adopted for the SNIPC indices [ILO, 2004, IBGE, 2013, 2014] all expenditures realized by the citizens outside of the country's borders are excluded from the index scope.

Another important feature of the SNIPC is that each state contained in the system has its own basket derived from the HBS, hence representing the rich diversity of the consumer habits observed along a country with continental dimensions. The national basket is composed by a combination of all the representative elements found in each local basket [IBGE, 2013, 2014]. For the selection of elements that are eligible to compose each **local basket** the criteria currently<sup>3</sup> adopted are:

1. Select all those subitems whose expenditure weights  $> 0.07\%$  relative to the total expenditures of the basket;
2. For the subitems whose weights lie between  $0.01\%$  and  $0.07\%$ , the subitems with largest weights are included (in descending order) until the summed weights of the subitems included

<sup>2</sup>Currently only 16 areas are covered by the SNIPC, representing the country's capital Brasília and another 15 states of a total of 26.

<sup>3</sup>“Currently” here refers to the criteria adopted for the basket in use derived via the 2008 – 2009 HBS. Methodological changes are under evaluation for the derivation of the new basket.

accumulates 70% of the item's weight. The remaining subitems are not eligible to compose the basket.

3. All subitems with weights below 0.01% are also non eligible.

The subitems that are not eligible have their weights redistributed according to specific criteria: attributed to similar items or redistributed proportionally within an item, subgroup or group [IBGE, 2014].

According to the above criteria, 372 subitems were selected to compose the national basket in use for the INPC and 383 for the IPCA, based on the results HBS 2008 – 2009, which was the source for the current baskets.

Figure 4 illustrates the evolution of the groups' weights for the IPCA and the INPC in the last three HBSs. In Figure 5, the regional character of the SNIPC baskets is displayed for selected areas. Note how the groups' weights are sensitive to the regional factor.

### 2.3. Sample selection, price collection and editing

The ideal frame for CPIs is a bidimensional one containing information on the point of purchases and the products commercialized by such places. With such information in hands, one can derive probabilistic criteria for the selection of the places and products of the CPI sample. Rigorous optimization criteria can also be derived.

Currently IBGE has no access to a frame with such detailed level of information on the products commercialized by the stores, only a frame (named CEMPRE) which provides information for the stores but not for the products they sell. The only information available is a broad definition of the activities performed by the stores, which serves as a support for the sample selection.

Due to the reasoning above, the sample is mainly constructed based on purposive criteria<sup>4</sup>. The outlets are selected based on information from the CEMPRE, head office indications based on web searches, and mainly via field collectors indications.

For the stores indicated, a specification process is conducted in order to check if the desired products are commercialized and to get the products main characteristics. The varieties of products selected for pricing are the ones most commercialized in each area of the index. The information on the most sold varieties are provided by the person in charge of the outlet.

The products eligible for use in the SNIPC correspond to the ones in perfect conditions, that are available for commercialization to general public in the moment of the collector's visit. The prices collected correspond to the ones offered for a purchase of a single unit (of a good or service) performed in cash by the time of the visit. Sales offers are only accounted if available to the general public.

The price collection of products and services contained in the baskets of the SNIPC is exclusively performed by field and office collectors in each of the 16 areas covered by the SNIPC. The collection is performed according to a predetermined calendar. The sample of places to be visited is spread along four time slots which neatly fit the four weeks of the month. Such scheme ascertains that each

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<sup>4</sup>An exception to the adoption of the purposive approach can be found for the subitems housekeeper and service for home maintenance and repairs, whose prices selection relies on probabilistic methods. See da Silva et al. [2019a] for more details.

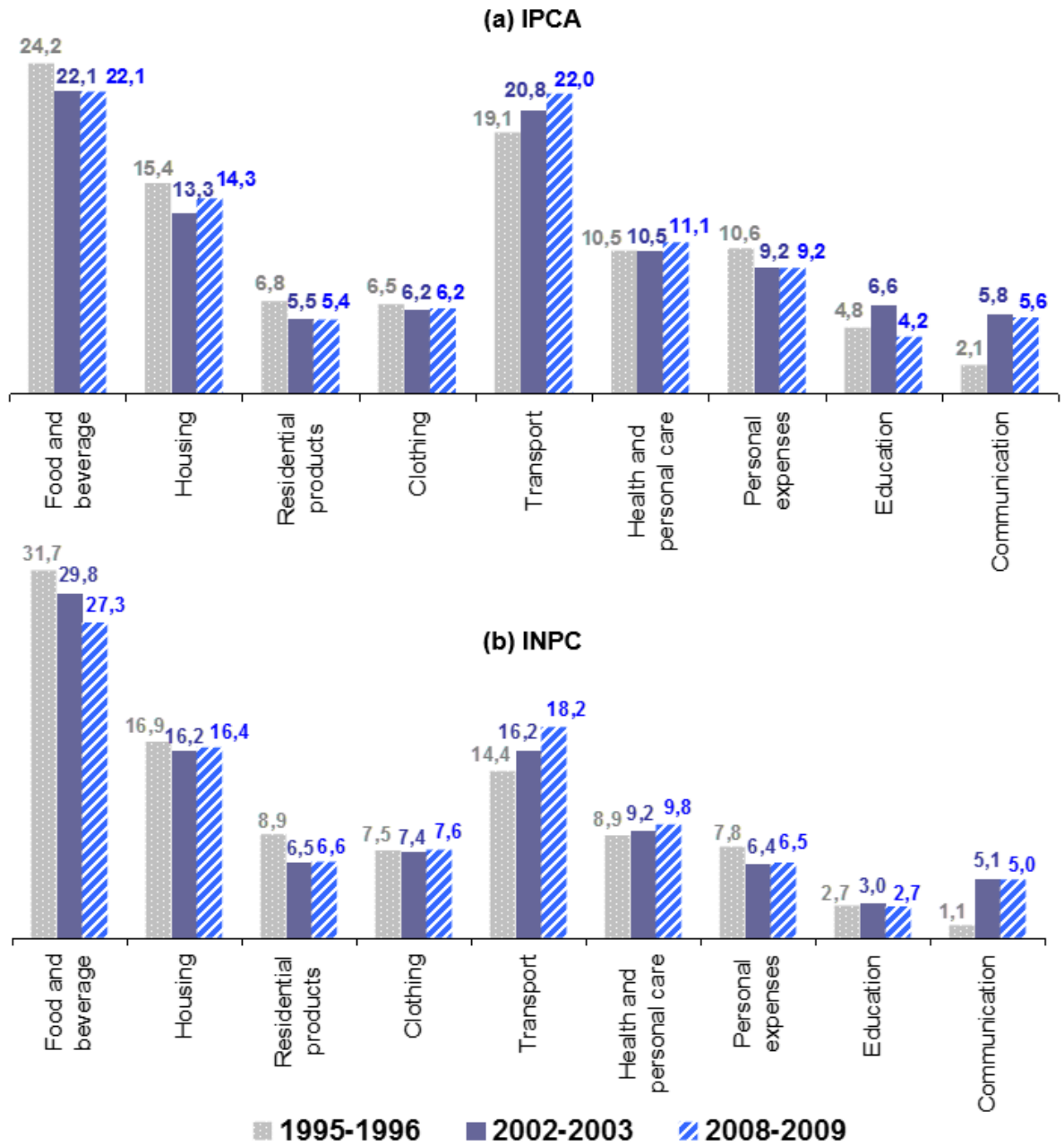


Figure 4: Brazil: evolution of the weighting structures of the IPCA (a) and INPC (b) obtained from HBSs 1995/96, 2002/03 and 2008/09 (original values in %).

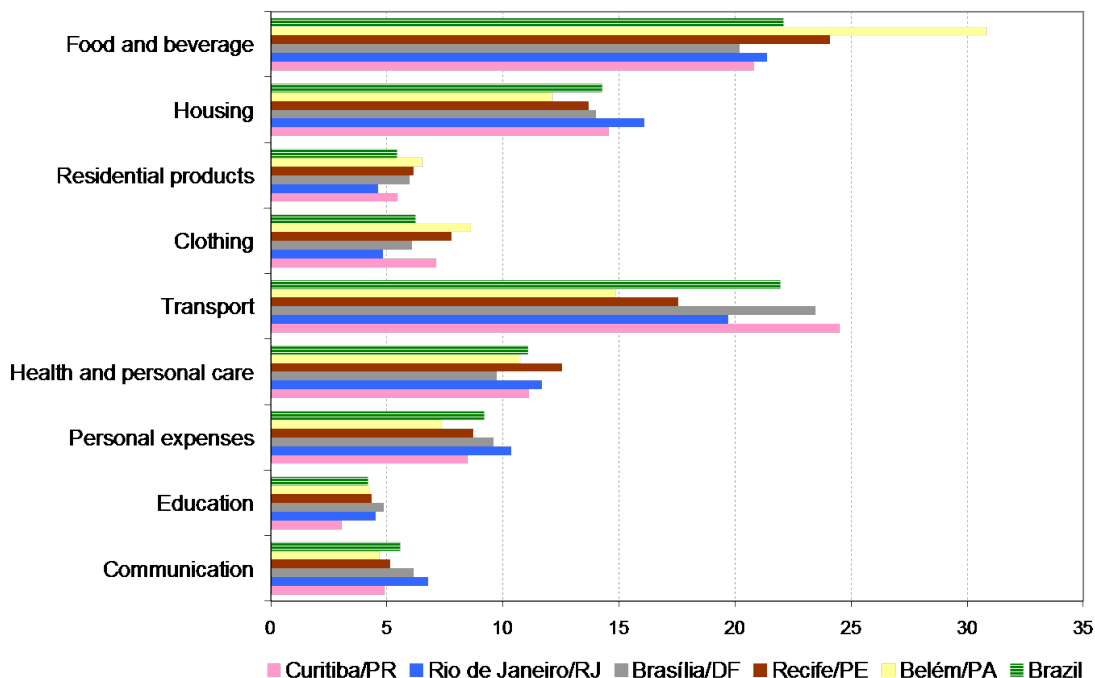


Figure 5: Weighting structures of the IPCA obtained from the HBS 2008/09 (original values in %): illustration on regional differences on the basket composition.

outlet is visited in the same time slot (1st, 2nd, 3rd or 4th) every month. However some products are collected in a different periodicity and by other means. For instance, for some special products involving public services tariffs such as electricity, the collection is conducted in the last day of the month's last slot.

Currently, the SNIPC collects, on a monthly basis, a total of  $\approx 480.000$  prices. The field collectors are provided with a digital portable device that contains, among others, information on the stores to be visited and the products to be priced in each of them. Recently a georeferencing routine was incorporated in the system. This tool allows to perform studies on how appropriately the locals and products registers are spread throughout the SNIPC coverage. The device also possess a warning system that alerts the collector to check if extremely discrepant prices (probably originated by typing mistakes during data entry) are correct by the moment of the collection.

