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The Cost of Food for those with Food Insecurity: The Brazilian Case[1]

Note by IBGE, Brazil

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Abstract

Since the beginning of the 2000s, the Brazilian Household Food Insecurity measurement Scale (EBIA) has been the official measure of household food insecurity (FI) in Brazil. But it was only in 2017-2018 that EBIA was included in the National Household Budget Survey (Pesquisa de Orçamentos Familiares – POF) which collects data on household's expenditure on goods and services (food expenditure, in particular).

The main objective of this paper is to identify the food costs of the vulnerable populations at risk of food insecurity (FI) in Brazil. The methodology is based on the construction of corresponding spatial price indexes obtained from POF conducted in

[1] IBGE and IPEA is exempt from any responsibility related to the opinions, information, data and concepts stated in this article that are of exclusive responsibility of the authors.

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2017-2018, which collected data from different Brazilian geographical areas. It is worth noting that Brazil also does not evaluate official spatial price indexes which specifies differences in the cost of living among different Brazilian regions. Following the EBIA, we identify the vulnerable population as one that is at risk of mild, moderate, and severe food insecurity.

Our study points to relevant disparities in price indexes between the regions of the country for this already population vulnerable to food insecurity that represents 60% of the Brazilian population. Among more than 40 food products selected for product price analysis, chicken was the product that recorded the highest average monthly household expenditure, with the Metropolitan Region of São Paulo being the geographic context that presented the greatest positive variation in relation to Brazil, 0,5% above. The average household expenses with products classified as fresh or minimally processed represented 55.5% of the total expenses for Brazil. Next was the expenses for ultra-processed foods, 26.3%. The share of processed foods and processed culinary ingredients was 13.4% and 4.8%, respectively.

To the best of our knowledge, this is the first time that is possible to investigate, simultaneously, data based on food expenditure and on food insecurity in the same survey. This study also offers a food regional price index for both, the whole population and the vulnerable one. Finally, these indexes can be used in future studies to provide information for public policies on poverty.

Keywords: Food Insecurity, Poverty, Social Vulnerability, spatial price index

JEL: I32, D63, C43, C01, C50, I38, D12

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1. INTRODUCTION

Identifying which population subgroups are eligible to a public policy is always one of the main issues and challenges when a project of social-economical format is elaborated. Such a challenge includes the study of profile of each group. When working with the population suffering from social vulnerability and the risk of food insecurity or even hunger, this dilemma becomes more challenging. The usual poverty statistics, based on relatively low lines, for example, does not seem suitable for the identification of families facing this vulnerability state because they focus more on extreme poverty and hunger than on vulnerability itself. Moreover, vulnerable families can transit among the poverty states over time, being poor in one moment and not poor in another moment; they can also coexist with the risks without becoming poor. They can have an income above the poverty line but live with legitimate concerns and doubts related to the maintenance of income and the capacity to buy appropriate food. Information like the food basket of this vulnerable part of the population, what is the minimum income to pay for this basket are questions that would help identify this target audience more efficiently.

It is based on these questions that this article suggests the calculation of a regional price index built from the food basket acquired by families vulnerable to food insecurity. To identify these families, the results of the Brazilian Scale of Food Insecurity – EBIA will be used.

EBIA identifies the families suffering of severe food insecurity (disruption of eating patterns among the residents in the household), moderate (quantitative reduction of food among adults and children) or mild (uncertainty related to the access to food in the short term). Previously, EBIA was studied using surveys not related to the mapping of the family budget[3]. In 2017-2018, it was incorporated into the Brazilian Household Budget Survey (POF) enabling for the first time the identification of the food basket of families in moderate or severe food insecurity.

Another aspect that is considered regarding the food basket of the vulnerable population is the nutritional quality of the products selected. The analysis was made with the use of the NOVA classification that divides food according to the extent and the purpose of the industrial processing they were exposed to before they are acquired by the individuals (MONTEIRO et al., 2010, 2018,

[3] Oliveira, Leonardo (2017) La medición de la inseguridad alimentaria y los indicadores no monetarios en el Sistema de Encuestas de Hogares IBGE, Brasil," Seminarios y Conferencias 44098 Chapter: XVII Publisher: Naciones Unidas Comisión Económica para América Latina y el Caribe (CEPAL) - LC/TS.2017/149

2019a). The NOVA classification is composed of four groups: i) Natural or minimally processed foods, ii) processed culinary ingredients, iii) processed foods and iv) ultra-processed foods.

Since the vulnerable population is already identified, as well as the food basket that represents this group, and the items were classified according to the level of processing, the next step is to measure the price variations of these products regionally. The regional price variations of similar goods are even more significant in developing countries once the integrated distribution system implies higher transportation costs. Given the Brazilian territorial dimensions, these discrepancies become even more significant. As a result, the price differences among the areas can be higher both in relative and absolute terms. Nowadays, IBGE (the Brazilian official institute of statistics and geography) does not calculate spatial price indexes that indicate (even in approximate rates) the differences in the cost of living in different geographical contexts or in a way that the values of income and consumption are reviewed according to the variations of regional prices. Although the release of IBGE (2008)[4] had made use of spatial price indexes of foods to map inequality and poverty in the Brazilian municipalities.

Therefore, this article aims to calculate spatial deflators of foods according to the NOVA processing level. The building of the price indexes that will be presented adopt five methodological steps: (1) Selection of a subgroup of the population; (2) Classification of products by processing level; (3) Selection of foods available in all geographical contexts; (4) Definition of implicit prices and average amounts of each context; (5) Definition and calculation of price indexes.

In addition to this introduction, this article has five more sections. The second one explains the EBIA methodology and then how it is possible to identify the vulnerable population from the classification of food insecurity. The third section presents the classification of foods according to the processing level using NOVA. The fourth section explains the method used for the definition of the food basket by geographical area and the calculation of implicit price by product and average amount by region. A descriptive analysis of expenses amounts and prices of products that compose the basket is also made. The fifth section presents the results of spatial deflators by processing level. In conclusion, the final considerations are made.

2. FOOD INSECURITY AND THE VULNERABLE POPULATION

One of the main issues faced in the study of family vulnerability is the definition of the target audience. That is also impacted by monetary and non-monetary factors that influence the budget or reveal other information about the living conditions of the population. Collecting the family income is not a simple task and it involves the identification of different monetary and non-monetary components. Monetary factors are not always capable of representing the true status of the pattern of family life since non-monetary acquisitions of goods and services are relevant components in consumption and income. Thus, non-monetary income has an important participation in the composition of the family budget, especially of the population with lower income, and in Brazil this percentage reaches around 9%. POF collects the information of non-monetary acquisitions in a systematic way and counts on a broad survey of monetary components of income. Additionally, other non-monetary factors that are not part of the income are covered by POF. This section explains how it is possible to use measures of Food and Nutrition Security (SAN) to determine the target population.

2.1. The Brazilian Scale of Food Insecurity

The limitation of the family income or other monetary indicators used to identify families at risk of Food Insecurity (IA) led to the development of a direct scale to measure IA and Hunger by the United States Department of Agriculture – USDA (BICKEL et al., 2000). This assessment tool of SAN at household level is suitable for the elaboration of a diagnosis of the condition of food security and the indication of populations at higher insecurity risk, also helping to observe the impact of public policies on the circumstances where the population has access to adequate food.

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[4] "MAPA de pobreza e desigualdade: municípios brasileiros 2003. Rio de Janeiro: IBGE, 2008". 1 DVD. Available at: https://biblioteca.ibge.gov. br/index.php/biblioteca-catalogo?view=detalhes&id=241385. Accessed in: Nov., 2021.

The Brazilian Scale of Food Insecurity - EBIA is a psychometric scale of the family access to food, based on the design of a quantitative measure scale of 14 questions that covers both the perception of the concern with a future food insufficiency and the problems related to the number of available calories, as well as the quality of the family diet (IBGE, 2006). An advantage of the use of psychometric scales is that they measure the phenomenon directly from the IA experience lived and noticed by the affected people. As a result, they capture not only the difficulty in having access to foods but also the psychosocial dimension of IA considering the households as unit of analysis. Besides, they can be adapted – with the use of qualitative methodologies – to different local sociocultural contexts and their application and analysis are relatively simple (PÉREZ-ESCAMILLA; SEGALL-CORRÊA, 2008).

