Challenges of Using National Accounts for a More Frequent Update of the Brazilian CPI Weights

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Abstract

A consumer price index (CPI) is usually calculated as a weighted average of the price change of a basket of goods and services covered by the index. The weights are meant to reflect the relative importance of the goods and services as measured by their shares in the total consumption of the households. It is often recommended in CPI's literature that the basket should be updated as frequently as possible – at least every five years – in order to ensure that the weights do not become unrepresentative leading to bias in the CPI. In addition, weights also need to be updated to reflect the introduction of new items and the removal of old ones. In general, increasing the weights updating frequency minimizes distorting impacts that changes in consumer preferences and item substitutions might have on the index. Countries like Brazil which are experiencing significant economic changes, and thus more rapid changes in the consumption pattern, should update their weights even more frequently, such as annually.

The Household Budget Survey (HBS) is the main data source for deriving expenditure shares for the goods and services covered by the Brazilian CPI. Hence, weights update depends on how often the HBS is conducted, which unfortunately is taking place on a less frequent basis (more than seven-year intervals) because the survey costs and budgets constraints. In this sense, National Accounts can be an alternative and complementary source for deriving CPI expenditure weights using the Household Final Consumption Expenditure (HFCE) estimates. There are two main practical advantages in using these data for estimating the weights. First, National Accounts data are disseminated annually on a calendar basis. Second, and most importantly, the scope and coverage of HFCE, adjusted to cover all expenditure by households within the economic territory, is consistent with the scope and coverage of the Brazilian CPI as defined by the domestic concept.

This paper contributes to this context by presenting the main challenges found for the implementation of a more frequent update of the Brazilian CPI weights using the National Accounts database. Challenges arise in different ways: (i) HFCE estimates are available only at the national level, and because of that, some sort of hypothesis or approximation should be taken to derive the regional weights; (ii) CPI and HFCE estimates are produced for different purposes and have some differences in scope and definition of consumption that must be treated; (iii) the bottom-up approach of the method of calculation of the Brazilian CPI, where the national basket of goods and services are derived from the regional ones and the national index is calculated by aggregating the regions (sub)indices due such local baskets; and (iv) non-integrated classification structures adopted for the CPI and National Accounts at IBGE.

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[*] The views expressed in this paper are those of the author and do not necessarily reflect the views of IBGE.

Contents

1. Introduction

The Cost of Living Index seeks to measure the variation of the minimum consumption expenditure necessary for households to maintain a certain standard of utility or well-being. The true Cost of Living index is a theoretical indicator. For this reason, the main approach used to fulfill this purpose is the calculation of Consumer Price Indexes (CPIs).

The CPI is calculated as a weighted average of the price variation of the goods and services that comprise a fixed basket covered by the index. The weights are meant to reflect the relative importance of the goods and services as measured by their shares in the total consumption of households. The weight attached to each good or service determines the impact that its price movements will have on the overall index. When measuring the price variation of a fixed basket of products, the consumer price index provides an approximation of the variation of the true Cost of Living Index.

The expenditure weights data can be obtained from different data sources and in particular from Household Budget Surveys (HBS). The HBS is in general the primary data source for deriving expenditure shares for categories of goods and services covered by the CPI. Its main advantages include the fact that it can be adapted to the specific needs of the CPI, provide data on expenditures at a regional level, and provide information on the characteristics of the family unit, points of sale where purchases are made, frequency and shares (P x Q) which families consume for each product.

Updating of weights depends on how often a HBS is conducted. For the purposes of the CPI, ideally the HBS should be conducted annually. However, a program of annual surveys with samples large enough to provide the type of estimates required for CPI weights could be very costful. For this reason, it is often recommended in CPI literature the basket updating of weights as frequently as possible – at least every 5 years – in order to ensure that they do not become unrepresentative and irrelevant.

In the short run, consumers may change consumption patterns in response to shifts in relative prices. Over longer time periods, consumption patterns are also influenced by factors other than price variations. Countries which are experiencing significant economic changes, rising incomes or changes in the level and distribution of household income usually present displacement of their aggregate demand towards goods and services with higher income elasticities. Examples of other factors that affect spending behavior in the longer run include technological changes (new products will be introduced and existing ones may be modified or become obsolete) and demographic factors such as ageing of population. In this context, a fixed basket will be unresponsive to all these changes and the weights may become out of date and less representative of current consumption patterns.

The upper-level substitution bias in a fixed basket index is likely to increase with the age of the weights. For this reason, in general, increasing the frequency of updating weights minimizes the distorting impact that changes in consumer preferences and item substitutions might have on the index. In this sense, the use of alternative data sources has proven to be an advantageous option to guarantee this more frequent updating of the CPI weighting structures along the five-year intervals between large-scale HBS. According to the CPI literature, various sources of data can complement each other by establishing more reliable and accurate general weights: a simplified and continuous HBS conducted every year, electronic invoice with consumer identification, market intelligence information, retail trade statistics, population censuses, various administrative sources and more recently scanner data. However, one of the main sources recommended and effectively used for this purpose is the Household Final Consumption Expenditure (HFCE) compiled in the System of National Accounts.

There are two main practical advantages in using these data for estimating the weights. First, National Accounts data are disseminated annually on a calendar basis. Second, and most importantly, the scope and coverage of HFCE, adjusted to cover all expenditure by households within the economic territory, is consistent with the scope and coverage of the Brazilian CPI as defined by the domestic concept. In addition, National Accounts estimates are likely to be more accurate and reliable for estimating weights for consumption categories that tend to be "wrongly" reported in the HBS, and where results from the HBS suffer some kind of significant and distorting non-response rate.

It is important to emphasize that the international literature does not recommend replacing the HBS with the National Accounts as a source for updating the weights. The recommendation is only the complementary use of the National Accounts in relation to the HBS. The HBS at regular intervals (less than 5 years), remains a fundamental element for the general updating of weights, especially in the more disaggregated classification levels for which there is no data availability via National Accounts.

In updating the weights via HFCE, the adjustments go only at the most aggregated level and at the national level. There is other important information for the weighting structures that the HBS provides – such as the outlet types – that are not available from the National Accounts. The introduction of new weights at the higher level of the classification structure while maintaining the weighting pattern fixed at the lower levels is referred to as "partial re-weighting" or "partial weight updates". In general terms, it is implemented as follows:

> *"In practice, weights for the main consumption groups can be obtained from the National Accounts down to a certain level of disaggregation. Each of these weights can then be further subdivided by applying the detailed HBS expenditure groups to the National Accounts consumption groups or classes. The combination of National Accounts and HBS data ensures consistency between the CPI and the National Accounts data on consumption expenditure of households at the level of the main consumption groups. Such an approach also facilitates more frequent weight updates. For instance, CPI weights can be updated at regular intervals from National Accounts data for higher level aggregates. These updated expenditures are then distributed using the shares obtained from HBS or other sources that may only be updated less frequently".*

> (ILO, 2018b)

The HBS is the main data source for deriving expenditure shares for the goods and services covered by the CPIs produced by the IBGE. Hence, weights update depends on how often the HBS is conducted, which unfortunately is taking place in Brazil on a less frequent basis (more than seven-year intervals) because the survey costs and budgets constraints. For this reason – and supported by the recommendation of the CPI literature and the increasingly widespread use by national statistical institutes (NSIs) around the world – the IBGE's Department of Price Indexes has been developing studies in this line of incorporating the National Accounts as an alternative and complementary data source for updating the Brazilian CPI weights.