The prices collected are analyzed at the head office by a group of analysts divided in sectorial groups of products. Such professionals check if the prices collected are in agreement with the products specification, if the prices movement and level are consistent with the products history and the economical scenario of the moment. Inconsistent prices might be asked for a check by the field collectors, rectified or edited according to defined criteria. Missing prices are inputed according to methods most adopted for prices indices [ILO, 2004, IBGE, 2013].

### 2.3. Methods for CPI compilation

Before we derive the formulas adopted for the compilation of the SNIPC indices, it is important to remember that the SNIPC CPIs are compiled based on a **bottom-up approach** (see Figure 6).



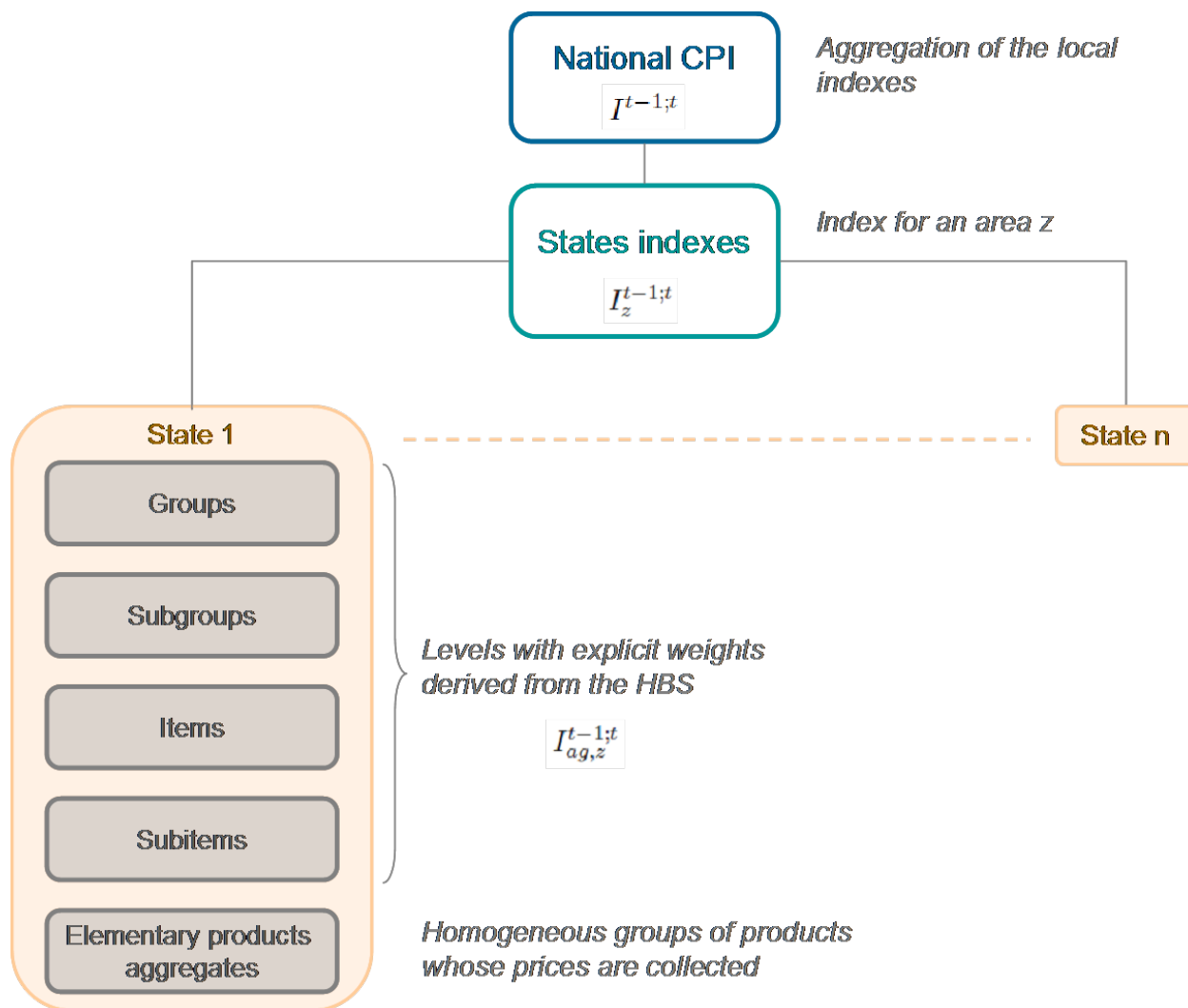


Figure 6: The bottom-up structure of the SNIPC: high level formula.

Since each area considered in the index possess its own basket, the indices are first compiled in a “local basis”, i.e., one for each area. Then, in a posterior step the area’s indices are aggregated to compose the national CPI. The methods used to compile the regional indices, are presented in the following. The final aggregation process to compute the national index is described by the end of the section.

### 2.3.1. Derivation of the elementary indices

As stated in section 2.1, the lowest level in the SNIPC classification system for which explicit weights provided by the HBS are available is the subitem. The subitems then constitute the building blocks of the SNIPC and probably are what is mostly similar to what the international literature defines as an *elementary aggregate* [ILO, 2004, Eurostat, 2018]. Though as explained in the manual of the working group on consumer prices indices [ILO, 2004], “elementary aggregates may be defined differently in different countries”.

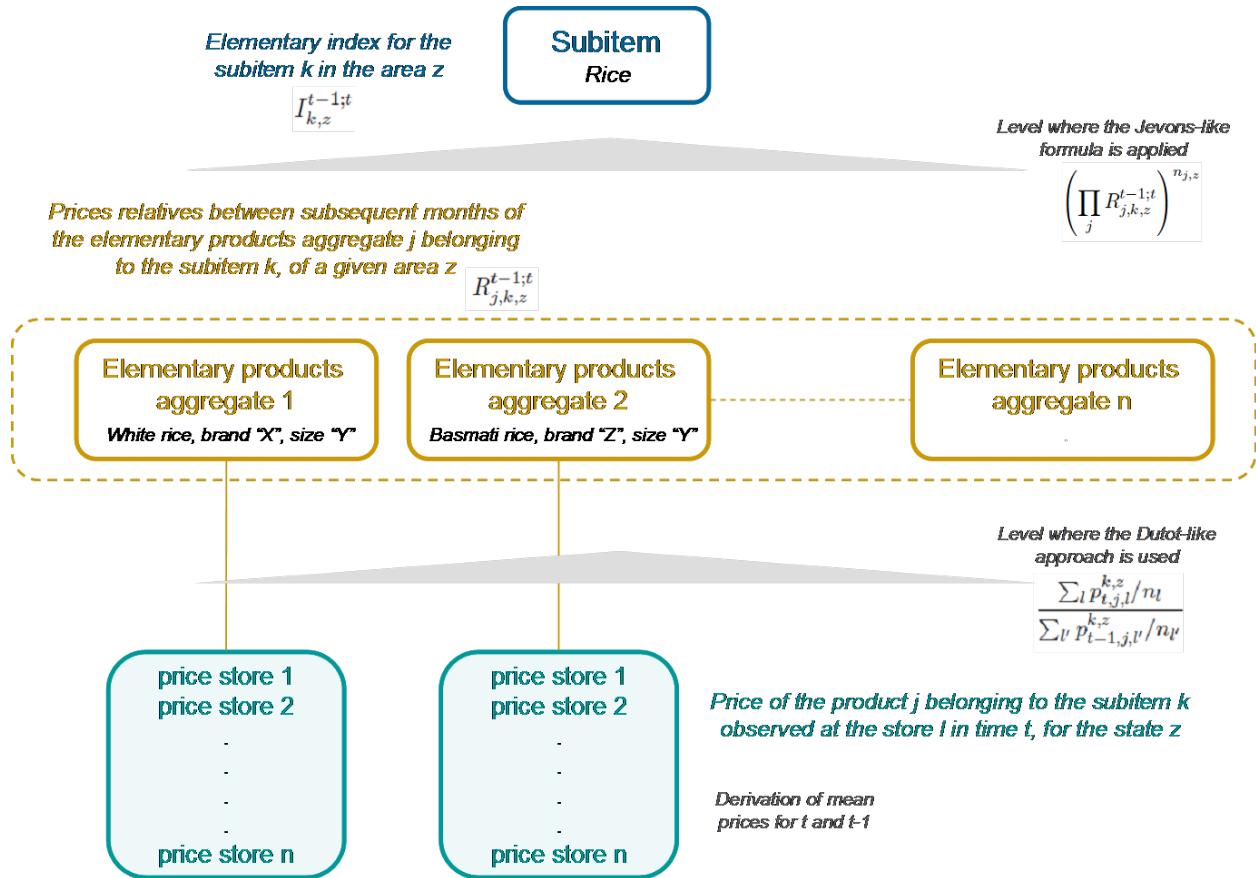


Figure 7: Illustration of the steps involved in the calculation of the elementary indices of the subitems of the SNIPC.

The first step for the calculation of a CPI is the calculation of indices for the elementary aggregates, the elementary indices. This is usually performed by making use of some sort of averaging process, referred as *elementary index formula*, of the prices of products within the elementary aggregate [ILO, 2004]. We now describe the general process<sup>5</sup> of derivation of the elementary indices for the SNIPC.

In order to understand the calculation of the elementary formula used in the SNIPC we note that below the subitem level lie the products and services whose prices are periodically collected (see Figure 7), monthly for most of the cases. The products inside each subitem constitute homogenous groups of similar (or equal) products of different varieties and brands. For those sets of products within the subitem with the same specification (same size, brand, etc) we here adopt the term *elementary products aggregate* (see Figure 7).

The elementary index adopted in the SNIPC is based on a two stage process which is a sort of “combination” of the Dutot and Jevons indices [ILO, 2004]. In the first stage a Dutot-like approach is used to derive the prices relatives between subsequent months of the *elementary products aggregate j* belonging to the subitem *k*, of a given area *z* namely [IBGE, 2013]:

<sup>5</sup>For information on the calculation of special cases please refer to [IBGE, 2013].

$$R_{j,k,z}^{t-1;t} = \frac{\sum_l p_{t,j,l}^{k,z}/n_l}{\sum_{l'} p_{t-1,j,l'}^{k,z}/n_{l'}} \quad (1)$$

where in Eq. (1)  $p_{t,j,l}^{k,z}$  denotes the price of the product  $j$  belonging to the subitem  $k$  observed at the store  $l$  in time  $t$ , for the state  $z$ .  $n_l$  ( $n_{l'}$ ) denotes the number of stores selling the product  $j$  in the sample at moment  $t$  ( $t-1$ )<sup>6</sup>.  $R_{j,k,z}^{t-1;t}$  denote the prices relatives of the elementary products aggregate  $j$ , of the subitem  $k$ , between months  $t$  and  $t-1$  for area  $z$ .