The direct measure scales of IA, such as EBIA, provide essential information for the management of policies and social programs because they allow both the identification and quantification of social groups at risk of IA in relation to their determinants and consequences. Considering the perception of the experience of a household in the last 90 days, EBIA indicates one of the following levels of IA experienced by the families (IBGE, 2020):

Frame 1: Description of the levels of food security and insecurity

Food security situation	Description
Food safety	The family/household has regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential needs
Mild food insecurity	Concern or uncertainty about access to food in the future; inadequate food quality resulting from strategies that aim not to compromise food quantity
Moderate food insecurity	Quantitative reduction of food among adults and/or disruption in eating patterns resulting from lack of food among adults
Severe food insecurity	Quantitative reduction of food also among children, that is, disruption in eating patterns resulting from lack of food among all residents, including children. In this situation, hunger becomes an experience at home

Search: Pesquisa de Orçamentos Familiares – POF / IBGE, 2017-2018

The first time EBIA was applied in Brazilian household surveys was in 2004 in the National Household Sample Survey – PNAD. Later, it was studied again in PNADs in 2009 and 2013 and in the National Survey of Demographics and Health of the Child and the Woman – PNDS, both elaborated by the Brazilian Institute of Geography and Statistics – IBGE. The results obtained in these surveys confirm IA is directly related to socioeconomic factors as well as of factors that compose the household unit such as, for example, the presence of residents under the age of 18, the number of residents, the gender or race of the reference person in the family, and the household income.

In 2017, EBIA started to be collected through the Household Expenditure Survey – POF, edition 2017-2018, also elaborated by IBGE. It was noticed that when the application of EBIA is transferred to a survey that captures food acquisition and analyzes the living conditions of families the possibilities of analysis are amplified.

The analysis of EBIA is based "on the sum" of affirmative answers of 14 aspects of the questionnaire[5], classified according to the cut-off points demonstrated in Table 1.

Table 1: Cut-off points for households, with and without residents under the age of 18, according to the status of food security

Food security situation	Cut off points for households	
	With people under 18	No people under 18
Food safety	0	0
Mild food insecurity	1 - 5	1 - 3
Moderate food insecurity	6 - 9	4 - 5
Severe food insecurity	10 - 14	6 - 8

Search: Pesquisa de Orçamentos Familiares – POF / IBGE, 2017-2018

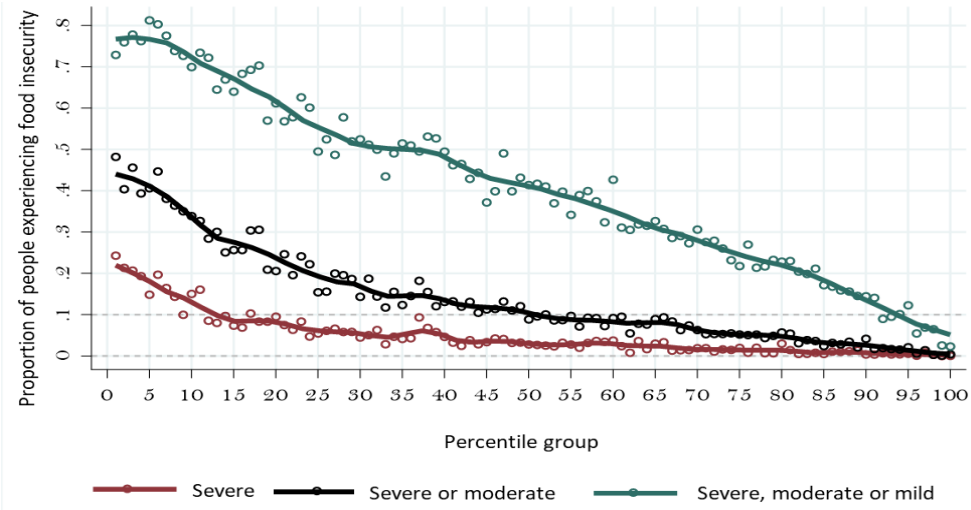
[5] IBGE, Pesquisa de Orçamentos Familiares 2017-2018 Análise da Segurança alimentar no Brasil, p.24., 2020.

2.2. The selection of the population from the level of Food Insecurity

After the clarification on the methodology and the importance of EBIA, this section will show how to identify the target audience for the building of a spatial prices deflator that identifies the regional discrepancies among the populations more vulnerable to food insecurity.

According to IBGE (2020), the proportion of the Brazilian population suffering from severe, moderate or mild IA is of 41%, severe or moderate IA is of 13.9% and severe IA is of 5%. However, the distribution of this population along hundredths of income varies significantly, as well as the level of IA in which it is inserted, as shown in Figure 1. In this chart is calculated the proportion of people in IA for each hundredth of income. It is clear that as the percentile group of income grow all the groups of people in IA tend to be zero, which reinforces that although the income is not capable of identifying the population in IA with accuracy, it is responsible for keeping people away from this situation. Only in percentile group 60, with *per capita* income close to R$1200, the probability of a person to be in Severe or Moderate IA is under 10%. For a status of Severe IA this percentile group is far below, indicating that almost 15% of the population is at risk of IA above 10%.

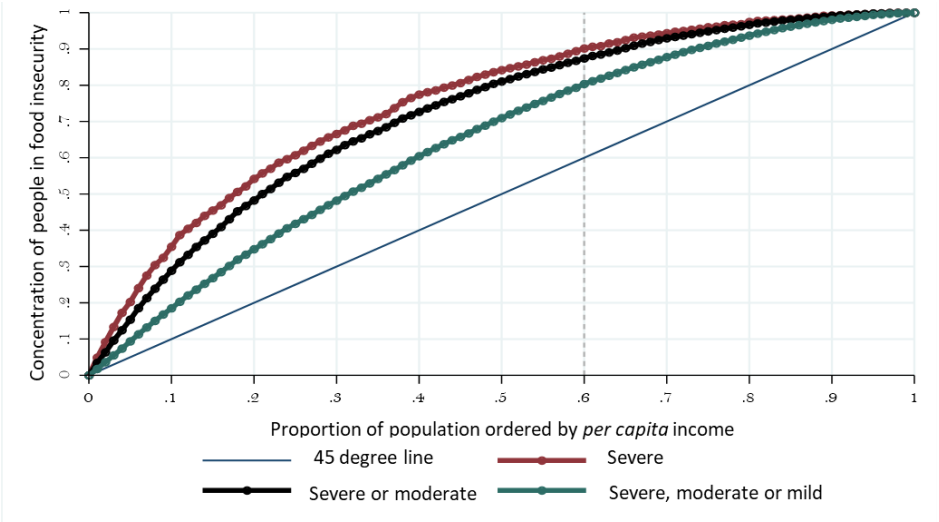
Figure 1: Proportion of people in food insecurity by percentile group of per capita income – Brazil –2017-2018



Search: Pesquisa de Orçamentos Familiares – POF / IBGE, 2017-2018

By observing Figure 2 it is possible to notice how people vulnerable to IA are concentrated along the income distribution. Thus, 90% of the people in Severe IA are among the 60% with lower income, while for people with Severe or Moderate IA this percentage is of almost 90%.

Figure 2: Concentration curves by type of food insecurity – Brazil –2017-2018



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In order to predict the probability of IA, a logit model was estimated for each depending on variable, that is, the levels of IA: Severe Insecurity, Severe or Moderate Insecurity and Severe, Moderate or Mild Insecurity. The independent variables (factors) used were: twentieths of income, number of residents in the family, gender of the reference person in the family, color or race of the reference person in the family, composition of the family (family structures formed only by adults, adults and children, only elderly people and remaining possibilities), location of the household (urban area / rural area and the Federation Units (UF: the 26 Brazilian states and the Federal District). Figure 3 shows the result of the probability of Severe or Moderate IA estimated for each person. There is a big variability in the predictions but a clear trend of reduction for this probability according to the increase of percentile group of income.

As a result of the variability of predictions observed in Figure 3, Figure 4 shows the propensity of people with probability of 20% or more and the proportion of people with probability equal to or greater than 10% to present a better idea of how this variability moves along the percentile group of income. Clearly, the drop is sharper in the beginning of the distribution, in the line that represents the people with probability of 20% or more. However, for people with chances equal to or greater than 10% this drop is less marked. The black line represents the average of all the estimated probabilities in each percentile group, that is, the average risk of the is around 10% or less around percentile group 60.

