



# **The Expansion of Consumption and the Dynamics of Welfare of the Brazilian Families: An Analysis of the Decomposition of Poverty and Inequality**

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# The expansion of consumption and the welfare dynamics of the Brazilian families: a decomposition analysis of poverty and inequality

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## Abstract

This article gathers analyses that involve dynamic aspects of welfare, inequality and poverty in Brazil in the periods of 2002-2003 and 2008-2009 from the perspective of the *per capita* consumption. By means of the data of the Brazilian Family Expenditure Survey (POF), from the construction of the consumption aggregates, the evolution of the consumption structures in the period mentioned above are evaluated, according to the location of families in the Major Brazilian Regions and in the urban and rural areas. For this purpose, the study incorporates the value of services related to existing durable goods in the households in each edition of the survey. The study resorts to graphical and dominance analyses as well as to the calculation of functions that allow measuring and separating the effects of growth and redistribution over social welfare. The role of the consumption structure in changes made to the levels of welfare and poverty is evaluated according to static and dynamic decompositions. The main results indicate that the Durable goods strongly contributed for the growth of consumption and social welfare but they were also a limiting factor for the inequality reduction. In relation to poverty, we observed that in all the geographic areas that were studied poverty in 2008-2009 was lower than in 2002-2003 for the different measures and poverty lines that were used in this study.

**Keywords:** Gini Index, Living standards, General Welfare, Consumer price index, Shapley Value

**JEL:** C02, C43, D31, D69, I31

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## 1. Introduction

The complexity and multidimensionality of poverty and inequality make the definition of an appropriate indicator, which captures the welfare of people and families, one of the essential issues for studying and dimensioning these themes. The purpose of this work is to contribute with the analyses of these topics by constructing an aggregate of family consumption based on data of the Brazilian Family Expenditure Survey (*Pesquisa de Orçamentos Familiares* - POF) carried out in 2002-2003 and 2008-2009, following the literature and recent advances, in order to allow measuring and analyzing the welfare, the poverty, the inequality of families with emphasis on their dynamic aspects.

Oliveira et al (2016), as recommended by Hentschel and Lanjow (1996), Slesnick (2001), Lanjow and Lanjow (2001), Deaton and Zaidi (2002), ILO-ICLS-17 (2003), Haughton and Khandker (2009), Lanjow (2009), Stiglitz, Sen and Fitoussi (2009) and OCDE (2013), constructed a consumption aggregate based on the POF 2008-2009, selected non sporadic expenses, which in general represent welfare gains, calculate the value of services related to durable goods by the use cost, the value of food costs when necessary and applied spatial deflators. As a result, they checked which of the suggested consumption aggregates reflects the choices of the families in multiple dimensions and allows the analysis of the socioeconomic welfare from POF data.

POF<sup>1</sup> is a household survey conducted by IBGE that provides information about the consumption pattern of the Brazilian families. By standardizing the calculation of the consumption aggregate in the two editions of the survey (POF 2002-2003 and POF 2008-2009), we enabled the monitoring of the evolution of welfare among the Brazilian families during a period of high economic growth and expansion of consumption. The POF editions carried out in 2002-2003 and 2008-2009, since they are the only ones that include all the national territory, enable the comparison at the geographic level and of the consumption structure from the expense items.

In this work, we followed the construction of the consumption aggregate for the period of 2008-2009 adopted in Oliveira et al (2016), we was also applied to data of the POF edition carried out in 2002-2003 enabling an analysis of consumption evolution, welfare, inequality and poverty between 2002-2003 and 2008-2009. As emphasized in Ferreira (2010), a great deal of attention has been given to dynamic aspects of welfare, which show how the distinct growth rates of consumption (or income) of the poorer and the richer determine the values of inequality, poverty and the mean consumption (or income) over time. The author suggested that studying this triangular relationship growth-poverty-inequality only under the macroeconomic perspective limits the analyses, considering the three vertexes of the triangle are moved by the dynamic interaction of individual incomes at the microeconomic level. The same argument can be used for consumption.

The period analyzed in this work was marked by important aspects of the internal and external economic scenarios that worth mentioning. In Brazil, the years between 2002 and 2009 were

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<sup>1</sup>The first edition of the POF was in 1987-1988 and the main purpose was to update the consumption matrix for the calculation of product considerations related to the index of national price and National Bills. Thus, a limited set of products was searched only for the metropolitan regions of the country, and the same happened with the second edition carried out in 1995-1996. Only in the POF edition carried out in 2002-2003 the purpose of the survey was expanded and the geographic coverage started considering all the national territory.

marked by a sharp economic growth, with real increase around 25% in the GDP, tax incentive for production and acquisition of durable goods, such as electronics and vehicles, declining interest rates (44%) and expansion of credit supply<sup>2</sup>. This period was called “consumption boom” in the country. In the international context, it is worth mentioning that at the outbreak of the subprime crisis, in 2008, initiated in the United States but with global effects, the POF had just started and the effects of the crisis may have been captured by the survey.

The impact of this economic growth on the reduction of poverty and inequality in this period has already been analyzed in several works, especially under an income perspective. The main source of these studies was the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios* - PNAD), sample household survey of annual frequency conducted by IBGE<sup>3</sup>. Barros et al (2007) showed a decrease in the Brazilian inequality that took place between 2001 and 2005. The authors investigated non-labor incomes to find out which one played a more relevant role on the decrease of inequality. The public transfers, in special, the retirements and the pensions caused the greater impact, while the effect of cash transfers social programs, *Benefício de Prestação Continuada (BPC)* and *Bolsa Família*, on the reduction of inequality was practically all a reflection of coverage expansion of such programs.

Neri (2011), on the other hand, analyzed the transition of the poorest social classes to the middle class, the so-called class C, between 2001 and 2009. During this period, the *per capita* income of the 10% poorer population in Brazil rose 69%, while the 10% richer rose only 13%. Between 2003 and 2009, the classes “AB” and “C” increased their population to 6.6 million and 29 million, respectively. In contrast, there was a reduction in the number of people who belong to the poorer classes “D”, 2.5 million, and “E”, 20.5 million. Also, there was a decrease in the inequality of income considering the evolution of the Gini index in the same period from 0.58 in 2003 to 0.55 in 2009. IPEA (2012) conducted another study that analyzed this Brazilian socioeconomic period, which highlighted that the downward trend of poverty during the first decade of the year 2000 was not interrupted by the financial crisis in 2008. The population whose household income *per capita* is below the poverty line dropped 11.4 p.p. between 2003 and 2008, while from 2008 until 2009 the reduction was of only 0.6 p.p.

Hoffmann (2010) also studied the evolution of the distribution of the Brazilian household income *per capita*, but he used the POFs carried out in 2002-2003 and 2008-2009. Since the capture of income in the POF is more detailed than in the PNAD, by including information related to the production value to self-consumption and asset variation, the author investigates if the reduction in inequality as observed by PNAD is also obtained by POF for this period. He found a decrease in inequality measured by the Gini index from 0.59 in 2002-2003 to 0.56 in 2008-2009.

Despite the contribution of these studies over the evolution of income and welfare of the Brazilian population during this period, only a few works evaluated the evolution under the consumption perspective itself, or even the expense perspective<sup>4</sup>. One example of these studies is Campolina and Gaiger (2013) who elaborated a study based on the evolution of expenditure.

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<sup>2</sup>Basic prices in the Gross Domestic Product (GDP): reference 2010 – IPEADATA: <http://www.ipeadata.gov.br>; Interest rate - SELIC (Special System of Settlement and Custody). Brazilian Central Bank <http://www.bcb.gov.br/Pec/Copom/Port/taxaSelic.asp>.

<sup>3</sup>See also Barros et al (2006a;2006b); Ferreira et al (2006); Soares (2006).

<sup>4</sup>See Gaiger Silveira et al (2007).

The authors used the history of the POFs carried out in the periods from 1987-1988 until 2008-2009 to study the changes in the Brazilian consumer market starting from the hypothesis of homogenization of demand profiles and expansion of credit. Considering a descriptive analysis, they evaluated the behavior of the participation of expense groups in the survey according to the social classes in all the Brazilian territory (2003-2009) and according to the metropolitan areas in the period from 1988 until 2009 since they have the same geographic coverage. They showed the increase in participation between 2003 and 2009 of the 70% poorer over the total value of the household monetary budget was of 0.4p.p., accounting for 31.2%, while the 10% richer maintained their participation. In spite of the increase of 2p.p. in the participation of half the poorer population in health, education and personal services expenses, it was with expenses related to the acquisition of electronics that the 70% poorer population had a significant increase in participation (38% in 2003 versus 42% in 2009).

This work proposes the evaluation of how the impact of the growth in consumption and its structure reflect upon the welfare, the poverty and the decrease in inequality among the Brazilian families, especially under the dynamic aspect. By including the period 2002-2003 in the analyses, this work expands what was done by Oliveira et al (2016) that analyzed the effects of welfare, inequality, poverty and vulnerability of families from the consumption aggregate only for the period of 2008-2009. Considering the consumption aggregates that were constructed, we notice the growth of consumption along the distribution, calculate the usual inequality and welfare as well as use analytical<sup>5</sup> (Rao, 1969; Shorrocks, 1982; Jenkins, 1995) and counterfactual (Shorrocks, 2012) decompositions for a dynamic analysis of consumption and its components. These components were defined as: i) Food; ii) Durable goods; iii) Housing; iv) Education, health, and transportation; and v) Other goods.

In addition to this introduction, this work has another five sections. The first one deals with the construction of consumption aggregates from information obtained from the POFs in the periods 2002-2003 and 2008-2009. Next, we make a descriptive analysis of the mean consumption *per capita* behavior and its components, according to Brazil, Major Regions and Urban and Rural Areas. In section three, we evaluate the effect of the consumption variation over the welfare and the inequality by static and dynamic decompositions. Similarly, in section four, we present static and dynamic counterfactual decompositions that show the impact of the consumption behavior and its components over poverty. Finally, in the last section, we make the final comments with some conclusions about the results that were presented and suggestions of improvements and further development in this study.

## **2. Consumption Aggregate**

The construction of the consumption aggregate is the first and essential step of this work, since it is a complex exercise that requires a detailed and precise breakdown of the expenses that should be included or not with the purpose of comparing the levels of welfare and the correct ordination/hierarchy of different families. This breakdown is oriented by the applied literature and the theoretical hypothesis about the contribution of different goods and services to welfare, as well as the necessary adaptations to Brazilian culture and habits.

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<sup>5</sup>See Lerman and Yitzhaki (1985); Soares (2006); Hoffmann (2006) for analytical decompositions and Shapley (1953); Barros et al (2006); Duclos and Araar (2006); Azevedo et al (2013) for counterfactual decompositions.

The Brazilian Family Expenditure Survey (Pesquisa de Orçamentos Familiares - POF) used as source of information is a sample survey conducted by IBGE, collected during twelve months, which investigates the topics expenses, income and asset variation of families, basic aspects for the analysis of household income, and some factors related to the subjective evaluation of the living conditions. The POF is organized in seven questionnaires that are subdivided in frames, where each one of them refers to a type of expense, income or survey topic. The survey editions of 2002-2003 and 2008-2009 created a database with information related to 3.860 and 4.728 records of distinct items, respectively, (products, goods, services, etc), which had to be identified, reconciled and classified one by one for the construction of the consumption aggregates.

The construction of the consumption aggregates used here followed the same methodology used in Oliveira et al (2016) that, by using the recommendations of Hentschel and Lanjow (1996), Slesnick (2001), Lanjow and Lanjow (2001), Deaton and Zaidi (2002), ILO-ICLS-17 (2003), Houghton and Khandker (2009), Lanjow (2009), Stiglitz, Sen and Fitoussi (2009) and OCDE (2013), selected expense items that enabled the comparison between the welfare levels of families, classifying them in five groups: i) Food; ii) Durable goods; iii) Housing; iv) Education, health and transportation; and v) Other goods. In order to define which expense items should compose the consumption aggregate, the following criteria were adopted: i) The expense item should not be of sporadic acquisition; ii) The acquisition should be for the consumption unity itself<sup>6</sup>, that is, the acquisition of the good will increase the welfare of the consumption unit under analysis and not that of another unit; iii) The item contributed for the comparison of welfare among different families and their correct ordination. Besides, it was necessary to treat the following information: imputation of the value of the food that is consumed for the families that did not have these expenses in the reference period and; the calculation of the service value for the use cost of household durable goods (that differs from the acquisition cost). The last step of the construction of consumption aggregates consisted of correcting the values obtained by the use of price deflators.

In order to construct the two consumption aggregates, in such a way that it is possible to compare them, some small adjustments had to be made regarding the consumption aggregate that was created in Oliveira et al (2016), especially in what concerns the spatial deflators. Next, we will briefly explain the steps of the treatment given to items of each expense group analyzed in the consumption aggregates in both periods.

### **2.1. Food Expenditure**

All the food expenditure was included in the aggregate. However, there was a need to treat this information considering that 3.8%, in 2003, and 5.8%, in 2008, of the consumption units that were interviewed in the survey did not have food expenditure. This behavior does not cause surprise, because the POF uses a short reference period (7 days) to capture the acquisition of

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<sup>6</sup>Consumption Unit: in the Brazilian Family Expenditure Survey, the concept of Consumption Unit comprises a single resident or group of residents who share the source of food, which can be approximated to the idea of household units or family. For further details, see IBGE (2008).

food. Thus, since it is a very short interval, it is common that some families did not have food expenditure, and it does not mean they did not consume this type of goods during the period of seven days.

Therefore, considering this null food expenditure can change the levels of social welfare, inequality and poverty of families, an imputation was made in the null food expenditure by using the Propensity Score Method (Rosenbaum e Rubin, 1983). This method compares the estimated probabilities of the units to present zero food expenditure in two groups called control and treatment. The treatment group was composed of units that did not declare food consumption and the control group was composed of the units with food consumption different from zero. For each unit of the treatment group, we search the control group for a donor unit of food consumption. The probability of the donor should be as close as possible of the probability estimated for the unit of the treatment group. In appendix 1, we present the variables that explain the logit model that was applied and the density function of the *per capita* consumption with and without food expenditure imputed for the POF editions carried out in 2002-2003 and in 2008-2009.

## **2.2. Durable Goods**

The inclusion of durable goods in the consumption aggregate was one of the main contributions made in Oliveira et al (2016). According to the authors, the possession of durable goods is an important indicator of welfare of the consumption units, but there is a difficulty in using it because most acquisition prices of these goods are elevated and they can impact the comparison among families that already have such goods and the remaining ones that were acquiring them only in the reference period of the survey. By considering only the calculated service value by the use cost of each durable good and not the acquisition value, this problem was solved. For further details, see Oliveira et al (2016).