After the calculation of the relatives of the elementary products aggregates  $R_{j,k,z}^{t-1;t}$ , the second stage consists in using a Jevons-like [ILO, 2004] formula for averaging the relatives corresponding to the different elementary products aggregates within the subitems. The elementary index for the subitem  $k$  in the area  $z$  is hence given by [IBGE, 2013]

$$I_{k,z}^{t-1;t} = \left( \prod_j R_{j,k,z}^{t-1;t} \right)^{1/n_j^{k,z}}, \quad (2)$$

where in Eq. (2)  $n_j^{k,z}$  are the number of elementary products aggregates within the subitem  $k$  in the area  $z$ .

We note that the indices are calculated within a short-term basis which amounts to calculating the variations between subsequent months.

### 2.3.2. High level formula and weights update.

Once the subitems' elementary indices are known, the indices for the higher level of the structure can be derived via use of a high level index formula [ILO, 2004]. For the CPIs produced by the SNIPC the high level formula allows to aggregate the lower levels indices to generate indices for upper level structures: item, subgroup, group, state and national.

SNIPC adopts a Lowe-like high level formula, which states that the weights derived in the HBS<sup>7</sup> at time  $b$  are price-updated to the price reference period 0 [ILO, 2004]. Hence, the index for an area  $z$  between the price reference period 0 and time  $t$  writes:

$$I_z^{0;t} = \sum_k w_{k,z}^{b:0} I_{k,z}^{0;t}, \quad \text{with} \quad w_{k,z}^{b:0} = \frac{p_{k,z}^0 q_{k,z}^b}{\sum_{k \in z} p_{k,z}^0 q_{k,z}^b}, \quad (3)$$

where in Eq. (3)  $w_{k,z}^{b:0}$  denotes the weight of the subitem  $k$ , in area  $z$ , price updated from the expenditures derived in the weight's reference period  $b$  to the price's reference period 0. Note that the sum in Eq. (3) extends to all the subitems contained in the basket of the area  $z$ .

The indices currently compiled in the SNIPC however rely on a short-term basis. In such approach the indices are compiled between moments  $t-1$  and  $t$ . Hence, the index for area  $z$ ,  $I_z^{t-1;t}$ , is expressed as:

<sup>6</sup>In general  $n_l$  and  $n_{l'}$  are the same. Missing prices usually are imputed according to predefined criteria.

<sup>7</sup>Since the HBS lasts 12 months the weights reference period generally refers to a year. In the last HBS 2008 – 2009, however, the weights reference period was set to january of 2009 [IBGE, 2014, 2011].

$$I_z^{t-1;t} = \sum_{k \in z} w_{k,z}^{t-1} I_{k,z}^{t-1;t}, \quad (4)$$

where the weights  $w_{k,z}^{t-1}$  in Eq. (4) are the weights of the subitems  $k$  belonging to the area  $z$  at the moment  $t - 1$ . The weights  $w_{k,z}^{t-1}$  are derived via the expression [IBGE, 2013]:

$$w_{k,z}^{t-1} = w_{k,z}^{b;0} \prod_{j=0}^{t-2} \frac{I_{k,z}^{j-1;j}}{I_z^{j-1;j}}. \quad (5)$$

In Eq. (5),  $I_{k,z}^{j-1;j}$  is the elementary index of the subitem  $k$ , of area  $z$ , between time  $j - 1$  and  $j$ , calculated through Eqs. (1) and (2).  $I_z^{j-1;j}$  is the index for area  $z$  between periods  $j - 1$  and  $j$ .

The indices for other levels of the SNIPC classification (items  $I_{m,z}^{j-1;j}$ , subgroups  $I_{sg,z}^{j-1;j}$ , and groups  $I_{g,z}^{j-1;j}$ ) can be derived in a similar fashion as in Eqs. (4) and (5). However, for such cases the sums are restricted to the subitems contained in each aggregate (item, subgroup or group). Also, the weights need to be standardized so that the weight of the aggregate sum to unity. Hence, the weight of a given aggregate  $ag$  writes [IBGE, 2013]:

$$I_{ag,z}^{t-1;t} = \frac{\sum_{k \in (ag,z)} w_{k,z}^{t-1} I_{k,z}^{t-1;t}}{\sum_{k \in (ag,z)} w_{k,z}^{t-1}}, \quad (6)$$

where in Eq. (6) the sums extends to all the subitems within the aggregate  $ag$  of the area  $z$ .

The compilation of the national CPI relies on the aggregation of the local indices. Mathematically the index is expressed as [IBGE, 2013]:

$$I^{t-1;t} = \sum_z w_z I_z^{t-1;t} \equiv \sum_z \sum_{k \in z} w_z w_{k,z}^{t-1} I_{k,z}^{t-1;t}, \quad (7)$$

where in Eq. (7)  $I_z^{t-1;t}$  amount to the index of area  $z$  between periods  $t - 1$  and  $t$  and  $w_z$  its respective weight. We note that the weights  $w_z$  used are not those corresponding to the relative expenditures shares of the areas respective the national basket [IBGE, 2013]. A different weight is used depending on the index of the SNIPC: INPC or IPCA. For the INPC the regional/area weights are based on population estimates for the urban areas encompassed by the states in the index scope. A reweighting process is used to account for the urban populations of the states that are currently not in the index scope (refer to [IBGE, 2013] for further details).

For the IPCA the weights are based on the estimates of monetary family incomes for the population of the urban areas of the Brazilian states covered by the index and, again, a reweighting process is adopted to cover the urban population of the states not accounted for in the current structure. More details on the INPC and IPCA indices will be given in Section 2.4.

The weights  $w_z$  currently adopted were also derived via information from the HBS 2008 – 2009 [IBGE, 2013].

### 2.3.3. Reference periods in use

An index number is characterized by three different reference periods: one for the weights, one for the prices and one for the index number series. The weights' reference period is related to the moment when the weights are derived by the HBS and usually relates to a year, since the survey lasts 12 months. The prices' reference period refer to the moment of the first collection of prices of a new basket, and is usually given by a month of a given year. Finally, the index reference period corresponds to the moment where the series is set to 100, also a given month of a year.

For the SNIPC indices the reference periods currently adopted are [IBGE, 2014, 2013]:

1. Weights reference period: January 2009. This is due to the fact that all the expenditures and incomes derived by the HBS 2008 – 2009 were adjusted to correspond to those of January of 2009.
2. Prices reference period: december 2011, the first price collection of the new basket provided by the HBS 2008 – 2009.
3. Index reference period: december 1993.

### 2.3.4. Linking of the series

Whenever a great methodological change or a basket's update occurs, a linking process of the “old” and “new” price index series resulting is necessary. The last linking process of the SNIPC series occurred with the implementation of the three new areas in the index in May, 2018. The linking process adopted in this case and in the implementation of the last basket was based on a single month overlap linking [ILO, 2004, IBGE, 2013].

## 2.4. Indices currently produced: INPC, IPCA, IPCA-15, IPCA-E

### 2.4.1. INPC

The National Consumer Price Index (INPC, in Portuguese) is one of a series of indicators produced by IBGE's Price Indices Coordination. It is calculated on a monthly basis and it currently covers sixteen different urban areas in all five regions of Brazil, namely: the metropolitan areas of Belém (State of Pará/PA), Fortaleza (State of Ceará/CE), Recife (State of Pernambuco/PE), Salvador (State of Bahia/BA), Belo Horizonte (State of Minas Gerais/MG), Vitória (State of Espírito Santo/ES), Rio de Janeiro (State of Rio de Janeiro/RJ), São Paulo (State of São Paulo/SP), Curitiba (State of Paraná/PR), and Porto Alegre (State of Rio Grande do Sul/RS); Federal District/DF; and the cities of Goiânia (State of Goiás/GO), Campo Grande (State of Mato Grosso do Sul/MS), São Luís (State of Maranhão/MA), Aracaju (State of Sergipe/SE) and Rio Branco (State of Acre/AC). (see coloured areas in Figure 8). The last three were added in May 2018, following efforts to increase the representativeness of the North and Northeast regions of Brazil.

To compile the INPC, prices are collected, in general, from the 1st to the 30th day of the month  $t$  and the sample consists of a wide range of commercial establishments and service providers, both public and private<sup>8</sup>.

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<sup>8</sup>For the indices compiled for the variation between months  $t$  and  $t - 1$  the prices are collected in month  $t$  and compared with those observed in month  $t - 1$ . The results are published in month  $t + 1$ .

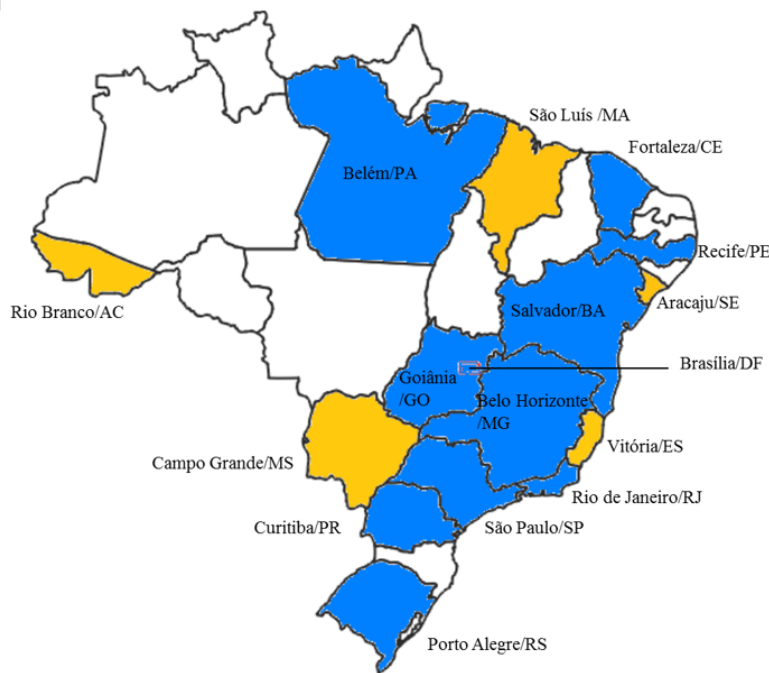


Figure 8: Areas where the SNIPC CPIs are compiled. The INPC and IPCA coverage is represented by the colored areas in the map. The coverage of the IPCA-15 and ICPA-E is restricted to the blue colored regions in the map.

One of the main goals of the INPC is to measure inflation for low-income families. Therefore, the target population of the index comprises families with household income from 1 to 5 minimum wages<sup>9</sup>, where the main source of income is of a salary earner householder. Families who earn less than one minimum wage are excluded because of their unstable or atypical income and structure of consumption. These criteria are set in order to guarantee a coverage of  $\approx 50\%$  of families in urban areas within the geographical scope of the survey.

