How do changes in the intrahousehold resource allocation affect poverty measurements in Brazil between 2003 and 2018?

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Abstract:

This paper examines changes in the intrahousehold allocation of resources among men, women, and children in Brazil between 2003 and 2018 and the consequences of these observed changes for measuring poverty over this period. We estimate a collective household model using the three most recent Brazilian Household Budget Surveys. We show a trend towards more balanced resource distribution among household members. Individual poverty rates for women and children in 2018 decreased compared to their 2003 levels, whereas men's poverty rates increased. Neglecting intrahousehold resource distribution suggests mostly lower estimates of individual poverty and extreme poverty in Brazil. The per capita poverty measures are not very informative to understand poverty in Brazil, hiding essential aspects about what happens to members of different groups (men, women, and children) within households. Our findings serve as a reference for public policymakers to understand how intrahousehold distribution of resources affected poverty measurements and to design more effective policies that target the most vulnerable populations in Brazil.

JEL codes: D11, D12, D13, D63, I30, I32

Keywords: Collective model, Consumer demand, Intrahousehold allocation, Poverty measures

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1. Introduction

Achieving poverty eradication, gender equality, and reduced inequality goals requires a better understanding of expenditure and consumption at the individual level and how resources are allocated among household members. Consumption is a better measure to use than income to understand poverty and inequality at the household level because consumption is more directly related to utility than income is, and consumption reflects household savings and access to credit in addition to household income. Households experience less variation in consumption than in income during the year (Hurd and Rohwedder, 2006). Considering how resources are allocated among household members is important to assess whether some individuals are disproportionately benefited within the household or not. Therefore, ignoring differences in the intrahousehold allocation of resources can lead to biased and misleading poverty and inequality analyses, resulting in a failure to target the most vulnerable population groups through social programs (Haddad and Kanbur, 1990; Rodríguez, 2016). This argument is supported by a growing empirical literature that shows the unitary consumption model[1] fails to account for within-household inequality, leading to misleading poverty measures (see, for example, Browning *et al*., 2013; Dunbar *et al*., 2013; Bargain *et al*. 2014; Cherchye *et al*. 2015; Calvi, 2020; Lechene *et al*., 2022). Current practice by many countries bases poverty measurements on per capita household income, which assumes equal resource allocation weights for every household member.

Because consumption is typically measured at the household level, a growing literature has focused on developing techniques to recover information about individual household members from household-level consumption data. These studies focus on the estimation of

[1] This model defines households as single decision-making units that considers only allocation among households and disregards individual preferences and inequalities inside the household, which may lead to misleading welfare implication (Haddad and Kanbur, 1990).

collective household models, in which each individual who composes the household has a well-defined preference function. The intrahousehold bargaining and collective decision processes among them generate Pareto efficient allocations (Cherchye *et al.*, 2007). The identification of individuals' resource shares, defined as each member's fraction of the total household consumption expenditures, provides the measure of intrahousehold bargaining power and reveals intrahousehold consumption inequality.

The collective consumption models of Browning, Chiappori, and Lewbel (2013) and Dunbar, Lewbel, and Pendakur (2013), referred to as BCL and DLP models respectively, have been applied recently in various settings: Mohd *et al.* (2016) in Malaysia, Bütikofer and Gerfin (2017) in Switzerland, Bargain *et al.* (2018) in South Africa, Calvi (2020) in India, De Vreyer and Lambert (2021) in Senegal, Li and Dorfman (2021) in USA, Fialová and Mysíková (2021) in Poland, the Czech Republic, Slovakia, and Hungary, van Leeuwen *et al.* (2021) in the Netherlands, and Calvi *et al*. (2023) in Bangladesh and Mexico. In the South America, the collective consumption model was applied only in the studies of Iglesias and Coelho (2018) and Travassos *et al.* (2022), both in Brazil. The first study used the DLP model to understand the intrahousehold distribution of resources and poverty rates in households with either adults living alone or married couples with or without children in 2009. Travassos *et al*. (2022) used the BCL model to focus on the poverty rates of elderly people between 1995 and 2018 and therefore only included households that consisted of elderly single men, elderly single women, and elderly couples with no other household members.

Brazil is one of the most important developing countries, combining a population of 214 million people (seventh in the World and first in Latin America) with a Gross Domestic Product (GDP) of US$ 1.2 trillion in 2021 (twelfth in the World and first in Latin America) (World Bank Group, 2022a). In addition, the focus in Brazil became important because until the recession of 2015, the country experienced impressive decreases in poverty rates and in

inequality (Alves, 2020). However, according to Sachs *et al*. (2023), 2.2% of the Brazilian population is still in extreme poverty, defined as living on less than US$2.15 per day, and 5.3% of the Brazilian population still lives with less than US$3.65 per day in 2023. In terms of gender equality, despite advances in recent years, the ratio of Brazilian female-to-male labor force participation is 73.1%; and women only hold 15.2% of seats in the national parliament (Sachs *et al*., 2023). Finally, Brazil still has one of the most unequal distributions of income in the world with a GINI index[2] of 0.524 (World Bank Group, 2022a).

The great poverty and inequality reductions experienced by Brazil between 2003 and 2014 were mainly attributed to economic growth, the expansion of the labor market, the increase of the minimum wage above inflation rates, and the implementation of the government social transfer program named *Programa Bolsa Família* (PBF) (Oliveira and Jacinto, 2015; Ribeiro *et al*., 2015; Souza *et al*., 2019). After this, there was a period of great recession between 2015 and 2016 (Alves, 2020). We do not know what happened with intrahousehold allocation of resources and poverty in Brazil during these periods: did poverty fall in the same way as measured by the per capita income approach? Did poverty fall more compared to the per capita income approach due to a more equitable resource distribution within the household? Answering these questions is very important for a better comprehension of the evolution of poverty in Brazil.

In this paper, we apply the new collective consumption approach proposed by Lechene, Pendakur, and Wolf (2022) (LPW), referred to here as the LPW model, to analyze the intrahousehold distribution of resources and poverty in Brazil using the three most recent Brazilian Household Budget Surveys (*Pesquisa de Orçamentos Familiares*, or POFs) – 2002/2003, 2008/2009, and 2017/2018. We find evidence of intrahousehold consumption

[2] The GINI Index is widely used indicator to measure inequality in international comparisons, allowing rankings of countries based on a consolidated methodology. The indicator ranges from 0 (perfect equality) to 1 (maximum inequality, a situation in which one person would receive all the income of an economy) (World Bank Group, 2022b).

inequality within Brazilian households, a more balanced resource distribution among household members with an increase in the amount of resource shares controlled by women and children, and an inversion in the gender gaps in resource shares favoring women over men in the more recent database. Finally, our results show that the collective consumption poverty rate at the individual level decreased between 2003 and 2009, but increased in 2018, while the per capita income approach results mostly in lower estimates of Brazilian poverty compared to the collective consumption rates in all the database years.

As we mentioned, our collective household model closely follows the methodology presented by Lechene, Pendakur, and Wolf (2022). The BCL and DLP models introduced a non-linear structural methodology that allows the use of typical household budget surveys to estimate the resource shares of individuals within households. However, only single-person households and households of couples without children could be analyzed as the BCL model was written, and the DLP model added households with children to the analysis. Therefore, one of the useful qualities of the LPW model was allowing for the analysis of single parent and multiple adults households. According to Lechene *et al.* (2022), this breakthrough was basically mathematic but very important to deal with different household compositions observed in many developing countries, such as Brazil, which includes households with multiple generations and families, in addition to single-parent households.

In addition to using the three most recent POFs, we contribute to the literature on intrahousehold poverty and inequality analysis by including households with single parents, multiple adults of the same gender with children, and multiple adults of different gender with or without children, which together represent 45.8% of all household types in the POF 2017-2018 (IBGE, 2019). Because of this, our calculations of the poverty rates cover around 80% of the households available. Comparing our sample with that used by Iglesias and Coelho (2020) using POF 2008-2009 database, we considered 45,859 households in our analysis, while

Iglesias and Coelho (2020) considered only 9,771 households due to methodological limitations. Adding households with single parents, multiple adults of the same gender with children, and multiple adults of different gender with or without children to the analysis can result in more accurate estimates of intrahousehold distribution of resources and individual poverty in Brazil. Therefore, our study differs from Iglesias and Coelho (2018) and also Travassos *et al*. (2022) because we look at a broader segment of the Brazilian population and analyze a more recent database. Finally, we contribute by using the LPW methodology for a developing country with a large population in Latin America, in addition to considering the specificities of the Brazilian population such as regional and race differences, and the impact of government transfers on households' consumption.

2. Theoretical model

In the LPW model, resource shares will be identified from estimates of Engel curve functions for assignable goods, in which we can assess the expenditure by each type of individual within the household (men, women, and children). The resource shares (η) will depend on the households' budgets (x), the number of individuals of each type in the household (N), and members' sociodemographic characteristics (s), and can vary by individual type (k) within each household (i). Resources are distributed equally among the individuals of the same type within the household. For example: in a household composition with three children in which the children's resource share is 0.30, 10% of the household budget is allocated to each child. Following LPW, the assignable good will be the clothing expenses for adult men, adult women, and children.