The main limitations and adaptation needs for the use of the National Accounts in the updating of the weight structure of the Brazilian CPI, the main methodological challenges, as well as the international practice to deal with these issues are being investigated and are summarized in this paper. After this introduction, the section 2 presents an overview of the Brazilian system of consumer price indexes, including the current IBGE practice for deriving the CPI weights. Section 3 outlines some initial challenges of using National Accounts data for the purpose of CPI weights updating and the proposed treatment to deal with them. The first empirical results are presented in section 4, which is followed by the conclusions of the project up to the present moment and its next steps.

2. Overview of the IBGE's CPI: main characteristics and the current practice for deriving the weights

The National System of Consumer Price Indexes – SNIPC, implemented and managed by the IBGE's Department of Price Indexes – COINP, produces monthly price indexes following economic and statistical criteria in line with international recommendations. This section presents an overview of the SNIPC, focusing on the current method and challenges related to derivation of weights.

2.1 The National System of Consumer Price Indexes – SNIPC[1]

The National System of Consumer Price Indexes – SNIPC was created in 1979 with the purpose of providing the regular production of measures for the variation of the cost of living in Brazil. The SNIPC is a combination of processes designed to produce consumer price indexes, considering basic surveys, methodological aspects and the dissemination of the information. The two main indexes produced by the SNIPC are the Extended National Consumer Price Index – IPCA and the National Consumer Price Index – INPC.

The motivation for the creation of the INPC was to measure the price changes in the consumption basket of the lowest-income salaried population. Currently, the target population for the INPC encompasses families with household income ranging from 1 to 5 minimum wages, whose reference person is employed, living in urban areas covered by the SNIPC.

The IPCA, in turn, was developed with the purpose of measuring inflation in the Brazilian economy as a whole. Therefore, its objective is to measure the price variations related to personal consumption, regardless of the source of family income. Families with household income ranging from 1 to 40 minimum wages, from whatever source, living in the urban areas covered by the SNIPC are the target population of the index. The IPCA is currently the benchmark used by the Brazilian Central Bank for the definition of monetary policy under the inflation targeting regime.
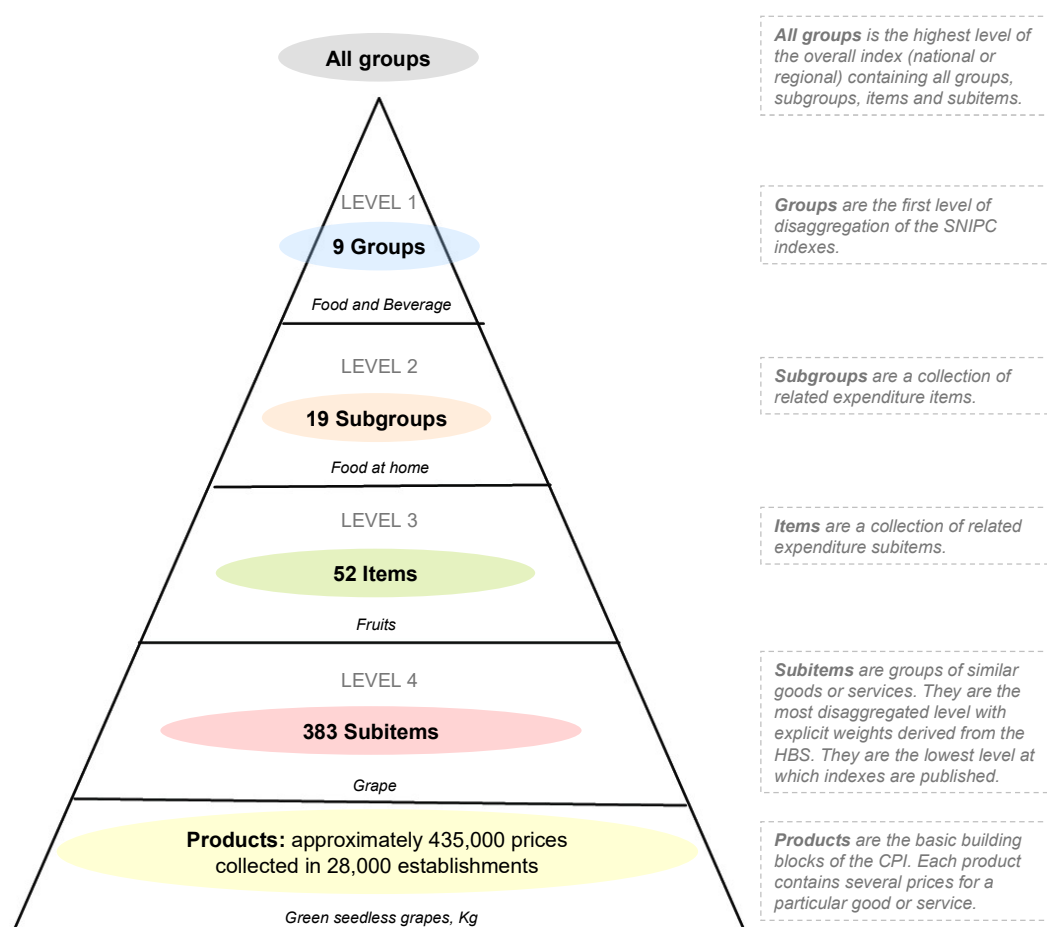
The SNIPC has its own system of classification also named SNIPC. This structure has an approach based on consumers' end-use of the products and services as a basis for the classification. However, the SNIPC is not yet structured according to the Classification of Individual Consumption by Purpose (COICOP approach).

The SNIPC classification has a four-level breakdown structure, from top-down defined as: groups, subgroups, items and subitems. The topmost level in the classification structure of the SNIPC is composed of nine major groups: *Food and beverage*, *Housing*, *Residential products*, *Clothing*, *Transport*, *Health and personal care*, *Personal expenses*, *Education*, and *Communication*.

These groups are further divided into 19 subgroups, and 52 items. The number of subitems may vary according to the CPI indicator and the geographical area considered (see Figure 1). The subitem is the most disaggregated level with explicit weights derived from the HBS.

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[1] A more detailed view on the history, key features, uses of the indexes produced, and the future challenges of SNIPC can be found in paper "Consumer price indices at IBGE: 40 years and counting", presented in the 16th Meeting of the Ottawa Group on Price Indices – Rio de Janeiro/Brazil.

FIGURE 1. Example of the classification structure used for the SNIPC, in particular for the IPCA

All groups	*All groups* is the highest level of the overall index (national or regional) containing all groups, subgroups, items and subitems.
LEVEL 1 — **9 Groups** — *Food and Beverage*	*Groups* are the first level of disaggregation of the SNIPC indexes.
LEVEL 2 — **19 Subgroups** — *Food at home*	*Subgroups* are a collection of related expenditure items.
LEVEL 3 — **52 Items** — *Fruits*	*Items* are a collection of related expenditure subitems.
LEVEL 4 — **383 Subitems** — *Grape*	*Subitems* are groups of similar goods or services. They are the most disaggregated level with explicit weights derived from the HBS. They are the lowest level at which indexes are published.
Products: approximately 435,000 prices collected in 28,000 establishments — *Green seedless grapes, Kg*	*Products* are the basic building blocks of the CPI. Each product contains several prices for a particular good or service.