Figure 3: Estimated probability of Food Insecurity with the Logit model – Brazil –2017-2018

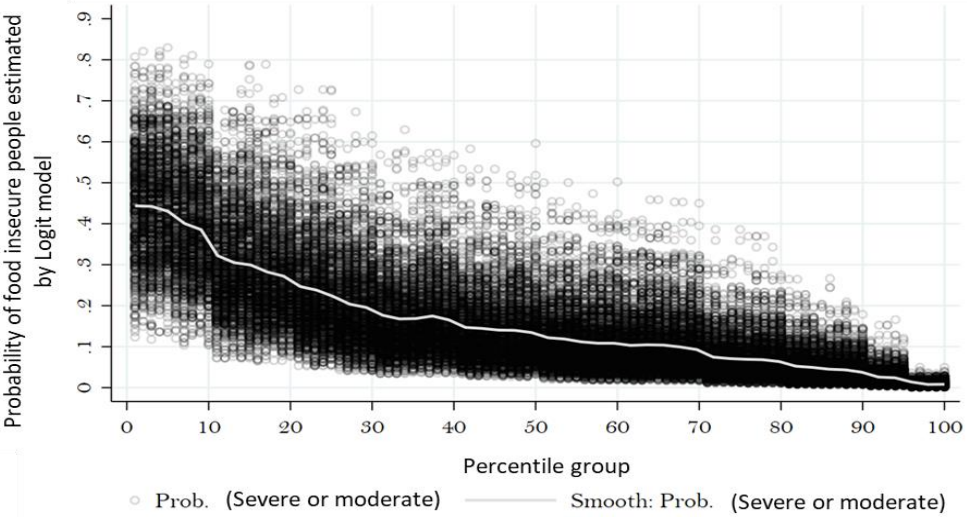

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Figure 4: Probability of people in Food Insecurity according to predictions of the Logit model, by hundredths of *per capita* income.

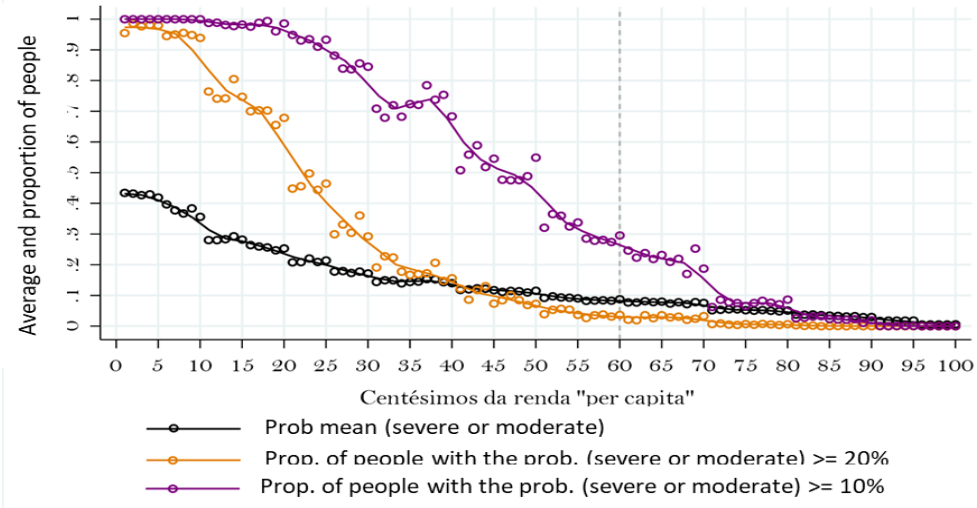

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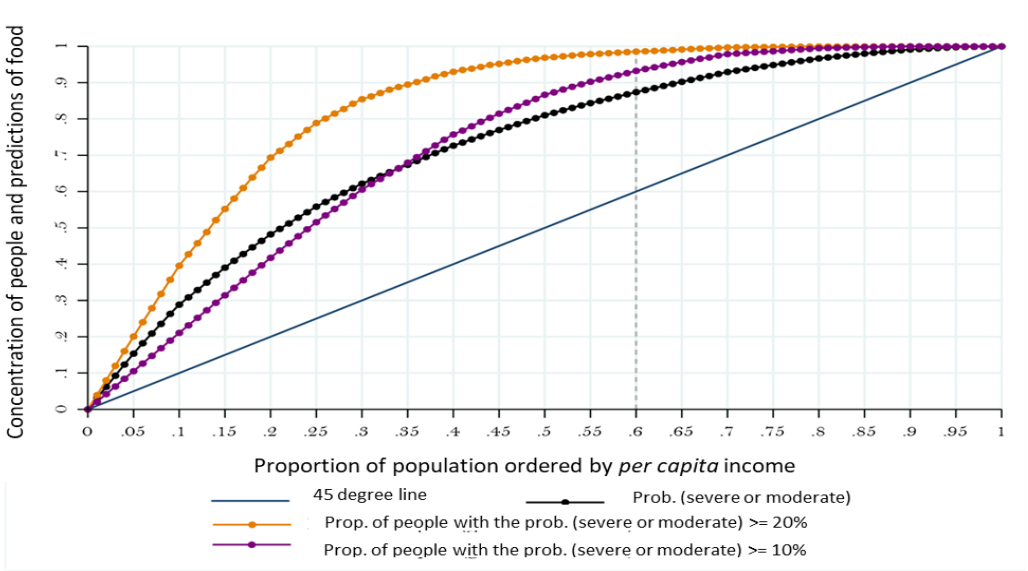
Figure 5 shows how the predictions for the risk of IA is concentrated in the population according to the *per capita* income. It is noticed that 60% of the population with lower *per capita* income accumulate more than 90% of the cases with risk of Severe or Moderate IA of 20% or more. For the group of people with chances of 10% or more of Severe or Moderate IA the concentration is of nearly 90% in percentile 60.

Considering the results of charts 3, 4 and 5, it is possible to take the operational concept that 60% of the population with lower income is the population vulnerable to the risk of IA, which meets the objectives of this article to identify the cost of a representative food basket to these people, and they will be designated onward as population vulnerable to IA.

Figure 5: Concentration curves of predictions of Food Insecurity – Brazil – 2017-2018



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3. NOVA CLASSIFICATION

NOVA is a classification of foods based on the extent and purpose of industrial processing developed by Monteiro et al (2010) that results in four groups: 1) Natural or minimally processed foods, 2) processed culinary ingredients, 3) processed foods and 4) ultra-processed foods. This classification is internationally recognized and has been extensively used in epidemiological studies on food consumption, quality of diet and health conditions of individuals (MONTEIRO et al., 2019b), as well as basis for food guidelines of several countries, including Brazil (BRAZIL, 2014).

Natural foods, Group 1, are those obtained directly from plants or animals (such as leaves and fruits or eggs and milk) and acquired for consumption without any change after leaving nature. The acquisition of Natural foods is limited to some varieties, such as fruits, vegetables, roots, tubers, and eggs. Minimally processed foods are Natural foods that were subjected to processes like removal of inedible or unwanted parts, drying, dehydration etc. Most of these processes aim to increase the durability of Natural foods, allowing extended storage.

Group 2, the Processed Culinary Ingredients are substances extracted directly from foods of Group 1 or from nature and they are usually consumed as items of culinary preparations. The processes involved in the extraction of these substances include pressing, grinding, milling, pulverization, drying and refinery. The purpose of processing is the manufacturing of products used to season and cook Natural or minimally processed foods and, in general, for culinary preparations based on these foods.

The third group that refers to Processed Foods is characterized by products manufactured with the addition of salt or sugar and possibly oil, fat, vinegar, or other substance of Group 2 to a food of Group 1, and most of the products have two or three ingredients at most. The processes involved in the manufacturing of these products can include different methods of cooking and, in the case of cheese and bread, non-alcoholic fermentation. The purpose of the processing underlying the

manufacturing of processed foods is to increase the durability of Natural or minimally processed foods or to modify their flavor being, therefore, similar to the purpose of the processing employed in the manufacturing of foods from Group 1.

The Ultra-processed Foods compose Group 4, which includes products manufactured with several ingredients and involving, in addition to substances of Group 2 (such as salt, sugar, oil and fat), substances also extracted directly from foods of Group 1 but not usually used in culinary preparations (such as casein, whey, soya protein and other foods isolate and hydrolyzed proteins), substances synthesized from food constituents (such as hydrogenated or inter-esterified oil, modified starch and other substances not naturally present in foods) and additives used with cosmetic function to modify the organoleptic characteristics of the products (colour, smell, taste or texture). Several industrial techniques are used in the manufacturing of ultra-processed products, including extrusion, molding and pre-processing by frying.

4. BUILDING METHODOLOGY OF SPATIAL PRICE INDEXES FOR BRAZIL

The building of price indexes that will be presented follow five methodological steps: (1) Selection of a subgroup of the population; (2) Classification of products by level of processing; (3) Selection of foods available in all geographical contexts; (4) Definition of implicit prices and average amounts of each context; (5) Definition and calculation of price indexes.