The current basket of goods and services that make up the INPC was established from the last HBS, which took place in 2008 – 2009. It comprises 372 subitems, the lowest aggregation level in the index for which weights are available, and it reflects the consumption patterns of the target population. Public transportation, for instance, weighs more in the budget of low income families than it does in the budget of high income ones. Thus, the weight attributed to public transportation should be higher in the INPC than in other indicators that cover wealthier families, such as the IPCA, which will be seen next. Figure 9 displays the weights obtained for the group levels in both the INPC and the IPCA.

Besides being an indicator of the inflation for low income families, the INPC has several other uses in Brazil. Together with the annual GDP, it is used to set the national minimum wage each year. In addition, it serves as a reference for the adjustment of social security benefits, such as pensions and retirement payments.

#### 2.4.2. IPCA

<sup>9</sup>In Brazil, minimum wage is measured on a monthly basis and not by the hour, as is common in other countries, such as the United States.

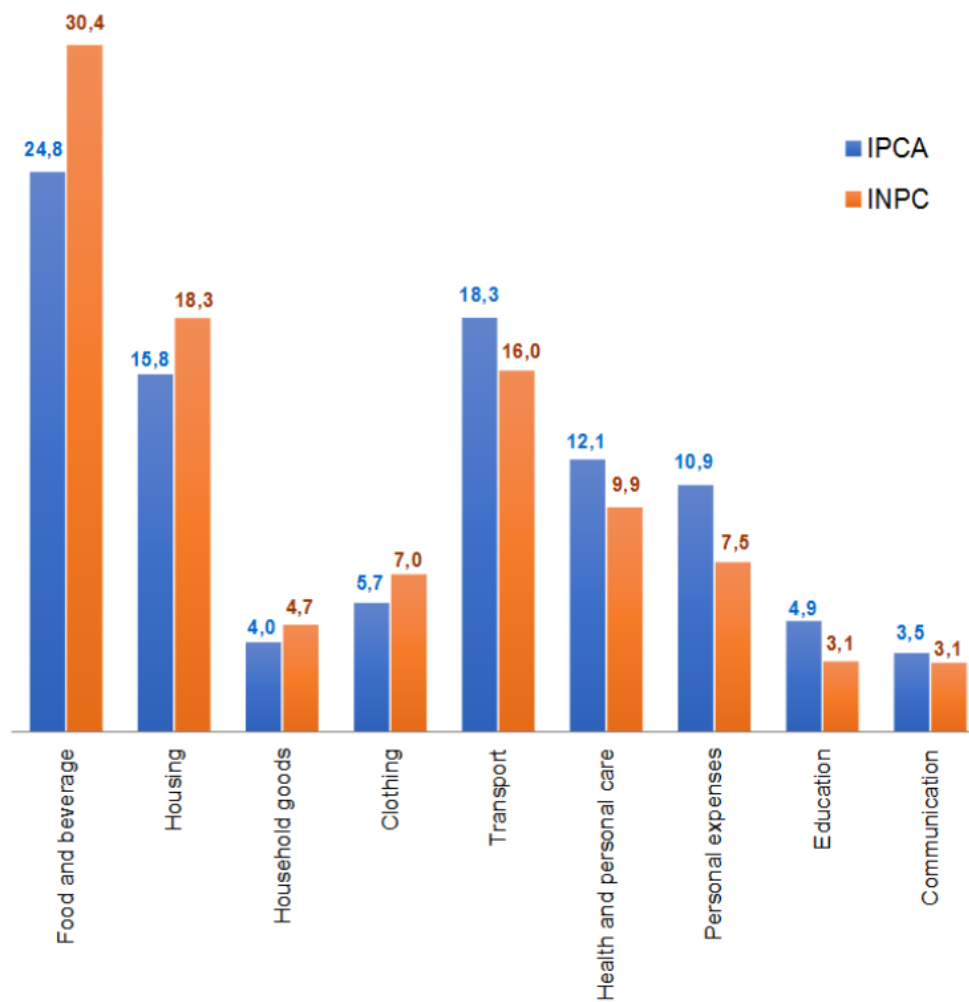


Figure 9: Comparison between the INPC and IPCA weights for the 9 Groups of the SNIPC classification. Results correspond to weights price-updated for February, 2019.

The Extended National Consumer Price Index (IPCA) is considered Brazil’s official inflation. When the members of the National Monetary Council<sup>10</sup> set its inflation target, their reference is the IPCA.

The IPCA and the INPC share the same geographical coverage (see Figure 8) and the prices are collected during the same period, that is, generally from the 1st to the 30th of each month  $t$ . However, the target population is much wider in the IPCA, ranging from 1 to 40 minimum wages, which covers over 90% of families in urban areas within the sixteen areas where data is gathered. It is also important to mention that, while in the INPC the source of the income is of a salary earner household, in the IPCA the income can come from any source.

The basket of goods and services in the IPCA comprises 383 subitems, only 11 more than the INPC. Though the indices share some similarities, the weights attributed in each case are significantly different, especially on a group level (see Figure 9). Food and Beverages, for example, weight over 30% in INPC while they weight around 25% in IPCA, which is explained by the differences in the target population.

When the IPCA was first introduced, its purpose was to measure the overall price movements in the retail market. Given its wide range, the idea was to offer an indicator of inflation for the average consumer. Nonetheless, it acquired several other uses over time. In addition to being the country’s official inflation, the IPCA is used to adjust figures in both private and public contracts. Some government bonds are also indexed to the IPCA, namely the National Treasury Notes - B Series (NTN-B), which offer a fixed rate plus inflation as return on investment.

#### 2.4.3. IPCA-15

The Extended National Consumer Price 15 (IPCA-15) has the same target population as the IPCA, but both the geographical coverage and the period when prices are collected are different. Its name, IPCA-15, comes from the fact that prices are collected usually from the 16th of month  $t - 1$ <sup>11</sup> to day 15 of month  $t$ . Also, it covers only 11 of the 16 areas encompassed by the IPCA, namely (see also Figure 8): the metropolitan areas of Belém (State of Pará/PA), Fortaleza (State of Ceará/CE), Recife (State of Pernambuco/PE), Salvador (State of Bahia/BA), Belo Horizonte (State of Minas Gerais/MG), Rio de Janeiro (State of Rio de Janeiro/RJ), São Paulo (State of São Paulo/SP), Curitiba (State of Paraná/PR), and Porto Alegre (State of Rio Grande do Sul/RS); Federal District/DF, and the city of Goiânia (State of Goiás/GO).

Regarding the basket of goods and services in the IPCA-15, prices are collected for 365 subitems, less than the 383 included in the IPCA. This difference relies on the distinct geographical coverage, meaning that some subitems have weight only in areas that are not included in the IPCA-15.

As the IPCA-15 results are published prior to the IPCA of the “same” period (given that half of the prices collected are shared by the two indices, i.e, the first 15 days of each month), the IPCA-15 is commonly portrayed by the media as a preview of the IPCA.

#### 2.4.4. IPCA-E

The Special Extended National Consumer Price Index (IPCA-E) can be described as the quarterly accumulation of the IPCA-15. Therefore, they both share the same geographical coverage, target

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<sup>10</sup>Brazil has adopted an inflation targeting system since 1999. The National Monetary Council is the entity responsible for setting the inflation rate to be achieved and it is formed by three different authorities: the Minister of the Economy, the president of the Central Bank and the Special Secretary of Finance of the Ministry of Economy.

<sup>11</sup>For the IPCA-15 the price collection lasts  $\approx 30$  days spread along two months  $t - 1$  and  $t$ . In this case, the monthly variation again considers the months  $t$  and  $t - 1$ , though the prices are partially collected in months  $t - 2$ ,  $t - 1$  and  $t$ . The results are published by the end of month  $t$ .



SNIPC Family				
	INPC	IPCA	IPCA-15	IPCA-E
Geographical coverage	See coloured areas in Figure 7	See coloured areas in Figure 7	See coloured areas in Figure 7	See coloured areas in Figure 7
Price collection period	Usually from the 1 <sup>st</sup> to the 30 <sup>th</sup> day of month $t$	Usually from the 1 <sup>st</sup> to the 30 <sup>th</sup> day of month $t$	Usually from the 16 <sup>th</sup> of month $t-1$ to day 15 of month $t$	Usually from the 16 <sup>th</sup> of month $t-1$ to day 15 of month $t$
Frequency	Monthly	Monthly	Monthly	Quarterly
Target population	Families with monthly income ranging from 1 to 5 minimum wages, where the income comes from a wage earned by the head of the family.	Families with monthly income ranging from 1 to 40 minimum wages, regardless of the source of the income.	Families with incomes ranging from 1 to 40 minimum wages, regardless of the source of the income.	Families with incomes ranging from 1 to 40 minimum wages, regardless of the source of the income.
Weights source	Household Budget Survey	Household Budget Survey	Household Budget Survey	Household Budget Survey
Main uses	Indicates inflation for low income families  Together with the GDP, it is used to set the national minimum wage each year  Serves as a reference for the adjustment of social security benefits, such as pensions and retirement payments	Is the country's official inflation  Measures the overall movement of prices in the retail market  Is commonly used to adjust figures in both public and private contracts  Serves as an index for some government bonds, namely the NTN-Bs	Is commonly portrayed as a preview of the IPCA	As the IPCA, it is commonly used to adjust figures in public and private contracts  It is also frequently used as a factor of adjustment of urban land and property taxes

Figure 10: summary of the main characteristics of the CPIs contained in the SNIPC.

population and data collection period. However, while the IPCA-15 is released on a monthly basis, the IPCA-E is only released on the months of March, June, September and December, when it coincides with the annual IPCA-15. One of the main uses of the IPCA-E is as a factor of adjustment of urban land and property taxes.

The main characteristics of the SNIPC CPIs are summarized in Figure 10.

## 2.5. Results published

IBGE, in order to follow international standards, adopted the Fundamental Principles of Official Statistics established by the Statistics Division of the United Nations in 1994 and approved by the General Assembly in January 2014. Based on that, IBGE issued an internal document with guidelines regarding the publication of official statistics, in accordance with principle 1, reproduced below:

*“Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical*

*utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information<sup>12</sup>.*

Therefore, IBGE ensures that the information produced by the institute are impartially disclosed and with equal access by all users, without privileges. To do so, IBGE disseminates, at the Internet, every December, a calendar specifying the dates each short-term (conjunctural) indicator should be released. On these dates, IBGE publishes its official statistics both through a press conference and through its website. In order to comply with the established dates of each publication, access to the data is granted only to the technicians directly involved in the production process of the results and its disclosure in the Internet or by press conference, which occurs only in the day before the release.

In addition to that, according to a Ministerial order, the publishing of the results of short-term (conjunctural) indicators produced by IBGE, including price indices, must follow specific steps. First, at the day of the publishing, at 7:00 a.m., the results, along with an executive summary, are forwarded to a list of government authorities, which can be found in the institute's website and includes the Ministry of Economy, the Chief of Staff of the Presidency of the Republic and the president of the Central Bank. The authorities in the list must observe the strictest secrecy of the information until its publication, which occurs at 9:00 a.m. of the same day.