The inflation of the subitem (which is an aggregate of homogeneous products) is calculated through the following procedure: for each product, the average prices of the current month (simple average) are divided by the average prices of the previous month; subsequently, these relative prices are aggregated through an unweighted geometric mean. At higher levels of aggregation (items, subgroups, groups and the overall index), the indexes are calculated through the modified Laspeyres method.

Currently, both the IPCA and the INPC covers the following metropolitan areas (see Figure 2a)[2]: 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), Vitória (State of Espírito Santo - ES), Porto Alegre (State of Rio Grande do Sul - RS), Brasília (Federal District - DF), and the municipalities of Goiânia (State of Goiás - GO), Campo Grande (State of Mato Grosso do Sul - MS), Rio Branco (State of Acre - AC), São Luís (State of Maranhão - MA), and Aracaju (State of Sergipe - SE). The 16 areas have their own baskets of products and for each of them separate CPIs are calculated.

Both the national IPCA and the national INPC are obtained by aggregating the regional indexes through a weighted arithmetic mean (see Figure 2b). The regional weighting variable "monetary disposable income" is used in the national IPCA aggregation. For the INPC, the regional weighting variable applied is the "urban

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[2] The IPCA-15, one of the indexes produced by the SNIPC which covers from the 16th of the previous month to the 15th of the current month, has as more restricted geographical coverage – 11 metropolitan areas. For further details, see: "Consumer price indices at IBGE: 40 years and counting", presented in the 16th Meeting of the Ottawa Group on Price Indices – Rio de Janeiro/Brazil.

resident population". Both regional weighting variables – as well as the weights as a whole – are obtained from the Brazilian Household Budget Survey (POF).

**FIGURE 2. Geographic coverage of the SNIPC**
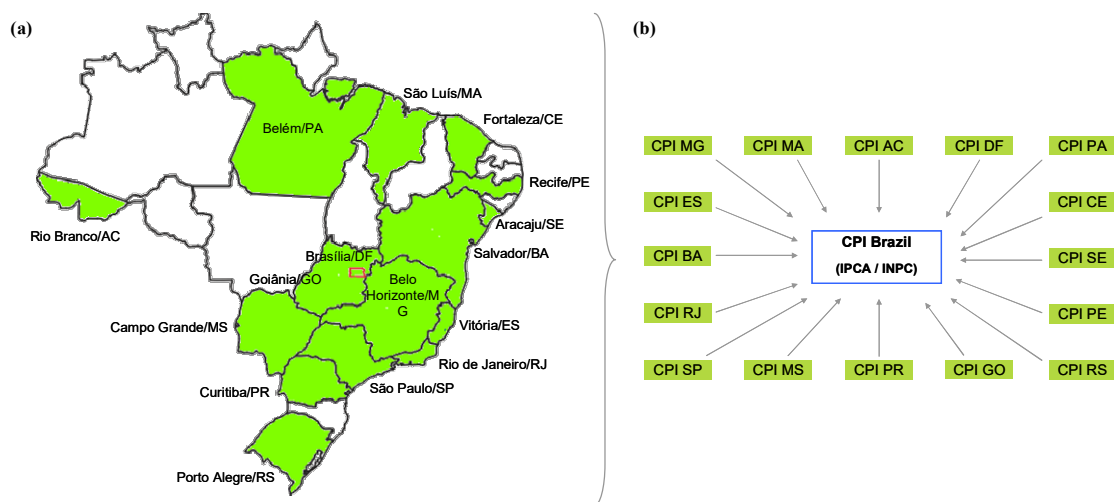
2.2 Deriving the weighting pattern: the Brazilian Household Budget Survey – POF

The weighting structure of the SNIPC is obtained from the Brazilian Household Budget Survey (*Pesquisa de Orçamentos Familiares* – POF), which reflects the average annual household consumption, distributed among several different items. From a historical perspective, POF has its origins in the National Family Expenditure Study (ENDEF), a nationwide survey conducted in the period 1974-1975. The ENDEF was carried out with the purpose of establishing the weighting structure for the implementation of the SNIPC in 1979. The first editions of POFs were conducted in the 1980s and 1990s, covering only the metropolitan regions. In the 2000s, the survey returned to national coverage.

The current weighting pattern of the SNIPC is based in the most recent POF that has taken place between May 2008 and May 2009. There were three previous editions in 1987-1988, 1995-1996, and 2002-2003. A new weighting structure is under construction based on POF 2017-2018, the newest edition of the survey that is still to be released.

Brazil is the fifth largest country in the world in territorial extension (8.51 million km²). It is challenging to perform a POF in a country of continental dimensions, which demands the wide and intensive use of human, financial and technological resources. In POF 2017-2018, between June 2017 and July 2018, approximately 1,000 interviewers applied 7 questionnaires during 7 days in 75,000 households distributed in 1,900 municipalities. The data collected in the survey can be used for multiple purposes, including the CPI's weighting structure update, the calculation of the Household Final Consumption Expenditure (HFCE) in the National Accounts and studies about life conditions, poverty, inequality and food, and nutrition security (see Figure 3).

FIGURE 3. POF: Questionnaires applied and geographic coverage of the edition 2017-18
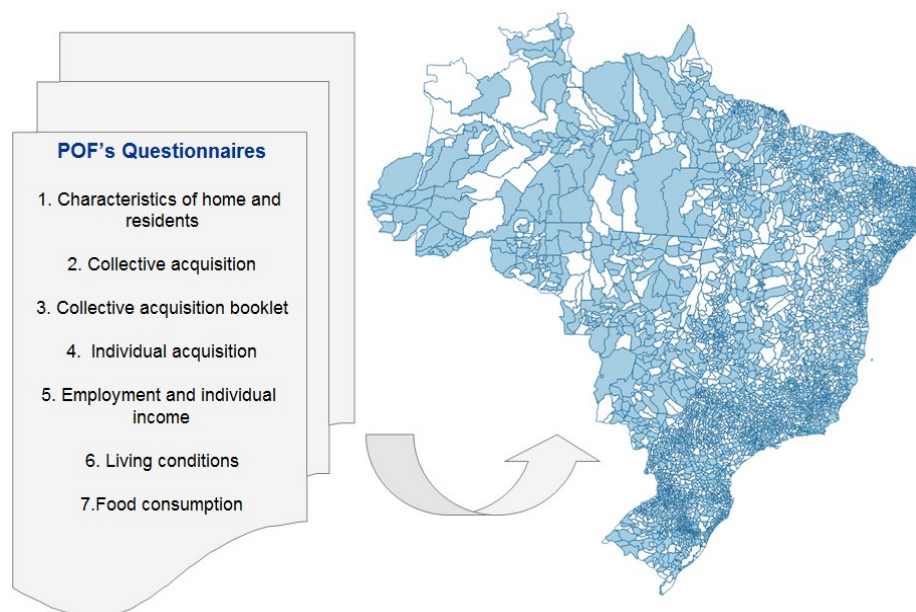
Both the IPCA and the INPC are measures of changes in the prices of a fixed basket of products and services consumed by households as determined in the POF, which depicts the consumption habits of Brazilian families. Table 1 shows the evolution of the weighting structures, at the national level, for the 9 SNIPC groups over time for the three most recent POFs.[3]

TABLE 1. Brazil: weighting structures of the INPC and IPCA obtained from POFs 1995/96, 2002/03 and 2008/09 (original values in %)

	INPC			IPCA		
	1995-1996	2002-2003	2008-2009	1995-1996	2002-2003	2008-2009
Food and Beverage	31,75	29,83	27,26	24,15	22,14	22,08
Housing	16,94	16,24	16,43	15,39	13,28	14,28
Residential Products	8,93	6,55	6,56	6,78	5,48	5,43
Clothing	7,52	7,44	7,58	6,55	6,17	6,23
Transport	14,37	16,18	18,21	19,10	20,79	21,95
Health and Personal Care	8,86	9,24	9,79	10,46	10,51	11,08
Personal expenses	7,84	6,43	6,47	10,63	9,23	9,19
Education	2,74	2,96	2,69	4,84	6,55	4,18
Communication	1,05	5,13	5,01	2,10	5,85	5,57

Source: IBGE, Directorate of Surveys, Department of Price Indexes, National System of Consumer Price Indexes.