The first step, the selection of a subgroup of the population, was made in section 2, when the target audience of our study was defined, the population vulnerable to food insecurity. The second step refers to the classification of foods by level of processing that was made in the previous section. Thus, this section will present the way of selecting the food basket acquired by the target population (step 3) and the definition of implicit prices and average amounts of each context (step 4). Having the food basket defined, a brief analysis of the expense values and the average amounts of products in Brazil and in the geographical contexts is also made.

Proceeding with the steps to build the spatial deflator, the third step is the identification of the food products that are common to all geographical contexts. The geographical contexts are formed by the stratification of the Great Regions in metropolitan areas, urban areas (except the metropolitan regions) and rural areas. The decision to use the geographical contexts was made due to the existence of differences in regional prices, according to the research made in previous articles (IBGE, 2008; Oliveira et al 2016, 2017) and because of the possibility of using the same stratification in the other editions of POF (2008-2009 and 2002-2003).

The twenty geographical contexts used are mutually excluding and they were created for the following areas: Metropolitan Urban Regions - MUA (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre); and the Federal District; Non-metropolitan Urban Area and Rural Area of each of the five Brazilian Great regions.

In order to build a representative price deflator for all the Brazilian vulnerable population, there was a selection of the foods items acquired for household consumption registered by POF 2017-2018 that were common to all geographical contexts. The basket obtained is composed of 191 food items that are listed in Appendix 1. Having the definition of the basket and the information related to the expense value and the amount of each item, one reaches step 4 and it is possible to calculate the implicit price (P_{ij}) by product that is obtained by the ratio of the total expenditure with the product divided by the total amount of the item acquired in the respective geographical context, as shown in Equation (1):

$$P_{ij} = \frac{\sum_n V_{nij}}{\sum_n q_{nij}} = \frac{Total\ expenditure\ on\ the\ product\ i\ in\ context\ j}{Total\ amount\ of\ product\ i\ in\ context\ j} \qquad (1)$$

Another measure that can be obtained from the information of items that compose the basket is the average amount acquired by families (Q_{ij}), which is the result of the ratio of total expenditure divided by the product acquired in the corresponding geographical context and the total of families (UCs) in each geographical context with food expenditure registered for the household, as shown in Equation 2:

$$Q_{ij} = \frac{\sum_n q_{nij}}{\sum_n UC_{nj}} = \frac{Total\ expenditure\ on\ product\ i\ in\ context\ \ j}{Total\ \ families\ in\ context\ j} \qquad (2)$$

Similarly, to Equations (1) and (2) the implicit prices and the average amounts are calculated for Brazil.

4.1. ANALYSIS OF THE FOOD BASKET OF THE POPULATION VULNERABLE (CAPV) TO FOOD INSECURITY

Using the food basked elaborated with the products acquired by the vulnerable population in all the geographical contexts, it is possible to calculate the expenditure, the average amount and the implicit prices of each product in Brazil and in each geographical area.

The basket of food item that is common to all vulnerable families in Brazil is composed of 191 types of foods acquired for consumption of the family in the household, combined in 68 groups, and the average monthly expenditure is of R$ 324.38 and the monthly average amount is of 62.57 kg (the amount of all the products was standardized in the unit of measure kilogram (kg), according to the POF publication). Table 2 presents a list of 20 products that registered the largest monthly average expenditure in the basket of food item acquired by the vulnerable population in Brazil, as well as the expenditure value, the monthly average amount, and the corresponding implicit price.

Table 2: Average and quantity monthly family expenditure and implicit price of the 20 items with the highest average monthly family expenses that make up the food basket of the population vulnerable to food insecurity - Brazil - 2017-2018

Ranking	Selected products	Average monthly family expense	Average monthly family amount	Implicit price	Processing level
1º	Chicken meat	32.06	4.040	7.93	Natural ou minimally processed food
2º	Bread roll	24.90	3.441	7.24	Processed foods
3º	Second Category Beef	18.89	1.433	13.18	Natural ou minimally processed food
4º	Rice	18.54	7.268	2.55	Natural ou minimally processed food
5º	First Class Beef	17.57	0.955	18.41	Natural ou minimally processed food
6º	Other Beef Meat	13.38	0.859	15.59	Natural ou minimally processed food
7º	Coffee	12.73	0.800	15.92	Natural ou minimally processed food
8º	Milk	12.65	5.199	2.43	Natural ou minimally processed food
9º	Chicken's egg	8.65	1.007	8.59	Natural ou minimally processed food
10º	Sugar	8.14	3.917	2.08	Culinary preparations based
11º	Soda	7.88	2.860	2.76	Ultra-processed foods
12º	Sausage	7.87	0.654	12.04	Ultra-processed foods
13º	oils	7.31	1.668	4.38	Culinary preparations based
14º	Sweet cookie	7.16	0.617	11.61	Ultra-processed foods
15º	Powdered milk	7.15	0.38	18.68	Natural ou minimally processed food
16º	crackers and snacks	7.03	0.622	11.31	Ultra-processed foods
17º	Fermented Alcoholic Beverages	5.70	0.896	6.37	Processed foods
18º	Tomato	5.26	1.15	4.58	Natural ou minimally processed food
19º	Other Tropical Climate Fruits	5.21	2.02	2.58	Natural ou minimally processed food
20º	Bean	5.16	1.42	3.62	Natural ou minimally processed food

Search: Pesquisa de Orçamentos Familiares – POF / IBGE, 2017-2018

Considering the 20 food products acquired with the largest monthly average expenditure in the household, five of them are related to a type of meat: chicken, beef of the second and first categories, other beef cuts and sausage. Chicken (that includes the other cuts and the bowels) was the food

product that registered the largest monthly average expenditure by families, with the value of R$32.06 and implicit price of R$7.93. Beef of the second category was the third food product with the largest expenditure, while beef of the first category was only the fifth. It is worth noticing the difference in the amount acquired of these products. If on the one hand chicken had an average acquisition of 4 kg per month, the amount acquired of meet of the second category drops to 1.4kg and the amount of beef of the first category is less than 1 kg.

The traditional products of the Brazilian breakfast, French bread, coffee, and milk are also among the products with largest expenditures, respectively: R$24.90, R$12.73 and R$12.65. In average, the Brazilian families acquire around 3.5kg of French bread per month and 5.2 kg of milk.

It is curious to notice that the famous rice and beans is no longer so present in the food basket of the country. Rice is still a significant product in the household budget, being the fourth product with largest expenditure (R$18.54) and average amount of 7.3 kg. On the other hand, bean is on the twentieth position in terms of expenditure (R$ 5.16) and average acquisition of only 1.4 kg per month. Products of low nutrient content such as soft drinks, biscuits and fermented alcoholic drinks (beer, for example) consume more of the family budget than beans.

An analysis of the food basket of Table 2 showing the level of food processing demonstrates that most products acquired with larger expenditure are still the minimally processed or Natural, that is, the healthiest ones, such as chicken, rice, beefs, coffee, and milk. However, the ultra-processed foods have a strong presence in the composition of the Brazilian food basket being the second most important. The acquisition of sweet and salted biscuits demonstrates that not always the option to acquire ultra-processed products is because they have lower value. These products have an implicit price of R$ 11.61 and R$ 11.31, respectively, a value that is higher than those of other products like milk, chicken, chicken eggs, fruits and with little difference in comparison with beef of the second category, for example.

In order to dimension the regional differences of price, Table 3 shows the price index of the product for the 10 products with the largest average expenditures for Brazil and according to the geographical contexts. The price index of the product is the ratio of product price i of geographical context j divided by the product price i in Brazil, and as a result it is possible to see how the geographical area is above or below the average Brazilian price.