At the scheduled time, the price indices' results are published at the website and a release is given to the press, containing important explanations on the figures. In addition, a presentation at the headquarters is conducted by the price index team, which remains available afterwards to answer any questions the press and the general public might have.

In order to fulfill the requirements related to the publication of the results, the price index team elaborates a report explaining the major movements accounted in each group of products and services of the index. Also, several spreadsheets with monthly, annual and twelve-month variations and weights are elaborated and made available at IBGE's website, as well as index numbers data. This same information can be obtained at SIDRA, a database provided by IBGE where users can find specific figures and create customized tables. It is noteworthy that the price index results for a specific month are published, at most, in the eighth working day of the following month.

### **3. 40 years of the SNIPC: historical notes and economic outlook**

#### **3.1. Legal framework and main uses of the CPIs produced at IBGE**

The SNIPC was created in 1979 as a system with the purpose of providing frequent and timely measures of the variation of the cost of living in Brazil. In the same year, within the SNIPC, the INPC was created as a measure to adjust the purchasing power of wages. The motivation for the creation of the INPC was the measurement of the price changes related with the consumption basket of salaried and low income populations. A few months after its creation, the INPC was officially adopted as the source for salary adjustment through Law 6708/79.

In December 1979, another CPI, the IPCA, was created aiming to provide a measure of the inflation in the Brazilian economy as a whole. To reach its goal, the IPCA probes the price variations related to a basket of goods that embodies the consumption habits of the bulk of the Brazilian population,

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<sup>12</sup>Extracted from the UNSD principles of official statistics available at <https://unstats.un.org/unsd/dnss/gp/FP-New-E.pdf>.

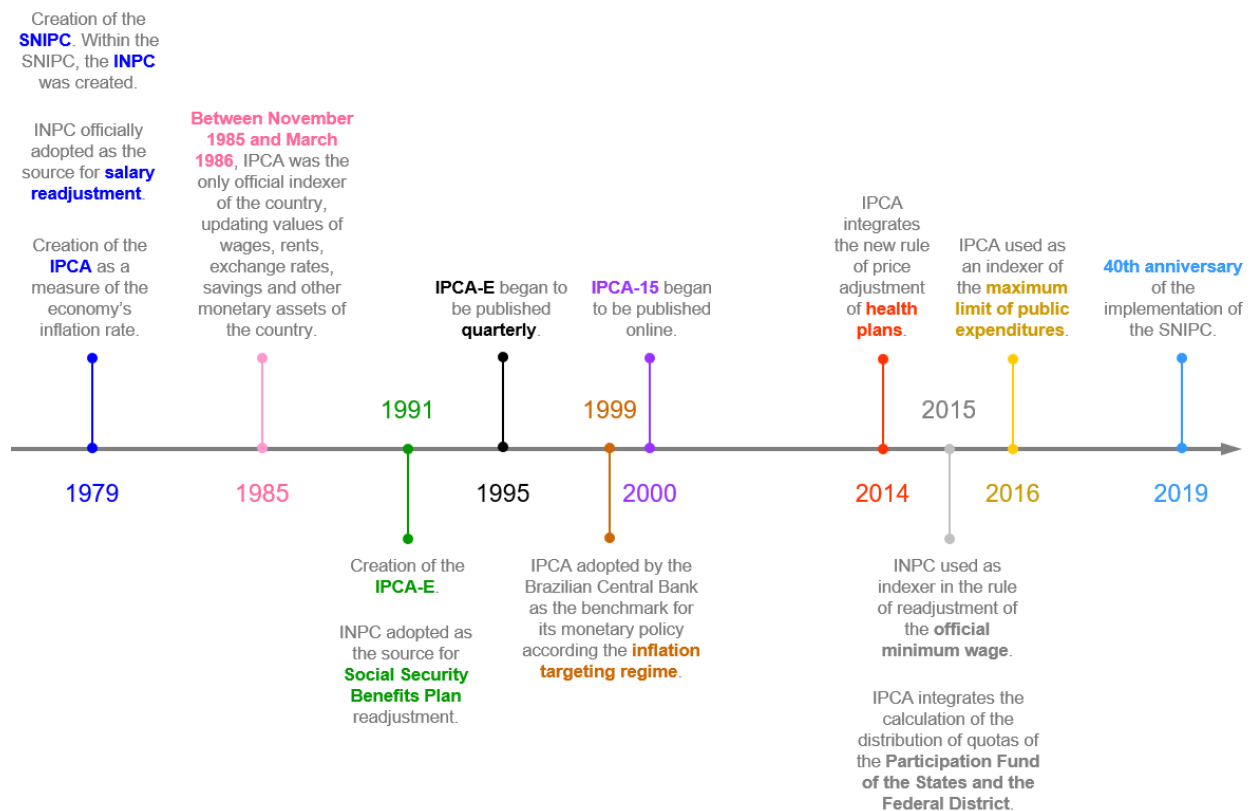


Figure 11: Timeline of the SNIPC: main historical landmarks of the indexes and evolution of its incorporation by Brazilian society.

regardless of the source of family income. Currently, the IPCA is the benchmark adopted by the Brazilian Central Bank for the definition of its monetary policy, according to the inflation targeting regime established through the Decree 3088/99.

In 1991 another important mark in the SNIPC history was established with the creation, through the Law 8383/91, of the IPCA-E. The original IPCA-E correspond to the index now known as the IPCA-15. This change derived from the fact that the IPCA-E periodicity was modified from a monthly to a quarterly basis. Then, in order to preserve the original series of the IPCA-E, the IPCA-15 was “created”.

Over the last 40 years, the CPIs produced under the SNIPC have been used by the Brazilian society in the most varied areas including: targeting for monetary policy, indexation of public contracts and public debt securities, annual readjustment of the Brazilian minimum wage, distribution of federal public resources among the Brazilian States, readjustment for private health insurances, updating of labor debts, and updating private contracts of the most diverse nature. In addition, the indexes are daily used by public and private agents for the purposes of macroeconomic modeling, projection of prospective scenarios, academic studies, and statistical production itself, including the deflation of series in the Brazilian System of National Accounts.

Figure 11 illustrates how, in chronological terms, the incorporation of the CPIs produced at IBGE has taken place by the Brazilian society over the last 40 years.

### 3.2. Macroeconomic outlook from the point of view of prices movements

The inflation rate is probably the macroeconomic indicator that mostly influences the economical perceptions of the general public. Since price changes have an immediate impact on the population daily habits, almost every person is influenced and experience the effects of the inflation, thus developing a “feeling” on the subject based on their own consumer’s daily experience. Though the consumer’s perception tend to be biased, this perception puts extra pressure on CPIs compilers since the consumers expect that the official figures correspond somehow to their own experiences.

The way consumers “feel” the impacts of the inflation also have important influence on their consumption habits promoting consequences to the whole economical cycle. For instance, consumers tend to “feel” the inflation impacts more “strongly” in those moments of prices increase specially if such movements lead to a diminishment of their purchasing power. Under scenarios of consumers purchasing power reduction, the whole cycle in the economical activities is affected: companies are forced to reduce their production which leads to a reduction in the supply of jobs. These movements will also influence the investors behavior that will react to the results of weaker corporate accounting balances with final consequences on the stocks market.

High inflation weakens the business environment and produces deleterious effects to a country’s economy with direct impacts on the population life quality. For this reason, measuring and monitoring the inflation rate is fundamental for the formulation of economic policies. In addition, analysis of its time evolution provides an important and elucidative picture of the socioeconomic conditions of a country.

Over the past 40 years Brazil has undergone major economic transformations. Among them, the achievement of monetary stability and its consolidation as a social value after a long period of hyperinflation stands out. The evolution of the two main CPIs produced by the SNIPC (IPCA and INPC) displayed in Figure 12 illustrate the great transformations experienced by the Brazilian economy in the last 40 years.

As the analysis of Figure 12 shows, during the 1980s Brazil faced a hyperinflation period whose effects persisted until the mid-1990s. The inflationary process had its origins in the 1970s, influenced, among other factors, by the world oil crises (1973 – 74 and 1978 – 79) and boosted by the high degree of indexation of the Brazilian economy. Thereafter a price-wage spiral began, in which wages were adjusted via government decrees to compensate for the rising cost of living, and then prices were corrected to quench the increase in the cost of labor on the producer.

The results presented in Table 1 reveal that in the first half of the 1980s, between 1980 and 1985, the average annual inflation rate of the Brazilian economy, measured by the IPCA, was 147%. In the period comprising 1986 – 1990, this inflation rate rose to 696.63%. In the second half of the decade, the effects of hyperinflation strongly impacted the lowest income groups: between 1986 and 1990, the average annual variation of the INPC was 1076.27%.

The explosive trajectory of the Brazilian economy’s inflation observed in the second half of the 1980s continued in the first half of the following decade. Between 1991 and 1994, the IPCA recorded an annual average variation of 1,062.92% (see Table 1). In March 1990, both the IPCA and the INPC increased by more than 80% in relation to the previous month. That is to say, the same product almost doubled in price from one month to the other, which used to bring not only economic and social difficulties, but also enormous statistical challenges for the compilation of CPIs.