A simple definition of an Engel curve is the fraction of expenditure spent on a good in relation to the overall household budget. Therefore, the expenditure fraction of the household

budget represents the Engel curve function. Define the resource share as $\eta^k(x,s)$, and, assuming that each person within the household consumes their own assignable good and demands zero of any other assignable good, the household Engel curve function for the assignable good of an individual type k in a household type i is given by ($W_i^k(x,s)$):

$$W_i^k(x,s) = \eta^k(x,s) w_i^k(\eta^k(x,s)x/N_i^K). \quad (1)$$

where $w_i^k(\eta^k(x,s)x/N_i^K)$ is the individual Engel curve of a person within the household facing the shadow budget and fixed shadow vector of prices. Equation (1) specifies that the household Engel curves for the assignable goods are equal to the individual Engel Curve of a person within the household times the resource share of that individual[3]. This equation basically represents the DLP model. The resource shares may be determined using Engel curve functions for assignable goods in households with several members[4] .

However, Equation (1) is still nonlinear because η^k is multiplied by the parameters of the individual Engel curve function w_i^k, and requires positive resource shares, because of the η^k term, requiring nonlinear optimization to estimate the parameters. Assuming that the individual Engel curve functions are linear in $\ln x$, so that $w_i^k(x,s) = \alpha^k(s) + \beta(s)\ln x$, results in an approximation of Engel curves in the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980), and therefore, equation (1) can be rewritten as:

$$W_i^k(x,s) = \eta^k(s)\alpha_i^k(s) + \eta^k(s)\beta_i(s)\ln x + \eta^k(s)\beta_i(s)\ln \eta^k(s) - \eta^k(s)\beta_i(s)\ln N_i^K. \quad (2)$$

[3] For more details about the mathematics behind equation (1) and the cancelation of the shadow price vector term, see Lechene *et al*. (2022).
[4] For more details about the identification strategy, see Dunbar *et al*. (2013).

The model specified in Equation (2) is the DLP nonlinear model and was recently applied by several researchers using databases from different countries, e.g., Iglesias and Coelho (2018) in Brazil, Calvi (2020) in India, De Vreyer and Lambert (2021) in Senegal and Calvi *et al*. (2023) in Bangladesh and Mexico. We highlight that, in equation (2), the resource shares ($\eta^k(s)$) are unaffected by the household budget (x), indicating that an increase in household consumption has no effect on how much is distributed inside the household. This is a strong assumption but empirically supported (see Cherchye *et al.* (2015)). Furthermore, the model assumes that preferences are similar but not identical across people, such that $\beta^k = \beta$. Dunbar *et al*. (2013) discussed the property called "similar across people" (SAP), and LPW discussed the preferences and cost conditions to satisfy the SAP assumption – "shape-invariance", and "independence of base" or "equivalence-scale exactness", respectively. More details about these conditions can also be found in Blundell *et al*. (2007).

3. Empirical model

3.1. Functional form

The LPW model presented the linear reframing of the DLP model. If we rearrange the terms of equation (2) to make the model linear and add the error term ε_i^k, we have the empirical LPW model:

$$W_i^k(x_i, s_i) = a_i^k + b_i^k \ln x_i + \varepsilon_i^k, \tag{3}$$

where:

$$a_i^k = \eta^k(s_i)\alpha^k(s_i) + \eta^k(s_i)\beta(s_i)\ln\eta^k(s_i) - \eta^k(s_i)\beta(s_i)\ln N_i^K, \quad (4)$$

$$b_i^k = \eta^k(s_i)\beta(s_i). \quad (5)$$

If η^k, α_i^k, and β_i were linear indices in s_i, then a_i^k and b_i^k would be a function of third-order and quadratic order in s_i, respectively. Following the LPW model, equation (3) may be estimated using Ordinary Least Squares (OLS) estimators. If instruments are available, Two-Stage Least Squares (2SLS) estimators may be used if certain regressors are endogenous. In the other case, if η^k, α_i^k, and β_i had unknown functional forms, then a_i^k and b_i^k would be nonparametric functions of s_i, and it would be necessary to use standard semiparametric methods to estimate the model.

In the LPW model neither of these approaches are feasible with a large conditioning vector s_i. In this case, they recommended approximating the terms α_i^k and b_i^k with linear indices:

$$a_i^k = a_0^k + a_{N_i}^k \ln N_i + a_s^{k\prime} s_i, \quad (6)$$

$$b_i^k = b_0^k + b_s^{k\prime} s_i. \quad (7)$$

Given the estimated coefficients $\hat{a}_i^k$ and $\hat{b}_i^k$, and regardless of the specification of b_i^k, the resource shares can be calculated in the LPW model. Assuming that $\sum_i \hat{b}_i^k$ can be used as an estimate of $\beta(s_i)$, and that the sum of resource shares is equal to 1, then an estimate of $\hat{\eta}_i^k$ of a household type i with characteristics s_i is given by:

$$\hat{\eta}^k(s_i) = \frac{\hat{b}_i^k}{\sum_i \hat{b}_i^k} = \frac{\hat{b}_0^k + \hat{b}_s^{k\prime} s_i}{\sum_i (\hat{b}_0^k + \hat{b}_s^{k\prime} s_i)}. \quad (8)$$

In the LPW model, we note that the resource shares identification does not depend on the estimation of $\hat{a}_i^k$ or the levels of the Engel curves, but depends on the observable budget semi-elasticity of the household Engel curve for the assignable goods ($b_i^k = \partial W_i^k / \partial \ln x_i = \eta^k \beta$), or the effect of changing the household's total expenditure on each member's clothing expenditure. Since the sum of η^k is equal to 1, the sum of this semi-elasticity across types (b_i^k) is β. The men's resource share will be half as large as the children's resource share if the household Engel curve for the men's assignable good has a slope (value of b_i^k) half as large compared to that of the children's assignable good. Therefore, if the man's clothing expenditures respond less to a change in the household budget than the children's clothing expenditures, then he has a lower resource share compared to the children in that household.

3.2. Estimation method

Equation (3) representing the Engel Curves, equation (6) representing the intercept, and equation (7) representing the slope of the Engel Curves may be estimated by OLS or by Linear Seemingly Unrelated Regression (SUR). In the LPW model, both methods give identical results if the regressors are the same across equations. However, because our estimations consider different types of household compositions, the regressors are different across equations. Therefore, as recommended and used in the LPW model application, we also estimate equations (3), (6), and (7) of our model by the SUR method. Resource shares may then be estimated by equation (8).

Four types of household compositions will be considered in the estimation of our empirical model: men and women only; women and children only; men and children only; and

men, women, and children. According to Lechene *et al.* (2022), there are two ways to estimate the LPW model taking into account different household types: estimate a pooled estimator, which interacts each household type with all regressors in the model; or estimate each model separately for each household type. As in the LPW model, we choose the second option for our empirical model.

3.3. Analytical concepts

3.3.1. Bargaining power within household

The individual resource share $\hat{\eta}^k(s_i)$ can be considered a direct measure of the household allocation of resources among members. As a consequence, the resource share may also be interpreted as a measure of relative bargaining power within the household. Assuming a household composed of men, women, and children, a lower resource share directed to men within the household can be interpreted as implying higher bargaining power of women and children with respect to household resource allocation. Furthermore, the difference between individual men's and women's resource shares in the same household can be interpreted as gender inequality within the household.

Therefore, the bargaining power between a man and a woman within a household can define their different preferences for the consumption of goods related to their children, as well as identify how parents' relative bargaining power, altruism, and gender preferences affect the welfare of children. A higher bargaining power is also related to lower individual poverty rates (because the observed household decision is more in line with the preferences of that individual). According to the LPW model, as described by equation (8) and explained above,

the resource shares can be identified and estimated just by using Engel curve functions for assignable goods.

3.3.2. Measures of individual poverty

The World Bank's approach to calculating poverty considers household members poor if their income falls below a predetermined level. The World Bank updated the global poverty lines in September 2022 and set a new target of reducing extreme poverty as assessed by the international poverty line (IPL) of US$2.15 per person per day in 2017 PPP (purchasing power parity) for low-income countries (LICs), US$3.65/day for lower-middle-income countries (LMICs), and US$6.85/day for upper-middle-income countries (UMICs) like Brazil (World Bank Group, 2022b). We can calculate the World Bank-based poverty rate for each person in the household by calculating their per capita income ($income_i/N_i$), then comparing this to the poverty line for UMICs, and reporting the poverty rate. We also compare the poverty line for UMICs with the per capita expenditure approach (x_i/N_i).

The poverty rates calculated using the LCW model differ from the World Bank per capita rates because the LCW approach uses consumption (expenditure) whereas the World Bank uses income and, more importantly, LCW allows for inequality among household members, so that individuals inside the household may be below the poverty rate even if the household budget exceeds the per capita expenditure threshold. Therefore, we use the estimated resource shares rather than the per capita share to compare this to the poverty line for UMICs and report the poverty rate. In this case, we can include single-person households ($N_i = \eta_i^k = 1$), childless households with just one type of adult (x_i/N_i), and households with one or more men, women, and children ($x_i\eta_i^k/N_i^k$). As in DPL and LPW models, we consider the possibility

that children may have lower needs compared to adults by using the OECD estimate of poverty line that is 40% lower for children.