Table 3: Product price index of the 10 items with the highest average family expenses, according to the products selected from the food basket of the population vulnerable to food insecurity, by geographic context, 2017-2018

Geographical Context	Chicken meat	Bread roll	Second Category Beef	Rice	First Class Beef	Other Beef Meat	Coffee	Milk	Chicken's egg	Sugar
Brazil	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Metropolitan urban area of Belém	1.10	1.05	1.03	1.14	0.86	1.00	0.95	1.54	1.06	1.12
Urban North excluding metropolitan urban areas	0.96	0.90	0.92	0.99	0.91	0.95	0.96	1.11	1.17	1.13
Rural North	0.98	0.95	0.87	1.05	0.85	0.83	1.07	1.00	1.21	1.16
Metropolitan urban area of Fortaleza	1.05	0.89	1.01	1.55	0.99	1.16	1.03	1.28	1.21	1.12
Metropolitan urban area of Recife	1.02	0.85	1.00	1.15	0.95	0.93	1.16	1.14	0.97	0.94
Metropolitan urban area of Salvador	1.00	0.79	0.98	1.14	0.99	1.03	1.03	1.20	0.88	1.07
Urban Northeast excluding metropolitan urban areas	1.04	0.82	1.02	1.05	1.00	1.05	0.95	1.17	1.01	1.06
Rural Northeast	1.05	0.84	0.99	1.03	0.96	0.95	0.96	1.13	1.05	1.08
Metropolitan urban area of Belo Horizonte	0.91	1.40	1.09	0.99	1.08	0.99	1.01	0.90	1.10	0.91
Metropolitan urban area of Rio de Janeiro	1.00	0.86	0.94	0.96	1.00	0.95	1.10	1.11	0.80	1.07
Metropolitan urban area of São Paulo	1.07	1.22	1.16	0.98	1.21	1.18	0.88	0.96	0.93	1.07
Urban Southeast excluding metropolitan urban areas	1.01	1.25	1.07	0.97	1.11	1.04	1.05	0.97	0.93	0.89
Rural Southeast	0.98	1.16	1.04	0.95	1.00	1.07	1.05	0.94	1.13	0.88

Metropolitan urban area of Curitiba	0.80	1.10	0.88	1.00	1.03	0.95	1.00	0.93	0.78	1.09
Metropolitan urban area of Porto Alegre	0.87	1.11	1.08	1.17	0.75	1.08	0.88	0.85	0.85	1.05
Urban South excluding metropolitan urban areas	0.84	1.15	0.97	0.90	0.99	1.04	1.06	0.94	0.85	0.86
Rural South	0.83	1.14	0.92	0.82	0.91	0.77	1.06	0.89	0.87	0.97
Distrito Federal	0.87	1.20	0.92	0.87	1.04	1.03	1.07	0.95	1.05	0.82
Urban Midwest excluding Distrito Federal	0.92	1.20	0.98	0.86	0.92	0.96	1.08	1.10	1.09	0.87
Rural Midwest excluding Distrito Federal	1.03	1.26	0.86	0.90	1.05	0.88	1.11	1.00	1.19	0.82

Source: Pesquisa de Orçamentos Familiares – POF / IBGE. 2017-2018

The first aspect to notice is that the price variation of the selected products is in most cases more distinguishable among the geographical contexts of the North and Northeast regions in relation to the Southeast, South and Midwest regions. When the product tends to have a price that is lower than the average price in Brazil in the North and Northeast areas, the movement is reverse in most contexts located in the remaining regions and vice-versa. The price of the bread roll that in the geographical contexts of North and Northeast tend to be lower than the national average, have higher prices registered in the rest of the country, with emphasis on the MUA of Belo Horizonte that presented a value 40% higher in comparison with the value in Brazil. From this group, the MUA of Rio de Janeiro was the only one where the bread roll had a price below the average.

Milk was another product that registered this trend of differentiation of the "North-South" areas in the prices, while in the contexts of the North and Northeast regions the variation in relation to Brazil was positive, having in the MUA of Belém a difference of 54%, while in the areas located in the South, Southeast and Midwest the price of the milk presented was lower than the average of the country. The MUA of Curitiba had prominence with the lowest value registered, -15%.

Another factor to consider is that despite the major converging prices between the "North-South" areas, among the geographical contexts that are in the North-Northeast or in the South, Southeast and Midwest, there is divergence in the level of price variation and even of the upward or downward trend. In the case of MUA of the Northeast (Fortaleza, Recife and Salvador), the price of the chicken egg. Recife and Salvador presented a negative difference in relation to Brazil of 3% and 12%, respectively. However, the price in MUA of Fortaleza was 21% above, and the price of sugar was higher than the price of Brazil in MUA of Fortaleza (12%) and MUA of Salvador (7%) and lower in MUA of Recife (6%). The same analysis can be made among MUAs of the Southeast Region (Belo Horizonte, Rio de Janeiro and São Paulo) that are geographically closer. In Belo Horizonte the difference in the price of milk was of 10% in relation to the price in Brazil, and in Rio de Janeiro and São Paulo the variation was negative of 20% and 7%, respectively.

Relevant price divergences are also found in Rural Areas. The price of the bread roll in the Rural North was 5% lower than the price in Brazil but in the Rural Northeast it was -16%. Only the Rural Northeast registered the price of coffee below the national average, 4%. All the remaining Rural Areas had the product value higher than the price in Brazil, having the Midwest Region the biggest difference, 11%.

Although most product prices follow the regional trend explained above, some items had a distinct behavior in certain geographical contexts such as, for example, rice. This product in a major part of the North and Northeast Regions had a variation higher than the price in Brazil with values from 3% to 15%, but in MUA of Fortaleza this addition was of 55%, being the higher price registered for the product in Brazil. Similar cases that also worth mentioning are milk in MUA of Belém (+54%). the bread roll in MUA of Belo Horizonte (+40%), meet of the second category in MUA of São Paulo (+16%) and in Rural Midwest (-14%) and beef of the first category in MUA of Porto Alegre (-25%).

Knowing a little about the areas where the farming activities of each product are prominent or even the local food culture makes it a little easier to understand the behavior of certain prices, such as in the case of meet in rural Midwest. However, it is not a rule that is observed in all the products not even those that do not depend of an economy of scale to be produced or of a region with specific

soil, climate, etc. As a result, the creation of a spatial price index in Brazil proves to be essential for the incorporation of inequalities in the food basket of the vulnerable Brazilian population.

5. AGGREGATED REGIONAL PRICE INDEX

Resuming the steps to build the price index, after the definition of the population vulnerable to food insecurity as target audience (step 1), the classification of foods by processing level (step 2), the selection of the food basket representing the target audience (step 3) and the calculation of the implicit prices and the average amounts of each product in all the geographical contexts (step 4), the fifth and last step will be finally demonstrated: the definition and calculation of the price indexes.

In order to study the behavior of prices, Brazil is taken as basis (B). Thus, P_B and Q_B denote the implicit price and the average amount of Brazil. Based on the information of the implicit prices in each context and in Brazil are presented the price ratios (P_{ij}/P_{iB}) for each product that compose the food basket created in the previous section (See Appendix 1). In addition, to the price ratios are calculated the price indexes of Laspeyres (L), Paasche (I) and Fisher (F) according to equations (3), (4) and (5), respectively. The indexes were built as per the processing level and for foods in general.

According to OECD[6], the Laspeyres index is a price index defined as a fixed weight, or fixed basket, which uses the basket of goods and services of the basis period. The basis period works as the reference period of the weight and the reference period of the price. The Paasche index is a price index defined as a fixed weight, or fixed basket, that used the basket of goods and services of the current period. The current period serves as the reference period of the weight and the basis period as the reference period of the price. The Fischer index is the result of the geometric average of the two indexes. Laspeyres and Paasche.

Paasche Index (Ij)

$$I_j = \frac{\sum_i P_{ij}.Q_{ij}}{\sum_i P_{iB}.Q_{ij}} = \frac{Cost\ of\ consumption\ in\ the\ geographic\ context\ j}{Cost\ of\ consumption\ of\ geographic\ context\ j\ at\ base\ prices\ (Brazil)} \quad (3)$$

Laspeyres Index (Lj)

$$L_j = \frac{\sum_i P_{ij}.\bar{Q}_{iB}}{\sum_i P_{iB}.\bar{Q}_{iB}} = \frac{Cost\ of\ consumption\ of\ the\ base\ UF\ (São\ Paulo)\ at\ the\ prices\ of\ UF\ j}{Cost\ of\ consumption\ of\ the\ base\ UF\ (São\ Paulo)} \quad (4)$$

Fisher Index (Fj)

$$F_j = \sqrt{L_j.I_j} = geometric\ mean\ of\ the\ two\ indices \quad (5)$$

Table 4 presents the result of the aggregated regional price index calculated from the three, as per the geographical contexts. With this data, it is possible to observe the differences of spatial prices in each index model (analysis by column) and analyze the differences of values in the contexts among the models (analysis by line). Brazil is used as reference basis and the values of the three indexes equals 1.

The values of the MUAs of Belém (+9.0%) and São Paulo (+7.5%) and the Federal District (+8.1) were the areas that presented the biggest positive difference in relation to Brazil according to the Laspeyres index, while the Urban North (-7.9%), the Urban South (- 6.9%) and the MUA of Recife (-5.9%) were the areas that registered the biggest negative differences. That is, as per this index the Urban North is the geographical context with the cheapest food basket in the country.

Considering the results calculated with the Paasche index, the Federal District (+9.8%) and the MUAs São Paulo (+7.7%) and Salvador (+5.8%) were the areas that registered the biggest index values above the basis Brazil. On the other hand, the MUA Recife (-8.7%), the Urban Southeast and the Rural South with indexes around -6% were the geographical contexts that had a prominent position with bigger negative differences in relation to Brazil. The Fischer index, since it is calculated

[6] OECD: https://stats.oecd.org/

from the values of the other two indexes cited. has a similar result in terms of regions with variations that are superior or inferior to the national parameter.