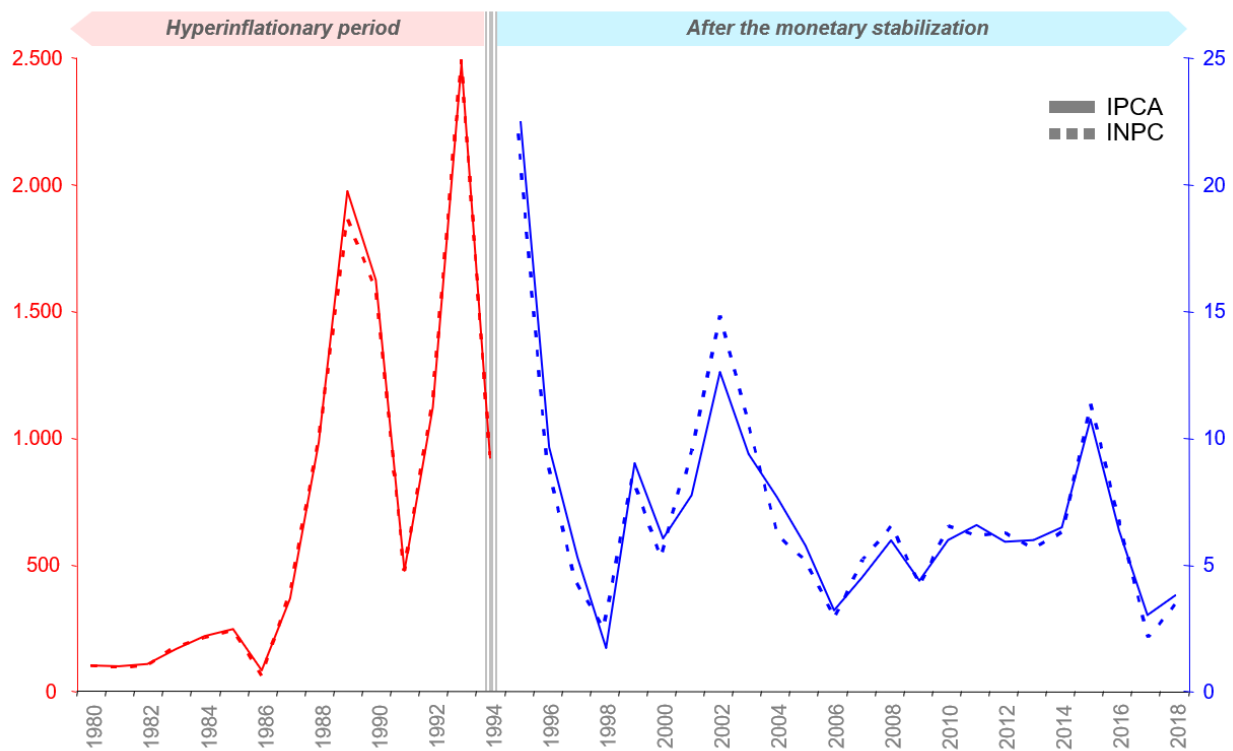


Figure 12: Annual inflation rates (% p.a.) measured by the IPCA and INPC through the 40 years of the SNIPC.

Table 1: Average annual inflation rates measured by the IPCA and the INPC through the 40 years of the SNIPC.

Year	INPC	IPCA
1980-1985	146.7	147.05
1986-1990	677.9	696.63
1991-1994	1076.7	1062.92
1995-2000	8.43	8.77
2001-2005	9.09	8.53
2006-2010	4.99	4.74
2011-2015	7.05	7.05
2016-2018	4.01	4.32

A period of almost 15 years elapsed during which the annual inflation rate of the Brazilian economy has reached a level of three or four digits. Over this time, five economic plans were implemented and failed in an attempt to restrain the hyperinflation. Among these five plans, three of them replaced the legal currency of the country, and generally were based on strategies of price controls, limitation on the movement of financial assets, and sudden shock policies that were unable to lead to the country’s economical stabilization. The plans that failed to control inflation in the 1980s and 1990s were named as: Cruzado Plan (1986), Bresser Plan (1987), Verão Plan (1989), Collor Plan I (1990), and Collor Plan II (1991) [do Prado, 2005, Cunha, 2018].

The Real Plan, launched in 1994, marked the beginning of a period of monetary stabilization of the Brazilian economy after years of hyperinflation. Along with the plan came a new currency, the Real - the fifth currency to which the Brazilians had to get accustomed within a decade. Fiscal adjustment, de-indexation of the economy, commercial liberalization, and the exchange and monetary anchors with a contractionary monetary policy were the main tools adopted by the Real Plan to stabilize the price changes of the economy.

Both the IPCA and the INPC, which recorded annual growths of more than 900% in 1994, fell abruptly to a level of 22% in the following year. In 1996, an annual inflation of one-digit was already observed as seen in Figure 12. Between the years of 1995 and 2000, the average annual variation of the IPCA and the INPC were 8.77% and 8.44%, respectively, as shown in Table 1.

The process of monetary stabilization of the Brazilian economy was put under test in the late 1990s, in the context of the currency crisis that affected emerging markets. In this period, after the exchange rate devaluation and its impact on the inflation rate, Brazil adopted an inflation targeting regime. The CPI chosen as the benchmark for the monetary policy by the Brazilian Central Bank was the IPCA, as mentioned previously. This framework consists of adjusting the monetary policy instrument - the interest rate in Brazil - so that the inflation rate projected pursues a target value. The instrument is tuned according to the proximity/distance between the “theoretical” projected target and the inflation probed by the IPCA.

The beginning of the 2000s were also marked by inflationary risk arising from the energetic crisis in 2001. Also important was the occurrence of a new process of currency devaluation in 2002 due to uncertainties in the financial markets. Since then, about ten years of monetary stability have elapsed, in which the inflation rate oscillated within the targets set by the Monetary Authority. In 2015,

the high inflation rate once again posed a threat to the stability of the Brazilian economy which faced a scenario of economic slowdown and financial markets turbulence. However, the inflation rate returned to a situation of stability in subsequent years. In 2018, the inflation rate of the Brazilian economy measured by the IPCA was 3.75%, an inflationary panorama quite different from the one that the index portrayed in the first years of existence of the SNIPC, four decades ago.

### 3.3. Main methodological changes

Over the course of these 40 years, SNIPC has undergone important technical modifications to keep in line with international recommendations and practices and better meet users' needs. Figure 13 summarizes the key enhancements and technical modifications the indexes have been experiencing since the System creation, following dimensions: target population, weighting structure, geographical coverage, regional weights, change of base, and calculation formula.

## 4. Moving on

In the previous Sections we discussed the main present and past aspects of the SNIPC. However, the measurement of CPIs is not a static science, since the society evolves and develops new habits. Consumer practices are not immune to such changes. CPI compilers need to be aware of such changes and develop and improve techniques and methods capable of tracking such changes and keep the CPI as a representative economical statistics.

Also important to mention is the pressure for the adoption of costless data sources and practices due the budget constraints NSOs are facing all over. The rise of new “private competitors” [Cavallo and Rigobon, 2016, Cavallo, 2017] providing CPI information by means of new cheaper data sources created with the advent of the digital era is another new challenge in the horizon. Summed to these aspects should also be mentioned the increasing demand for more timely and accurate information by a society each time more adepted and eager by data information.

Taking this scenario into account, in this Section we describe the main key initiatives already in course or in development aiming to improve the SNIPC for the forthcoming years.

### 4.1. Use of new data sources

One of the major resource consuming parts of the CPI compilation is the data collection (prices and weights) as described in Section 2. The rise of new price sources with potential lower acquisition costs has triggered an increasing interest by part of the official agencies responsible for the CPI compilation [Loon and Roels, 2018, Hov and Johannessen, 2018, Mendonça and Evangelista, 2018, Breton et al., 2016, Guðmundsdóttir and Jónasdóttir, 2016, da Silva et al., 2019b].

The main drivers' sources in such run are web prices, scanner data and administrative records [Loon and Roels, 2018, Hov and Johannessen, 2018, Mendonça and Evangelista, 2018, Breton et al., 2016, Guðmundsdóttir and Jónasdóttir, 2016, da Silva et al., 2019b]. All such sources have pros and cons. Web prices are offer prices for goods and services announced in the web pages of a given retailer. Such source of information sounds attractive at a first sight since the information are apperently “free” (anyone with an unrestricted internet connection can access the page information) and can be

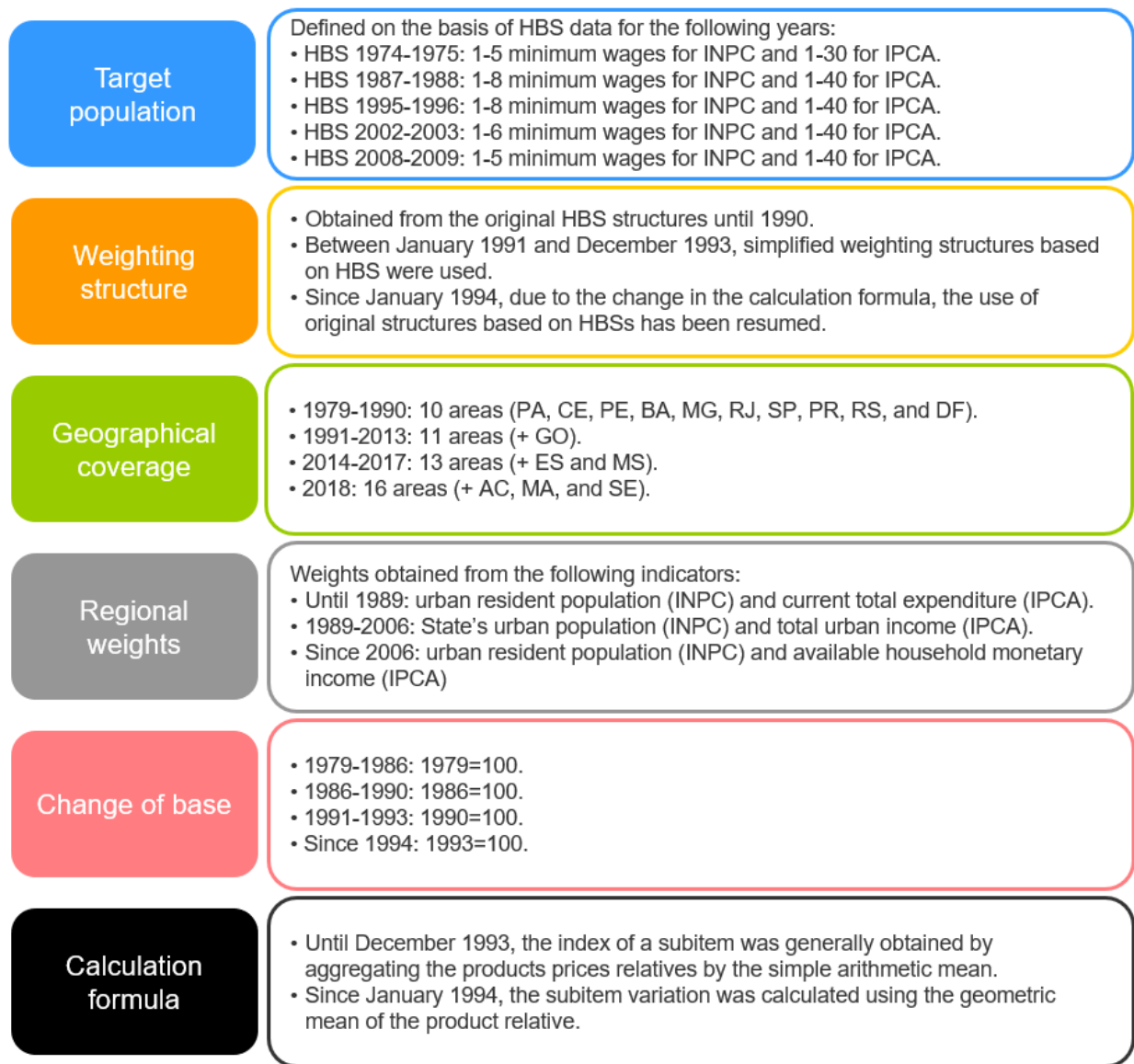


Figure 13: SNIPC's main methodological changes and key enhancements over the last 40 years.



extracted massively (all the prices of all goods offered by a given retailer in a certain time moment) and in a high frequency basis (every hour, day, etc) by means of an automatic tool.