However, neither approach accounts for economies of scale in consumption. Along this line, the OECD poverty approach accounts for economies of scale in large households, where first the household expenditure is inflated ($(N_i)^{1/2}$), then divided by each member within the household $\left((N_i)^{1/2}\, x_i/N_i = x_i/(N_i)^{1/2}\right)$, then compared to the poverty line for UMICs, and reported as the poverty rate. We also calculate a poverty rate approach based on OECD economies-of-scale using the resource share of the LPW model. For this, we also inflate the household budget, however, we multiply by the resource share to consider a consumption level by each household member ($(N_i)^{1/2} x_i \eta_i^k$), then compare this to the poverty line for UMICs, and report the poverty rate.

3.4. Data

We used the microdata of the three most recent Brazilian Household Budget Surveys (POFs) conducted by the Brazilian Institute of Geography and Statistics (IBGE) for the years 2002-2003, 2008-2009, and 2017-2018 (IBGE, 2004; IBGE, 2010; IBGE, 2019). The POF is a national survey that gathers information on household expenditures, incomes, and sociodemographic characteristics. The survey allows us to generate estimates for the twenty-six federal units and the Federal District, the five Brazilian regions, for rural and urban areas, and for different socioeconomic levels.

Men's, women's, and children's clothing expenditures, as well as a measure of household overall consumption, are included in the POF database. Using these variables, we can calculate the fraction of expenditure spent on clothing in relation to the overall household expenditure. Although POFs record personal expenses information by each household member

over ten years old that registered any purchases of products and services, in general those are only for personal use (pharmaceuticals, transport, food away from home, vehicle expenses, clothing, among others) and the individual expenses/acquisitions of residents under ten years old are included in the register of another resident. Therefore, the only good that we can use to identify the resource shares for adult men, adult women, and children is clothing[5]. Regardless of the resident who recorded the expense, we can assign clothing consumption by individual type, guaranteeing that this good will not be shared or consumed jointly by different individual types, with children's clothing not differentiated between male and female children (IBGE, 2004; IBGE, 2010; IBGE, 2019).

We also include in the analyses a set of demographic variables: the household size; the average ages of household members; the average education level of adults household members; a dummy variable which identifies the racial predominance of white people in the households; a dummy variable if any household member receives any kind of government transfers; a set of dummy variables that identifies the household location by the major regions of Brazil (North, Northeast, Midwest, Southeast, and South); and a dummy variable identifying whether the household is located in an urban area. All demographic variables are allowed to affect the Engel curves for all household members.

In the POF databases, children's clothing expenditures are defined as the purchase of clothing for children aged up to 14 years. Therefore, according to this definition, we define children as household members aged 14 or less. Following the LPW model, we allow more than one individual of each type, up to four men, four women, and six children per household. We exclude observations with missing values on clothing expenditures for all household members simultaneously, as it would not be possible to identify the resource share. We also exclude

[5] LPW compares the estimation of resource shares using clothing and food consumption for a dataset in Bangladesh that includes both, and finds that the resource shares are not statistically distinguishable from each other, concluding that clothing allocation works well to estimate the resource shares.

households with members who are not related to the household head, as we could not confirm that these members participated in the bargaining process for household resources. Finally, we excluded observations with missing data for any variable used in the estimation. We describe all the steps that we take with the sample on Table 1. For the resource shares estimation (Resource share sample), we exclude households with only one adult (single-person households) and also childless households that include at least two adults who are all the same gender (single-gender childless households) because there is no intrahousehold distribution of resources in single-person households and we cannot assign the clothing good in single-gender childless households. However, we include these households in the poverty rates calculation (Poverty analysis sample) totaling 81.5% (39,600 households) of the POF 2002-2003 sample, 81.8% (45,859 households) of the POF 2008-2009 sample, and 78.8% (45,721 households) of the POF 2017-2018 sample.

Table 1 - Sample details

	POF 2002-2003	**POF 2008-2009**	**POF 2017-2018**
Sample	48,568	56,091	58,039
Missing values for members' characteristics	171	381	49
Missing values for clothing expenses	7,062	8,489	11,442
Initial Sample	41,335	47,221	46,548
Presence of non-relative (>0)	1,181	968	620
Number of Men (>4)	246	176	102
Number of Women (>4)	184	139	84
Number of Children (>6)	124	79	21
Poverty analysis sample	39,600	45,859	45,721
Single person and single-gender childless	5,773	8,064	10,464
Resource share sample	33,841	37,808	35,257

This selection can potentially bias our measures of poverty. There are two potential sources of selection bias. One is related to family composition, because we excluded single-gender childless households from the resource share estimation and households with more than

four men, or four women, or six children for both poverty analysis and resource share estimation. The second is that some households have missing values for some of the characteristic's variables or clothing expenditures for all member's type. However, sample selection is not likely to significantly affect our results for the following reasons.

First, households at every percentile of total household expense have missing values for clothing expenditure in all database years, and not only poorer households. Second, to determine the extent to which the exclusion of these households biases our national poverty rate estimates, we reweighed our measures so that they reflect the distribution of expenditures in the entire sample. We were assuming that excluded households, that are in a range for total household expenditure, would have the same poverty rate as the households in that same range for total household expenditure that are included in the sample. So, for example, we reweighed the sample so that we gave more weight to poor households, which are more likely to have missing values for clothing expenditures. The individual poverty and extreme poverty rates estimated using resource shares were higher for the reweighed sample that represents all of Brazil than the poverty rates that we estimated with our sample, with the exception of the results for poverty considering data from POF 2002-2003. However, the trend of the results over the years was the same for the reweighed estimates, as well as the results compared to the per capita income approach[6]. Therefore, our results are unlikely to be significantly affected by sample selection bias. We must emphasize that the POFs collect clothing expenses over the past 90 days. Therefore, a household with missing values for clothing means that there may have been no consumption in this period, but it does not mean that there was no consumption in the year of data collection. This is a limitation of the database.

[6] For more details about the comparison between the individual poverty rates with economies of scale using our poverty analysis sample and the complete sample (including the missing households) see Table A5 of the Appendix.

4. Results and Discussion

4.1. Descriptive Statistics

Table 2 provides summary statistics of household members and household characteristics variables for each POF using the averages before we select our sample and using the poverty analysis sample. The objective is to show that the characteristics of the members and their households in the sample used for the poverty analysis (Poverty) are very similar to the sample prior to our selection (Sample). We will only discuss the average numbers in the poverty analysis sample. The total expenditure variable was deflated to the last reference period of our database (January 2018). As we can see by the characteristics of the members, the average number of men and women inside the households was practically the same among the different POFs, with a small drop in both cases. However, as a consequence of the demographic transition and the decrease in the fertility rate in Brazil, the average number of children in the households fell 39.9% between POF 2002-2003 and POF 2017-2018.

The average age of the children was almost the same across the POFs. However, again as a consequence of the demographic transition and population ageing, the average age of women and men in the households increased 14.5% and 12.5%, respectively from POF 2002-2003 to POF 2017-2018. The last variables related to the characteristics of the household members were the average education levels of women and men. As expected, the average years of education increased for both women and men between POF 2002-2003 and POF 2017-2018respectively. Brazil continues a long period of growth in educational participation and attainment since 2000, however, the level of education is still relatively low because high school completion in Brazil requires eleven years of schooling, and the average is still less than ten years of schooling (OECD, 2021).

Table 2 – Summary statistics

	POF 2002-2003		POF 2008-2009		POF 2017-2018	
	Sample	**Poverty**	**Sample**	**Poverty**	**Sample**	**Poverty**
Households	48,568	39,600	56,091	45,859	58,039	45,721
Members characteristics						
Number of women	1.34	1.32	1.29	1.28	1.26	1.25
Number of men	1.26	1.24	1.19	1.17	1.14	1.11
Number of children	1.04	1.02	0.83	0.82	0.62	0.61
Household size	3.64	3.58	3.31	3.26	3.01	2.97
Women age	39.07	38.55	41.48	40.93	44.79	44.14
Men age	38.32	37.78	40.48	39.75	43.21	42.51
Children age	7.25	7.19	7.47	7.45	7.32	7.24
Women education	8.04	8.37	8.02	8.29	9.52	9.84
Men education	7.80	7.98	7.85	8.09	9.12	9.38
Household characteristics						
Urban	83.05%	83.72%	84.27%	85.04%	86.23%	86.86%
North region	6.48%	6.28%	6.83%	6.87%	7.26%	6.93%
Northeast region	25.21%	24.56%	26.12%	25.75%	25.89%	26.09%
South region	16.01%	16.41%	15.39%	15.61%	15.43%	15.94%
Southeast region	45.12%	45.83%	44.09%	44.60%	43.66%	43.17%
Midwest region	7.19%	6.91%	7.57%	7.18%	7.76%	7.87%
Race (predominant White)	50.63%	51.82%	45.52%	46.73%	40.48%	41.22%
Total expenditure	$9,734.07	$10,153.06	$11,960.21	$11,960.21	$8,619.98	$9,359.87
Govern transfers	62.59%	60.86%	62.79%	61.01%	66.19%	65.02%

In relation to household characteristics, most Brazilian households lived in urban areas, and this share is still growing. Additionally, the majority of Brazilian households lived in the Southeast and Northeast regions, followed by the South, Midwest, and North regions. Another important household characteristic to consider is race. The predominance of individuals considered white in the households decreased between POF 2002-2003 and POF 2017-2018.