As in Oliveira et al (2016), only the items of durable goods that are part of the “Inventory of durable goods of the main residence” (frame 14) were included in the consumption aggregates. This selection is necessary because, to calculate the value of services by the use cost, we need information of the acquisition date of goods and they are only captured in frame 14 of the POF. The list of inventory goods is related to technology and the frequency of acquisition according to the period of each survey, and there are some small differences between the POF inventory of 2002-2003 and the POF inventory of 2008-2009. Since technology is in intense evolution, mainly in what concerns electronics, many goods of high frequency of acquisition in a survey fell into disuse in the following survey or were no longer indications of welfare, such as VCR, floor polisher, recorder, cassette player and laser read-head of disc player. On the other hand, other goods that were not yet created or that were not commonly acquired became popular during the period between the surveys and were included in the inventory of the consumption units such as, for example, the electric oven and the food processor. In appendix 2, we list the two inventories of the corresponding surveys so as to show the items used in the composition of durable goods.

### 2.3. Housing

In the housing group, we included the following expense types: rent, utility services, home refurbishment, furniture and household articles, electronics and electronic fixing and cleaning material.

### 2.4. Education, health and transportation

Despite the distinct nature, education, health and transportation expenses were grouped because they deserve differentiated treatment and evaluation. Some items of these components can be interpreted as "regrettable needs"<sup>7</sup> and reveal little about the choices/preferences of consumers or even about their rank/hierarchy of family welfare.

According to Oliveira et al (2016), based on Lanjow (2009) and Deaton and Zaidi (2002), the health and education expenses could be included in the aggregate if their elasticity<sup>8</sup> related to the total expenses was greater than one. Thus, the total education expenses and the health expenses related to healthcare and dental insurance contracts were included (POF's block 42). The elasticity values found for education and health were, respectively, 1.42 and 0.87 in 2002-2003 and 1.28 and 0.92 in 2008-2009.

Now, regarding the transportation expenditures, we decided to exclude the expenses with mass transportation (bus, subway, train, ferryboat, alternative means of transportation and their connections), since the high values are associated with a longer distance between the residence and the workplace, and these areas are usually peripheral, as suggested in Nordhaus and Tobin (1972) and Sen, Stiglitz and Fitoussi, (2009). The other expenses related to private transportation, such as own car (fuel, parking, toll and car wash), taxi, plane and car rental were included because, to a certain extent, these expenses reflect choices and individual preferences.

The travel expenses of POF's block 41 had a distinct treatment when compared with the one adopted by Oliveira et al (2016), because the POF edition carried out in 2002-2003 does not inform the reason of the trip. As a result, it is not possible to distinguish the leisure trip from the other ones. In order to compare both surveys, we included all the information related to travel expenses registered in POF's block 41 in the editions carried out in 2002-2003 and 2008-2009.

### 2.5. Other goods

This group aggregates expenses related to clothing, culture and leisure, personal services (manicure, pedicure, barber, hairdresser etc.), hygiene and personal care, smoking habits and other miscellaneous expenditures. Among the miscellaneous expenditures, were considered

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<sup>7</sup> A "regrettable necessity" involves acquisitions under differentiated circumstances, which make it more difficult to measure the welfare based on consumption/expense: (1) It can involve undesirable conditions (in many cases of short term) that negatively impact the welfare of families/individuals and lead to an increase in expenses only to mitigate such impacts; (2) It can also involve expenses that, for some people, have a purely instrumental nature, making them difficult to avoid and necessary only as a means to acquire a "second item or objective". Including the expenses in these items, without a proper treatment of the loss of welfare involved, would lead to an inappropriate measurement of the "long term" welfare, indicating, for example, that a person who spent a lot of money on medication when he/she was sick is better than someone who did not have this expense. Oliveira et al (2016), Lanjow (2009) and Deaton and Zaidi (2002) suggested the exclusion of many of these items.

<sup>8</sup>The concept of elasticity associates the percentage change in  $y$  with a given variation in  $x$ . It is possible to estimate the elasticity of expenses with a specific item related to the total expense by the following model:  $\ln y_i = \alpha + \beta \ln x_i + \mu_i$ , where  $y_i$  is the expense with the item in question,  $x_i$  is the total expense for a given observation  $i$ . The coefficient  $\beta$  measures the elasticity of  $y$  in relation to  $x$ . Lanjow and Lanjow (2001) suggested a similar approach to avoid the impact of measurement mistakes on the behavior of the consumption aggregate and the remaining results, especially the measurement of poverty.



expenses with other properties, parties, communications and professional services, such as registry, lawyer and brokers.

The expenses with wedding, wedding dress and funeral and the rare and expensive acquisitions were not included in the aggregate, according to orientation provided by Deaton and Zaidi (2002) and Haughton and Khandker (2009), Lanjow (2009).

Frequent expenses with public services (such as light, water, sewage, condominium, parking, etc) related to other properties of the consumption unit and used for self benefit (beach house, for example) were included, while expenses with taxes, social contributions, pensions, subsidies, donations to other families and private pension were excluded. Banking expenses were included in the consumption aggregate, except for banking services with interests of overdraft and credit card.

## 2.6. Price Deflator

In order to compare the consumption pattern among different geographic contexts, it is necessary to apply a spatial deflator, which corrects differences between prices. According to Oliveira et al (2016), the deflators were created for the following twenty geographic contexts: Metropolitan Regions (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre); and Federal District (Brasília); Non-metropolitan Urban Area and Rural Area of each one of the five Major Brazilian regions).

For the calculation of the spatial deflator based on the POF 2002-2003, we created a basket with only the common items among the 20 geographic contexts. Likewise, we created a second basket for the calculation of the spatial deflator based on the POF 2008-2009. As a result, only some food items that is not usually consumed was not found in the two baskets. The list of these products is available in appendix 3. The non-food items of the spatial deflation are utility services and/or essential services and are present in the two baskets. However, we should keep in mind the possibility of having changes in the weight of products and, consequently, in the composition of the baskets in the POF editions.

Table 1: Participation of expense groups that compose the consumption basket

<b>Expenditure Groups</b>	<b>POF 2002-2003</b>	<b>POF 2008-2009</b>
Gas	8.9%	6.6%
Comunication	6.8%	6.7%
Water and sew	5.0%	6.0%
Eletric power	11.7%	14.0%
Housing	8.8%	11.2%
Food	58.8%	55.5%

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

As observed in table 1, the structure of the expense groups within the selected consumption basket was not changed, that is, the importance of these expenses in the family budget remained balanced in the period between the two surveys. The selection of items of the food group did not present relevant changes as well, so that for the calculation of price indexes per geographic contexts, we have a homogeneous basket for both periods of time.

In this work, we compare the two consumption aggregates in distinct periods of time then, besides the spatial correction of prices, it is also necessary to correct them in relation to time.

### 2.6.1. Spatial Price Deflator

In Oliveira et al (2016), we used a Paasche price index as spatial deflator for the consumption aggregate with data of the POF 2008-2009, following a suggestion made by Deaton and Zaidi (2002). According to the authors, the calculation of other methods of price index, such as the ones created by Laspeyres and Fischer, had a similar behavior to that of Paasche, then the choice of the price index would not be decisive for the obtained results. However, when we replicate the same methodology with the Paasche index to the aggregate that was constructed from the POF 2002-2003, the estimated quantities for the communication item were very high in some geographic areas, which led the Paasche index not to have the same structure of the remaining indexes.

The solution found for this problem was the replacement of the Paasche price index adopted in the spatial deflation in Oliveira et al (2016) by an adapted version of the Laspeyres price index. The decision for this substitution is due to the nature of the calculation of indexes, because the Laspeyres index sets a consumption basket of a reference region, in this case the metropolitan region of São Paulo (RMSP), and compares the prices of each geographic context analyzed in relation to this basket. Defining the RMSP as base, the problems caused by the estimated quantities of the communication item are eliminated. The adapted version of the Laspeyres index applied to the aggregates constructed for the years of 2002-2003 and 2008-2009 was based on Ferreira, Neri and Lanjow (2000) and World Bank (2007), where they used the participation of the housing expense of each geographic area over the region of reference, apart from the remaining calculation of the traditional Laspeyres index. In this work, we applied this ratio for the communication expenses.

In order to standardize the consumption baskets of families, the consumption units that are in the income range that covers from the second to the fifth decile were selected, as well as expenses of the categories of gas, communication, water and sewage, electric power, housing and food. After selecting these expenses, the adapted Laspeyres index was applied, which consists of the relation between the acquisition cost of the consumption basket of the region of reference (RMSP) and the acquisition cost of the same consumption basket in the remaining geographic contexts. However, the portion related to communication expenses has a separate calculation. Thus, the ratio of the total communication expenses of the geographic context was used over the total communication expenses of the region of reference. The equation (1) presents the adapted Laspeyres index used in the aggregates, for each context.

$$(1) L_{adpt,j} = (1 - S_B) \frac{\sum_i P_{ij} \cdot \bar{Q}_{iB}}{\sum_i P_{iB} \cdot \bar{Q}_{iB}} \Big|_{i \neq communication} + S_B \frac{V_{communication,j}}{V_{communication,B}}$$

Where  $P_{ij}$  = price of product or service  $i$  in the geographic context  $j$ ;  $\bar{Q}_{iB}$  = amount of product or service  $i$  in the basic geographic context (Metropolitan Region of São Paulo);  $P_{iB}$  = price of product or service  $i$  in the basic geographic context;  $S_B$  = fraction of expense with communication in total expense of basic geographic context;  $V_j$  = total "communication" expenses of geographic context  $j$ .

After the calculation of the adapted Laspeyres index for each consumption basket of the corresponding years of research (see appendix 4), it would be possible to use the spatial deflator

generated in 2008-2009 to correct the prices in both editions of the survey or use the deflator generated in 2002-2003. However, we chose to use the mean of the index numbers that were obtained.

### 2.6.2. Time Price Deflator

The database of the POF 2002-2003 was provided with all the products and services using the prices of January, 2003, and the POF 2008-2009 used prices of January, 2009. As a result, to match the prices of the two consumption aggregates and make them comparable over time, we need to change the values of the aggregate of 2002-2003 to prices of January, 2009.

In order to have the time deflator of the consumption aggregate of 2002-2003, we used the National Extended Consumer Price Index (*Índice de Preços ao Consumidor Amplo* - IPCA), calculated by IBGE, the same index that is already applied to the POF. We chose to adjust the prices of each expense group with their corresponding index, since we are dealing with consumption information.

**Table 2: Time deflators, according to the expense groups of the consumption aggregate and their corresponding compatibility with IPCA groups and subgroups**

Expenditure Groups of Consumption Aggregate	Group / Subgroup IPCA Code	Group / Subgroup IPCA	Deflator (jan/2009)
Food	1	Alimentação e bebidas	1.40
Durable Goods	3201	Eletrodomésticos e equipamentos	1.31
	5102	Veículo próprio	1.25
Healthcare, education and transportation	5	Transportes	1.33
	6203	Plano de saúde	1.73
	8	Educação	1.50
Housing	2	Habitação	1.39
	9	Comunicação	1.47
Other goods	2	Habitação	1.39
	4	Vestuário	1.44
	6102	Óculos e lentes	
	6301	Higiene pessoal	
	7101	Serviços pessoais	
	72	Recreação, Fumo e Filmes	
	8103	Papelaria	
	9	Comunicação	

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

In table 2, the IPCA categories are listed and their corresponding indexes are used to deflate the categories of the consumption aggregate of 2002-2003. In the case of the Other goods category, we created a weighted grouped index from the weight of each corresponding group in the price index. That is, the deflator of the Other good category of the consumption aggregate results of the ratio of the sum of products with monthly weighted variation of prices by the weight of each corresponding group over the total weight of items that compose this category, according to equation (2).

$$(2) \frac{\sum_{i=1}^n (\text{monthly variation of prices}_i) (\text{weight}_i)}{\sum_{i=1}^n \text{weight}_i}$$

where  $i$  = IPCA group, subgroup or item;  $n$  = total number of IPCA group, subgroup or item that compose the Other category of frame 1 ( $n=8$ ).

The time deflator is the last step of the elaboration of consumption aggregates. Thus, we can start the analysis of the *per capita* consumption performance of Brazil in the periods that range from 2002-2003 until 2008-2009 presented in the following sections.

### 3. Growth of consumption, inequality and their effects on Welfare

In this section, we analyze the growth of consumption in the period between the two releases of the studied POFs, as well as their effects on welfare. Also, we analyze the evolution of the consumption components.

#### 3.1. The evolution of the mean per capita consumption in the period that ranges from 2002-2003 until 2008-2009

After the calculations described in the previous section, we can observe the consumption behavior. First, we analyze the evolution of consumption between the periods of 2002-2003 and 2008-2009 by the mean *per capita* and the participation rate of components, according to the location of families in the Major Regions and in the urban and rural areas. The participation of *per capita* consumption components is also measured according to their deciles.

As observed in table 3, the mean *per capita* consumption grew in all the geographic areas that were analyzed between the periods of 2002-2003 and 2008-2009. In Brazil, it grew 17.5%, from R\$544 to R\$639. Regarding the geographic areas, there was an increase in all the Major Regions, and the South (22.5%) and North (22%) regions presented the highest variations. Comparing the urban and rural areas, the second one registered an increase around 30%, a lot bigger than the rate observed in the urban areas, of approximately 16%.

**Table 3: Mean *per capita* of consumption components according to geographic areas**

Geographical Area	Total		Food		Durable goods		Housing		Healthcare, education and transportation		Other goods	
	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009
<b>Brazil</b>	<b>544</b>	<b>639</b>	<b>128</b>	<b>140</b>	<b>47</b>	<b>86</b>	<b>183</b>	<b>205</b>	<b>85</b>	<b>96</b>	<b>100</b>	<b>111</b>
<b>Major Regions</b>												
North	357	436	111	126	19	37	112	129	40	49	76	95
Northeast	363	429	112	119	24	48	108	122	46	55	73	85
Southeast	654	757	137	150	57	102	231	258	111	124	118	123
South	658	807	147	162	74	134	219	250	105	121	114	140
Midwest	555	657	116	130	51	98	189	221	94	96	105	112
<b>Location</b>												
Urban Areas	591	686	130	143	50	91	204	227	96	106	111	120
Rural Areas	314	408	121	125	31	64	79	100	32	48	51	71

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

When we evaluate the consumption components, we notice all the categories registered an increase, but it did not happen in a homogeneous way. The Durable goods component had an increase of 83.7% in the period while the remaining components grew in average 11.2%. This distinction in the durable goods category was registered in all the major regions, both in urban and rural areas. Such result was expected and complies with the incentive policy carried out by the government for the renewal of the line of household appliances that present sustainable power consumption and also with the pro-cyclical growth policy via automotive industry. Regions that usually present difficulty in accessing technology, due to distance or social issues, such as the rural areas and the Northeast region were the ones that presented the greatest growth, 103.2% and 98.5%, respectively. The rural area also registered significant increases of consumption in the groups of health, education and transportation (50.8%), other goods (38.8%) and housing (26.9%).