It is possible to emphasize the results of the Federal District and of the MUA of São Paulo that regardless of the index model used are always the areas with the biggest distance (more expensive) compared to the basis of reference. In contrast, with MUA of Recife occurs the opposite, and in the three indexes presented it is the region that is always among the ones with the smallest values in relation to Brazil.

Table 4: Price indexes for Brazil and geographical contexts - Brazil - 2017-2018

Geographical Context	LASPEYERES INDEX	PAASCHE INDEX	FISHER INDEX	PLS
Brazil	1.000	1.000	1.000	0.000
Metropolitan urban area of Belém	1.090	1.043	1.066	0.044
Urban North excluding metropolitan urban areas	1.011	0.989	1.000	0.022
Rural North	0.981	0.969	0.975	0.012
Metropolitan urban area of Fortaleza	1.013	1.003	1.008	0.011
Metropolitan urban area of Recife	0.954	0.916	0.935	0.041
Metropolitan urban area of Salvador	0.992	0.973	0.983	0.019
Urban Northeast excluding metropolitan urban areas	0.977	0.964	0.970	0.013
Rural Northeast	0.944	0.952	0.948	0.009
Metropolitan urban area of Belo Horizonte	1.008	0.992	1.000	0.016
Metropolitan urban area of Rio de Janeiro	1.016	1.009	1.013	0.007
Metropolitan urban area of São Paulo	1.091	1.086	1.089	0.005
Urban Southeast excluding metropolitan urban areas	1.033	1.026	1.029	0.006
Rural Southeast	0.984	0.980	0.982	0.004
Metropolitan urban area of Curitiba	1.011	1.001	1.006	0.010
Metropolitan urban area of Porto Alegre	1.054	1.020	1.037	0.033
Urban South excluding metropolitan urban areas	0.985	0.974	0.980	0.012
Rural South	0.937	0.915	0.926	0.024
Distrito Federal	1.018	1.013	1.015	0.004
Urban Midwest excluding Distrito Federal	1.016	1.004	1.010	0.012
Rural Midwest excluding Distrito Federal	0.976	0.977	0.976	0.001

Search: Pesquisa de Orçamentos Familiares – POF / IBGE. 2017-2018

Still in Table 4 are found the measure values of the Dispersion Paasche – Laspeyres (Paasche–Laspeyres Spread - PLS) designed by Hill (1999) that indicate the heterogeneity of prices among these indexes and can be analyzed from the measure expressed by Equation 6:

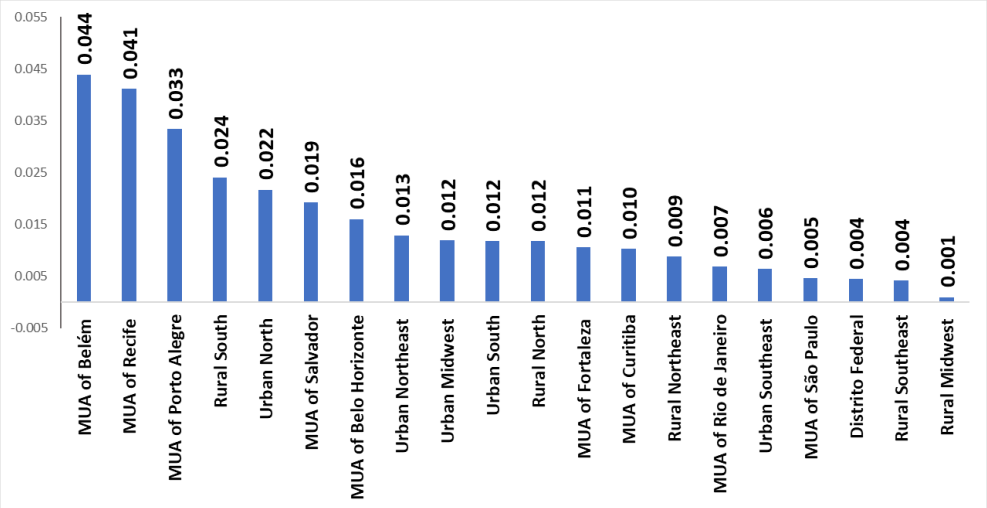
$$PLS_{st} = \left|\ln\left(\frac{P_{st}^{L}}{P_{st}^{P}}\right)\right| \qquad (6)$$

Where PLS_{st} is the absolute value of the log for the Laspeyres price index divided by the Paasche index for period t.

In Figure 6 are presented the PLS values for all the geographical contexts. making the visual comparison among the areas easier. The MUAs of three different Major Regions were the geographical contexts that presented the biggest dispersions: in the North Region, the MUA of Belém with 0.044, in the Northeast Region the MUA of Recife with 0.041 and in the South Region the MUA of Porto Alegre with 0.033. On the other hand, the MUA of São Paulo was among the metropolitan areas the one with the smaller distance among the values of the two indexes.

Comparing the urban areas, the Urban North was the one that registered the biggest dispersion with 0.022, followed by the Northeast with 0.013. The urban context with the smallest value was the Southeast, 0.006. While in the Rural Areas, the South (0.024) and the North (0.012) were the regions with the biggest dispersions, and again the Southeast was the region with the smallest dispersion, 0.004.

Figure 6: Paasche–Laspeyres Spread (PLS) by geographical contexts



Search: Pesquisa de Orçamentos Familiares – POF / IBGE. 2017-2018

After the results of the aggregated price indexes by geographical context and following the idea of evaluating the cost of the Brazilian food basket of the vulnerable population according to its composition, the values of the spatial deflators were calculated for the three models (Laspeyres, Paasche and Fischer) as per the level of processing of the products, for the geographical contexts. As before, Brazil is used as reference area, and the values of the three indexes equal 1. These values can be seen in Appendix 2. However, to demonstrate the comparison of indexes by processing level and geographical context. Figures 7, 8 and 9 will be used, representing the Paasche index for the processing levels: Natural or minimally processed, processed and ultra-processed for all the areas.

The Paasche index was chosen for the demonstration. since according to Deaton and Zaidi (2002)[7] the use of the Paasche index is suggested as spatial deflator for two reasons. Oliveira et al (2016)[8] also suggest the use of the Paasche index to evaluate regional differences by POF. First of all, this index emphasizes the consumption habits of each geographical context. Secondly, the money metrics utility function is obtained, or approximated, when the expense is divided by the Paasche index, according to the explanation in the sequence below.

Considering the utility of the X_a basket observed in area a (taking the price vector of the area P_a as given) in the monetary metrics (M_{aa}) expressed as:

$$M_{aa} = E\big(P_a, U(X_a)\big) = E(P_a, U_a) = min_X(P_a{}'X)\ as\ U(X) \geq\ U_a =\ U(X_a), \quad (6)$$

where P_a and X are vectors and a represents an area (or location). As result, the expenditure in area a is: $M_{aa}=P_a{}'X_a$. where X_a is the argument that minimizes the expression above.

According to Shepard´s Lemma[9] :

$\partial E/\partial P_a =\ X_a$, with X_a being the demand for prices P_a. (7)

The monetary metrics utility $M_{ba}=E(P_b.U_a)$ takes the price vector P_b and U_a as references. M_{ba} is the expenditure that people in area a should incur to obtain the utility U_a taking the price vector P_b as given. The first order approximation of M_{ba} results in Equation (8):

$$M_{ba} = E(P_b, U_a) \approx E(P_a, U_a) + (P_b -\ P_a)'.(\partial E/\partial P)|_{P=P_a}$$

$$M_{ba} = E(P_b, U_a) \approx\ P_a{}'.X_a +\ (P_b -\ P_a)'.X_a =\ P_b{}'X_a \quad (8)$$