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[3] For further details see: "Estruturas de ponderação a partir da Pesquisa de Orçamentos Familiares 2008-2009". Série Relatórios Metodológicos Volume 39, 2ª edição. IBGE, 2014.

The impact of the introduction of new products (goods or services) and technologies on the indexes weighting pattern is highlighted, especially in dynamic markets or in economies in transformation in their productive structure. An example of this is seen in the evolution of the weight of the Group *Communication* between the POF 1995-1996 and the POF 2002-2003 (increase of 4.07 pp in the INPC and of 3.75 pp in the IPCA), a period in which ocurried the massification of information and communication technologies (ICTs), such as mobile phones, portable computers, and the Internet itself.

The impact of ICTs on weighting structures can be seen through a finer analysis of the composition of the Group *Communication*.[4] In the POF 1995-1996, the Subitem *Landline phone* accounted for 77% of the weight of the Group *Communication* for the IPCA. It then fell to 56% in POF 2002-2003 and to 31% in POF 2008-2009. On the other hand, the Subitem *Mobile phone* increased its share from 13% in POF 1995-1996 to 23% in POF 2002-2003 and subsequently reached 29% in POF 2008-2009. With the advent of the digital economy, this is an issue that will become increasingly critical for maintaining the representativeness of the basket. Besides that, the evolution of the weight structure between POFs for the two indexes points to a continuous increase over the whole period of the participation of the Group *Transport* in total household expenditure.

The weighting pattern also changes over time under the regional approach. Table 2 shows the time evolution of the regional weights for the IPCA and the INPC for the last three POFs. The results are presented for the areas contained in the index scope by the time of the implementation of the POF's baskets: 11 areas in the POFs 1995-1996 and 2002-2003, and 13 areas in the POF 2008-2009.[5] It should be noted that due to the incorporation of the new municipalities in the POF 2008-2009 – Vitória (State of Espírito Santo) and Campo Grande (State of Mato Grosso do Sul) –, the relative weights of the surveyed areas were altered within the Southeast and Midwest macroregions. Although the variations in the weights seem small in magnitude, they can have very significant economic and social impact due the different uses of the CPIs.

TABLE 2. Regional weights for calculating the INPC and IPCA obtained from POFs 1995/96, 2002/03 and 2008/09 (original values in %)

	INPC			IPCA		
	1995-1996	2002-2003	2008-2009	1995-1996	2002-2003	2008-2009
BRAZIL	100,00	100,00	100,00	100,00	100,00	100,00
Belém / PA	5,70	6,90	7,03	3,80	4,20	4,65
Fortaleza / CE	6,20	6,40	6,61	3,30	3,90	3,49
Recife / PE	7,20	7,10	7,17	4,20	4,10	5,05
Salvador / BA	10,30	10,60	10,67	6,20	6,90	7,35
Belo Horizonte / MG	11,00	11,10	10,60	9,10	10,80	10,86
Rio de Janeiro / RJ	10,80	10,20	9,51	13,40	13,70	12,06
São Paulo / SP	26,80	25,60	24,24	36,30	33,10	30,67
Curitiba / PR	7,10	7,20	7,29	7,50	7,40	7,79
Porto Alegre / RS	7,70	7,50	7,38	9,20	8,90	8,40
Goiânia / GO	5,00	5,10	4,15	3,80	3,70	3,59
Brasília / DF	2,20	2,20	1,88	3,70	3,40	2,80
Vitória / ES	-	-	1,83	-	-	1,78
Campo Grande / MS	-	-	1,64	-	-	1,51

Source: IBGE, Directorate of Surveys, Department of Price Indexes, National System of Consumer Price Indexes.

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[4] Ibid.

[5] Subsequently, 3 new areas were added: Rio Branco (State of Acre - AC), São Luís (State of Maranhão - MA) and Aracaju (State of Sergipe - SE).

In general, CPIs are based on a fixed basket hypothesis (Laspeyres formula). It can be shown that the use of the Laspeyres approach overestimates the true cost of living. Such bias effect will be more pronounced as the basket degree of obsolescence. One method to estimate the bias of the current formula would be the use of a superlative index that takes into account the possibility of exchanging products within a basket in response to relative price changes and its retroactive application, this is, the calculation of an experimental series retroactively. An example of this approach could be the estimation of a Törnqvist index through a symmetrical temporal treatment of weights in two consecutive months.

Ideally, CPIs need frequent updates of the weighting structures to maintain the representativeness of household consumption pattern. In this sense, the use of new data sources (in complementarity to the HBS) would be an advantageous alternative to guarantee this more frequent updating of the weights. According to the international literature, several data sources can complement each other by establishing more reliable and accurate general weights. For example, a simplified continuous household budget survey between the regular HBSs; scanner data information; administrative records; invoices with consumer identification; and intelligence market information. However, one of the main sources recommended and effectively used for this purpose is the HFCE estimates present in the National Accounts.

Due to the increasingly widespread use of the National Accounts to update the CPI weighting structure, as part of a permanent program to modernize and adapt the methodologies and processes of CPI production based on the recommendations of the literature and international best practices, the IBGE's Department of Price Indexes (COINP) started in 2018 a pilot project to re-weight the indexes on an annual basis using the HFCE data. The main challenges and the proposed treatments for the adoption of the System of National Accounts for updating the weights of the SNIPC are discussed in the next sections.

3. Using National Accounts for weight updates: some challenges and this implications for the process

In general, the majority of HFCE data "fit" into the CPI weight structure. However, there are some conceptual and scope differences between household consumption under the CPI and the National Accounts approaches. For example, only monetary consumption expenditures are relevant for the construction of CPI weights, while in the National Accounts the household consumption's coverage is broader.

Some challenges do exist due to these conceptual, data source, and coverage differences. The main challenges arise because the CPI and HFCE estimates are produced for different purposes and make use of different data sources. In this section the initial challenges found are detailed along with the proposed treatments adopted to circumvent them and allow the derivation of weights for the SNIPC via National Accounts.

3.1 Non-integrated classification structures

A classification system is used to group data collected from survey respondents in a structured and consistent way. Classifications are developed to support the purpose and outputs of a specific set of statistics. In the case of household expenditure, various classifications are available and used by the IBGE, depending on the survey purpose. As different classifications are used, there is a need to map the data collected under one classification to the other to make the data meaningful for each use, so concordance mapping is needed.