**Table 4: Participation rate of consumption components, according to geographic areas**

Geographical Area	Food		Durable goods		Housing		Education, health, transport		Other goods	
	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009
<b>Brazil</b>	23.6	21.9	8.6	13.5	33.6	32.2	15.7	15	18.5	17.5
<b>Major Regions</b>										
North	30.9	28.9	5.4	8.4	31.4	29.6	11.1	11.3	21.1	21.7
Northeast	30.8	27.7	6.7	11.2	29.8	28.5	12.7	12.8	20	19.8
Southeast	21	19.9	8.6	13.5	35.3	34.1	17	16.3	18	16.2
South	22.3	20.1	11.3	16.6	33.2	30.9	15.9	15	17.3	17.3
Midwest	20.9	19.7	9.2	15	34.1	33.6	17	14.7	18.9	17
<b>Location</b>										
Urban Areas	21.9	20.8	8.5	13.2	34.6	33.1	16.3	15.4	18.7	17.5
Rural Areas	38.5	30.6	10	15.7	25.1	24.5	10.2	11.8	16.2	17.3

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002–2009

Regarding the composition of the consumption aggregate (table 4), we notice the structure of the consumption pattern did not change despite the strong growth of durable goods, from 8.6% to 13.5% of participation, between 2002-2003 and 2008-2009. The component that was responsible for most expenses of the Brazilian consumption units remains housing, followed by food. This relation remains despite the increase of 4.9 p.p. in the participation of durable goods, because the remaining consumption components had small reductions in their participations. Food was the component that suffered the greatest loss in the period, around 1.7 p.p..

**Table 5: Participation rates of the consumption components by decile of *per capita* consumption**

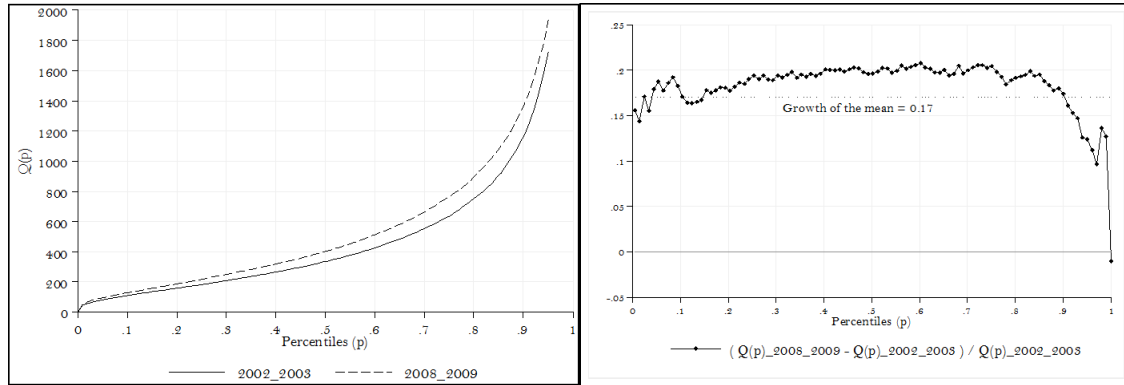
	Food		Durable goods		Housing		Education, health, transport		Other goods	
	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009	2002-2003	2008-2009
<b>Brazil</b>	23.6	21.9	8.6	13.5	33.6	32.2	15.7	15	18.5	17.5
<b>Decile</b>										
1	38.2	33.7	5.5	7.7	36.9	37.5	2.3	2.5	17.2	18.6
2	36.9	33.8	5.8	7.3	36.1	36.3	3	3.2	18.2	19.5
3	34.8	33.1	6.2	7.7	36.6	34.9	3.7	4	18.7	20.2
4	33.4	31.5	7.4	9.7	35.5	33.6	4.6	5.1	19.2	20.1
5	30.9	29.4	9.1	11.4	35.2	33.2	5.6	6.5	19.2	19.5
6	30.3	27.1	9.6	14.2	33.4	31.6	7.5	8.7	19.2	18.4
7	27.7	24.9	10.8	15.5	33	30.9	9.9	10.5	18.5	18.2
8	25.2	23	10.9	16.6	32.4	29.6	12.9	13.6	18.6	17.3
9	22.3	20.7	10.6	16.7	31.4	28.5	17.9	17.2	17.8	16.9
10	16.8	15.8	6.9	12.3	34.2	34	23.6	21.5	18.5	16.4

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002–2009

In table 5, we check the composition of the consumption categories behaved according to the deciles of *per capita* consumption. The food component was the only one that registered a drop in participation in all the deciles of distribution, while the durable goods had the opposite result, increasing their participation. It is worth mentioning that the greatest decrease in the participation of food took place in the lowest deciles, and the Durable goods group had the highest increases in participation among the classes with the greatest consumption. The housing component only presents an increase in participation in the two first deciles of distribution, while the participation of Education, health and transportation reduced only in the two last deciles. It is worth mentioning that the components with greater participation in all deciles are food and housing in both periods. In the food expenditure exceeded the housing expenditure only in the two first deciles. However, in 2008-2009, this relationship reversed in these deciles and housing had the greatest participation in all the distribution.

### 3.2. The incidence of growth over the consumption distribution in Brazil

This subsection analyzes how the distribution of the *Per capita* Consumption (PCC) evolved between the POF 2002-2003 and 2008-2009, their impacts over growth (mean), inequality and social welfare.



**Figure 1: (a) Pen's Parade – truncated in 95% - Brazil**

**(b) Growth Incidence Curve**

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

The Pen's Parade, Figure 1-a, shows the values of the PCC from the 1st to the 95th percentile of distribution, enabling to easily see the inequality in the PCC values of several percentiles of the population. Also, we can observe the PCC values of 2008-2009 are always higher than the PCC values of 2002-2003, demonstrating a growth in consumption from the 1<sup>st</sup> to the 95<sup>th</sup> percentile of the population. For example, the PCC of the 90th percentile was (approximately) R\$1200 in 2002-2003 and R\$1400 in 2008-2009. With the support of the Growth Incidence Curve (GIC), Figure 1-b, we notice the Pen's Parade evolved. That is, it shows the growth rate of PCC for each percentile, and we can better observe the incidence of growth. As we can see, the consumption growth in the period is not widespread because there is no increase in the last percentile of distribution. Since the PCC did not increase in the higher percentile, the GIC has a negative part and it not possible to state the welfare of each individual/family increased. For a better evaluation of social welfare, we take a function that values both increments in PCC and progressive transfers (Pigou-Dalton)<sup>9</sup>.

According to Figure 1-b, for approximately 90% of the population the PCC grew above the mean (17%), being above 20% in many cases. From the 85th percentile on, the growth rates decrease, falling below the mean after the 90<sup>th</sup> percentile. This growth pattern brings consequences for both the social welfare and the inequality and poverty, as we will see in the following sections.

While the Pen's Parade basically describes the consumption increments along the distribution, the Generalized Lorenz Curve (GLC) considers how gains or losses that occurred impact the social welfare, for a society that values consumption increments and progressive transfer. In each percentile of distribution, the GLC shows how the population share contributes (in R\$) to the observed mean value<sup>10</sup>.

<sup>9</sup>Progressive transfer of Pigou-Dalton occurs when the consumption (income) is transferred from a richer person to a poorer person, without changing the original rank of people in the consumption aggregate (income). See Chakravarty (2009), Sen and Foster (1997).

<sup>10</sup>After ordering the population by the PCC, you can define the coordinates of the Generalized Lorenz Curve as  $GLC(p) = \sum_{p_i} c_i / N$ , where  $N$  is the total population and  $\sum_{p_i} c_i$  is the accumulated total of per capita consumption until percentile  $p$ .  $GLC(p)$  can also be written according to the partial mean  $p$ :  $GLC(p) = (\sum_{p_i} c_i / N_p) \cdot (N_p / N) = (\mu_p) \cdot p$ , where  $N_p$  is

The Figure 2-a below show the GLC of 2008-2009 is always greater than the GLC of 2002-2003. In this case, we can state: the social welfare is greater in 2008-2009 for a broad class of functions (strictly S-concave and increase functions)<sup>11</sup> that value not only the consumption increments but also progressive transfers.

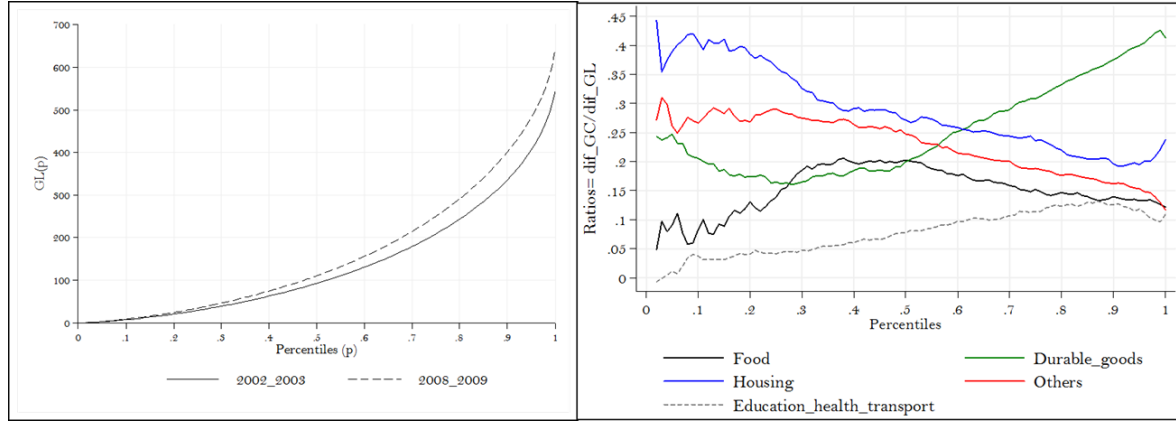


Figure 2: (a) Generalized Lorenz Curves

(b) Partial means growth decomposition by consumption components

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002–2009

Now in Figure 2-b we describe how the increments of GLC are decomposed by increments in each consumption component. The curves presented result of the ratio between the changes in the generalized concentration curve of each component ( $k$ ) of consumption ( $GCC_k$ )<sup>12</sup> and the changes in GLC.

As shown in Table 5, the housing items and the other goods were responsible for the greatest consumption increments in the tenth percentile but, if we look at Figure 2-b, we can identify how these variations contribute for the growth of the mean PCC of different population groups. As a result, we have that for the first 10% of the population a little more than 40% of the GLC increase results of the housing item, around 27% of the other goods and around 8% of the food item.

In percentile 60, we have an important result: the components housing and durable goods contribute with the same participation for the growth of GLC, around 25%. After that point (P60), the durable goods become the component that contributes more to the growth of GLC. Considering 100% of the population, we clearly notice the big distinction of the durable goods item in relation to the others. Alone, this component was responsible for over 40% of the growth

the accumulated total of population until the percentile  $p$ . More details on the Generalized Lorenz curve are found in Chakravarty (2009), Sen and Foster (1997), Lambert (2001), Duclos and Araar (2006).

<sup>11</sup>The function  $W(X_n)$  is strictly S-concave when  $W(X_n, A_{n \times n}) > W(X_n)$  for any  $X_n$  belonging to the domain and any matrix  $(A_{n \times n})$  whose elements  $a_{ij}$  are all non-negative, having 1 as the total of each line and the total of each column (Chakravarty, 2009).

<sup>12</sup>After ordering the population by the PCC, you can define the coordinates of the generalized concentration curve of component  $k$  for the group  $p$  of the population, such as:  $GCC_k(p) = \sum_p C_{k,i} / N$ , where  $N$  is the total population and  $\sum_p C_{k,i}$  is the accumulated total of consumption (per capita) in component  $k$  until percentile  $p$ . Notice that the GLC results of the sum of the generalized concentration curves, that is  $GLC(p) = \sum_k GCC_k(p)$ , where  $\sum_k$  represents the sum of consumption components. Besides, remember the  $GLC(p)$  can be interpreted as the product of the "partial mean  $p$ " and the percentile  $p$  itself, as explained in a previous comment. Similarly,  $GCC_k(p)$  can be written as a function of the "partial mean  $p$  of component  $k$ ":  $GCC_k(p) = (\sum_p C_{k,i} / N_p) \cdot (N_p / N) = (\mu_{pk}) \cdot p$ , where  $N_p$  is the accumulated total of the population until the percentile  $p$ .

of the mean PCC, the housing component was the second more important with participation close to 25%. The others contribute with little more than 10% each.

### 3.3. Effects of the growth in consumption and inequality on welfare

In order to measure the impact of consumption over the welfare of the Brazilian families, social welfare functions were adopted <sup>13</sup>, and they can be affected by both the growth and the redistribution that occurred in the periods of 2002-2003 and 2008-2009. Such functions, in abbreviated form, summarize the information contained in the social welfare functions in two parameters, the mean PCC (that indicates the "size of the pie") and the inequality (that indicates how the "pie" is shared). These abbreviated functions are represented in this article by the Sen mean (associated with the Gini index) and the geometric mean (associated with the Atkinson index, with parameter equal to 1). The expressions of the Sen mean  $W_{Sen}(c)$  and the geometric mean ( $W_{Geo}(c)$ ), are represented below <sup>14</sup>:

$$(3) W_{SEN}(c) = \frac{\sum_i \sum_j \min(c_i, c_j)}{N^2} = \mu(c)[1 - I_{GINI}(c)]$$

$$(4) W_{GEO}(c) = (\prod_i c_i)^{1/N} = \mu(c)[1 - I_{ATK}(c)]$$

where:  $c_i$  = consumption of individual  $i$ ;  $c_j$  = consumption of individual  $j$ ,  $N$  = total population,  $I_{Gini}(c)$  = Gini index;  $I_{Atk}(c)$  = Atkinson's inequality index;  $\mu(c)$  = mean *per capita* consumption.

