Using a Collective Model to Evaluate Intra-Household Inequality and Individual Poverty in Brazil

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Abstract
This paper provides the first estimates of intra-household consumption allocation in Brazil and evaluates individual poverty based on resources allocated to each family member among Brazilian families. Building on a collective model of household consumption and using the *Pesquisa de Orçamentos Familiares* (POF 2008-2009), we also estimate adult economies of scale in households from Brazil. Our results show that men's share of total expenditures is slightly larger than women's shares for almost all the family structures considered in our study. The magnitude of children's shares is in turn comparatively smaller. Moreover, we find that standard poverty indices overstate the incidence of child poverty. The estimates also indicate substantial scale economies of living together which affect poverty measures. Adult poverty is then smaller because parents are highly compensated by the scale economies due to joint consumption. Finally, our results establish that the distribution of resources within households is crucial to the understanding of its members' material well-being and for the design of redistributive policies in Brazil.
Key words: Collective model; Engel curves; Sharing rule; Scale economies

Resumo

Este trabalho fornece as primeiras estimativas do processo de alocação de consumo intrafamiliar no Brasil e avalia a pobreza individual com base nos recursos atribuídos a cada membro do domicílio das famílias brasileiras. Com base em um modelo coletivo de consumo das famílias e usando a Pesquisa de Orçamentos Familiares (POF 2008-2009), são também estimadas as economias de escala nos domicílios do Brasil. Os resultados indicam que a parcela dos gastos totais dos homens é ligeiramente maior do que as parcelas das mulheres para quase todas as estruturas familiares consideradas no presente trabalho. Por sua vez, a magnitude das parcelas das crianças é comparativamente menor. Outros resultados também mostraram como as medidas tradicionais de pobreza tendem a superestimar a incidência da pobreza infantil. As estimativas também indicam que as economias de escala dos adultos são grandes e afetam as medidas de pobreza. Especificamente, a pobreza entre adultos é menor porque os pais são altamente compensados pelas economias de escala decorrentes do consumo conjunto. Finalmente, os resultados estabelecem que distribuição dos recursos nos domicílios é importante para a compreensão do bem-estar material de seus integrantes e para a formulação de políticas redistributivas no Brasil.

Palavras-chave: Modelo coletivo; curvas de Engel; Regra de partilha; Economias de escala
Classificação JEL: D12, D13, C31, I31
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1. Introduction

Understanding the welfare of individuals has been one of the central questions in development economics. Two leading measures of economic well-being are poverty and income distribution among households. Although poverty rates and income concentration have undergone an evident drop in Brazil during 2000s[3], the country is well known for having one of the highest worldwide inequality levels which

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[3]According to De Souza (2012, p. 7), Brazil's GINI Index of the household *per capita* income has slowly decreased from 0.594 in 2001 to 0.539 in 2009 indicating a rather significant problem of income disparity. Regarding poverty, from 2004 to 2009 the

has attracted attention of economists from all over the world (KAKWANI et al., 2010; ROEMER, 2013; LUSTIG et al., 2013; among others). In this context, the question of poverty intensity becomes relevant because it is crucial to assess whether all household members are equally poor or whether some persons are disproportionately poor. Hence, ignoring resource allocation behavior within the household can lead to failure in targeting the population group of concern in policy and social program designs.

Despite the voluminous literature on inequality and poverty, there is still a relatively small body of research concerning the distribution of resources within households and poverty at the individual level. To account for the intra-household resource allocation process, individual consumption must be used, but empirically, consumption is typically measured at the household level[4]. One possible solution to this problem is the use of a collective household model to fill in the missing information about the within-household allocation of resources[5]. Menon et al. (2012) argued that, given household-level data, useful measures of individual consumption expenditures are resource shares (i.e., each member's share of total household consumption expenditures) which reveal if there is intra-household inequality. Thus, standard per-capita calculations assuming equal resource shares to all household members are invalid measures of individual well-being. Following an earlier literature dated back to Becker (1965, 1981) and Chiappori (1988, 1992), the collective models have become increasingly popular for analyzing household consumption behavior. The more recent versions of this approach, including Lewbel and Pendakur (2008), Browning et al. (2013), Dunbar et al. (2013), Bargain and Donni (2012a; 2012b) and Bargain et al. (2014), rely on the identification of resource shares from household-level expenditures. This identification is important for many economic topics such as welfare and poverty analysis (e.g., DUNBAR et al., 2013, or BARGAIN et al., 2014; CHERCHYE et al., 2015), and social-level redistribution or determination of alimony and life insurance payments (e.g., LEWBEL, 2003; ATTANASIO; LECHENE, 2014).