Information collected through the Brazilian HBS are structured according to its own classification. The same occurs with the SNIPC which, as stated in the previous section, has its own classification system. It is no different with the Brazilian System of National Accounts, and the HFCE, that covers a wider range of goods and services, adopts a third different classification structure.

Therefore, the CPI and HFCE collect and publish data using different classifications. The availability of classification "translators" allows expenditure to be mapped between HFCE and CPI. As part of the annual Brazilian System of National Accounts, Supply-Use Tables provide expenditures that are more detailed than expenditure aggregates defined by categories of the SNIPC classification. Mapping the HFCE and the CPI

data can require further disaggregation of the expenditures of a given National Accounts product since its components can map to elements of multiple SNIPC items, subgroups or even groups. In these special instances, the expenditures are further disaggregated using more detailed data from HFCE (at the level of classification in which the works of balance of supply and demand of goods and services are carried out in the Brazilian National Accounts System).

No matter how good or accurate the concordance mapping is, ideally the classification structures should be harmonized. Ideally, HBS, SNIPC and National Accounts should all be structured in the same classification. Currently, they have distinct structures and none fully follow the COICOP one.

3.2 Scope: exclusion of specific expenditures

There are differences in scope and definition of consumption between CPI and National Accounts approaches, and, consequently, databases. HFCE estimates include expenditures that are excluded from the CPI. The CPI is restricted to monetary expenditures, and then only a subset of HFCE must be used, excluding its non-monetary components.

In the National Accounts, for example, persons who own the dwellings in which they live are treated as owning unincorporated enterprises that produce housing services that are consumed by the household to which the owner belongs.[6] As the National Accounts separate the ownership of dwellings from the household sector they create notional transactions between households as landlords and tenants using specific models and methods.

However, the SNIPC do not include estimates for owner-occupied housing, only the rental expenses actually paid by the tenants. So, before using HFCE data for CPI weights, the imputed rentals approach used in the Brazilian National Accounts should be removed.

The same idea applies to the Financial Intermediation Services Indirectly Measured (FISIM). In the System of National Accounts it is an estimate of the value of the services provided by financial intermediaries, such as banks, for which no explicit charges are made; instead these services are paid for as part of the margin between rates applied to savers and borrowers. The supposition is that savers would receive a lower interest rate and borrowers pay a higher interest rate if all financial services had explicit charges. Like the imputed rentals, this value should be excluded from HFCE data for CPI weighting purpose.

The challenge of excluding some expenditures of the HFCE for CPI weighting purposes also covers the issue of non-market expenditures. The Not for Profit Institutions Serving Households (NPISH) consist of non-market non-profit institutions (NPIs) that are not controlled by government. Unlike other NPIs, which are treated as corporations, NPISH can and do engage in final consumption expenditure in the form of goods and services provided to households free or at prices that are not economically significant.

This does not mean that NPISH cannot produce market output but the majority of their costs of production are devoted to the provision of non-market output.[7] Examples of NPISH units include (but are not limited to) charities, aid agencies, religious institutions, cultural clubs and relief agencies.

As NPISH are not within the scope of the SNIPC (it does not constitute expenditure by households) their expenditure must be removed from HFCE data in order to derive conceptually correct weights for CPI use. In order to remove NPISH expenditure, it is considered strictly the expenditures on consumption goods and services produced by market producers. It does not include, therefore, expenditures on the outputs of non-market producers.

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[6] UNSD, 2008.

[7] Ibid.

3.3 Impact of revisions of National Accounts data on CPI weights

The headline for the CPI is the original series. Because it is a contract indexer, the CPI is rarely revised, only in exceptional circumstances. On the other hand, National Accounts' annual HFCE data undergoes annual cyclical revisions, where preliminary estimates can be revised twice after release and periodical historical revisions can take place, spanning the entire Supply-Use series. This occurs when there are significant statistical developments or when more complete benchmark data – such as the HBS – become available.

As the preliminary results from National Accounts for a given year t are in general revised several times before they can be considered as final (that occurs only in year $t+2$), the most recent available data (the preliminary estimates for t based on Quarterly National Accounts published in t or the revised data published in $t+1$) may not be sufficiently stable. In order to ensure its consistency with the objectives of the CPI, the HFCE data is obtained on a financial year basis from Brazilian System of National Accounts, enabling definitive expenditure weights to be derived annually.

As the weight reference period usually precedes the price reference period, the expenditure weights may be price updated to take account of the relative price changes from the weight reference period to the price reference period. In this procedure of price updating of weights, the expenditure shares in an earlier period are revalued at the prices of a later period. This is consistent with the Lowe approach used in the CPIs produced by the SNIPC.

3.4 Producing annual weights for the individual metropolitan areas

Geographical coverage is a key difference between HFCE (with information available only at a national level) and the CPI (with information used at different levels of disaggregation, the lowest one corresponding to the metropolitan areas of the states in the indexes scope). The SNIPC CPIs are compiled from a bottom-up approach where each index is calculated separately for metropolitan areas of the states covered by each index. The compilation of the CPIs for the "whole" country are obtained by performing a weighted average on the regional CPIs, with each state composing the calculation with its own weight.

It is estimated that the geographic coverage of the SNIPC covers approximately 90% of the population-target for the IPCA and 50% for the INPC.[8] Ideally, the Brazilian CPI would encompass all Brazilian households (like HFCE), however practical implementation is hindered by the additional costs associated with collecting prices outside metropolitan areas.

National Accounts HFCE data, in turn, are compiled at the national level. Its use for the purpose of CPI weighting update fits better for a top-down approach, method in which the index is compiled from a national basket and then the components are splited according the regions representativity for each component. The bottom-up approach of the Brazilian CPI poses a challenge to derive expenditure weights for the individual metropolitan areas.

In order to use the national HFCE data for updating the SNIPC weights at the metropolitan area level, a pro–rata approach is suggested to overcome the differences in the geographical coverage.[9] The proposal addressed here to deal with this challenge makes use of (a) applying the movements from the HFCE data matched with each SNIPC aggregate to update the national weights of the SNIPC aggregates; (b) deriving HBS based proportions for each metropolitan area SNIPC aggregate using HBS data of expenditure in each metropolitan area; (c) applying these metropolitan areas proportions for each SNIPC aggregate in (b), to the updated weighted metropolitan areas index in (a) to produce new regional expenditure weights for each SNIPC aggregate.

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[8] IBGE, 2013.

[9] ABS, 2018.

This approach can be expressed as follows:

Step 1: Update weights at national level using movements in HFCE.[10]

$$w^{*}_{iBR} = w_{iBR} \times (HFCE_i^t / HFCE_i^{t-1})$$

Step 2: Derive "intermediate" aggregates' regional weights pro-rating national weights across metropolitan areas.

$$w'_{ij} = w^{*}_{iBR} \times (w_{ij} / w_{iBR})$$

Step 3: Normalize the SNIPC aggregates' weights in each region such that the weights of the components of the regional basket equals 100.[11]

$$w^{*}_{ij} = w'_{ij} \times (100 / \sum_{i=1}^{n} w'_{ij})$$

Where:

w_{iBR} = previous national weight for SNIPC aggregate i.

w^{*}_{iBR} = new national weight for SNIPC aggregate i adjusted using HFCE movements.

$HFCE_i^{t-1}$ = HFCE weight for the previous year for SNIPC aggregate i.