Annual real household expenditure decreased 7.8% between POF 2002-2003 and POF 2017-2018. The economic recession between 2015 and 2016 and the pandemic years have made

the last decade the worst in 120 years with respect to Brazil's GDP growth (Alves, 2020), which explains the greater drop in annual household expenditure between the last two POFs. Finally, another important statistic is related to government transfers. Most of the households received some kind of government benefit, and these include any kind of pensions, social welfare transfers, and/or federal social programs. This result reflects the expansion in federal social programs at the beginning of the 21st century in Brazil, mainly the benefit called *Benefício de Prestação Continuada* (BPC), a government social assistance benefit that aims to provide a minimum income for elderly or for disabled people, and the PBF, a conditional cash transfer to families in poverty or extreme poverty.

4.2. Resource shares in Brazil

First in this section, we show the means and standard deviations of clothing budget shares of the households, the slope of the Engel curves evaluated at average characteristics results, a z-test for the differences of the slopes from zero, and the percentage of the sample that was statistically significant, in Table A1 of the Appendix. These results are important because the statistical significance of the Engels' curve slope shows that the resource share can be identified. In summary, the clothing share of the total budget increased from 4.8% in POF 2002-2003 to 6.7% in POF 2017-2018. The slopes of the clothing Engel curves were statistically significant in all years of POF. We can also confirm the model identification by the percentage of the sample in which the slope is statistically different from zero. This percentage was 99.1% for POF 2002-2003 and reached 99.9% for POF 2017-2018. According to LPW model, the methodology can be used with a sample percentage of Engel curve slopes statistically different from zero above 75.0% of the whole database. Therefore, our model is identified for all periods of the database.

Figure 1 shows the resource shares estimated at the mean of observed covariates with the standard errors. We show the results for men, women, and children, by each POF year. Additionally, in Table A2, we show the results at the mean of observed covariates with the standard errors together with the results at the mean of the resource shares evaluated at all s_i with the standard deviations, and in the last three lines of this table, we show the fraction of estimated resource shares that were outside the interval of [0, 1], the Wald test for the per capita model associated with the degrees of freedom, and the p-values. If many resource shares were estimated outside the range of (0, 1), this may mean that the models are not capturing the data well, because the estimated slope for one household member is different in sign from the estimated slope of another member. The Wald test for the per capita model[7] is important to confirm that the distribution of resources inside the Brazilian households are different among members and, therefore, the per capita approach is not recommended. Furthermore, the Brazilian population is very heterogeneous in terms of regions, ethnicities, age, education level, among other characteristics, and per capita model would not capture these heterogeneities.

In general, the estimated and mean resource shares are similar for the same household group within each POF in Brazil. For example, the estimated men's resource share in the POF 2002-2003 is 31.0%, while the mean resource share for men in the same year is 31.4%. Also, the standard deviations are higher than the standard errors, mainly in the POF 2008-2009 and POF 2017-2018, indicating the presence of heterogeneity in the resource shares by member type among different households. According to the estimated resource shares using POF 2002-2003, men (31.0%) got a larger share of the household resources than women (19.6%) and children (22.6%) on average in Brazil. By 2017-2018, the women's and children's estimated

[7] According to the LPW model, the resource shares function expressed in equation (8) can be reduced to the per capita resource share. Assuming that the denominator of equation (8) has a lot of variation or if is close to zero ($\sum_i b_s^k = 0$), implying that $\sum_i b_i^k = \sum_i \left(b_0^k + b_{N^m}^k N_i^m + b_{N^w}^k N_i^w + b_{N^c}^k N_i^c\right)$. If $b_0^k = 0$ for all k, $b_s^k = 0$ for all k, $b_{N^{k'}}^k = 0$ for $k' \neq k$, and $b_{N^k}^k = t$ for all k, then we have the per capita resource shares ($\hat{\eta}^k(s_i) = N^k t / \sum_i N^k t = N^k / \sum_i N^k$).

resource shares increased by 57.1% and 11.5% respectively, even with the average reduction in the number of children per household, whereas men's resource shares decreased by -12.9%. Iglesias and Coelho (2020), using the POF 2008-2009 database, found that the average resource share was slightly larger for men than for women in most of the household types, and different from the results we found, children's resource shares were lower than the adults in all household compositions. In their paper, LPW used data from five countries and found that the average resources shares were higher for men than women in Albania, Bangladesh, Iraq, and Malawi. Only in Bulgaria the resource shares were higher on average for women than men. In all countries analyzed by LPW, children's resource shares were lower than men's and women's resource shares, as the result we found in the last POF year.

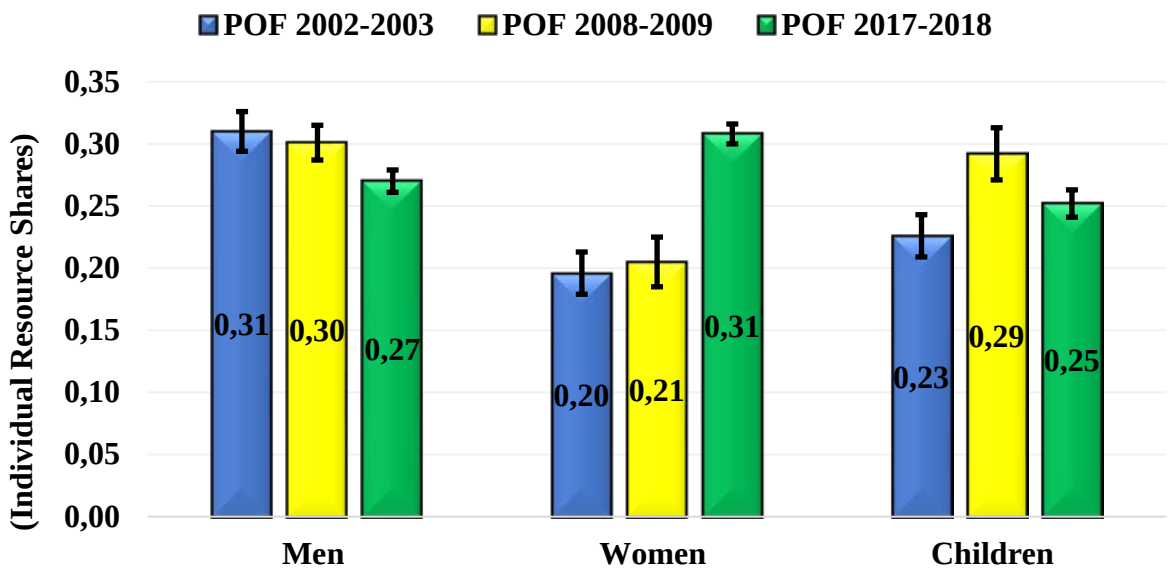

Figure 1 - Resource shares estimated at the mean of observed covariates with standard errors

A more balanced resource distribution among household members with the increase in the amount of resource shares controlled by women and children over the years might be explained by the expansion in the number of families participating in PBF, that increased from 5.1 million in 2004 to 13.3 million in 2017, along with an increase in the program's average real value, that increased from 143.50 Brazilian Real (BRL) in 2004 to 180.00 BRL in 2017,

deflated by IPCA, the National Broad Consumer Price Index (Souza *et al*., 2019). , . In addition, the effect of the PBF tends to benefit women and children more compared to men for two reasons: first, transfers are greater for families with more children and/or adolescents; and second, the person responsible for receiving the PBF must be sixteen years of age or older, with preference to make the payments to females (Decree n. 6,135/2007) (Bartholo *et al*. 2019).

When we looked at our database, we find some evidences that the PBF may have influenced the resource shares inside Brazilian households. The increase in women's resource shares occurred at a faster pace in households that met the PBF per capita income criteria and received the transfer benefit (217.9%) than it did in households that met the criteria but did not receive the PBF (93.2%) when we compare POF 2008-2009 and POF 2017-2018 databases[8]. Despite this increase, the average women's resource share was still larger in households who met the criteria but did not receive PBF (0.393) compared to those in households that received the transfer benefit (0.318) in POF 2017-2018. This result can be explained by the household size, the number of women, and the proportion of households with at least one woman and child being all higher in households that met and received PBF compared to eligible households that did not received PBF, which may reduce the average women's resource share. Therefore, the PBF may have contributed to an increase in the bargaining power within households favoring women and children, thereby balancing the resource shares among the household members, mainly among the poorer households in Brazil. This is a topic for future research, although identification might be a challenge because there are no clear treatment and control groups due to the conditionalities, such as school attendance, that are required to receive the PBF.