In this paper, we provide estimates of the share of household resources accruing to adults and children, and its implications for the levels of poverty in the Brazilian context. Building on the framework developed by Bargain and Donni (2012) and Bargain et al. (2014), we retrieve the intra-household resource allocation in order to compute a direct measure of individual poverty for Brazil. This approach is a generalization of the conventional Rothbarth-Gronau method[6]. In the context of developing countries, this method has been used to measure the cost of children and the existence of gender discrimination among children[7]. However, the disadvantage of Rothbarth-Gronau method is that it considers consumption as a purely private activity. But the consumption of some goods and services is an activity partially, or completely collective (in the case of household public goods) that generates economies of scale in multi-person households.

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share of the population with less than a minimum wage per month decreased from 71% to 58%, yet in 2009 the extremely poor accounted for 4.7% of the population and the poor came to almost 9.4% of Brazilians and people vulnerable to poverty amounted to around 44% of the total population (OSORIO et al., 2011). More recent figures indicate that, in 2014, the Brazil's GINI Index was 0.494, and the rates of extreme poverty and poverty were 2.8% and 7.3% of the population, respectively. See Brazil (2015).

[4] Traditionally, microeconomic theory considers the households as single decision-making units. This so called unitary model only considers allocation among households and disregards questions concerning individual preferences and intra-household inequalities, which may lead to wrong welfare implications (HADDAD; KANBUR, 1990, 1992). Unitary model has been criticized both from a theoretical and an empirical perspective by several authors who have developed alternatives termed as collective approaches to household behavior (BOURGUIGNON; CHIAPPORI, 1992).

[5] The collective models of household consumption are those in which the household is described as a group of individuals, each of whom is characterized by particular preferences, and among whom intra-household bargaining and collective decision processes are assumed to take place (VERMEULEN, 2002). According to Xu (2007, p. 3), the collective framework explain phenomena that cannot be understood under the unitary approach and reshape policy instruments to make social welfare and individual development programs more efficient.

[6] As clearly explained in Bargain et al. (2014), the Rothbarth approach "… is a method that allows retrieving how household resources are allocated between parents and children. It consists in examining the extent to which the presence of children depresses the household consumption of adult-specific goods" (see, particularly, p. 262, and the references therein).

[7] See Deaton (1989, 1997), Rose (1999) and Dunbar et al. (2013) for recent discussions.

As a benchmark, our study not just deals with the fact that individual allocation within families are practically unobserved, but also with the appropriate inclusion of joint consumption[8] in the household to measure individual's welfare. Our analysis thus implies that poverty rates often ignore not only the distribution of resources within households, but the gains from joint consumption. Alternatively, using anthropometric information as measure of individual welfare, some studies have revealed a significant level of intra-household inequality (e.g, HADDAD; KANBUR, 1990; SAHN; YOUNGER, 2009) and significant impacts of economic policy on child poverty (e.g, THOMAS, 1990; THOMAS et al., 1996). In addition, there is evidence that parent-specific characteristics as well as the resulting pattern of household decision-making power sharing can play an important role on the welfare of other members of the household, particularly children (e.g., DOSS, 2013). Based on this observation, we estimate a measure of resource allocation in a multi-person model consistent with consumption economies of scale and parental bargaining. More specifically, our framework allows the estimation of indifference scales in Lewbel (2003)'s sense[9], and thereby to account for the existence of scale economies and for the possibly diverging opinions of the parents.

Our results indicate that the differences in consumption behavior between singles and couples can be explained by the sizeable scale economies within multi-person households. The empirical findings based on our baseline model also show that the parents' expenditures made for children living in the household amount to about 20% of the resources for one-child households and 26% for families with four children. Regarding the distribution of resources between adults, spouses' education (as well as their age) seems to be related to a larger fraction of the total expenditure they receive. The share of total expenditure devoted to household members is positively related to urban residency, house ownership, white persons and woman's participation in the labor market (in the case of women and children). In particular, the share of total expenditure devoted to children increases with their number and their age, but the average share per child tends to decrease. In addition, we do not find evidence of gender discrimination in the allocation of resources among children.