However, a careful analysis reveals that there are important issues to be overcome for the adoption of such sources. Just to mention some of the drawbacks, web prices usually lack a source of weights for those products. Web prices, in general, are announced at a national level and the derivation of regional prices can be a hard task, since the discriminatory features usually rely on information such as delivery fees. Also, the construction and maintenance of automatic web scrapers for data capture requires a skilled staff on such programming subjects. Finally, some web sites can have anti-robots politics that may block a massive's price extraction.

Several NSOs are currently conducting researches on the use of web information for CPI compilation. At IBGE, the adoption of web data is being developed in a more parcimoniously way, trying to combine new and traditional sources for the improvement of the efficiency of collection practices and methodologies of the SNIPC.

Some web prices have already been collected manually at IBGE for a small number of subitems whose commercialization is known to be conducted mainly via web, such as airfares. A pilot project is in development in order to replace the manual collection of airfares' prices by an automatic tool and some promising results have been derived (see Ref. [da Silva et al., 2019b] for further details). Parallel to this, we plan to identify all those possible eligible products that can be collected online and expand the automatic collection, and also evaluate the possibility of increasing the range of products contained in the baskets.

It is also expected that the HBS 2017 – 2018 bring some information on the kind of outlets (web or brick-and-mortar) where a given good is commercialized and allow a more reliable selection of subitems from which price collection can be performed online via incorporation of web stores on the sample.

Other important use of web data is under evaluation in another pilot project (see Ref. [da Silva et al., 2019b] for further details) where web data is being collected to support the implementation of hedonic methods for quality adjustment at the SNIPC. A very costful part of the implementation and maintenance of such methods is the creation and maintenance of a dataset comprising the products' main important characteristics, a key information for the implementation of the technique. By means of web data such information can be derived in a cheap and efficiently manner. A home-made scraper has been developed for this goal and the modelling process is under development. See [paper web] for more details.

The development of a CPI with web products-only as a new indicator of the SNIPC system is also under consideration since it would be an important tool to track the sole evolution of web pricing practices. Evidences have been shown that it can be used as a tool to anticipate the traditional CPI movements [Cavallo and Rigobon, 2016, Cavallo, 2017].

Another data source that has been attracting much interest by CPI compilers are scanner data and administrative records. Scanner data are private data which essentially rose with the bar code technology. The use of this technology allows a higher control and organization of the retailers' sales. Scanner data provides a rich variety of information than web data. Among the information contained in scanner data are prices and quantities of transacted products. These information allow the use of superlative indices formulas providing more powerful CPI estimates.

However, such sources are private and without a legislation that guarantees legal authority to the NSOs to have access to them, data access poses a major barrier. In Brazil, IBGE does not have



 <b>PREFEITURA MUNICIPAL DE NITERÓI</b> <b>SECRETARIA MUNICIPAL DE FAZENDA</b> <b>NOTA FISCAL DE SERVIÇOS ELETRÔNICA - NFS-e</b>					
<b>20190000000106</b> <small>Exigibilidade</small>		<small>Data e Hora de Emissão</small> <b>13/02/2019 17:10:13</b>	<small>Competência</small> <b>02/2019</b>	<small>Código de Verificação</small> <b>CCGW-PABE</b>	
<small>Exigível em Niterói/RJ</small>			<small>Localidade da Prestação</small> <b>Niterói/RJ</b>		
PRESTADOR DE SERVIÇOS					
<small>CPF/CNPJ</small> <b>10.392.433/0001-93</b>		<small>Inscrição Municipal</small> <b>01417104</b>			
<small>Nome/Fazção Social</small> <b>L2M ATIVIDADES EDUCACIONAIS LTDA - ME</b>					
<small>Endereço</small> <b>R NOBREGA 9, E 15 - ICARAI - CEP: 24220-320</b>					
<small>Município</small> <b>Niterói</b>			<small>UF</small> <b>RJ</b>		
TOMADOR DE SERVIÇOS					
<small>Nome/Fazção Social</small> [REDACTED]					
<small>CPF/CNPJ</small> [REDACTED]		<small>Inscrição Municipal</small> ---			
<small>Endereço</small> [REDACTED]					
<small>Município</small> <b>Niterói</b>			<small>UF</small> <b>RJ</b>		<small>E-mail</small> [REDACTED]
DISCRIMINAÇÃO DOS SERVIÇOS					
<small>REFERENTE A MENSALIDADE DE JANEIRO/2019 DO</small> [REDACTED]					
<small>Description on the service purchased</small> <b>"Conforme a Lei da Transparência Fiscal n° 12.741/2012:          Aliquotas aproximadas: 11,938"</b>					
<small>CNAE</small> <b>0511200 - Educação infantil - creche</b>					
<small>Estatim</small> <b>03.01 - Ensino Regular Pré-Escolar, Fundamental, Médio e Superior</b>					
<b>VALOR TOTAL DA NOTA = R\$ 2.596,00 ➡ Amount (\$)</b>					
<small>Valor Total das Deduções (R\$)</small> <b>0,00</b>	<small>(*) Base de Cálculo (R\$)</small> ---	<small>(*) Alíquota (%)</small> ---	<small>(*) Valor do ISS (R\$)</small> ---	<small>Crédito p/ Abatimento do IPM</small> <b>5,18</b>	
OUTRAS INFORMAÇÕES					
<small>- A legislação tributária de Niterói pode ser consultada em <a href="http://www.fazenda.niteroi.rj.gov.br/site/categoria/legislacao">www.fazenda.niteroi.rj.gov.br/site/categoria/legislacao</a></small>					
<small>- O ISS desta NFS-e deverá ser recolhido através do Documento de Arrecadação do Simples Nacional.</small>					
<small>- (*) Documento emitido por ME ou EPP optante pelo SIMPLES NACIONAL.</small>					
<small>- O crédito gerado estará disponível somente após o recolhimento do Simples Nacional.</small>					
<small>- Departamento de Lançamento e Fiscalização - Rua da Concórdia, 100 - Centro - 24020-092 - Niterói - RJ.</small>					
<small>- PROCDON: Rua Visc. de Sepetiba 519, Térreo, Centro, Niterói, RJ, Tel. 0800 262-7060.</small>					

Figure 14: Example of electronic register (e-register) of service purchases.

such legal “tools” and we still have no access to scanner data. Individual negotiations with retailers are necessary to provide such information.

According to the experience of some countries the negotiations to obtain scanner data can take years and the data transfer can be chargeable. Though it is known that scanner data is a valuable source for CPIs, in Brazil we have a peculiar situation where data of similar quality to those of scanner data can be caught by other means.

The Brazilian tax authorities are in charge of rich and powerful sources of price information. This statement relies on the fact that every legal purchase performed in the country generates an electronic register (e-register) with information on the goods purchased (for instance, price, quantity, products code and description, time of purchase), the seller (address, CNPJ - unique code that identifies the establishment) and may also possess information on the consumer who performed the purchase (either a company or an ordinary person). An example of some of the information provided is shown in Figures 14 and 15.

The custody of such information belongs to the State’s tax authorities (for the case of the State’s

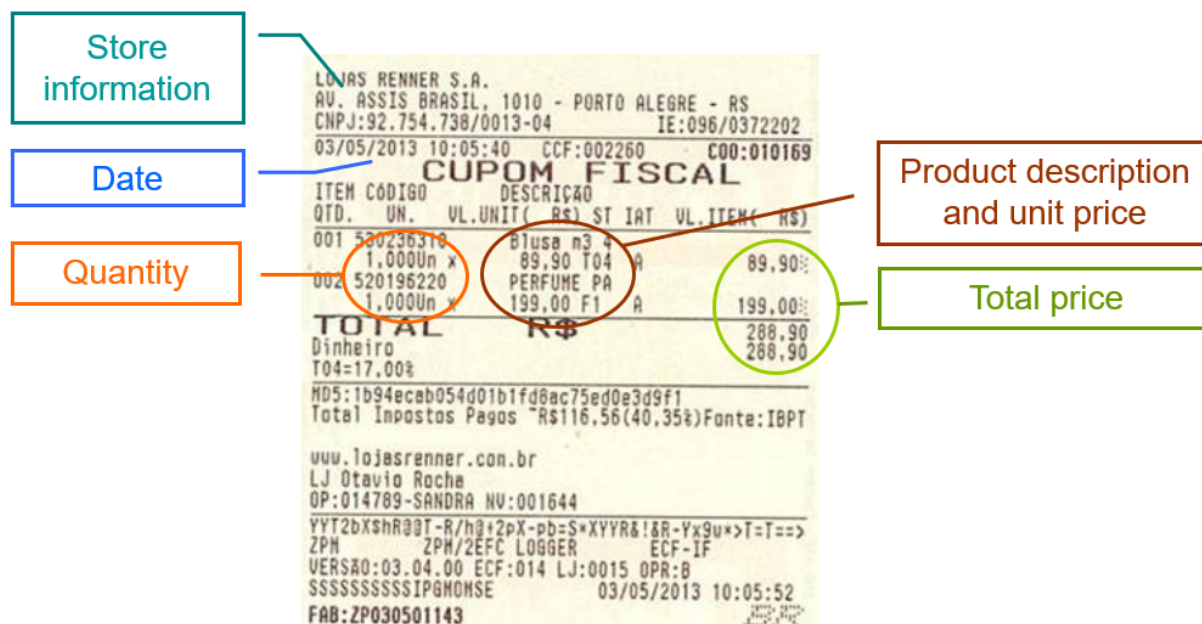


Figure 15: Example of electronic register (e-register) of goods purchases.

information) and the national IRS receives the information for the whole country. Full access to such data source would allow an enormous potential to improve the development of the indicators produced by the SNIPC and probably provide a unique opportunity to expand the range of indicators produced to finer geographical levels. A larger range of CPIs for different target populations with different baskets could, in principle, also be developed since compilation costs might be reduced. Also, since information on quantities and prices would be provided, superlative prices indices formulas could be adopted and providing more powerful indicators. The e-registers could also be a useful as an alternative source to provide information for updating the baskets and weights of the CPIs.

Again a lack of legal authority to provide IBGE the enforcement to get access to such information is a major barrier. So far, as a legal framework is not available attempts to initiate conversations with the tax authorities in order to develop a partnership and have access, at least partially, to the e-registers data.

## 4.2. Geographical expansion of the index

Brazil is a huge country with continental dimensions and the compilation of indices to cover the whole country is a complex and expensive task. In recent years an effort has been made to improve the coverage of the SNIPC indicators by incorporating new areas (States) in the system. In 2018 three new areas were incorporated Aracaju (State of Sergipe - SE) São Luís State of Maranhão - MA) and Rio Branco (State of Acre - AC). Cuiabá (State of Mato Grosso - MT) is supposed to be incorporated in a near future.