**Table 6: Social welfare function, growth and inequality**

Welfare	POF	Brazil	North	Northeast	Southeast	South	Midwest	Urban Areas	Rural Areas
$\mu(c)$	2002-2003	544	357	363	654	658	555	591	314
	2008-2009	639	436	429	757	807	657	686	408
	Dif.(%)	17%	22%	18%	16%	23%	18%	16%	30%
$I_{Gini}(c) \times 100$	2002-2003	50.2	47.1	50.4	48.4	45.4	49.1	49.6	45.5
	2008-2009	49.5	47.1	50.1	48.0	43.3	47.9	49.0	47.6
	Dif.	-0.7	0.1	-0.2	-0.4	-2.1	-1.2	-0.7	2.1
$I_{Atk}(c) \times 100$	2002-2003	36.0	31.4	35.5	33.8	30.3	34.4	35.2	30.2
	2008-2009	35.4	31.7	35.3	33.5	28.1	33.0	34.6	32.8
	Dif.	-0.6	0.2	-0.2	-0.3	-2.1	-1.4	-0.6	2.6
$W_{Sen}(c) = W_{\mu}(c) \cdot (1 - I_{Gini}(c))$	2002-2003	271	189	180	337	359	282	298	171
	2008-2009	322	230	214	393	457	342	350	214
	Dif.(%)	19%	22%	19%	17%	27%	21%	18%	25%
$W_{Geo}(c) = W_{\mu}(c) \cdot (1 - I_{Atk}(c))$	2002-2003	348	245	234	433	459	364	383	220
	2008-2009	412	298	278	503	580	440	449	274
	Dif.(%)	19%	22%	19%	16%	26%	21%	17%	25%
Growth effect (%) $\approx$	$\Delta \ln(W_{\mu}(c)) / \Delta \ln(W_{Sen}(c))$	93%	101%	97%	95%	84%	88%	92%	118%
	$\Delta \ln(W_{\mu}(c)) / \Delta \ln(W_{Geo}(c))$	95%	102%	98%	97%	87%	89%	94%	117%

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

Table 6 shows the values of the mean  $W_{Sen}(c)$ ,  $W_{Geo}(c)$ ,  $\mu(c)$ , as well as inequality indexes  $I_{Gini}(c)$  and  $I_{Atk}(c)$  in the POF 2002-2003 and 2008-2009. Two points call attention. The first point is the growth of 17% in the  $\mu(c)$ , already detailed in the previous section. The second point is the "relative stability" of inequality in Brazil between the two editions of the survey. To Brazil, we see that  $I_{Gini}(c)$  diminishes 0.7, from 50.2 to 49.5 while  $I_{Atk}(c)$  diminishes 0.6, from 36.0 to 35.4.

<sup>13</sup>We assume the social welfare functions are homogeneous of degree 1 (or there is a monotonous transformation that makes it homogeneous of degree 1).

<sup>14</sup>More details on these welfare functions and these inequality indexes can be found in Sen and Foster (1997), Lambert (2001), Duclos and Araar (2006) and Chakravarty (2009).



Two exceptions are the South region and rural areas where the variations are greater. The greatest reductions in inequality are in the South region - where  $I_{Gini}(c)$  changes from 45.4 to 43.3 and  $I_{Atk}(c)$  changes from 30.3 to 28.1. In the rural areas, the both indexes indicate an increase in inequality in the period.

Considering the observed subtle reduction of inequality and the growth of consumption, we can conclude that the growth of consumption was the main reason for the evolution of the social welfare, registered both in  $W_{Sen}(c)$  and  $W_{Geo}(c)$ . The two last lines of Table 6 show the contribution of the changes of  $\mu(c)$  to the changes of  $W_{Sen}(c)$  and  $W_{Geo}(c)$ , using the logarithmic scale. To Brazil as a whole, we see the growth explains 93% or 95% of the increase in social welfare depending on the adopted measure,  $W_{Sen}(c)$  or  $W_{Geo}(c)$ . In the South region, the role of growth was a little smaller, contributing with around 84% or 87% of changes of  $W_{Sen}(c)$  or  $W_{Geo}(c)$ , the remaining (16% or 13%) is explained by the reduction of inequalities. In the rural areas, the growth was followed by the increase of inequalities, reducing the gains of welfare.

As seen before (Figure 2-b), 40% of the increase of  $\mu(c)$  in Brazil is explained by the durable goods, around 25% is explained by housing and the remaining by the other components. In this sense, the durable goods contribute in a significant way for the increase of social welfare but it does not explain the modest reductions of inequality that were reported. In order to have an overview of how the consumption components influenced inequality and welfare, it is necessary to evaluate the evolution of their concentration over the period, according to the approach that will be present in the next subsection.

#### 4. Inequality Decomposition

In order to understand which consumption components were the most important for the small reduction of inequality that was observed, several decompositions exercises will be made in this section. First, we analyze the consumption components according to the deficit share of the Lorenz curves and the concentration curves. In the two following subsections, we describe the exercises of static and dynamic decompositions made and the analyses of the results of such decompositions.

##### 4.1. Graphic Decomposition

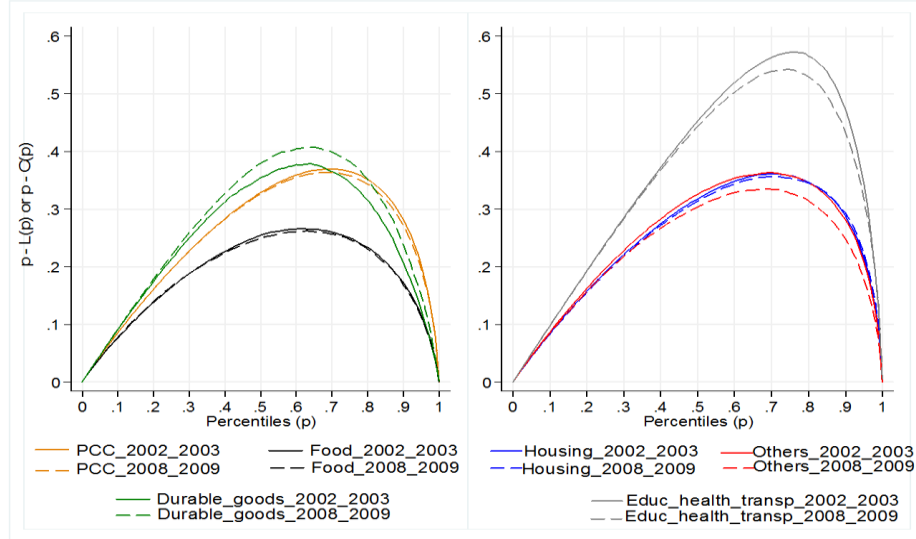
In this subsection, we graphically analyze which factors contributed to the small reduction of inequality, preventing a greater growth of welfare among the families

Figure 3 shows the behavior of the Lorenz curve (L) of the PCC and the Concentration Curves (C) of their components<sup>15</sup>, using as reference the distance of the curves from the straight line of perfect equality (straight line of 45°)<sup>16</sup>. Thus, the areas below these curves indicate inequality and consumption concentration. The dotted lines show the results of the POF edition carried out in 2008-2009, the remaining show the results of the POF edition carried out in 2002-2003. We notice that for the components Education, Health and Transportation and Other Goods the

<sup>15</sup>The coordinates of the Lorenz curve can be obtained by dividing the values of the coordinates of the generalized Lorenz curve by the mean:  $L(p)=GLC(p)/\mu$ , where  $\mu$  is the mean PCC and  $GLC(p)$  is defined in a previous comment. The coordinates of the Concentration Curves are obtained in a similar way:  $C(p)=GCC_k(p)/\mu_k$ , where  $\mu_k$  indicates the mean value of component k and  $GCC_k(p)$  is defined in a previous note. More details on these curves are found in Chakravarty (2009), Sen and Foster (1997), Lambert (2001), Duclos and Araar (2006).

<sup>16</sup>In this case, the differences  $[p - L(p)]$  for the Lorenz curves and  $[p - C(p)]$  for the concentration curves.

curves of 2008-2009 are always below the curves of 2002-2003. That indicates these components became less concentrated, contributing to the reduction of inequalities. The opposite happens with the durable goods, which became more concentrated and, to a certain extent, reduced the speed of the reduction of inequality.



**Figure 3: Deficit Share: (a) Lorenz Curve (PCC) and Concentration Curves (Food and Durable goods)**

**(b) Deficit Share: Concentration Curves (other components)**

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

## 4.2. Static Decomposition

In this subsection, the exercises of analytical and counterfactual decomposition used to measure the contribution of growth and of each consumption component to inequality.

In order to numerically evaluate the contribution of the five consumption components to inequality, we make use of four static decompositions, where two of them are considered analytical and the other two counterfactual. The analytical decompositions are based on Rao (1969), Lerman and Yitzhaki (1985), Shorrocks (1982), Jenkins (1995), Soares (2006) and Hoffmann (2006) and counterfactual decompositions are based on Shapley's value (1953), Shorrocks ([1999]2013), Barros et al (2006), Duclos and Araar (2006) and Azevedo et al (2013).

### Analytical Decomposition

The calculation of the analytical decomposition of the *per capita* consumption CV follows Shorrocks (1982)<sup>17</sup>, where for each component  $k$  ( $k=1,...,5$ ) are calculated the weight in total consumption ( $S_k$ ), the correlation with the PCC ( $\rho_k$ ) and the coefficient of variation ( $CV_k$ ). Thus, for the CV, the relative contribution of component  $k$  is given through  $R_{CV,k}=[S_k\rho_kCV_k/CV]$  and the absolute contribution is given by  $R_{CV,k}=[S_k\rho_kCV_k/CV]$  and the absolute contribution is given by  $A_{CV,k}=[S_k\rho_kCV_k]=R_{CV,k}CV$ , and the sum of the relative contributions are one,  $\sum_k R_{CV,k}=1$ .

<sup>17</sup>Shorrocks suggests the relative contribution of component  $k$  is given through the ratio  $R_k=cov(PCC_k,PCC)/var(PCC)$ , where  $PCC_k$  is the per capita consumption of component  $k$ , regardless of the inequality measure used. Notice that this expression is equivalent to the expression used in the CV decomposition. Jenkins (1995), Ferreira et al (2006) and Brewer and Wren-Lewis (2012) use the same principle to decompose the generalized entropy  $I_{GE(2)}=[CV^2/2]$ .

On the other hand, the calculation of the Gini analytical decomposition was based on Rao (1969) and Lerman and Yitzhaki (1985). In this method, we calculate for each component  $k$  their weight in total consumption ( $S_k$ ), their Gini correlation  $Gini^{18}(r_k)$ , their Gini index ( $I_{Gini,k}$ ), as well as their concentration coefficient ( $\theta_k$ ). As a result, to Gini, the relative contribution of component  $k$  is given by  $R_{Gini,k}=[S_k r_k I_{Gini,k}/I_{Gini}]=[S_k \theta_k/I_{Gini}]$  and the absolute contribution is given by  $A_{Gini,k}=[S_k r_k I_{Gini,k}]=[S_k \theta_k]$ , where  $A_{Gini,k}=R_{Gini,k} I_{Gini}$  com  $\sum_k R_{Gini,k}=1$ .

The main advantage of these methods is that they describe inequality from three characteristics of their components: weight, inequality and association with PCC. The greatest disadvantage is in the fact these analytical decompositions do not correspond directly to a counterfactual exercise (Jenkins, 1995). For this reason, inequality was also analyzed through counterfactual decompositions.

### Counterfactual Decomposition

For the counterfactual decompositions, we followed Shorrocks ([1999]2013) e Duclos e Araar (2006) that describe the use of the Shapley<sup>19</sup> value in the decomposition of inequality measures. Next, two exercises are presented, which follow similar routines, with the first having the five PCC components replaced by their means and the second having the components replaced by zero.

In the first exercise, called Shapley-Gini(mean), we take an initial sequence of five steps. In each step, one of the components of consumption ( $k$ ) is replaced by their mean. The variation of the inequality index given by  $A^1_{mean,k}=\Delta^1_{mean,k} I_{Gini}$  is calculated and kept as an estimated contribution for this component. In the end of this initial sequence, we have five estimated contributions, one for each component. Later, we make another sequence of five steps where the components are replaced in a new order. Again, the variation of the inequality index is calculated and kept in each one of the steps, obtaining  $A^2_{mean,k}$ ,  $k=1,...,5$ . The exercise proceeds until all the  $T$  sequences (of possible replacements in five steps) are covered. In the end, we consider the mean of all the estimated contributions of component  $k$  as the absolute contribution, which is given by  $A_{mean,k}=\frac{\sum A^t_{mean,k}}{T}$ ,  $t=1,...,T$ . The relative contribution of component  $k$  is given by the ratio of the absolute contribution over the Gini index, expressed by  $R_{mean,k}=A_{mean,k}/I_{Gini}$ .

The second exercise, called Shapley-Gini(zero), is similar but the components are replaced by zero. Comparably, we can define the estimated contribution of component  $k$  in the sequence  $t$  as  $A^t_{zero,k}=\Delta^t_{zero,k} I_{Gini}$ . Thus, the absolute contribution and the relative contribution of component  $k$  are given, respectively, by  $A_{zero,k}=\sum A^t_{zero,k}/T$ ,  $t=1,...,T$  e  $R_{zero,k}=A_{zero,k}/I_{Gini}$ .

The results of these two decompositions, using the consumption aggregates of 2002-2003 and 2008-2009, are presented in table 7.

<sup>18</sup> The Gini correlation can be define as  $r_k=[cov(PCC_k, F_{PCC})/cov(PCC_k, F_{PCC,k})]$ , where  $F_{PCC}$  and  $F_{PCC,k}$  are the accumulated distribution functions of the PCC and of their component  $k$ .

<sup>19</sup> In the original formulation, the Shapley value is a solution of cooperative games used to designate the gains the different players obtain when they engage in coalitions, Shapley (1953). Shorrocks ([1999] 2013) show the Shapley value can be applied to the decompositions of poverty and inequality.