Carlos and Saiani (2021) calculated two synthetic indices of female empowerment in Brazil, which reflect economic, domestic, and psychological dimensions. Evidence suggested that female empowerment is multidimensional in Brazil, and factors such as greater

[8] We did not use POF 2002-2003 database for comparison because the PBF had not been created yet during this database collection.

participation in the labor market, urbanization, age, and the PBF positively influence female empowerment. Table 1 shows that women's age and urbanization increased in Brazil between POF 2002-2003 and POF 2017-2018, in addition to the women's years of education. The PBF had not yet been created at the time of POF 2002-2003 database, so if we consider the households that received the programs that preceded the PBF (*Bolsa Escola*, *Auxílio Gás*, and *Programa de Erradicação do Trabalho Infantil* (PETI)), the proportion of households that benefited from at least one of these programs was 12.20%, which was equivalent to 4,976,265 Brazilian households using sample weights. In POF 2017-2018, the proportion of households that benefited from PBF or PETI increased to 17.26%, which was equivalent to 9,727,360 households, using sample weights. This represents an increase of 95.5% in the number of households that benefited. Finally, the proportion of women who were working during the POF 2002-2003 collection was 43.9%, while in POF 2017-2018 this proportion increased to 58.9%. Therefore, as in Carlos and Saiani (2021), the greater participation of women in the labor market, urbanization, increases in the average women's age and education levels, in addition to the PBF may have influenced the increase in estimated resource shares for women and children. Future research might determine which of these factors were most important for explaining the changes in resource shares.

Below the results of estimated and mean resource shares in Table A2, we show the percentage of resource shares that are outside the [0, 1] range by each database year. In the three years of the database, the largest percentage of resource shares outside the interval of (0, 1) was 3.5% in POF 2002-2003, and the lowest was 1.4% in POF 2017-2018. Therefore, although some individuals had point estimates outside the interval of (0, 1) in each database, there are not statistically significant. In the lower lines of Table A2, we show the results of the Wald test for the per capita model associated with the degrees of freedom, and the p-values for the test in each year of our database. Despite a more balanced resource distribution among household

members as we moved to the results of POF 2017-2018, we showed considerable inequality across household members by each year. Therefore, the per capita model is rejected by the Wald test for all database years, suggesting that there is a considerable variation in resource shares among household members and within each member type in Brazil. The standard deviations of estimated resource shares indicate that the per capita model can either lead to lower or higher estimates for the resource shares by each household member. In the next sections, we show that the failure of the per capita model leads to a misunderstanding of gender gaps in resource shares and poverty rates in Brazil.

4.3. Gender gap/Bargaining Power in Brazil

In Figure 2, we show the resource shares estimated at the mean of observed covariates with the standard errors for households including at least one adult man and one adult woman. In Table A3, we show the resource shares estimated at the mean of observed covariates with the standard errors and at the mean of the resource shares evaluated at all s_i with the standard deviations, in households in which adult men and adult women are present simultaneously by each database year. In the lower rows of Table A3, we show the gender gap or bargaining power inside the Brazilian households represented by the difference between men's and women's resource shares, along with the standard errors and statistical significance.

Our results show that men had a statistically higher estimated resource share than women in POF 2002-2003 and POF 2008-2009. In the first period of our database, we estimated a gender gap of 11.8%. In POF 2008-2009, the bargaining power was 9.3% statistically higher for men. However, when we look at the results for POF 2017-2018, the estimated gender gap is 3.7% statistically higher for women. As we observed in the results of Figure 3 and Table A3, when we moved to a more recent database, we observed a 78.0% increase in women's resource

share compared to a decrease of -7.4% in men's resource shares in households in which adult men and adult women are present simultaneously. Therefore, again, we can assume that the greater insertion of women in the labor market, urbanization, increases in the women's average age and education, and the expansion of the PBF may have favored women's bargaining power in Brazilian households over the years[9]. Iglesias and Coelho (2020) also found that an increase in the woman's work participation, age, and education influenced the household resource distribution favoring the women in Brazil by increasing their bargaining power to access more intrahousehold resources.

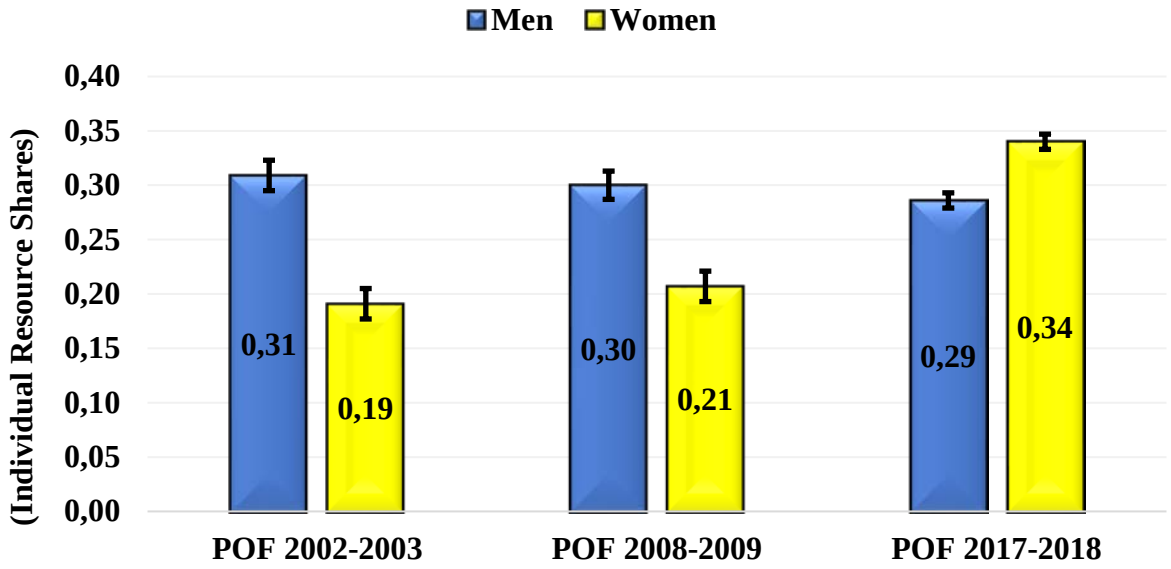

Figure 2 – Estimated resource shares for households with at least one adult man and one adult woman

LPW found statistically significant gender gaps in in Bangladesh (Lower-middle income) and Iraq (Higher-middle income), and both benefiting men, as we observed in Brazil

[9] We may hypothesize that an increased labor market participation of women may cause an increase in their clothing expenses. Indeed, when we look at the mean of the resource shares evaluated at all s_i on POF 2002-2003 and POF 2017-2018 databases, the woman's resource shares from those who were working (0.330 and 0.392, respectively) were higher than the woman's resource shares from those who were not working (0.253 and 0.305, respectively). However, we can see that both resource shares increased by almost the same rate from POF 2002-2003 to POF 2017-2018 on average. Regarding age and education, we can see the increase in women's education and age in Table 2.

in the POF 2002-2003 and POF 2008-2009 results. However, the literature on gender gaps in developed countries, predominantly based on the BCL model (that considers only households without children), showed that the resource shares favored women more than men, which is the case of the Netherlands (van Leeuwen *et al*. (2021)), or that the resource shares are equally distributed among women and men, such as in Switzerland (Bütikofer and Gerfin (2017)) and the USA (Li and Dorfman (2021)). Therefore, it is possible that Brazil is approaching an intrahousehold resource distribution between men and women closer to that observed in developed countries.

Several studies evaluated the influence of gender on household expenditures in Brazil (Carvalho and Alves (2012), Queiroz and Coelho (2017), Galvão and Almeida (2018), and Sette and Coelho (2020)). In general, these studies showed that when women were household heads, expenditures were higher for housing, clothing, health, and education. On the other hand, when men were household heads, these studies observed higher expenditures on food, transportation, and recreation, including smoking, games, and alcohol. Therefore, as our results show an increase in household bargaining power for women (reduction of gender gaps) over the years, we expect that households will spend more on health and education and spend less on tobacco and alcoholic beverages.

4.4. Individual poverty rates in Brazil

The World Bank's usual approach to measure poverty is the per-capita income approach, which assumes equal resource shares among household members. This approach does not consider economies of scale. Therefore, in Table A4 of the Appendix, we show the results for the per capita income and consumption approaches, and our collective consumption approach using the extreme poverty rate based on the IPL of $2.15 per day (upper block of

rows) and the poverty rate based on UMICs threshold of $6.85 per day (lower block of rows), as recommended to Brazil by the World Bank (2022b), by each year of the POF database without considering the economies of scale inside the households[10].