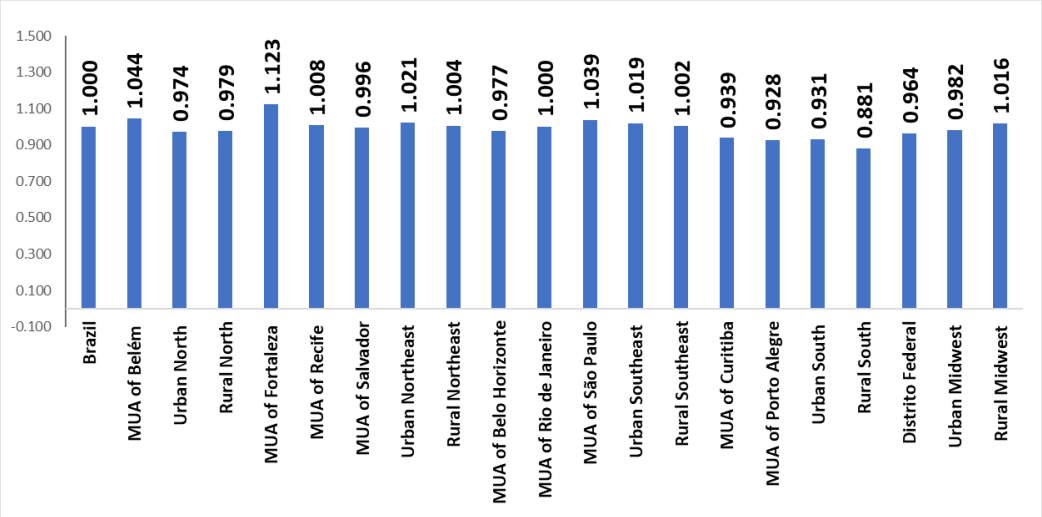
[7] Deaton, A. and S. Zaidi, "Guidelines for Constructing Consumption Aggregates for Welfare Analysis", Living Standards Measurement Survey Working Paper 135, Washington DC, The World Bank, 2002.
[8] Previously mentioned in footnote number 3.
[9] Varian, Hal (1992) Microeconomic Analysis 2nd ed. USA: W. W. Norton & Company Inc.

The monetary metrics utility is approximately $P_b'X_a$. This approximation occurs without the need to suppose specific utilities functions and stronger restrictions (homogeneity, quadratic functions or translog).

Finally, if the expenditure observed in area *a* ($M_{aa}=P_a'.X_a$) is divided by the Paashe index that takes P_b as reference ($I_{ba}=P_a'.X_a/P_b'.X_a$). the result is (approximately) the *money metrics utility function* ($M_{ba}\approx P_b'.X_a$). as reported in equation 8.

According to the Paasche index for natural or minimally processed foods (Figure 7), three MUAs of different regions presented the biggest differences in relation to base 1, represented by Brazil. The MUA of Fortaleza is the geographical context with the biggest difference, 12.3%, followed by the MUAs of Belém (4.4%) and São Paulo (3.9%). That demonstrates the relevance of studying the behavior of prices in the different realities of Brazil, since it is not possible to infer that a type of food is more expensive or cheap in a certain area considering the general cost of living of this location. Considering the contexts with results below of the value in Brazil, the three contexts with the lowest values were in the South Region. having the Rural South -11.9%, MUA of Porto Alegre -7.2% and the Urban South registering -6.9%.

Figure 7: Paasche price index of Natural or minimally processed products by geographical contexts



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Among the processed foods (Figure 8), the Paasche index with the highest value was in the MUA Belo Horizonte, 22.7%. The Urban Southeast and MUA of São Paulo have also registered high differences in relation to Brazil, 16.6% and 14.6%, respectively. The MUA of Salvador (-17.4%) and Urban Northeast (-14.9%) had the biggest negative variations, as well as the MUAs of Recife, Rio de Janeiro and Fortaleza around 9%.

The MUA of Porto Alegre (Figure 9) was the geographical context with the highest price of ultra-processed foods in relation to the reference Brazil, 5.0%. In second place, is the Rural Midwest with a variation 3.5% above the national reference. The MUA of Recife and the Rural Northeast were the areas with the biggest negative variations, respectively, 8.2% and 4.2%.

Figure 8: Paasche price index of processed foods by geographical contexts

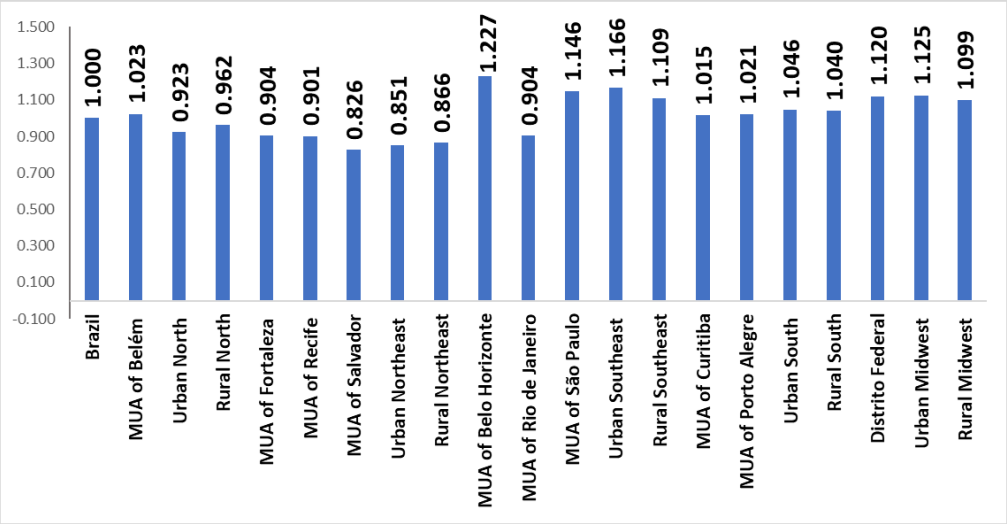

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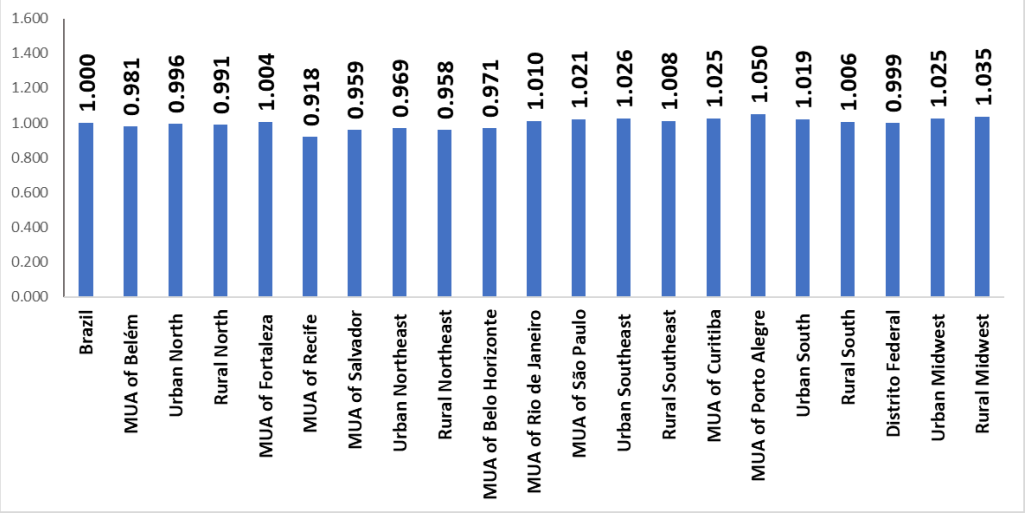
Figure 9: Paasche price index of ultra-processed foods by geographical contexts



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6. FINAL CONSIDERATIONS

The inclusion of EBIA in POF enabled an operational definition of vulnerable subgroup of the population. Up to 60% of the total population has a non-negligible chance of experiencing moderate or severe food insecurity. The operational definition allows the monitoring of the target audience of public programs that aim to combat hunger and promote safe food security, identifying consumption habits and regional differences in the cost of living, especially in urban and rural areas. Such information and monitoring will only be possible in the future with the maintenance of this information in POF. Thus, it is recommended to update EBIA on a regular basis in POF.

The methodology developed can be applied to studies that search for the analysis of poverty and inequality from the perspective of the vulnerable population in IA. Therefore, the next steps involve the use of deflators in the calculation of poverty measures and monetary inequality revealing the regional disparities and the differences of among significant subgroups of the population, such as the Rural Northeast and the Urban Southeast. This information is relevant because Brazil still does not have an official calculation to measure these regional price changes. This article seeks to contribute to fill this gap in a country of continental extent.

A second development is the estimation of demand systems that make it possible to assess the impacts of public policies on the subgroup identified as vulnerable, such as tax increases and reductions.

Another contribution that can be applied in the future would be a time analysis with the elaboration of a historical series of price indexes that are based on the food basket defined for the vulnerable population. This temporal price index can serve as a basis for readjustments, for example, for benefits and public programs aimed at combating hunger and food insecurity in Brazil.