$HFCE_i^t$ = HFCE weight for the current year for SNIPC aggregate i.

w_{ij} = previous regional weight for SNIPC aggregate i and metropolitan area j.

w'_{ij} = "intermediate" (previous to normalization step) regional weight for SNIPC aggregate i and metropolitan area j, before the normalization.

w^{*}_{ij} = new regional weight for SNIPC aggregate i and metropolitan area j.

This approach assumes that there is no relative change in the households expenditure proportions of a given metropolitan area with respect to the rest of the metropolitan areas surveyed; that is, the metropolitan household expenditure changes are the same as national household expenditure changes. Another assumption is that for each metropolitan area, ratios by SNIPC aggregates are fixed along the period between HBSs. This fixes the relative proportion of expenditure on, for example, electronic devices by Rio de Janeiro households relative to total electronic devices expenditure by all metropolitan areas. In the process of producing annual weights for the CPI regional indexes, it should be stressed that it is important to monitor and test these hypotheses routinely.

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[10] This step is necessary only to avoid a level shift in relation to the weights derived from the HBS. In Brazil, the HBS expenditures are not adjusted considering the National Accounts data.

[11] This step is necessary since the regional weights for aggregation of the national index are obtained from variables other than household consumption expenditures (monetary disposable income for the IPCA, and urban resident population for the INPC, as explained in the previous section).

4. Preliminary empirical results

In order to evaluate the magnitude and the type of impact of incorporating the National Accounts data into the IPCA weights system, the first exercise was to construct alternative weighting structures for the index using only the HFCE as expenditure source. At this first moment, the National Accounts data availability for the analysis occurred at the disaggregation level of subgroups. However, this approach is applicable for any SNIPC aggregate.

These weighting structures were calculated for the period between 2010 (Brazilian National Accounts current base year, in which changes in methodology and data sources were introduced) and 2016 (most recent data, published in September 2018). Then, the alternative weighting structures calculated using National Accounts data are compared to the published IPCA weights for each year – expenditure weights that are originally obtained from the Brazilian Household Budget Survey and price updated to take into account the price changes that have occurred along the time. For example, for the year 2016 the alternative weighting structure based on Brazilian National Accounts 2016 are compared to the published IPCA weights for January 2016[12] that are originally derived from the POF 2008-2009 and updated by the price changes recorded until then.

The average weight of 19 SNIPC subgroups between 2010 and 2016 are presented in Figures 4 and 5 for both IPCA (as published) and IPCA as it would look were it to be calculated based primarily on National Accounts data. The comparative analysis of the weighting structures of the years 2010 and 2016 reveals that the greatest difference – in percentage points – between the weights obtained via HBS and the weights calculated from the National Accounts data is observed in the subgroup of greater weight in the composition of the index: *Food at home*. The weights estimated using the National Accounts data are relatively higher, which may be evidence of underreporting of expenditures – something that is common for this type of grouping of products according to the CPI literature.

There are six subgroups where there are significantly smaller average weights in the IPCA (as published) than when the National Accounts is used as the primary data source for constructing weights. These are: *Food at home*; *Furniture*; *Electrical and electronic devices*; *Jewelery and bijouterie*; *Health*; and *Communication*. This can be explained by the additional data sources used for the expenditure estimates used to calculate the HFCE in the National Accounts.

Figures 6 and 7 show the impact of using the National Accounts data to weight IPCA (holding everything else constant), compared with the IPCA as published. The IPCA that is constructed using data primarily from the National Accounts is referred to as Alternative IPCA (NA weighted), while the official IPCA is referred to IPCA (as published).[13]

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[12] Subsequently, the weights obtained via HFCE data are used for the calculation of an alternative/experimental IPCA. According to the Laspeyres approach, the weights for the month of January of each year should be used to derive annual average inflation rates.

[13] In this first empirical analysis phase of the project, a "pure" experimental IPCA was derived based exclusively on the household expenditures from the HFCE data. So, the variable w^*_{iBR} presented in the previous section 3.4 is obtained directly from the National Accounts database and the "Step 1" described is unnecessary. So, for this purpose, $w^*_{iBR} = HFCE^t_i$.

FIGURE 4. Average IPCA weight compared to the average weight calculated using National Accounts data as the primary expenditure source (%) - Brazil, 2010
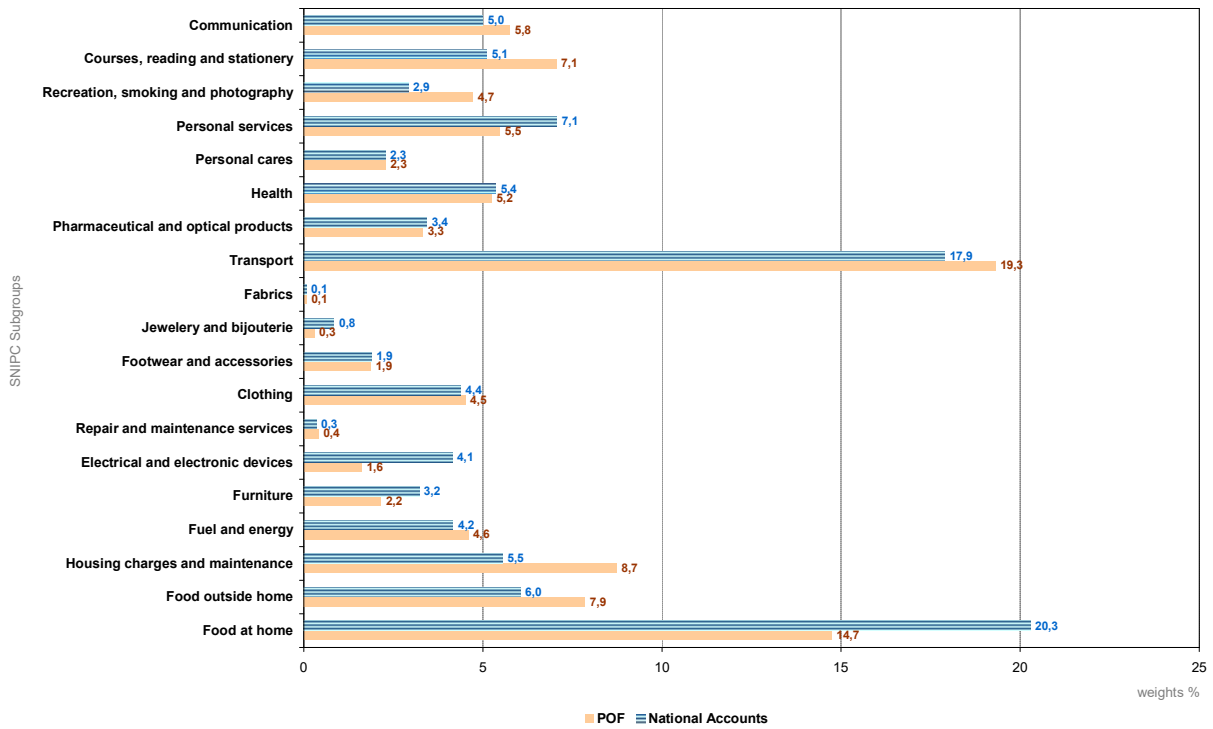