In the leftmost columns of the two blocks named "Per Capita Income" in Appendix Table A4, we present the estimated poverty rates calculated by the per capita income approach using our POFs databases. In the next column named "Per Capita Consumption", we show the per capita approach using our database based on total expenditure by each person and year of POF. In the next three columns ("Men", "Women", and "Children"), we show our estimated poverty rates at the individual level using the calculated resource shares. Finally, in the rightmost columns in both blocks named "All", we present the overall poverty rate at the individual level using our estimated resource shares for the entire sample called the collective consumption approach. Below each result in parenthesis, we show the standard errors using the bootstrap procedure. According to LPW, the poverty rates calculated without considering the economies of scale could be taken as an upper limit on the real poverty rates in the countries. In general, both per capita approaches give lower estimates of extreme poverty and poverty in Brazil when compared to the collective consumption poverty rates at the individual level without accounting for economies of scale. Women's individual poverty and extreme poverty rates using the collective consumption approach reduce from POF 2002-2003 to POF 2017-2018, whereas men's and children's poverty and extreme poverty rate increase from POF 2008-2009 to POF 2017-2018, as well as the overall poverty rate at the individual level.

We must emphasize that the poverty rates based on the per capita income approach released by the World Bank used the Brazilian National Household Sample Survey (PNAD) for the years of 2003 and 2009, and the Brazilian Continuous National Household Sample

[10] Poverty measures based on household income and consumption have different money metrics and are not directly comparable. However, our main objective here is to show the consequences of using the collective consumption approach compared to the per capita approaches, mainly due to the use of standard poverty and inequality measurement based on the per capita household income by the Brazilian government.

Survey (PNADC) for the year of 2018, and do not consider the economies scale. The comparison between PNAD and POF reveals that the income level was higher in the POF databases at least until POF 2008-2009 (Souza, 2015). Therefore, when we compare the World's Bank poverty and extreme poverty measurements based on the per capita income approach without consider the economies of scale and using PNAD/PNADC for the years of 2003 (49.0%/12.6%), 2009 (34.0%/6.1%), and 2018 (27.0%/5.3%) with our per capita income results using POF and without economies of scale, the World Bank results are lower for the years of 2003 and 2009, and higher for 2018, and show the same downward trajectory that we found using the per capita income approach in both poverty and extreme poverty levels during this period.

However, a more realistic approach is considering the economies of scale inside the households, using the OECD approach. As we mentioned, the LPW model can accommodate this methodology. Therefore, we will discuss in more detail in this section the poverty and extreme poverty rates in Brazil using the economies of scale calculation based on the OECD approach, as we explained in subsection 3.3.2. Figures 3 and 4 show the per capita income approach, the per capita consumption approach, and the collective consumption approach using our estimated resource shares accounting for economies of scale and using the IPL of $2.15 per day (extreme poverty criteria) and the UMICs threshold of $6.85 per day (poverty criteria), by each year of the POF database. The objective in these two figures is compare the poverty and extreme poverty results based on two different methodologies: the per capita approaches (income and consumption) and the collective consumption approach.

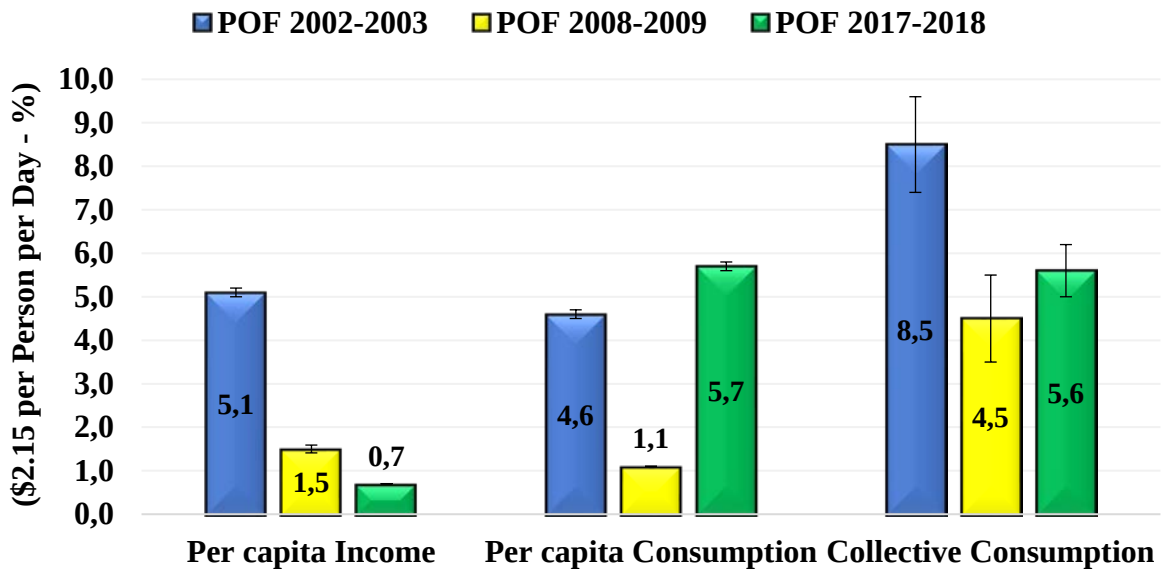

Figure 3 – Per capita Income, Per capita Consumption, and Collective Consumption extreme poverty rates taking into account economies of scale

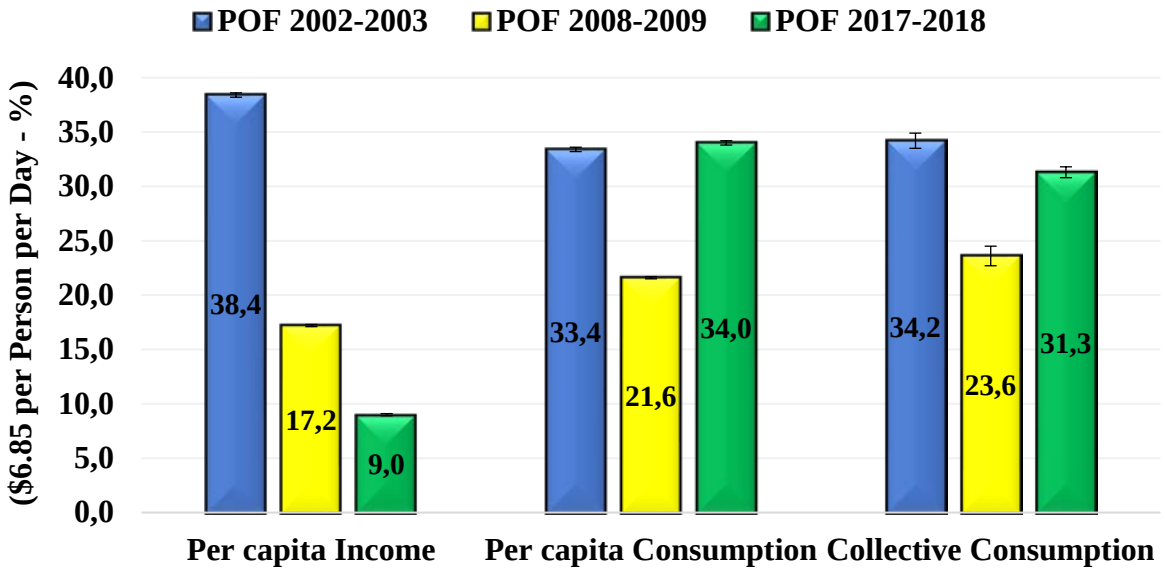

Figure 4 - Per capita Income, Per capita Consumption, and Collective Consumption poverty rates taking into account economies of scale

In general, the per capita approaches result in lower poverty and extreme poverty rates in Brazil in all database years when compared to our estimations based on the resource shares (collective consumption approach), with the exception of the per capita income poverty rate for POF 2002-2003 and the per capita consumption poverty and extreme poverty rates for POF 2017-2018. The per capita consumption approach ("Per Capita Consumption" bars) results in

lower extreme poverty rates when compared to the per capita income approach, with the exception of POF 2017-2018, and in higher poverty rates, with the exception of POF 2002-2003. The collective consumption poverty rates decreased in Brazil when compare the first and last year of our database and accounting for economies of scale. However, there was an increase in poverty and extreme poverty rates considering the collective consumption approach between the POF 2008-2009 and the POF 2017-2018, which did not happen when consider the per capita income approach. We attribute this increase due the economic recession period faced by Brazil between 2015-2016, the years right before the start of POF 2017-2018 database collection.

Several studies evaluated the determinants of poverty reduction in Brazil, mainly in the first decade of this century (Oliveira and Jacinto (2015), Ramos (2015), Ribeiro *et al*. (2015), Annengues *et al.* (2016), De Souza *et al.* (2017), and De Souza *et al.* (2021)). In general, these studies showed that economic growth at an average rate of 4.2% per year between 2004 and 2011, coupled with a sustained expansion of the labor market, the policy of increasing the minimum wage, which had a real increase of 50% from September 2003 to September 2011, and the expansion of social transfer programs, mainly BPC and the PBF, explained poverty reduction in Brazil during the first decade of 2000's. According to Souza *et al*. (2019), the PBF has contributed to reduce both poverty and extreme poverty by approximately 1-1.5 percentage points (p.p) per year, which in 2017 meant a reduction of about 15% or 3.4 million people in poverty and more than 25% or 3.2 million people in extreme poverty compared to 2003.