Another interesting finding is that adult's scale economies are large and affect poverty measures. That is, adult poverty is smaller because parents are highly compensated by the scale economies due to joint consumption. Despite that the children command a reasonably large share of household resources, such share is not enough to avoid having higher rates of poverty than their parents. We also show how resources devoted to each household member vary by family size and structure, and we find that, particularly, standard poverty measures tend to overstate the incidence of child poverty. One important consequence of this is that standard per-capita poverty measures, which by construction ignore intra-household inequality, present a misleading picture of poverty, particularly for children. Thus, our estimates are important for redistributive policy interventions, because they constitute more accurate measures of the relative material welfare of Brazilians in households of varying composition. Furthermore, the fact that it is plausible to measure of each member‘s resource shares within households is a very useful step in measuring actual individual poverty, and thus informing in a more precise way to policy makers which are focused on poverty alleviation.

The rest of our paper is organized as follows. In Section 2, we present the framework and the theoretical results on which the empirical analysis is based. Section 3 summarizes the functional form, the estimation method, and the process to compute inequality within the household as well as poverty

[8] Joint consumption is the shared use of commodities in multi-person households, i.e. collective enjoyment of goods, like housing, television, fridge, or utilities, which are in the nature of ‘public goods’ to the family and by which ‘scale economies' take place. In family economics, household consumption can be divided into private or collective (public) depending on the type of good being shared among the household members. This applies to household goods such as furniture, housing, family car, home heating/cooling, etc.

[9] In the Lewbel (2003)’s sense, an indifference scale is a scalar that equates the utility of a person living alone to the utility of the same individual if he or she lived with a partner. More generally, an indifference scale represents the income adjustment applied to person when living in a multi-person household (with or without children) for her/him to reach the same indifference curve as when living alone.

measures at the individual level. Section 4 describes the data set and sample selection. In Section 4, we present and discuss the main empirical results. Section 5 concludes.

2. Theoretical Framework

We follow closely the theoretical framework of Bargain and Donni (2012a) and Bargain et al. (2014). Our model assumes three types of households $n = 1,2,3$ denoting single adults, childless couples, and couples with children. Let superscripts $k = 1,\ldots,K$ refer to goods and subscripts i refer to household members, with $i= m,w,c$, indicating men, women, and children, respectively. Let x denotes the log household expenditure and let $\mathbf{p}$ be the vector of log prices. For each individual i living in a household of type n, there is a set of *utility functions*, a set of *sharing functions*, and a set of *scaling functions*. In particular, individual log resources for single-person households ($n = 1$) is the same as the household log expenditure x whereas multi-person households ($n > 1$) individual log resources ($x_{i,n}$) is assumed to have the following structure:

$$x + \log \eta_{i,n}(\mathbf{p},\mathbf{z}) - \log s_{i,n}(\mathbf{p},\mathbf{z}) \tag{2.1}$$

where $\log \boldsymbol{\eta}_{i,n} > 0$ is the logarithm of the share of total expenditure accruing to individual i in household n, $\log s_{i,n} > 0$ represent the logarithm of the economies of scale associated to this individual's consumption, and $\mathbf{z}$ is a vector of individual and household characteristics (such as age, education or region of residence). The utility of individual i living in a household of type n can be characterized by a well-behaved indirect utility function that takes the form:

$$v_i(x + \log \eta_{i,n}(\mathbf{p},\mathbf{z}) - \log s_{i,n}(\mathbf{p},\mathbf{z}), \mathbf{p}, \mathbf{z}_i) \tag{2.2}$$