**Table 7: Inequality decomposition by consumption componets**

Inequality Decomposition				Food	Durable goods	Housing	Education, health, transport	Others goods	Total
POF 2002-2003	Analytical	CV	Component Share ( $S_k$ )	24%	9%	34%	16%	18%	100%
			Correlation ( $\rho_k$ )	0.671	0.630	0.867	0.836	0.785	.
			$CV_k$	1.087	1.359	1.532	2.321	1.599	.
			$\rho_k \times CV_k$	0.730	0.856	1.328	1.939	1.254	.
			Absolute Contribution	0.172	0.074	0.447	0.305	0.232	1.229
			Relative Contribution	0.140	0.060	0.363	0.248	0.189	1.000
		Gini	Gini Correlation ( $r_k$ )	0.770	0.788	0.906	0.912	0.870	.
			$Gini_k$	0.481	0.630	0.545	0.794	0.574	.
			Concentration Index ( $\theta_k$ )	0.370	0.496	0.494	0.724	0.499	.
			Absolute Contribution	0.087	0.043	0.166	0.114	0.092	0.502
			Relative Contribution	17%	9%	33%	23%	18%	100%
	Shapley	Gini (Mean)	Absolute Contribution	0.089	0.043	0.164	0.113	0.092	0.502
			Relative Contribution	18%	9%	33%	23%	18%	100%
			Absolute Contribution	0.024	0.114	0.072	0.200	0.093	0.502
		Gini (Zero)	Relative Contribution	5%	23%	14%	40%	18%	100%
POF 2008-2009	Analytical	CV	Component Share ( $S_k$ )	22%	13%	32%	15%	17%	100%
			Correlation ( $\rho_k$ )	0.664	0.682	0.834	0.812	0.728	.
			$CV_k$	1.084	1.407	1.623	2.370	1.558	.
			$\rho_k \times CV_k$	0.720	0.959	1.354	1.924	1.134	.
			Absolute Contribution	0.158	0.129	0.436	0.289	0.198	1.209
			Relative Contribution	13%	11%	36%	24%	16%	100%
		Gini	Gini Correlation ( $r_k$ )	0.763	0.827	0.897	0.903	0.838	.
			$Gini_k$	0.480	0.646	0.547	0.772	0.552	.
			Concentration Index ( $\theta_k$ )	0.366	0.534	0.491	0.697	0.462	.
			Absolute Contribution	0.080	0.072	0.158	0.105	0.081	0.495
			Relative Contribution	16%	15%	32%	21%	16%	100%
	Shapley	Gini (Mean)	Absolute Contribution	0.082	0.072	0.156	0.104	0.081	0.495
			Relative Contribution	17%	15%	31%	21%	16%	100%
			Absolute Contribution	0.030	0.122	0.075	0.187	0.082	0.495
		Gini (Zero)	Relative Contribution	6%	25%	15%	38%	16%	100%

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

Table 7 shows how each consumption component contributed for the inequality level observed in the POF 2002-2003 and 2008-2009, according to the four decompositions described above. We can observe the similarity of results between the two analytical decompositions, Analytical: CV and Gini, and the counterfactual decomposition that replaces the components by their mean, Shapley-Gini(mean). For these three decompositions, in 2002-2003, housing contributed with approximately 33% to 36% of the observed inequality and Education, health and transportation contributed with approximately 23% to 25%. The high contribution of Housing results, to a great extent, of its weight on consumption (34%). The contribution of Education, health and transportation results of the inequality and concentration on the consumption of the own component. Anyway, these two components are the ones that contributed more to inequality in 2002-2003. However, the component Durable goods has the smaller contribution (from 6% to 9%) due to the smaller weight on consumption (9%) in 2002-2003.

When we analyze the same three decompositions in 2008-2009, we notice that the contributions of Housing (31% to 36%) and Education, health and transportation (21% to 24%) decreased, while the contribution of Durable goods (11% to 15%) increased, indicating a certain change in the inequality structure in this period. Nevertheless, Housing and Education, health and transportation remained the components with the bigger contribution to inequality, while Durable goods is the component with the smaller contribution.

The counterfactual decomposition that replaces the components by zero, called Shapley-Gini(zero), also indicates an increase in the contribution of Durable goods (from 23% to 25%) and a reduction in the contributions of Housing (from 40% to 38%) and Education, health and transportation (from 18% to 16%) between the two editions of the survey.

#### 4.3. Inequality Change Decomposition

The last procedures adopted in relation to inequality aim at decomposing its evolution. For this purpose, six exercises were made, two of them, Gini(Hoffmann-Soares) and one Shapley-Gini(new), are dynamic aspects and the remaining four simply use the information already calculated of static decompositions above. The last four exercises are made, basically, from the variations of the absolute contributions of each component ( $\Delta A_{CV,k}$ ,  $\Delta A_{Gini,k}$ ,  $\Delta A_{mean,k}$  ou  $\Delta A_{zero,k}$ ) and the variations of the inequality indexes ( $\Delta CV$  ou  $\Delta I_{Gini}$ ). Next, the ratios of the variation of each component over the variation of inequality are calculated ( $\Delta A_{CV,k}/\Delta CV$ ,  $\Delta A_{Gini,k}/\Delta I_{Gini}$ ,  $\Delta A_{mean,k}/\Delta I_{Gini}$  ou  $\Delta A_{zero,k}/\Delta I_{Gini}$ ). The result is an estimate of the relative contribution of each component for the evolution of inequality.

The two dynamic decompositions follow different approaches. Shapley-Gini (new) is based on a new counterfactual exercise where the consumption components of 2002-2003 are replaced by the consumption components of 2008-2009, as suggested by Barros et al (2006) and Azevedo et al (2013). The Shapley value was used and, as the previous "static" exercises, we calculated the estimated contribution of component k in sequence t as  $A_{new,k}^t = \Delta_{new,k}^t I_{Gini}^t$ . Thus, the absolute and the relative contributions of component k are given, respectively, by  $A_{new,k} = \frac{\sum A_{new,k}^t}{T}$ , (onde  $t = 1, \dots, T$ ) and  $R_{new,k} = A_{new,k}/\Delta I_{Gini}$ .

Notice that in this decomposition there is no concern or interest in calculating the contribution of the component for the inequality level, but only the contribution to the change (or to the evolution) of the Gini index.

The second dynamic decomposition follows Hoffmann (2006) and Soares (2006). These authors calculate the absolute contribution of a component k as the result of two effects. The "composition effect" given by (5) and the "concentration effect" expressed by (6):

$$(5) W_k = \Delta S_k (\theta_k^* - I_{Gini}^*), \text{ onde } \theta_k^* = \frac{(\theta_{k,a} + \theta_{k,b})}{2}, I_{Gini}^* = \frac{(I_{Gini,a} + I_{Gini,b})}{2}, a = 2002\_2003, b = 2008\_2009$$

$$(6) U_k = \Delta \theta_k S_k^*, \text{ onde } S_k^* = \frac{(S_{k,a} + S_{k,b})}{2}$$

As a result, the absolute contribution of component k is given by:  $A_{wu,k} = W_k + U_k$  and the relative contribution of k is given by the ratio of the absolute contribution over the variation of the Gini index, that is,  $R_{wu,k} = A_{wu,k}/\Delta I_{Gini}$ .

The results obtained from these new exercises can be seen in the table below

**Table 8: Inequality Change Decomposition by Consumption Components**

<b>Δ Inequality Decomposition</b>				<b>Food</b>	<b>Durable goods</b>	<b>Housing</b>	<b>Education, health, transport</b>	<b>Others goods</b>	<b>Total</b>
<b>Ineq(POF_2008_2009) - Ineq(POF_2002_2003)</b>	<b>Analytical</b>	<b>CV</b>	$\Delta S_k$	-0.017	0.049	-0.015	-0.007	-0.010	0.000
			$\Delta(\rho_k \times CV_k)$	-0.010	0.103	0.026	-0.015	-0.121	.
			Absolute Contribution	-0.015	0.056	-0.011	-0.016	-0.034	-0.020
			<b>Relative Contribution</b>	<b>74%</b>	<b>-284%</b>	<b>56%</b>	<b>81%</b>	<b>171%</b>	<b>100%</b>
		<b>Gini</b>	$\Delta S_k$	-0.017	0.049	-0.015	-0.007	-0.010	0.000
			$\Delta \theta_k$	-0.004	0.038	-0.003	-0.027	-0.037	.
			Absolute Contribution	-0.007	0.029	-0.008	-0.009	-0.011	-0.007
			<b>Relative Contribution</b>	<b>109%</b>	<b>-448%</b>	<b>125%</b>	<b>139%</b>	<b>175%</b>	<b>100%</b>
		<b>Gini (Hoffmann-Soares)</b>	$W_k = \Delta S_k (\theta_k^* - l_{Gini}^*)$	0.002	0.001	0.000	-0.001	0.000	0.002
			$U_k = \Delta \theta_k S_k^*$	-0.001	0.004	-0.001	-0.004	-0.007	-0.008
			Absolute Contribution ( $W_k + U_k$ )	0.001	0.005	-0.001	-0.006	-0.006	-0.007
			<b>Relative Contribution</b>	<b>-21%</b>	<b>-77%</b>	<b>13%</b>	<b>86%</b>	<b>98%</b>	<b>100%</b>
	<b>Shapley</b>	<b>Gini (Mean)</b>	Absolute Contribution	-0.007	0.029	-0.008	-0.009	-0.011	-0.007
			<b>Relative Contribution</b>	<b>110%</b>	<b>-442%</b>	<b>123%</b>	<b>141%</b>	<b>168%</b>	<b>100%</b>
		<b>Gini (Zero)</b>	Absolute Contribution	0.006	0.008	0.003	-0.012	-0.011	-0.007
			<b>Relative Contribution</b>	<b>-88%</b>	<b>-121%</b>	<b>-51%</b>	<b>189%</b>	<b>171%</b>	<b>100%</b>
		<b>Gini (New)</b>	Absolute Contribution	-0.001	0.006	-0.005	-0.001	-0.006	-0.007
			<b>Relative Contribution</b>	<b>14%</b>	<b>-86%</b>	<b>71%</b>	<b>14%</b>	<b>86%</b>	<b>100%</b>

OBS:  $S_k^* = (S_{k,a} + S_{k,b})/2$ ,  $\theta_k^* = (\theta_{k,a} + \theta_{k,b})/2$ ,  $l_{Gini}^* = (l_{Gini,a} + l_{Gini,b})/2$ , a= 2002-2003 and b=2008-2009

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

Table 8 shows the result of these six processes, with the analytical being called: CV, Gini and Gini (Hoffmann-Soares); and the counterfactual based on Shapley's value are called: Gini (mean), Gini (zero) and Gini (new). The relative contributions with negative values indicate the component contributed to the increase of inequality; similarly, the positive values contributed to its reduction. We can notice that for the CV and Gini decompositions only the durable goods component has negatively contributed to the reduction of inequality. That is, if the inequality associated with this component is eliminated, the drop in inequality would be of 284% and 448%, respectively, more than that observed. The component other goods had significant impact for the reduction of inequalities, from 86% to 175%, depending on the decomposition method used.

In the Shapley-Gini(mean) decomposition, the consumption concentration of durable goods contributed, in absolute terms, with 0.029 points to the increase of Gini between 2002-2003 and 2008-2009, in relative terms the evolution of this concentration meant the component prevented inequality from dropping 442% more than the registered drop.

The dynamic decompositions Shapley-Gini (new) and Gini (Hoffmann-Soares) indicate that, if the inequality generated by the evolution of durable goods is eliminated, the Gini index would be reduced 86% and 77%, respectively, more than it has been observed. On the other hand, the component Other goods was the one that contributed more for the reduction of inequalities (86% and 98%).

## 5. Analysis of Poverty from the perspective of the consumption behavior and its components

In this section, we study the effects of the evolution of consumption over poverty using graphical and dominance analyses as well as counterfactual analyses based on Shapley's value. For this

purpose, two previous exercises are necessary, as defined by Sen (1976, 1982): the identification exercise and the aggregation exercise<sup>20</sup>.

The Identification exercise is, in general, based on some poverty line ( $z$ ) that sets a limit to the welfare indicator, in this case the PCC. The poor are the ones whose welfare indicator (PCC) is below the poverty line. The non-poor are the ones whose welfare (PCC) is greater or equal to this line<sup>21</sup>. In this work, as in Oliveira et al (2016), we adopted two absolute lines based on the minimal wage. The calculation of the poverty line and the identification were made in two steps: i) selection of families with *per capita* income around half minimum wage (between R\$202.50 and R\$212.50) and a quarter of the minimum wage (between R\$101.25 and R\$106.25) in 2008; ii) calculation of the median *per capita* consumption of these two groups, which generated the lines R\$ 207 and R\$104. It is worth highlighting that this calculation process was made using the values of the consumption aggregate that was carried out in 2008-2009.

For the aggregation step of poverty analysis, let's calculate the three poverty measures of the FGT family (Foster, Greer and Thorbecke, 1984) that are the indexes of main reference in literature for the subject. According to equation 7, we have:

$$(7) FGT(\alpha) = \frac{1}{n} \sum_{i=1}^n \left[ \frac{z - c_i}{z} \right]^\alpha S_i$$

where  $z$  is the value of the poverty line,  $c_i$  is the value of the consumption of individual  $i$  and  $S_i$  is a dummy variable that equals 1 if the  $i$ -nth individual is below the poverty line and 0, otherwise.

The poverty measures of the family FGT are functions of the poverty gap and the value of  $\alpha$ . The measures of incidence and intensity of poverty are not sensitive to the consumption inequality among the poor, that is, a progressive redistribution of consumption in the poor population is not captured by the measures FGT [ $\alpha=0$ ] or FGT [ $\alpha=1$ ]. Only the severity of poverty is sensitive to inequality among the poor, then the more heterogeneous the poor population, *ceteris paribus*, the greater the value of the FGT [ $\alpha=2$ ] indicator. For this reason, we will focus our analyses in this index.