The individual collective consumption poverty rates, using the IPL of $2.15 per day (extreme poverty criteria) and the UMICs threshold of $6.85 per day (poverty criteria), by each year of the POF database, presented in Figures 5 and 6 reflect the resource shares differences among household members. The individual poverty rates are higher for women than men and children in POF 2002-2003 and POF 2008-2009, and higher for men compared to women and children in POF 2017-2018. Children's poverty rates are lower in the last two years of the

database compared to the men and women in those years. In addition, average men's and children's poverty rates increase substantially between POF 2008-2009 and POF 2017-2018, while women's poverty rate and the extreme poverty rate decrease steadily across our databases. When we look at the individual per capita income poverty and extreme poverty rates considering the economies of scale (Figures A1 and A2 in the Appendix), we confirm that neglecting intrahousehold resource distribution suggests mostly lower estimates of individual poverty and extreme poverty, mainly for women, in Brazil.

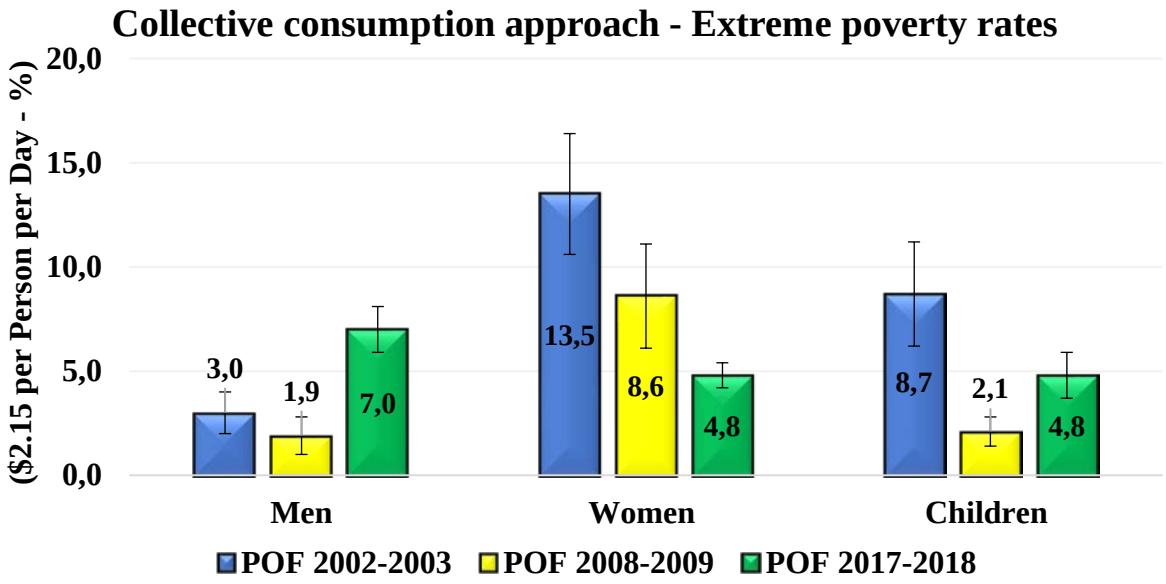

Figure 5 – Individual collective consumption extreme poverty rates calculated with economies of scale

Therefore, women were more vulnerable in the POF 2002-2003 and POF 2008-2009, while children became less vulnerable compared to men and women as we move to the most recent database, despite the substantially increase in children's poverty and extreme poverty rates in the last POF. This is an important result, because some studies suggest that among individuals affected by poverty, children are more vulnerable due to the lack of cognitive, physical, and emotional abilities (Andresen (2014), Schweiger (2019)). Therefore, more efforts need to be made, as child poverty and extreme poverty in Brazil increased on average in POF

2017-2018. Persistent child poverty can lead to health problems in later life (Conroy *et al.* (2010)); delinquency (Rekker *et al.* (2015)); lower educational achievements (McKinney (2014)); early pregnancy (Conrad (2012)); and adult unemployment and poverty (van Ham *et al*. (2014)).

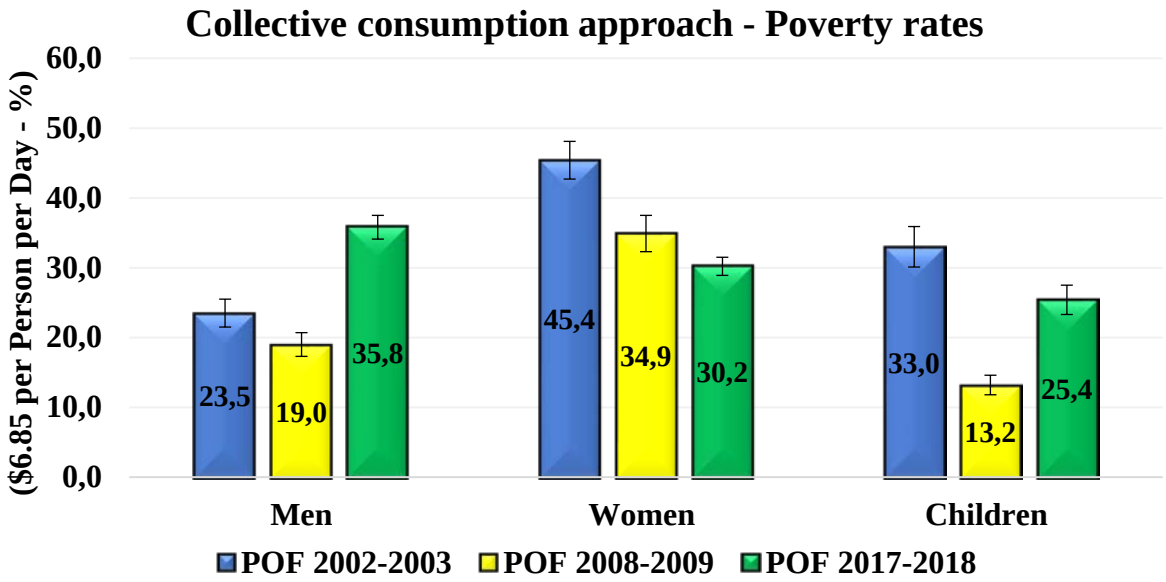

Figure 6 – Individual collective consumption poverty rates calculated with economies of scale

5. Conclusions

Our main results showed evidence of intrahousehold consumption inequality within Brazilian households, which leads to the rejection of the unitary consumption model as well as the traditional per capita household income model as the current standard practice for poverty measurement in Brazil. We also found that the per capita measures of poverty are not very informative to understand poverty in Brazil, hiding essential aspects about what is happening to groups of individuals within households. Therefore, intrahousehold estimates are important to fully understand poverty and inequality in Brazilian households, especially in a context of consolidation of pro-women public policies.

Our results also indicated that as we moved to the more recent database, we observed a more balanced resource distribution among household members with the increase in the amount of resource shares controlled by women. We showed statistically significant gender gaps in resource shares that favor men over women in POF 2002-2003 and POF 2008-2009, and then changed to women over men in the more recent database. Therefore, the increase in women's resource share took place in a context of conditional cash transfer policies that prioritize women, reinforcing how this mechanism can increase women's bargaining power in households. The increase in children's share between the first and last years of our database may also be a result of the increase in women's bargaining power. Finally, our results showed that when we considered economies of scale inside the households, the collective consumption poverty rate at the individual level decreased between POF 2002-2003 and POF 2008-2009, but increased in the last database year in Brazil, while the per capita income approach results mostly in lower estimates of Brazilian poverty and extreme poverty compared to the collective consumption rates in the database years.

Overall, our study suggests that neglecting intrahousehold resource distribution among household members led to lower estimates of women's poverty and extreme poverty in Brazil. The reduction of women's and children's individual poverty in Brazil between 2003 and 2018 was unprecedented, and the magnitude was unknown until our results. We suggest that resources allocated to mothers such as through PBF were being allocated to children's consumption, at a higher amount by 2009. Our measurements of the intrahousehold distribution of resources and individual poverty can serve as the basis to improve individual welfare in Brazil, and also for policymakers to understand how the intrahousehold distribution of resources affected poverty measurements. Our results might help public policymakers to design more effective policies to target the most vulnerable population groups. For example, a tax reduction or redistributive tax policies tend to benefit household members in a balanced way

due our resource share results when compared to former years. Conditional cash transfers (i.e., PBF) could be revised to optimally vary across household sizes and compositions. Future research might examine how intrahousehold allocation and poverty measurements differ by region, federal states, age, level of education, household composition, and/or by racial and ethnic group to improve targeting of social programs.