POF ▤ National Accounts

FIGURE 5. Average IPCA weight compared to the average weight calculated using National Accounts data as the primary expenditure source (%) - Brazil, 2016
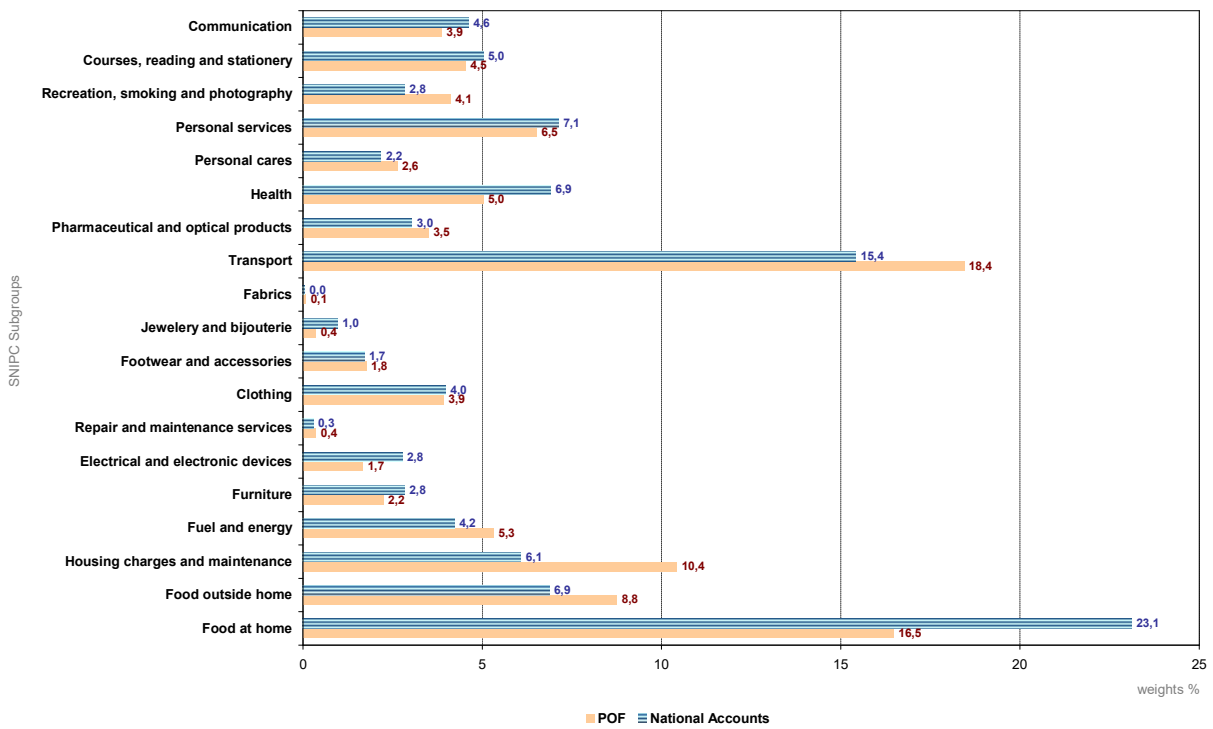

POF ▤ National Accounts

FIGURE 6. Official IPCA (as published) compared to an alternative IPCA calculated using National Accounts data as the expenditure source for the weights - Brazil, 2010-2016
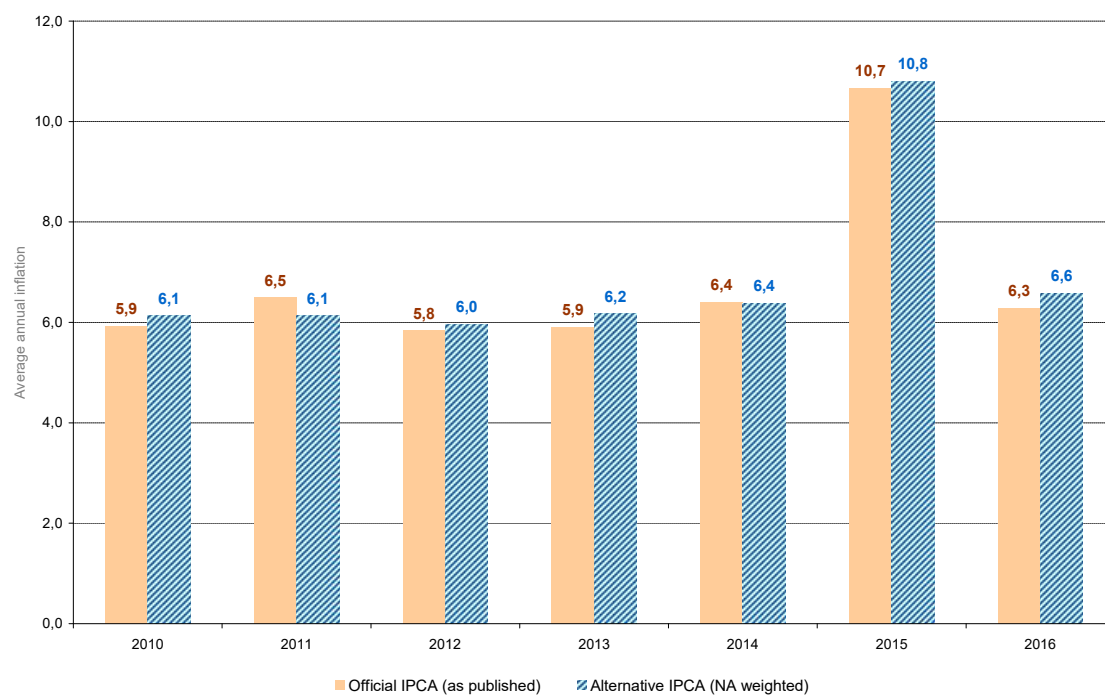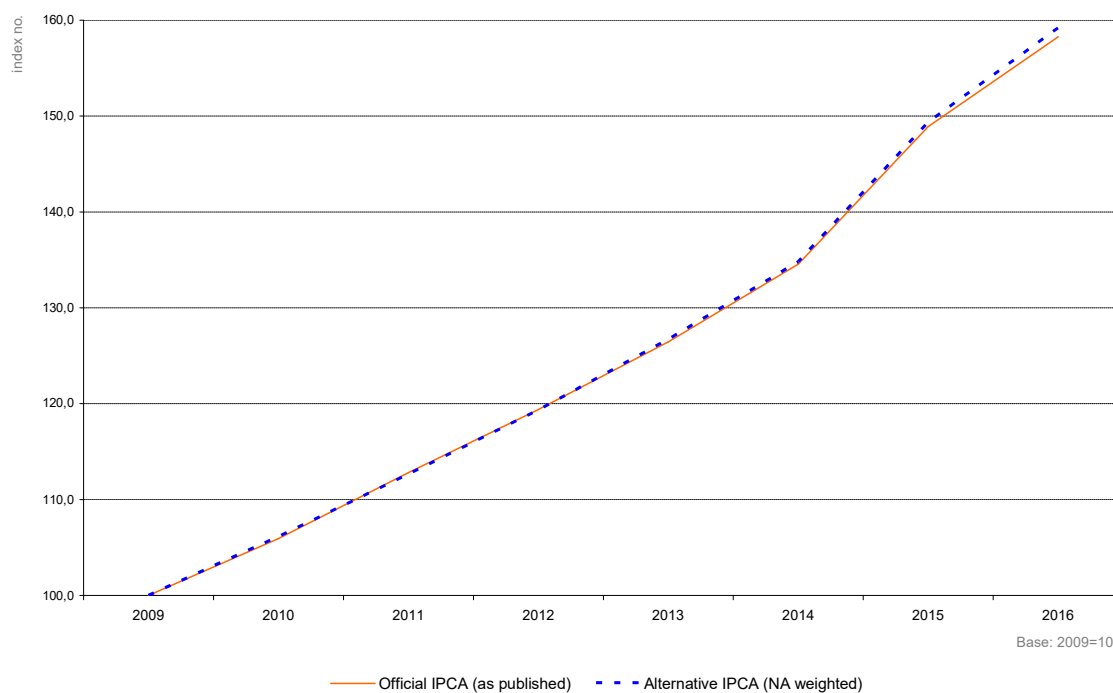