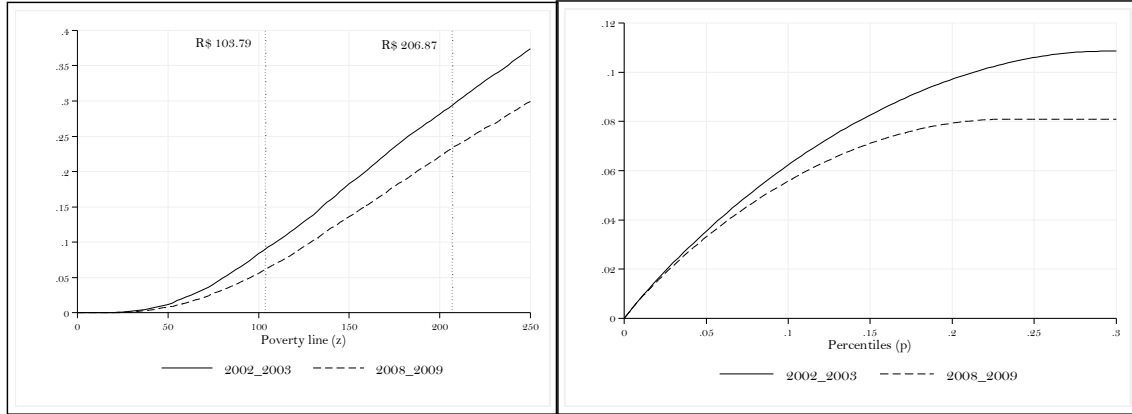
Figure 4-a shows the proportion of poor people in Brazil, in 2002-2003 and 2008-2009, for different poverty lines ( $R\$1 \leq z \leq R\$ 250$ ). That helps viewing the sensitivity of the identification exercise showed on the inclination of the curves around the lines R\$ 207 and R\$ 104. We notice the curve of 2002-2003 is always more inclined (more sensitive) than the curve of 2008-2009, which indicates that in 2002-2003 the number of poor people grows more than in 2008-2009 as the value of the poverty line increases. Besides, we notice there is a decrease in the proportion of poor people in this period, no matter the line used. As a result, we can say the curve of 2008-2009 dominates the curve of 2002-2003<sup>22</sup>. Then, the poverty measures of the FGT family, which are presented in this work, were all greater than in 2002-2003. For example, for the line R\$104,

<sup>20</sup>Besides the emphasis given to the identification and aggregation, the Sen studies showed the limitations of the poverty measures more commonly used at that time and stimulated an axiomatic approach where the indexes are created to meet certain properties/axioms and are evaluated by the adequacy of these axioms.

<sup>21</sup>For more details on the different methodologies, definitions and interpretations of the absolute, relative and subjective lines, see Ravallion (2001), Atkinson et al (2002) and Soares (2009).

<sup>22</sup>More details can be found in Chakravarty (2009), Sen and Foster (1997), Lambert (2001), Duclos and Araar (2006).

the proportion of poor people ( $FGT(\alpha=0)$ ) is around 9% in 2002-2003 and around 6% in 2008-2009. In turn, for the line R\$ 207, the portion of the poor population is close to 29% in 2002-2003 and close to 23% in 2008-2009.



**Figure 4: (a) FGT Curves ( $\alpha = 0$ )** **(b) Cumulative Poverty Gap Curves ( $z = R\$ 207$ )**  
Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002–2009

The calculated gaps poverty curve (accumulated)<sup>23</sup>, Figure 4-b, shows another dominance relation that reflects the results of the Generalized Lorenz Curve. The gaps curve for the line R\$207 of 2002-2003 is always above the curve of 2008-2009. That means the poverty measures with good properties and sensitive to consumption inequalities among the poor will be all greater in 2002-2003 than in 2008-2009.

The two dominance relations described above ensure poverty will be smaller in 2008-2009 for the indexes of the FGT family and many others such as, for example, the Watts and the Sen-Shorrocks-Thon indexes<sup>24</sup>.

## 5.1. Poverty Decomposition

The effects of the consumption evolution and its components over poverty was also measured from the static and dynamic decompositions. In the following subsections, we will describe the methods used in the decompositions and the results obtained.

### 5.1.1. Growth of *per capita* consumption, inequality and poverty reduction

The distribution of the *per capita* consumption can be described by its mean and the Lorenz curve,  $c(\mu, L)$ . Thus, we can represent the poverty index as  $FGT(\alpha, \mu, L, z)$ . That enables the separation of the impact of consumption growth from the impact of inequality on poverty by some counterfactual simulations and the Shapley value. In this case, the two elements of counterfactual simulation are  $\mu$  and  $L$ , and the exercises consist of evaluating the index value when we change each one of these elements in two possible orders. Remember that the Shapley value is the mean of the obtained impacts. As a result, for constant  $\alpha$  and  $z$ , the absolute impact of growth on poverty is given by:

<sup>23</sup>The absolute gaps are given by  $G_i = \max\{z - c_i, 0\}$ , where  $z$  is the poverty line and  $c_i$  is the per capita consumption of individual  $i$ . The standardized gaps are given by  $g_i = \max\{(z - c_i)/z, 0\}$ . In Figure 4-b, the coordinates of the gaps curve are defined as:  $CPG(p) = \sum_p g_i / N$ , where  $N$  is the total population and  $\sum_p g_i$  is the accumulated total of standardized gaps until percentile  $p$ . More details are found in Chakravarty (2009), Sen and Foster (1997), Lambert (2001) and Duclos and Araar (2006).

<sup>24</sup>These other indexes are found in Chakravarty (2009), Sen and Foster (1997), Lambert (2001), Duclos and Araar (2006).



$$(8) A_{FGT,\mu} = \frac{[FGT(\mu_1, L_0) - FGT(\mu_0, L_0) + FGT(\mu_1, L_1) - FGT(\mu_0, L_1)]}{2}$$

Where  $\mu_0$  = mean PCC of 2002-2003;  $\mu_1$  = mean PCC of 2008-2009;  $L_0$  = Lorenz curve of 2002-2003;  $L_1$  = Lorenz curve of 2008-2009.

Comparably, the absolute impact of inequality on poverty is given by:

$$(9) A_{FGT,L} = \frac{[FGT(\mu_0, L_1) - FGT(\mu_0, L_0) + FGT(\mu_1, L_1) - FGT(\mu_1, L_0)]}{2}$$

Since the Shapley value generates exact decompositions, the relative impact is obtained from the ratios:

$$(10) R_{FGT,\mu} = \frac{A_{FGT,\mu}}{A_{FGT,\mu} + A_{FGT,L}} = \frac{A_{FGT,\mu}}{FGT(\mu_1, L_1) - FGT(\mu_0, L_0)} = \frac{A_{FGT,\mu}}{\Delta FGT}$$

$$(11) R_{FGT,L} = \frac{A_{FGT,L}}{A_{FGT,\mu} + A_{FGT,L}} = \frac{A_{FGT,L}}{FGT(\mu_1, L_1) - FGT(\mu_0, L_0)} = \frac{A_{FGT,L}}{\Delta FGT}$$

Table 9: Poverty decomposition by Brazil and Geographical Areas

Poverty = FGT		POF	Brazil	North	Northeast	Southeast	South	Midwest	Urban Areas	Rural Areas
Poverty Line = R\$206.87	FGT( $\alpha=0$ )	2002-2003	0.294	0.444	0.472	0.197	0.173	0.263	0.254	0.487
		2008-2009	0.234	0.347	0.390	0.158	0.107	0.194	0.201	0.391
		Dif.	-0.060	-0.096	-0.082	-0.039	-0.066	-0.069	-0.053	-0.096
		Growth effect	93%	98%	97%	103%	75%	89%	93%	122%
	FGT( $\alpha=1$ )	2002-2003	0.109	0.170	0.190	0.066	0.055	0.090	0.090	0.200
		2008-2009	0.081	0.122	0.147	0.049	0.032	0.062	0.066	0.152
		Dif.	-0.028	-0.048	-0.044	-0.017	-0.023	-0.028	-0.023	-0.048
		Growth effect	98%	103%	101%	104%	87%	93%	95%	142%
	FGT( $\alpha=2$ )	2002-2003	0.054	0.086	0.100	0.031	0.024	0.042	0.044	0.107
		2008-2009	0.039	0.059	0.074	0.023	0.013	0.027	0.031	0.079
		Dif.	-0.015	-0.027	-0.026	-0.009	-0.011	-0.015	-0.013	-0.028
		Growth effect	100%	108%	104%	105%	91%	91%	96%	150%
Poverty Line = R\$103.79	FGT( $\alpha=0$ )	2002-2003	0.090	0.153	0.171	0.050	0.034	0.061	0.071	0.184
		2008-2009	0.061	0.096	0.122	0.033	0.018	0.037	0.047	0.134
		Dif.	-0.029	-0.057	-0.049	-0.016	-0.017	-0.025	-0.024	-0.050
		Growth effect	95%	101%	102%	85%	95%	104%	88%	154%
	FGT( $\alpha=1$ )	2002-2003	0.025	0.040	0.051	0.013	0.009	0.017	0.019	0.057
		2008-2009	0.017	0.025	0.035	0.009	0.004	0.008	0.012	0.039
		Dif.	-0.009	-0.014	-0.016	-0.004	-0.005	-0.009	-0.007	-0.018
		Growth effect	102%	122%	107%	103%	90%	72%	96%	160%
	FGT( $\alpha=2$ )	2002-2003	0.011	0.015	0.022	0.005	0.003	0.007	0.008	0.025
		2008-2009	0.007	0.010	0.015	0.004	0.001	0.003	0.005	0.016
		Dif.	-0.004	-0.006	-0.007	-0.001	-0.002	-0.005	-0.003	-0.009
		Growth effect	108%	139%	110%	125%	97%	58%	104%	164%

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

Table 9 shows the values of FGT( $\alpha=0$ ), FGT( $\alpha=1$ ) and FGT( $\alpha=2$ ) of 2002-2003 and 2008-2009 to Brazil, major regions, urban and rural areas, as well as their variations and the contribution (or the effect) related to growth using the two poverty lines of reference (R\$ 207 and R\$ 104).

As expected, poverty reduced in Brazil for the three values of  $\alpha$  and for the two poverty lines. Moreover, that occurs in all the regions, in the urban and rural areas. The greater decreases occurred in the North and Northeast regions and in the rural areas. For FGT( $\alpha=2$  and  $z=R\$207$ ), poverty dropped from 0.054 to 0.039 in Brazil. The reduction of poverty in the North and the Northeast regions was of 0.027 and 0.026, respectively. In the rural areas, poverty reduced from 0.107 to 0.079. For the FGT( $\alpha=2$  and  $z=R\$104$ ) index, the reduction of poverty was also more

significant for these regions. Brazil registered a drop of 0.004, the North and Northeast regions moved from 0.015 to 0.010, from 0.022 to 0.015, respectively, and in the rural areas, the reduction was of 0.009.

The Southeast region was the Major Region that registered the lower decrease in poverty for both poverty lines used in the FGT indexes.

As we can notice, in general, the effect of the consumption growth has values close to or greater than 100%, which indicate the reduction in poverty registered by  $FGT(\alpha=2)$  for the two lines of poverty ( $z=R\$207$  and  $R\$104$ ) are explained by the growth and not for the variation of inequalities.

In the Midwest region, there was the lowest reduction in poverty due to the consumption growth since only 58% of the drop in  $FGT(\alpha=2)$  and  $z=R\$104$  is explained by the increase of  $\mu$  and the remaining (42%) by variations of  $L$ .

### 5.1.2. Poverty Decomposition by Consumption Components

The contribution of consumption components for the poverty levels observed and their evolution was measured from the counterfactual exercises and the decompositions based on Shapley value, similarly to the exercises made for inequality in section 3.2.

The first exercise, called Shapley-FGT(zero) is based on Shorrocks ([1999]2013) and Duclos and Araar (2006). It is a static exercise that tries to identify how the consumption components determine the poverty levels observed. The calculation was made for the three values of  $\alpha$  (0, 1 and 2) and for the two poverty lines adopted ( $R\$207$  and  $R\$104$ ). In this exercise, we initially consider the maximum value of poverty, when all the consumption components are zero (max  $FGT=1$ ). Then, we consider the first sequence of five steps. In each step, one of the consumption components ( $k$ ) is added. The variation of the poverty index, given through  $A^1_{F,zero,k} = \Delta^1_{zero,k} FGT$ , is calculated and kept as an estimated contribution for this component. In the end of the first sequence, we have five estimated contributions, one for each component. Later, we make a second sequence also with five steps, where components are added in a new order. Again, the variation of the poverty index is calculated and kept in each one of the five steps, and we obtain  $A^2_{F,zero,k}$ ,  $k=1, \dots, 5$ . The exercise proceeds until all the possible  $T$  sequences of five steps are covered.

We consider the mean of the estimated contributions of component  $k$  as the absolute contribution, which is given by  $A_{F,zero,k} = \frac{\sum A^t_{F,zero,k}}{T}$ ,  $t=1, \dots, T$ . Negative values in  $A_{F,zero,k}$  indicate that the component  $k$  reduces poverty. When the component is eliminated, poverty increases by  $[-A_{F,zero,k}]$ . The relative contribution of component  $k$  is given by  $R_{F,zero,k} = A_{F,zero,k} / (\sum A_{F,zero,k}, k=1, \dots, 5) = A_{F,zero,k} / (FGT-1)$ .

Table 10 shows the results of the Shapley-FGT(zero) decomposition for the several calculated indexes. Housing and food represent the greatest absolute contributions in 2002-2003 and 2008-2009 for all the adopted measures and lines. However, the relative contributions of these components were reduced in the period under analysis. For the  $FGT(\alpha=2)$  index and the poverty line  $R\$207$ , the relative contributions of housing and food changed from 31% to 30% and from 29% to 27% in 2008-2009, respectively. On the other hand, the relative contribution of durable

goods increased, changing from 10% to 13% in 2008-2009. For the  $FGT(\alpha=2)$  index and the poverty line R\$104, we notice similar movements. These results suggest a change in the consumption of the poorest people, with the durable goods gaining importance in the determination of the observed poverty levels.