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Appendix

Table A1 – Budget share and test for identification by each POF year

	Sample	Budget share		Slope	z-Test of Slope	% of Sample Significance
		Mean	Standard Deviation			
POF 2002-2003	33,841	0.048	0.04	-0.010	-13.5	99.1
POF 2008-2009	37,808	0.053	0.05	-0.011	-14.9	99.3
POF 2017-2018	35,257	0.067	0.07	-0.030	-17.8	99.9

Table A2 - Predicted resource shares

	POF 2002-2003		POF 2008-2009		POF 2017-2018	
Sample	33,841		37,808		35,257	
	Resource shares	**Standard Error**	**Resource shares**	**Standard Error**	**Resource shares**	**Standard Error**
Men	0.310	0.02	0.301	0.01	0.270	0.01
Women	0.196	0.02	0.205	0.02	0.308	0.02
Children	0.226	0.02	0.292	0.02	0.252	0.01
	Resource shares	**Standard Deviation**	**Resource shares**	**Standard Deviation**	**Resource shares**	**Standard Deviation**
Men	0.314	0.16	0.301	0.14	0.267	0.77
Women	0.203	0.13	0.218	0.27	0.312	0.14
Children	0.220	0.17	0.280	0.56	0.254	0.45
η outside [0,1]	3.5%		3.1%		1.4%	
Wald per capita Test (p-value)	517, 85 (0.000)		434, 85 (0.000)		1366, 85 (0.000)	

Table A3 – Predicted resource shares, and gender gaps (households with at least one adult man and one adult woman)

		POF 2002-2003		POF 2008-2009		POF 2017-2018	
Sample		31,503		35,139		33,016	
		Resource shares	**Standard Deviation**	**Resource shares**	**Standard Deviation**	**Resource shares**	**Standard Deviation**
Mean	**Men**	0.340	0.15	0.324	0.16	0.270	0.12
	Women	0.215	0.12	0.226	0.13	0.307	0.14
		Resource shares	**Standard Error**	**Resource shares**	**Standard Error**	**Resource shares**	**Standard Error**
Estimated	**Men**	0.309	0.01	0.300	0.01	0.286	0.01
	Women	0.191	0.01	0.207	0.01	0.340	0.01
Gender Gap	**Estimate**	0.118	0.03	0.093	0.03	-0.037	0.01
	Significance	< 0.01		< 0.01		< 0.01	

Table A4 – Individual poverty rates (not accounting for economies of scale)

	$2.15 per Person per Day					
	Per Capita Estimate		**Estimated Using Resource Shares**			
	Income (SE)	**Consumption (SE)**	**Men (SE)**	**Women (SE)**	**Children (SE)**	**All (SE)**
POF 2002-2003	19.1% (.002)	20.9% (.002)	15.4% (.019)	35.8% (.028)	28.7% (.027)	26.8% (.007)
POF 2008-2009	6.9% (.009)	7.4% (.001)	7.8% (.015)	21.8% (.027)	7.7% (.013)	13.1% (.010)
POF 2017-2018	3.1% (.001)	14.2% (.002)	18.5% (.015)	14.3% (.011)	15.6% (.018)	16.1% (.006)
	$6.85 per Person per Day					
	Per Capita Estimate		**Estimated Using Resource Shares**			
	Income (SE)	**Consumption (SE)**	**Men (SE)**	**Women (SE)**	**Children (SE)**	**All (SE)**
POF 2002-2003	61.3% (.002)	59.3% (.003)	55.6% (.018)	69.6% (.015)	60.1% (.020)	62.0% (.004)
POF 2008-2009	39.6% (.001)	46.4% (.002)	47.4% (.018)	57.3% (.017)	42.2% (.020)	49.8% (.004)
POF 2017-2018	24.7% (.002)	55.2% (.002)	60.2% (.013)	54.8% (.012)	53.5% (.020)	56.5% (.003)

Table A5 – Comparison between the individual poverty rates calculated with economies of scales using our poverty analysis sample (Sample) and considering the excluded households (Complete)

	$2.15 per Person per Day							
	Estimated Using Resource Shares							
	Men		**Women**		**Children**		**All**	
	Sample	**Complete**	**Sample**	**Complete**	**Sample**	**Complete**	**Sample**	**Complete**
POF 2002-2003	3.0%	3.8%	13.5%	14.1%	8.7%	9.1%	8.5%	8.8%
POF 2008-2009	1.9%	2.2%	8.6%	10.0%	2.1%	2.3%	4.5%	5.2%
POF 2017-2018	7.0%	9.3%	4.8%	6.8%	4.8%	7.1%	5.6%	7.8%
	$6.85 per Person per Day							
	Estimated Using Resource Shares							
	Men		**Women**		**Children**		**All**	
	Sample	**Complete**	**Sample**	**Complete**	**Sample**	**Complete**	**Sample**	**Complete**
POF 2002-2003	23.5%	23.5%	45.4%	44.8%	33.0%	30.0%	34.2%	32.6%
POF 2008-2009	19.0%	21.4%	34.9%	37.4%	13.2%	15.8%	23.6%	26.0%
POF 2017-2018	35.8%	40.6%	30.2%	34.7%	25.4%	30.7%	31.3%	36.0%

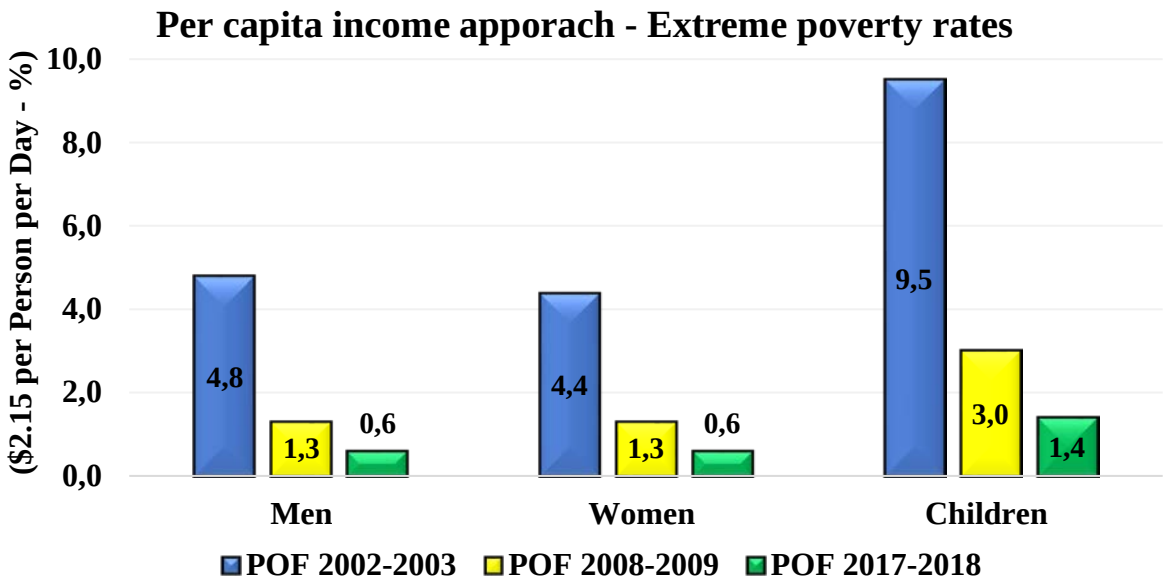

Figure 1A – Individual per capita income extreme poverty rates calculated with economies of scale

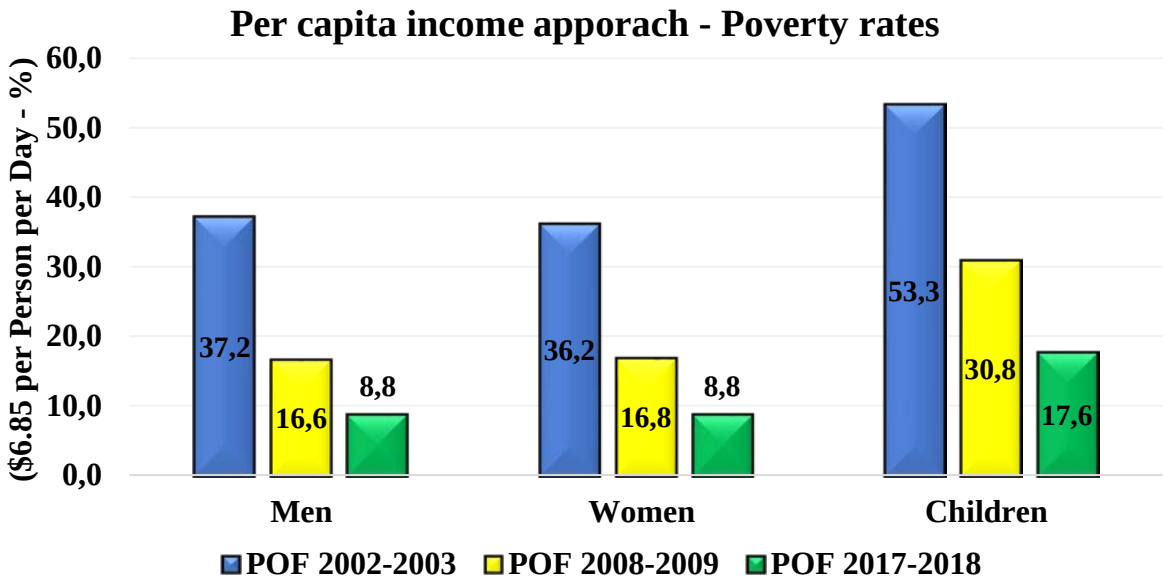

Figure 2A – Individual per capita income poverty rates calculated with economies of scale