FIGURE 7. Index comparison between official IPCA (as published) compared to an alternative IPCA calculated using National Accounts data as the expenditure source for the weights

The results show the Alternative IPCA tracking closely to the IPCA as published. Indeed, Alternative IPCA (NA weighted) has grown at a slightly faster rate than the Original IPCA (as published) over the period 2010 to 2016. The Alternative IPCA grew by a total of 59.2% over the whole period, while the Original IPCA grew by 58.3%. The National Accounts weighted index recorded an average annual growth rate of 6.9% between 2010 and 2016, while the IPCA as published presented average annual growth of 6.8% over the equivalent period.

This behavior can be explained by the greater relative weight of the subgroup *Food at home* in the Alternative IPCA's composition. Between 2010 and 2016, this subgroup recorded average annual inflation of 9.0%, higher than the average rate of the total economy (6.8%). On the other hand, another important subgroup in the composition of the IPCA, *Transport*, presented a relative lower weight in the experimental structure based on the National Accounts. *Transport* recorded average annual growth rate of 4.3% over the period, lower than the inflation rate of the whole economy.

5. Conclusions

The first empirical results from the study to incorporate the National Accounts into the CPI weights system produced under the SNIPC show that in the period 2010-2016 the experimental IPCA constructed using HFCE data as the source of the household expenditures presented a close behavior to that of the official IPCA as published. The results also show that the upper bias of the index – inherent to the calculation formula based on the measurement of a fixed basket over time – was relatively counterbalanced by the impact that the variation of the prices of *Food at home* had on the general IPCA. This subgroup gained weight in the alternative structure calculated from National Accounts and recorded average annual inflation higher than the average rate of the total economy along the whole period. Opposite movement occurred with another important subgroup in the IPCA's composition, *Transport*, that lost weight in the new structure and recorded price variation below the general index.

Another important conclusion is the need to deepen the analysis from an even more disaggregated level for the National Accounts data. In this first moment the simulations were performed up to the subgroup level, and an item-disaggregation analysis would be desirable. In this sense, it is necessary to study and treat some specific products and services whose expenses are not fully compiled as HFCE in the System of National Accounts. Some financial services, insurance, vehicle maintenance and repair services, licenses, public fees and charges, and toll payments, for example, are partly compiled as Intermediate Consumption and they should be integrated to the HFCE vector for CPI weighting purpose.

The deepening of the study should also include the extension of the analysis to the INPC, as well as a monthly detailing of the simulations involving the experimental indexes based on the weighting structure constructed via National Accounts and the indexes as published. In addition, a wide public consultation, involving discussion with experts and users of price statistics, is important as future step of the study.

Another point for future reflection is the price update of the weights derived from National Accounts through due to the two year gap in the final publication. Because of this lag, using the Young method instead of Lowe's method for calculating the indexes may be more appropriate.

An additional important discussion for the future that emerges from this first essay concerns the calculation method of the Brazilian CPI itself. Apparently, a top-down approach – in which the index is compiled from a national basket and then the components are splited according the regions representativity for each component – fits better for the purpose of using National Accounts HFCE data for CPI weighting update. The bottom-up approach of the Brazilian CPI demands a series of premises and hypotheses for the behavior of the regional weights that must be monitored.

On the other hand, local baskets provide a better regional representativity. It is an important question for a multicultural country of continental geographical dimensions such as Brazil. In addition, the formula for aggregating regional indexes in Brazil for the composition of the national index, based on variables other than

household expenditures (monetary disposable income for the IPCA, and urban resident population for the INPC), should be evaluated and discussed in this context.

Finally, it is important to emphasize again that the international literature does not recommend replacing the HBS with the National Accounts data as a source for updating the weights. The recommendation is only the complementary use of the latter in relation to the former. The HBS at regular intervals (less than 5 years), remains a fundamental element for the general updating of weights, especially in the more disaggregated classification levels for which there is no data availability via National Accounts.

The key issue is actually keeping the weighting structures up to date. And it is precisely in this context that the importance of having a regular HBS every 5 years and the use of National Accounts for a more frequent updating of the weights is inserted. In a scenario of budgetary constraint, the use of new data sources would be an advantageous alternative to ensure the most frequent updating of the CPI weights system and, therefore, to ensure its credibility in the midst of an economy in constant transformation. This is a question of great importance, especially when considering the economic and social cost caused by a bias in the price index, caused by obsolete basket of products and outdated weighting structures.

Acknowledgements

References

Australian Bureau of Statistics – ABS, 2018. *An Update on the Annual Re-weightingof the Australian CPI and Living Cost Indexes*. Commonwealth of Australia.

Australian Bureau of Statistics – ABS, 2018. *Increasing the Frequency of Consumer Price Index Expenditure Class Weight Updates*. Commonwealth of Australia.

European Commission – Eurostat, 2018. *Harmonised Index of Consumer Prices (HICP) - Methodological Manual*. Luxembourg.

Instituto Brasileiro de Geografia e Estatística – IBGE, 2013. *Sistema Nacional de Índices de Preços ao Consumidor: métodos de cálculo*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística – IBGE, 2014. *Sistema Nacional de Índices de Preços ao Consumidor: estruturas de ponderação a partir da Pesquisa de Orçamentos Familiares 2008-2009*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística – IBGE, 2016. *Sistema de Contas Nacionais do Brasil - Ano de Referência 2010*. Rio de Janeiro.

Instituto Brasileiro de Geografia e Estatística – IBGE. Sistema IBGE de Recuperação Automática - SIDRA. Accessible in: www.sidra.ibge.gov.br.

International Labour Office – ILO, 2018a. *Update of the Consumer Price Index Manual - draft chapters for comments, Chapter 1 - Introduction, overview, and basic steps for CPI development*. Geneva.

International Labour Office – ILO, 2018b. *Update of the Consumer Price Index Manual - draft chapters for comments, Chapter 3 - Expenditure weights and their sources*. Geneva.

International Labour Office – ILO, 2018c. *Update of the Consumer Price Index Manual - draft chapters for comments, Chapter 9 - Updating CPI weights and linking new to previous CPI series*. Geneva.

International Labour Office – ILO, 2018d. *Update of the Consumer Price Index Manual - draft chapters for comments, Chapter 12 – Errors and bias*. Geneva.

Office for National Statistics – ONS, 2017. *Investigating the impact of different weighting methods on CPIH*. London.

United Nations Statistics Division – UNSD, 2008. *System of National Accounts (SNA) 2008*. Geneva.

Vladimir G. Miranda, Pedro K. da Costa, Rodrigo V. Ventura, and José Fernando P. Gonçalves. *Consumer price indices at IBGE: 40 years and counting*. Paper submitted to the 16th meeting of the Ottawa Group, Rio de Janeiro, Brazil, 2019.