**Table 10: Share and Shapley-FGT(zero) decompositions - absolute and relative contribution by consumption components**

Share and Decompositions: Absolute and Relative Contribution				Food	Durable goods	Housing	Education, health, transport	Others goods	Total		
POF 2002-2003	Poverty Line = R\$ 207		Component Share	24%	9%	34%	16%	18%	100%		
			FGT( $\alpha=0$ )		Absolute Contribution	-0.197	-0.060	-0.242	-0.080	-0.127	-0.706
					Relative Contribution	28%	9%	34%	11%	18%	100%
			FGT( $\alpha=1$ )		Absolute Contribution	-0.261	-0.086	-0.290	-0.085	-0.170	-0.891
					Relative Contribution	29%	10%	32%	10%	19%	100%
			FGT( $\alpha=2$ )		Absolute Contribution	-0.275	-0.099	-0.296	-0.089	-0.187	-0.946
	Relative Contribution	29%			10%	31%	9%	20%	100%		
	Poverty Line = R\$ 104		FGT( $\alpha=0$ )		Absolute Contribution	-0.275	-0.084	-0.310	-0.079	-0.161	-0.910
					Relative Contribution	30%	9%	34%	9%	18%	100%
			FGT( $\alpha=1$ )		Absolute Contribution	-0.286	-0.103	-0.302	-0.089	-0.195	-0.975
					Relative Contribution	29%	11%	31%	9%	20%	100%
			FGT( $\alpha=2$ )		Absolute Contribution	-0.280	-0.114	-0.291	-0.096	-0.207	-0.989
					Relative Contribution	28%	12%	29%	10%	21%	100%
	POF 2008-2009	Poverty Line = R\$ 207		Component Share	22%	13%	32%	15%	17%	100%	
FGT( $\alpha=0$ )				Absolute Contribution	-0.201	-0.106	-0.246	-0.079	-0.134	-0.766	
				Relative Contribution	26%	14%	32%	10%	18%	100%	
FGT( $\alpha=1$ )				Absolute Contribution	-0.251	-0.120	-0.283	-0.089	-0.176	-0.919	
				Relative Contribution	27%	13%	31%	10%	19%	100%	
FGT( $\alpha=2$ )				Absolute Contribution	-0.261	-0.126	-0.287	-0.095	-0.192	-0.961	
		Relative Contribution	27%	13%	30%	10%	20%	100%			
Poverty Line = R\$ 104		FGT( $\alpha=0$ )		Absolute Contribution	-0.265	-0.119	-0.301	-0.083	-0.170	-0.939	
				Relative Contribution	28%	13%	32%	9%	18%	100%	
		FGT( $\alpha=1$ )		Absolute Contribution	-0.268	-0.126	-0.292	-0.097	-0.200	-0.983	
				Relative Contribution	27%	13%	30%	10%	20%	100%	
		FGT( $\alpha=2$ )		Absolute Contribution	-0.262	-0.136	-0.281	-0.104	-0.210	-0.993	
				Relative Contribution	26%	14%	28%	10%	21%	100%	

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002–2009

### 5.1.3. Poverty Change Decomposition

In order to evaluate how the changes in the consumption structure impacted the evolution of poverty, two additional exercises were made. The first one used information of the static decompositions of the previous subsection. For this purpose, we consider the differences of the absolute contributions of each component  $k$  (given by  $\Delta A_{F,zero,k}$ ) and the variations of poverty indexes ( $\Delta FGT$ ). Then, we calculate the ratios of the variation of each component over the variation of the FGT ( $\Delta A_{F,zero,k}/\Delta FGT$ ). As a result, we have estimates of the relative contributions of components in the evolution of poverty.

The second exercise, called Shapley-FGT(new), is a dynamic exercise based in counterfactuals already made, in a similar way to the work done in section 3.3, where the consumption components of 2002-2003 were replaced by consumption components of 2008-2009, as suggested by Barros et al (2006) and Azevedo et al (2013). The Shapley value was used and, in a similar way, we calculated the estimated contribution of component  $k$  in the sequence  $t$  as

$A_{F,new,k}^t = \Delta_{F,new,k}^t FGT$ . Thus, the absolute and the relative contributions of component k are given through, respectively, by  $A_{F,new,k}^t = \frac{\sum A_{F,new,k}^t}{T}$ , (onde  $t = 1, \dots, T$ ) e  $R_{F,new,k} = A_{F,new,k}^t / \Delta FGT$ .

It is worth highlighting that in the Shapley-FGT(new) exercise there is no concern or interest in calculating the contribution of the component to the poverty level, but only its contribution to the variation of the FGT index.

**Table 11: Poverty Change Decomposition – Absolute and Relative Contribution by Consumption Components**

Decomposition ( $\Delta$ poverty): Absolute and Relative Contribution				Food	Durable goods	Housing	Education, health, transport	Others goods	Total	
Poverty(POF_2008_2009) - Poverty(POF_2002_2003)	Shapley (zero)	Poverty Line = R\$ 207	FGT( $\alpha=0$ )	Absolute Contribution	-0.004	-0.046	-0.004	0.001	-0.007	-0.060
				Relative Contribution	7%	76%	7%	-1%	11%	100%
			FGT( $\alpha=1$ )	Absolute Contribution	0.010	-0.034	0.007	-0.004	-0.006	-0.028
				Relative Contribution	-37%	124%	-24%	16%	21%	100%
			FGT( $\alpha=2$ )	Absolute Contribution	0.015	-0.028	0.009	-0.006	-0.005	-0.015
				Relative Contribution	-95%	181%	-59%	41%	32%	100%
		Poverty Line = R\$ 104	FGT( $\alpha=0$ )	Absolute Contribution	0.010	-0.035	0.009	-0.004	-0.009	-0.029
				Relative Contribution	-35%	121%	-31%	15%	30%	100%
			FGT( $\alpha=1$ )	Absolute Contribution	0.017	-0.023	0.010	-0.008	-0.005	-0.009
				Relative Contribution	-201%	265%	-113%	90%	59%	100%
			FGT( $\alpha=2$ )	Absolute Contribution	0.018	-0.021	0.011	-0.008	-0.003	-0.004
				Relative Contribution	-488%	585%	-291%	217%	77%	100%
	Shapley (New)	Poverty Line = R\$ 207	FGT( $\alpha=0$ )	Absolute Contribution	-0.012	-0.011	-0.019	-0.003	-0.016	-0.060
				Relative Contribution	19%	18%	32%	4%	27%	100%
			FGT( $\alpha=1$ )	Absolute Contribution	-0.003	-0.005	-0.010	-0.001	-0.008	-0.028
				Relative Contribution	11%	19%	37%	3%	30%	100%
			FGT( $\alpha=2$ )	Absolute Contribution	-0.001	-0.003	-0.006	0.000	-0.005	-0.015
				Relative Contribution	5%	21%	40%	3%	31%	100%
		Poverty Line = R\$ 104	FGT( $\alpha=0$ )	Absolute Contribution	-0.002	-0.006	-0.011	-0.001	-0.009	-0.029
				Relative Contribution	5%	21%	40%	4%	31%	100%
			FGT( $\alpha=1$ )	Absolute Contribution	0.000	-0.002	-0.004	0.000	-0.003	-0.009
				Relative Contribution	-5%	26%	43%	3%	33%	100%
			FGT( $\alpha=2$ )	Absolute Contribution	0.001	-0.001	-0.002	0.000	-0.001	-0.004
				Relative Contribution	-14%	32%	47%	2%	34%	100%

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002--2009

Table 11 shows the contributions of the different components for the drop of poverty in the counterfactuals. In the dynamic Shapley-FGT(new) exercise, housing is the PCC component with the greatest contribution to the drop of poverty, for all the measures and lines used. For the FGT( $\alpha=2$ ) index, the contribution was of 40% (for the line R\$207) and 47% (for the line R\$104). The durable goods also contributed for the drop in poverty, but in a more discrete way when compared to housing and other goods. When we analyze the drop in the FGT( $\alpha=2$ ) index, the contribution of the durable goods was of 21% (for the line R\$207) and 32% (for the line R\$104).

The results obtained with the Shapley-FGT(zero) exercise suggest a different scenario where the durable goods had an even greater contribution. The FGT( $\alpha=2$ ) index was of 181% and 585% for the poverty lines R\$207 and R\$104, respectively. Thus, we can say that, when we analyze this decomposition, the component durable goods had an essential role for the reduction of poverty.

## 6. Concluding Remarks

This article had the purpose of evaluating how the impact of the consumption growth and its composition reflect on the welfare, the reduction of inequality and poverty among the Brazilian families, incorporating a dynamic aspect in the analysis. In order to do that, consumption aggregates were constructed with data of the POF editions carried out in 2002-2003 and 2008-2009, based on the methodology applied in Oliveira et al (2016).

To construct a consumption aggregate capable of reflecting the welfare of families, several complex steps of expenditure item selection and data treatment are necessary. In order to compare the POF editions of 2002-2003 and 2008-2009 it was necessary to make some changes in the procedures adopted in Oliveira et al (2016). Two types of price deflators were used. For the spatial correction of prices, we used a Laspeyres (adapted) price index to replace the Paasche index used in the article mentioned above. In relation to the time correction, we chose to use specific and more suitable deflators for the expense items that compose the consumption aggregate.

Other important step in the construction of the consumption aggregate was the use of the value of services related to durable goods that are incorporated according to the use cost and not the acquisition value. The inclusion of the durable goods is made from the survey inventory, which registers the history of acquisition of these goods by the families. Thus, the consumption aggregate starts capturing the evolution of the available services in the domicile, as well as the associated welfare.

The evaluation of the *per capita* consumption registered an increase of 17% between 2002-2003 and 2008-2009. Besides, there was also an increase in all the major regions, and in urban and rural areas, as well as in all the five components that were evaluated (Food, Durable goods, Housing, Education, health and transportation and Other goods) registered growth in the period. However, the component Durable Goods was the main focus, being responsible for around 40% of this growth, followed by Housing (25%).

In order to analyze the effects of the consumption growth on the social welfare, social welfare functions were adopted represented by the Sen mean (associated with the Gini index) and the geometric mean (associated with the Atkinson index) and they are sensitive to both growth and redistribution. The results show the main engine of the welfare growth was the consumption growth and not its redistribution, since the reduction of inequalities was modest. One exception was the South region, whose reduction of inequalities contributed with more than 10% for the welfare growth.

By the deficit share of the Lorenz and the concentration curves, we can evaluate how the consumption components influenced inequality and welfare. Thus, we noticed that Education, health and transportation and Other goods became less concentrated, contributing for the reduction of inequality. On the other hand, the concentration of Durable goods increased, reducing the speed of the drop in inequality.

These evidences were also showed by exercises of analytical and counterfactual decompositions based on the calculation of Shapley value. According to the results of Shapley-Gini(new) and Gini(Hoffmann-Soares) dynamic decompositions, if the inequality generated by the evolution of Durable goods is eliminated, the inequality reduction would be of 86% and 77%, respectively, greater than that observed. Both the static and the dynamic exercises showed the unequal growth of Durable goods limited the inequality reduction and changed its structure between the two editions of the POF.

In relation to the measurement of the growth impact of the mean PCC and the inequality over poverty, results showed there is a dominance relationship of the proportion curve of poor people in 2008-2009 compared with 2002-2003, demonstrating poverty in 2008-2009 was lower for the different lines of absolute poverty.

The exercises of counterfactual decomposition of poverty and the calculations made by Shapley value, indicated that in this period poverty decreased in Brazil for any value of  $\alpha$  (0, 1 or 2) used and for the two poverty lines (R\$207 and R\$104) applied. The same result appeared for all the major regions and urban and rural areas. The North and Northeast regions and the rural areas were the places where the greatest reductions of poverty were registered.

The decomposition analysis of poverty per consumption component that was carried out by the Shapley-FGT(zero) exercise showed the housing and food components were the ones that registered the greatest absolute contributions to the poverty reduction, in the two periods analyzed, for all the values of  $\alpha$ , according to lines R\$207 and R\$104. Also, a change in the consumption structure of the poorest people was registered due to the increase of the relative contribution of the durable goods component in 2008-2009.

The results obtained by the Shapley-FGT(new) dynamic decomposition indicated housing was the component that contributed more in relative terms for the reduction of poverty for all the analyzed FGT measures and poverty lines. The relative contributions of this component varied from 32% to 47% depending on the analyzed index. Other component that deserves highlighting was durable goods, which measured by FGT( $\alpha=2$ ) contributed with 21%( $z=R\$207$ ) and 32%( $z=R\$104$ ). However, this component registered an even more significant result by the Shapley-FGT(zero) decomposition, contributing with 181% ( $z=R\$207$ ) and 585% ( $z=R\$104$ ) for the FGT( $\alpha=2$ ).

The main results found in this work showed that although the growth of the mean *per capita* consumption was headed by the strong increase of the durable goods component, it was also the main responsible for the limited reduction of inequality in the period between 2002-2003 and 2008-2009. Then we have the durable goods component being responsible for both the considerable increase of welfare among the Brazilian families and the generation of new inequalities, that limited the drop in the Gini index. In relation to the impact of the consumption growth over poverty, we observed poverty reduction in all the geographic areas studied regardless of the measure and the poverty line used. Considering the decompositions per consumption component, we showed housing and durable goods were the components that contributed more for the reduction of the registered poverty.

Possible extensions of this study are, among other exercises, to apply other decompositions should be made and they should be based on demographic and socioeconomic profiles and also in characteristics of domiciles with the purpose of improving the studies on welfare, inequality and poverty or even other topics.

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## Appendix

### Appendix 1: Imputation of food expenditures

(a) Explanatory variables of the model for the imputation of food expenditures POF 2002-2003

Variable	Coefficient	Standard Error	Wald Chi-Square	Pr>ChiSq
Intercept	-0.6369	0.1838	12.0099	0.0005
If the household is own	-0.1429	0.0474	9.0827	0.0026
If the household head holds health plan	-0.1659	0.0656	6.3928	0.0115
If the household head has 7 years or less of school completed	0.0959	0.0512	3.5088	0.0610
Spouse in the household	-0.3155	0.0593	28.2823	<.0001
No bathroom in the household	0.1154	0.0583	3.9200	0.0477
Type of family: male household head having children	-0.2300	0.1257	3.3486	0.0673
Type of family: female household head having children	-0.2162	0.0694	9.6948	0.0018
Members of household per room	-0.1057	0.0659	2.5715	0.1088
Household head age	-0.0163	0.0084	3.8103	0.0509
Household head squared age	0.0002	0.0001	3.9607	0.0466
Total of children under 7 years old in the household	-0.0839	0.0316	7.0486	0.0079
Monthly household income	-0.0001	0.0000	8.6621	0.0032
If the household is in the North Region	-0.5580	0.0672	69.0322	<.0001
If the household is in the Northeast Region	-0.5148	0.0551	87.4038	<.0001
If the household is in the Southeast Region	-0.3112	0.0658	22.3653	<.0001
If the household is in the South Region	-0.2753	0.0620	19.7350	<.0001
AIC			14,124,205	
Number of Observations			48,568	

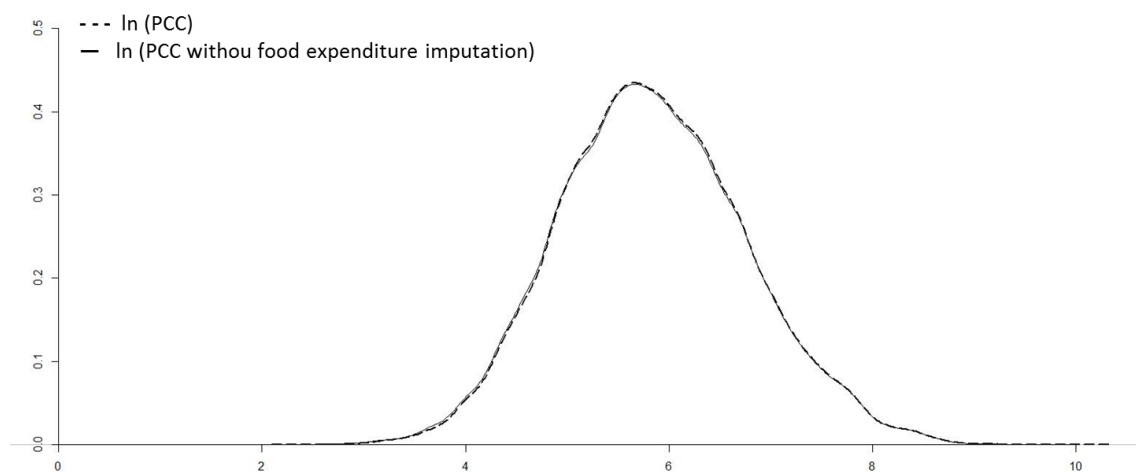
(b) Explanatory variables of the model for the imputation of food expenditures POF 2008-2009