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APPENDIX 1 – ITEMS OF FOOD BASKET OF THE POPULATION VULNERABLE

POF'S CODE	DESCRIPTION ITEMS	POF'S CODE	DESCRIPTION ITEMS
64006	Massa De Pastel	81029	Peito Bovino
65026	Pipoca Para Viagem	71011	Banana (Nao-Especificada)
85012	Queijo tipo De Minas	68011	Vinagre De Álcool
79020	Creme De Arroz	70033	Peixe Sardinha Em Conserva
65001	Aveia Em Flocos	77030	Suco De Fruta Ou Vegetal em caixa
65024	Macarrão Sem Ovos	82047	Carne Não-Especificada
65032	Couve	71089	Milho Verde Com Ervilha Em Conserva
67005	Repolho	65004	Tangerina
67009	Chuchu	68022	Lagarto Comum
67041	Tomate	71007	Pao De Forma De Padaria (Salgado)
67051	Cebola	80004	Feijão Preto
67057	Abacaxi	63015	Manga
68026	Maçã	68032	Melancia
68030	Maracujá	68034	Salsa
68033	Chá De Dentro	67010	Orégano (Tempero Industrializado)
71004	Costela Bovina	70022	Ervilha Em Conserva
71013	Carne Moída De Primeira	77002	Pão De Forma Industrializado
71014	Fígado Bovino	80005	Toucinho De Porco Defumado
71025	Milho Verde Em Conserva	81010	Batata Frita Para Viagem
77004	Peito De Galinha Ou Frango	85015	Açúcar Indeterminado
78004	Muçarela	69066	Flocos De Milho
79018	Mortadela	65009	Massa De Lasanha
81026	Fubá De Milho	65029	Abóbora Moganga
65006	Macarrão instântaneo	67033	Bolo industrializado
65048	Salsicha	80025	Peixe Não-Especificado
81021	Óleo De Milho	76009	Biscoito Não-Especificado
84004	Macarrão Com Ovos	80052	Leite De Coco
65033	Tempero industrializado	70038	Vinho De Uva E Outros
70118	Refrigerante De Laranja	83024	Limão Nao Especificado
82002	Água Mineral	68093	Ovo De Páscoa
82010	Cerveja	69058	Pão Não-Especificado
83001	Carne Assada Ou Bife Preparado Para Viagem	80015	Tempero Não-Especificado
85011	Batata Doce	70084	Queijo Não-Especificado
64004	Alface	79030	Aguardente De Cana
67001	Banana D'água	83003	Óleo De Girassol
68001	Laranja Pêra	84008	Pá (carne bovina de segunda)
68014	Mamão	71009	Salame
68031	Patinho	81027	Sopa Desidratada
71005	Frango Congelado	77014	Goiaba
78002	Parte De Galinha Ou Frango Não-Especificada	68042	Brigadeiro

78003	Torrada	**69036**	Capa De Filé
80019	Batata Não-Especificada	**71012**	Molho De Soja
64008	Linguiça	**70036**	Confeitos de bolos e doces
81022	Fécula De Mandioca	**69022**	Queijo prato
65015	Banana Prata	**79017**	Salsicha em conserva
68002	Doce De Frutas Em Pasta De Qualquer Sabor	**77028**	Cesta Básica
69012	Pão Integral	**90005**	CESTA BASICA
80014	Presunto De Qualquer Tipo		

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APPENDIX 2 - Laspeyres. Paasche and Fisher price index. according to food processing levels. by geographic context - Brazil - POF 2017 – 2018

Geographical Context	Processing level	Laspeyres Index	Paasche Index	Fischer Index
Brazil	Natural ou minimally processed food	1.000	1.000	1.000
	Culinary preparations based	1.000	1.000	1.000
	Processed foods	1.000	1.000	1.000
	Ultra-processed foods	1.000	1.000	1.000
Metropolitan urban area of Belém	Natural ou minimally processed food	1.085	1.044	1.064
	Culinary preparations based	1.140	1.123	1.131
	Processed foods	1.035	1.023	1.029
	Ultra-processed foods	0.992	0.981	0.986
Urban North excluding metropolitan urban areas	Natural ou minimally processed food	1.002	0.974	0.988
	Culinary preparations based	1.025	1.007	1.016
	Processed foods	0.941	0.923	0.932
	Ultra-processed foods	1.008	0.996	1.002
Rural North	Natural ou minimally processed food	1.001	0.979	0.990
	Culinary preparations based	1.060	1.063	1.062
	Processed foods	0.966	0.962	0.964
	Ultra-processed foods	1.029	0.991	1.010
Metropolitan urban area of Fortaleza	Natural ou minimally processed food	1.124	1.123	1.124
	Culinary preparations based	1.112	1.086	1.099
	Processed foods	0.942	0.904	0.923
	Ultra-processed foods	1.021	1.004	1.012
Metropolitan urban area of Recife	Natural ou minimally processed food	1.025	1.008	1.016
	Culinary preparations based	1.052	1.035	1.043
	Processed foods	0.926	0.901	0.913
	Ultra-processed foods	0.966	0.918	0.942
Metropolitan urban area of Salvador	Natural ou minimally processed food	1.015	0.996	1.005
	Culinary preparations based	1.115	1.124	1.120
	Processed foods	0.834	0.826	0.830
	Ultra-processed foods	0.956	0.959	0.957
Urban Northeast excluding metropolitan urban areas	Natural ou minimally processed food	1.030	1.021	1.025
	Culinary preparations based	1.033	1.021	1.027
	Processed foods	0.877	0.851	0.863
	Ultra-processed foods	0.975	0.969	0.972
Rural Northeast	Natural ou minimally processed food	1.017	1.004	1.010
	Culinary preparations based	1.011	1.016	1.014
	Processed foods	0.891	0.866	0.878
	Ultra-processed foods	0.973	0.958	0.965
Metropolitan urban area of Belo Horizonte	Natural ou minimally processed food	1.004	0.977	0.990
	Culinary preparations based	1.062	1.049	1.055
	Processed foods	1.252	1.227	1.240
	Ultra-processed foods	0.992	0.971	0.981
Metropolitan urban area of Rio de Janeiro	Natural ou minimally processed food	1.009	1.000	1.005
	Culinary preparations based	1.133	1.119	1.126
	Processed foods	0.904	0.904	0.904
	Ultra-processed foods	1.029	1.010	1.019
	Natural ou minimally processed food	1.068	1.039	1.053

Metropolitan urban area of São Paulo	Culinary preparations based	1.036	1.000	1.018
	Processed foods	1.145	1.146	1.145
	Ultra-processed foods	1.038	1.021	1.029
Urban Southeast excluding metropolitan urban areas	Natural ou minimally processed food	1.028	1.019	1.023
	Culinary preparations based	1.018	0.995	1.006
	Processed foods	1.180	1.166	1.173
	Ultra-processed foods	1.030	1.026	1.028
Rural Southeast	Natural ou minimally processed food	1.010	1.002	1.006
	Culinary preparations based	0.899	0.898	0.898
	Processed foods	1.121	1.109	1.115
	Ultra-processed foods	1.009	1.008	1.008
Metropolitan urban area of Curitiba	Natural ou minimally processed food	0.970	0.939	0.954
	Culinary preparations based	1.072	1.051	1.062
	Processed foods	1.049	1.015	1.032
	Ultra-processed foods	1.050	1.025	1.037
Metropolitan urban area of Porto Alegre	Natural ou minimally processed food	0.983	0.928	0.955
	Culinary preparations based	1.050	0.971	1.010
	Processed foods	1.049	1.021	1.035
	Ultra-processed foods	1.149	1.050	1.098
Urban South excluding metropolitan urban areas	Natural ou minimally processed food	0.958	0.931	0.944
	Culinary preparations based	0.944	0.905	0.924
	Processed foods	1.095	1.046	1.070
	Ultra-processed foods	1.031	1.019	1.025
Rural South	Natural ou minimally processed food	0.905	0.881	0.893
	Culinary preparations based	0.967	0.960	0.963
	Processed foods	1.087	1.040	1.063
	Ultra-processed foods	1.018	1.006	1.012
Distrito Federal	Natural ou minimally processed food	0.986	0.964	0.975
	Culinary preparations based	0.999	0.987	0.993
	Processed foods	1.147	1.120	1.133
	Ultra-processed foods	1.006	0.999	1.002
Urban Midwest excluding Distrito Federal	Natural ou minimally processed food	1.001	0.982	0.992
	Culinary preparations based	0.915	0.897	0.906
	Processed foods	1.149	1.125	1.137
	Ultra-processed foods	1.033	1.025	1.029
Rural Midwest excluding Distrito Federal	Natural ou minimally processed food	1.030	1.016	1.023
	Culinary preparations based	0.894	0.873	0.883
	Processed foods	1.166	1.099	1.132
	Ultra-processed foods	1.030	1.035	1.032

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