Such process is key to improve the national representativity of the index and to provide local users with an inflation measure of their own, based on their local baskets. Another important outcome is the production of a more accurate local price change measure to be used by the System of National

Accounts (SNA) in order to derive regional GDPs.

### **4.3. Improvement of harmonization with international practices and standards**

Another key point to enhance the quality, transparency and representativity of the SNIPC is to harmonize the main practices and methods of the system with the best international standards. In this sense, some aspects of the SNIPC are already focus of ongoing projects such as the study of the use of the National Accounts database (see Ref. [Ventura, 2019]) for a more frequent update of the CPI weights and the additional adoption of the COICOP classification system. Other themes of interest are the evaluation of the change of the elementary and high level indices formulas to those best recommended by the CPI community and the implementation of hedonic quality adjustment methods. We briefly discuss such projects in the following.

#### **4.3.1 Move to COICOP classification**

The Classification of Individual Consumption by Purpose (COICOP) is the internationally recommended classification for household expenditures. This classification is under the custody of the the United Nations Statistics Division (UNSD). The COICOP is still not adopted by the SNIPC, the HBS or the SNA at IBGE. However it is recognized as a key point to be covered and work is being developed to promote such change.

The adoption of the COICOP is not only important at the national level but also in the international context for initiatives such as the International Price Comparison and the Purchase Parity Power programs of the CEPAL and World Bank of which IBGE has been participating since a long date.

#### **4.3.2 More frequent updates of the weights structures: use of National Accounts**

As described in Section 2.2, the main data source used to update the baskets and weights used by the indicators of the SNIPC is the HBS. However, due the large interval between subsequent HBSs the weights adopted can become obsolete and lead to representativity bias of the CPIs [ILO, 2004]. One of the best approaches to deal with such problem is the conduction of continuous HBS. The development of a continuous HBS is on the scope of the SIPD system, though due to budgets constraints the future of this project is uncertain. Another important approach is to guarantee that the interval between consecutive HBSs do not exceed five years, as international best practices recommend [ILO, 2004]. The HBS at IBGE are planned to be performed each five years but again the accomplishment of such schedule relies on government funding.

An important approach to try to minimize such problems is the adoption of alternative sources to update the basket weights. In conformity with CPI literature recommendations and international practices [ILO, 2004, Eurostat, 2018], IBGE is conducting a study for the adoption of the SNA for partial update of the CPIs' weights of the SNIPC (see Ref. [Ventura, 2019] for further details). Though the update may not be able to reach the subitem level, the use of the SNA should be able to provide information until the item level.

Some important drawbacks to consider for the use of the SNA as a source for updating the CPIs' weights are the lack of a unified classification system adopted between the SNA, HBS and the SNIPC by IBGE. The *bottom-up approach* in which the national indices are constructed relying on

the compilation of state's indices based on local baskets, a finer level of detail than the one provided by the SNA, which only provides expenditures information at the national level. Preliminary results however show that the adoption of the SNA as an alternative source for updating the SNIPC's weights is promising (see [Ventura, 2019] for more details).

### **4.3.3 Study of the use of other indices formulas**

The elementary indices currently adopted and described in Section 2.3.1 are not in full agreement with the practices most widely used which rely on the use of a Dutot or a Jevons index [ILO, 2004, Eurostat, 2018], the latter being the most recommended for use in the case of unweighted indices [ILO, 2004, Eurostat, 2018]. The adoption of one of the recommended approaches would be beneficial for the SNIPC indicators since would provide more international comparability and harmonization with international practices.

The current approach also presents important drawbacks. Once the elementary indices discussed in Section 2.3.1 rely on a “double” averaging process, the resulting elementary indices tend to be “oversmoothed” and quenching genuine fluctuations inherent to the original prices data. In the second averaging step, a single mean value is used to every elementary product group. This implicitly attributes the same weight for every elementary product aggregate, within a given subitem, independently of the their sample sizes. Under this approach less representative products (those with smaller sample sizes) tend to be overweighted. To opposite effect occurring for the most representative products.

Thus, before changing to new a elementary indices formula, simulations are necessary in order to evaluate the impacts of such changes and the necessary adjustments. Besides, ideally such changes should be conducted in the moment of the implementation of a new basket.

Attention should also be devoted to the high level formulas adopted. As presented in Section 2.3.2, the current approach adopts a Lowe-like formulation which amounts to price updating the HBS weights derived at the weights reference period to the prices' reference period [ILO, 2004, Eurostat, 2018]. Such process has been questioned by some experts which point that the use of the Lowe index tend to overestimate the estimates of the target indices in comparison to estimates derived via a Young formulation (no weights update) [ILO, 2004]. Also, the greater the interval between the weight's reference period and the price's reference period is, the worst is the effect.

As the international best practices state [ILO, 2004], to minimize such effects one important procedure is the definition of a target index to which the index formula aims at, thus allowing the evaluation of the bias incurred by the high level formula chosen. Studies on the degree of consumers substitutions under prices movements are also an important point to check the adequacy of the Lowe versus the Young approaches. If substitution rates are low, than the use of the Lowe approach applies, rather it should be avoided.

### **4.3.4. Implementation of hedonic methods for quality adjustment**

Quality adjustment is a central matter for price indices since quality change is one of the most important sources of bias in CPIs [ILO, 2004, to Study the Consumer Price Index, 1996, Reinsdorf and Schreyer, 2018, de Haan and Diewert, 2017]. The problem relies, essentially, on the fact that CPIs are based on a fixed basket of goods and quantities purchased by consumers. Ideally the

same set of products should be tracked and priced throughout time, an approach known as the *matched model method* [ILO, 2004]. However, as time evolves the market dynamics implies that new goods are created and existing ones are extinguished or modified. If the prices' relatives are derived between old and new products and the latter present different degrees of *utility* for the consumer, than the comparison will not capture a pure price variation, which is the aim of CPIs [ILO, 2004].

The most celebrated method to deal with *quality change* effects on CPIs is hedonic modelling, which essentially aims to express the price of a good in terms of its attributes. The implementation of such techniques are however costly since require the collection of detailed characteristics of the products.

Hedonic quality adjustments still are not adopted at the SNIPC indicators, however a pilot project to overcome this deficiency is in course. The project aims to circumvent the costs and difficulties of collecting the products characteristics by making use of web data and web scrapers. By doing so we expect to be able to implement and maintain a robust framework for the use of hedonics at the SNIPC. For more details refer to [da Silva et al., 2019b]

#### **4.3.5. International engagement and collaboration**

An active participation in the experts discussions forums and meetings is of capital importance for the development of the staff of the SNIPC and for the system as a whole since such activities allow the exchange of experiences on state-of-the-art problems and methods occurring in the field. An active participation in such forums is also necessary to present the main challenges and projects being implemented at the SNIPC in order to hear the opinions and critics of experts all over and improve our proposals.

During many years, in a near past, IBGE has been away of such forums and the results were detrimental to the improvement of the SNIPC indicators. More recently an incentive for the participation in the main important forums such as the Ottawa Group Meeting and the Meeting of the group of experts on prices indices by the UNECE/ILO has been promoted. The IBGE is also participating on the international consultation for the revision of the CPI manual conducted by the UN Intersecretariat Working Group on Price Statistics. Suggestions on the first 14 chapters released were provided. This engagement has also been very fruitful to promote internal discussions by the CPI staff of IBGE on the topics discussed by the manual.

A more active participation on the discussion forums is also being promoted by the incentive to produce and submit works and papers for discussions.

In the international collaboration side, IBGE joined the International Comparison Program of the World Bank, conducted by CEPAL in Latin America. Engagement to the activities of the continuous version of the program are also in progress.

As a result of the recent participation in international forums the exchange of experiences with CPI experts of other NSOs has also improved substantially and initial conversations for participation in other global projects have also been initiated.

#### **4.4. Implementation of a robust quality management system**

The CPI is one of the most important indicators produced by NSOs. For this reason, its production quality control under a robust quality management system has become a strategic issue due to the

complexity of the entire process from the price collection to index dissemination.

A quality management system is a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives. A quality management system helps coordinate and direct an organization's activities to meet customer and organization requirements and to comply with regulatory requirements and to improve its effectiveness and efficiency on a continuous basis.

The priority area in the quality management of a CPI is the quality control of the production process. In this context, IBGE has been investing in the strengthening of its quality management system, with a focus on the business process mapping of the SNIPC aligned with the GSBPM.

The Generic Statistical Business Process Model (GSBPM) describes and defines the set of business processes needed to produce official statistics, detailing the different steps to produce them. It contributes to the statistical production processes modernization in multiple ways: providing standard terminology to help statistical organizations, defining and describing statistical processes in a coherent way, and comparing and benchmarking processes within and between organizations.

The business process mapping must be seen as a permanent routine that guarantees the improvement of the work from the operational and strategic point of view, with prospective monitoring and resolute approach. Besides that, provides the exchange of experiences, anticipation of problems, leveling of information, and sharing of issues of mutual interest.

Documenting statistical production is another GSBPM important usefulness under a Knowledge Management perspective. The purposes of a process and methodology documentation include succession planning, standardization, metadata, international reporting, and the descriptions of processes, techniques and the methodologies for producing CPIs.

## Conclusions

This paper aims to celebrate the 40th anniversary of the Brazilian National System of Consumer Price Indices - SNIPC maintained by the Brazilian Institute of Geography and Statistics (IBGE) through the description of the main present features, historical points and future perspectives for the SNIPC. This paper also tries to partially fill a gap of documentation on the SNIPC in English language and hence provide access to a broader audience of users and researchers interested in the CPIs produced by the SNIPC.

In the manuscript we discussed the general methodological characteristics of the SNIPC such as the system of classification adopted to organize and aggregate the elements of the SNIPC baskets. We presented the main techniques (sampling strategy, collection methods, etc.) and some results (time evolution of consumption patterns and regional differences) of our HBS, the primary source of information for the derivation of the baskets and weights adopted at the SNIPC.

We emphasized the bottom-up character of the system where the national indices are obtained via aggregation of local indices. We showed that the compilation of local indices based on local baskets is essential to capture the rich diversity of habits of this huge country.

The general rule used to calculate the different CPIs was presented. We scrutinized the elementary and high-level formulas adopted in the SNIPC. We covered the peculiarities and similarities of the indices currently produced. The results released to the public were summarized.

The connection between the changes in the SNIPC and the economic scenario in the past 40 years was established. In this context, it is important to note how the results presented by the SNIPC were important to reflect the challenges faced by the Brazilian economy in the past years and how it became an important tool used by the Central Bank for the formulation of economic policies in modern times.

Finally, we pointed topics of relevance where the system could be improved and presented some of the main important challenges the SNIPC needs to overcome in order to keep providing accurate pictures of the Brazilian society in the “digital era”. We summarized the main projects under development and important routes that can be used to reach this goal.

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