Variable	Coefficient	Standard Error	Wald Chi-Square	Pr>ChiSq
Intercept	0.3100	0.1544	4.0323	0.0446
If the household water is provided by the supply company	-0.0892	0.0480	3.4516	0.0632
If the household is own	-0.2183	0.0452	23.3601	<.0001
If the household is rented	-0.2156	0.0591	13.3072	0.0003
Literate household head	-0.2041	0.0400	25.9691	<.0001
If the household head holds health plan	-0.0591	0.0444	1.7743	0.1829
If the household head has 7 years and less of school completed	0.0916	0.0381	5.7865	0.0162
Spouse in the household	-0.2696	0.0450	35.9538	<.0001
Mud and coated household	-0.1222	0.0509	5.7595	0.0164
No bathroom in the household	0.1795	0.0711	6.3782	0.0116
Type of family: husband-wife household having children	-0.1668	0.0467	12.7715	0.0004
Type of family: male household head having children	-0.3779	0.1147	10.8559	0.0010
Type of family: female household head having children	-0.3299	0.0552	35.7113	<.0001
If the household is in the urban area	-0.1019	0.0526	3.7523	0.0527
Members of household per room	-0.1548	0.0581	7.1000	0.0077
Household head age	-0.0131	0.0051	6.7160	0.0096
Household head squared age	0.0002	0.0000	9.2377	0.0024
Total of children under 7 years old in the household	-0.0425	0.0264	2.5777	0.1084
Total of children between 7 and 14 years old in the household	-0.0969	0.0253	14.7075	0.0001
Proportion of household members receiving some income	-0.4721	0.0776	36.9603	<.0001
Monthly household income	0.0000	0.0000	6.3649	0.0116
If the household is in the North Region	-0.7035	0.0578	147.8841	<.0001
If the household is in the Northeast Region	-0.6756	0.0445	230.5557	<.0001
If the household is in the Southeast Region	-0.3037	0.0421	51.9432	<.0001
If the household is in the South Region	-0.3593	0.0511	49.4329	<.0001
AIC			20,148,578	
Number of Observations			56,091	

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2009

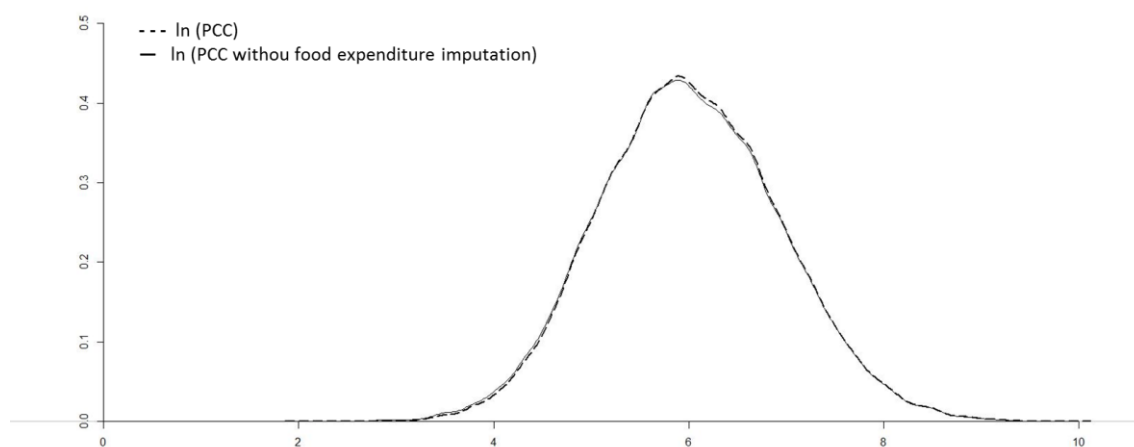
## Appendix 1: Imputation of food expenditures

(c) *Per Capita* Consumption Distribution 2002-2003 (log scale)



Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2009

(d) *Per Capita* Consumption Distribution 2008-2009 (log scale)



Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2009

## Appendix 2: Main household durable goods inventory

POF 2002-2003		POF 2008-2009	
Code	Itens	Code	Itens
14031	ANTENA PARABOLICA	14027	ANTENA PARABOLICA
14020	AR-CONDICIONADO	14028	APARELHO DE DVD
14008	ASPIRADOR DE PO	14017	AR-CONDICIONADO
14024	AUTOMOVEL	14009	ASPIRADOR DE PO
14005	BATEDEIRA DE BOLO	14021	AUTOMOVEL
14025	BICICLETA	14030	BATEDEIRA DE BOLO
14015	CONJUNTO DE SOM ACOPLADO	14022	BICICLETA
14033	DVD	14005	CHUVEIRO ELETRICO
14009	ENCERADEIRA	14015	EQUIPAMENTO DE SOM
14010	FERRO ELETRICO	14011	FERRO ELETRICO
14001	FOGAO	14020	FILTRO DE AGUA
14030	FORNO DE MICROONDAS	14001	FOGAO
14002	FREEZER	14026	FORNO DE MICROONDAS
14003	GELADEIRA	14010	FORNO ELETRICO
14016	GRAVADOR E TOCA-FITAS	14002	FREEZER
14006	LIQUIDIFICADOR	14003	GELADEIRA
14022	MAQUINA DE COSTURA	14008	GRILL
14004	MAQUINA DE LAVAR LOUCAS	14006	LIQUIDIFICADOR
14011	MAQUINA DE LAVAR ROUPAS	14019	MAQUINA DE COSTURA
14012	MAQUINA DE SECAR ROUPAS	14032	MAQUINA DE LAVAR LOUCAS
14027	MICROCOMPUTADOR	14012	MAQUINA DE LAVAR ROUPAS
14026	MOTOCICLETA	14029	MAQUINA DE SECAR ROUPAS
14029	PURIFICADOR DE AGUA	14024	MICROCOMPUTADOR
14017	RADIO	14023	MOTOCICLETA
14023	SECADOR DE CABELOS	14007	PROCESSADOR DE ALIMENTOS
14013	TELEVISAO EM CORES	14025	PURIFICADOR DE AGUA
14014	TELEVISAO EM PRETO E BRANCO	14016	RADIO
14032	TOCA-DISCOS A LASER	14031	SECADOR DE CABELOS
14007	TORRADEIRA ELETRICA	14013	TELEVISAO EM CORES
14021	VENTILADOR E/OU CIRCULADOR DE AR	14014	TELEVISAO EM PRETO E BRANCO
14028	VIDEOCASSETE	14018	VENTILADOR E/OU CIRCULADOR DE AR

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2009

### Appendix 3: Food Items Consumption basket

(a) Food Items Consumption basket 2002-2003

POF CODE	Food Items Consumption basket 2002-2003	POF CODE	Food Items Consumption basket 2002-2003
1103	Arroz não especificado	7105	Contrafilé
1104	Arroz polido	7201	Acém
1105	Milho em grão	7203	Carne moída
1107	Milho verde em espiga	7204	Carne não especificada
1207	Feijão-preto	7205	Costela
1208	Feijão-rajado	7207	Músculo
1299	Outras leguminosas	7304	Carne moída não especificada
2103	Alface	7399	Outras carnes bovinas outras
2109	Repolho	7503	Mortadela
2201	Abóbora	7506	Presunto
2205	Cebola	7508	Salsicha comum
2206	Chuchu	7603	Lingüiça
2210	Pepino fresco	8103	Fígado
2211	Pimentão	9118	Sardinha em conserva
2213	Tomate	10105	Frango abatido (inteiro)
2301	Alho	11102	Leite condensado
2305	Batata-doce	11104	Leite de vaca pasteurizado
2306	Batata-inglesa	11202	Queijo mozzarella
2307	Beterraba	11205	Queijo prato
2309	Cenoura	11301	Iogurte
3111	Banana-prata	11303	Manteiga
3112	Outras bananas	12101	Açúcar cristal
3118	Laranja-pêra	12104	Açúcar refinado
3120	Outras laranjas	12206	Doce de fruta em pasta
3122	Limão comum	12299	Outros doces e produtos de confeitaria
3125	Manga	12301	Chocolate em pó
3127	Melancia	13102	Sal refinado
3204	Maçã	13201	Caldo de carne em tablete
5101	Farinha de mandioca	13202	Caldo de galinha em tablete
5103	Farinha de trigo	13207	Maionese
5104	Farinha vitaminada	13208	Massa de tomate
5201	Amido de milho	13210	Tempero misto
5202	Creme de arroz	13299	Outros condimentos
5208	Fubá de milho	14106	Óleo de soja
5301	Macarrão com ovos	14202	Margarina vegetal
5302	Macarrão não especificado	15103	Cerveja
5303	Macarrão sem ovos	15202	Refrigerante de cola
6108	Pão doce	15203	Refrigerante de guaraná
6109	Pão francês	15204	Refrigerante de laranja
6201	Bolos	15209	Refrigerante não especificado
6301	Biscoito doce	15211	Suco de fruta em pó
6303	Biscoito salgado	15212	Suco de fruta envasado
7101	Alcatra	15301	Café moído
7103	Carne não especificada	16201	Mistura para bolo
7104	Chã-de-dentro		

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2003

### Appendix 3: Food Items Consumption basket

(b) Food Items Consumption basket 2008-2009

POF CODE	Food Items Consumption basket 2008-2009	POF CODE	Food Items Consumption basket 2008-2009
1103	Arroz não especificado e outros	7499	Outras Carnes suínas com osso e sem osso
1104	Arroz polido	7503	Mortadela
1105	Milho em grão	7506	Presunto
1106	Milho verde em conserva	7508	Salsicha comum
1207	Feijão-preto	7511	Toucinho defumado
1299	Outras Lguminosas	7599	Outras carnes suínas outras
2103	Alface	7603	Lingüiça
2105	Cheiro-verde	9118	Sardinha em conserva
2106	Couve	10102	Carne de frango não especificada
2109	Repolho	10103	Coxa de frango
2201	Abóbora	10105	Frango abatido (inteiro)
2205	Cebola	10107	Miúdos de frango
2206	Chuchu	10108	Peito de frango
2211	Pimentão	10201	Ovo de galinha
2213	Tomate	11101	Crema de leite
2301	Alho	11102	Leite condensado
2306	Batata-inglesa	11104	Leite de vaca pasteurizado
2307	Beterraba	11106	Leite em pó integral
2309	Cenoura	11199	Outros Leite e crema de leite
2310	Batata não especificada e outras	11202	Queijo mozzarella
2312	Mandioca	11203	Queijo não especificado
3105	Banana-d'água	11205	Queijo prato
3112	Outras bananas	11301	Iogurte
3118	Laranja-pêra	11302	Leite fermentado
3120	Outras laranjas	11303	Manteiga
3124	Mamão	12101	Açúcar cristal
3125	Manga	12201	Bombom
3129	Tangerina	12208	Sorvete
3204	Maçã	12299	Outros Doces e produtos de confeitaria
5101	Farinha de mandioca	12301	Chocolate em pó
5103	Farinha de trigo	13102	Sal refinado
5199	Outras Farinhas	13201	Caldo de carne em tablete
5201	Amido de milho	13202	Caldo de galinha em tablete
5208	Fubá de milho	13203	Outros caldos em tablete
5301	Macarrão com ovos	13207	Maionese
5302	Macarrão não especificado e outros	13208	Massa de tomate
6104	Pão de forma industrializado	13209	Molho de tomate
6108	Pão doce	13299	Outros Condimentos
6109	Pão francês	14101	Azeite de oliva
6110	Pão integral	14106	Óleo de soja
6201	Bolos	14202	Margarina vegetal
6301	Biscoito doce	15104	Vinho
6302	Biscoito não especificado e outros	15201	Água mineral
6303	Biscoito salgado	15202	Refrigerante de cola
7102	Carne moída	15203	Refrigerante de guaraná
7103	Carne não especificada	15204	Refrigerante de laranja
7104	Chã-de-dentro	15209	Refrigerante não especificado
7109	Patinho	15211	Suco de fruta em pó
7201	Acém	15212	Suco de fruta envasado
7203	Carne moída	15301	Café moído
7204	Carne não especificada	16102	Batata frita
7205	Costela	16105	Frango empanado
7304	Carne moída não especificada	16107	Refeição
7305	Carne não especificada	16199	Outros Alimentos preparados
7399	Outras Carnes bovinas outras	16201	Mistura para bolo

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2008—2009

## Appendix 4: Adapt Laspeyres Index

Geographical Context Code	Geographical Context	Adapt Laspeyres Index		Mean
		2003	2009	
1	Metropolitana Urbana de Belem	0.86	0.96	0.91
2	Norte Urbano	0.85	0.91	0.88
3	Norte Rural	0.93	0.83	0.88
4	Metropolitana urbana de Fortaleza	0.82	0.85	0.84
5	Metropolitana urbana de Recife	0.81	0.89	0.85
6	Metropolitana urbana de Salvador	0.82	0.99	0.91
7	Nordeste Urbano	0.83	0.89	0.86
8	Nordeste Rural	0.68	0.73	0.71
9	Metropolitana urbana de Belo Horizonte	0.83	0.99	0.91
10	Metropolitana urbana do Rio de Janeiro	1.02	0.96	0.99
11	Metropolitana urbana de São Paulo	1.00	1.00	1.00
12	Sudeste Urbano	1.01	1.02	1.02
13	Sudeste Rural	0.79	0.86	0.83
14	Metropolitana urbana de Curitiba	0.90	0.90	0.90
15	Metropolitana urbana de Porto Alegre	0.95	0.97	0.96
16	Sul urbano	0.91	0.95	0.93
17	Sul rural	0.68	0.80	0.74
18	Distrito federal	0.96	0.96	0.96
19	Centro-oeste urbano exclusive Distrito federal	0.88	0.98	0.93
20	Centro-oeste rural exclusive Distrito federal	0.76	0.88	0.82

Source: IBGE, Brazilian Family Expenditures Survey – POF: 2002—2009