where $\mathbf{z}_i$ is a vector of individual characteristics, with $\boldsymbol{\eta}_{i,n}(\boldsymbol{p},\boldsymbol{z}) = s_{i,n}(\boldsymbol{p},\boldsymbol{z}) = 1$ if $n = 1$ by convention. In general, collective models posit that each household member has a utility function. Two important points worth mentioning in this regard: First, the utility function $v_i(\cdot,\mathbf{p},\mathbf{z}_i)$ of each family member does not depend on the type n of the household once we controlled for the sharing of total expenditure and the existence of joint consumption. Thus, scaling and sharing functions can explain the differences in expenditure patterns between a person living alone and an individual living with other people. This assumption implies that the individual preferences across household types are stable, as in the Rothbarth method (GRONAU, 1988, 1991; BARGAIN et al., 2014). Second, preferences of children in the household are aggregated into a unique index, which could then be used to represent the indirect utility function of the children living in the household. This does not imply the strong assumption that the resource shares are equally distributed among children. In effect, the total share of children are allowed to depend on demographic characteristics ($\mathbf{z}$) which includes (among others) the age of children and the number of boys versus girls in order to test for any potential discrimination among children in household expenditure.

The set of sharing functions $\eta_{i,n}(\mathbf{p},\mathbf{z})$ allows identifying the intra-household allocation and control of resources among household members. We employ a two-stage budgeting decision process based on Browning et al. (1994)'s collective approach. Specifically, household resources are supposed to be allocated between household members according to some sharing rule at the first stage. At the second stage, each member i maximizes their own utility function subject to an individual budget constraint given by the fraction of $\boldsymbol{\eta}_{i,n}(\mathbf{p},\mathbf{z}) \cdot \exp(x)$, choosing in this way consumption expenditure vectors. The basic assumption here is that sharing function is independent of household total expenditure, so that the resource shares depend on the socio-demographic variables and, possibly, variables that capture the relative bargaining position of the parents.[10] This assumption is made for the sake of identification

[10] In the literature on equivalence scales, this restriction that resource shares are independent of expenditure is known as 'independent of base' (IB) scaling of consumption (BLACKORBY; DONALDSON, 1993; LEWBEL, 1991). IB is a function, independent of total expenditure –and, hence, of the utility level – at which it is evaluated, which scales the expenditure of

(LEWBEL; PENDAKUR, 2008; BARGAIN; DONNI, 2012a; DUNBAR et al., 2013). Although this restriction is potentially strong, it fortunately can be tested empirically and tends to be supported by recent evidence (MENON et al., 2012; BARGAIN al., 2014).

The set of scaling functions $s_{i,n}(\mathbf{p},\mathbf{z})$ characterizes the adult economies of scale and scope in consumption. This functions must be individual-specific[11]. Following Lewbel and Pendakur (2008) and Bargain et al. (2014), we assume that the 'value' of total expenditure is inflated by the presence of several persons in the household (e.g., a married couple that always rides together in a car 'will consume' gasoline twice) and that economies of scale have a pure wealth effect. That is, scale economies generated by joint consumption can be represented by the deflator $s_{i,n}(\mathbf{p},\mathbf{z})$. As explained previously, the scale $s_{i,n}(\mathbf{p},\mathbf{z}) < 1$ is then interpreted as a measure of the cost savings experienced by person *i* as a result of scale economies in the household. The general budget constraint to which the individual consumption behavior is subject can be calculated if the Roy's identity is applied to equation (2.2). If we assume that households face constant prices, the individual budget shares equation for good *k* of person *i* living in household *n* become then in:

$$w_{i,n}^{k}(x,\mathbf{z}) = \varepsilon_{i,n}^{k}(\mathbf{z}) + \omega_{i}^{k}(x + \log\eta_{i,n}(\mathbf{z}) - \log s_{i,n}(\mathbf{z}), \mathbf{z}_i) \qquad (2.3)$$

for $i = w, m, c$, $n = 1, 2, 3$, and $k = 1,\ldots, K$,

where $w_{i,n}^{k}(x,\mathbf{z})$ represents the 'reduced-form' budget share on good *k* of person *i* in household of type *n* as a function of household (log) expenditure *x* and household characteristics **z** and $\varepsilon_{i,n}^{k}(\mathbf{z}) = \partial \log s_{i,n} / \partial p_k$ is a elasticity of the scaling function $s_{i,n}$ with respect to the *k*th price, following the explanation provided in Lewbel and Pendakur (2008)[12]. Household expenditures on each good *k* can thus be written as the sum of individual expenditures on that good. Intuitively, if we divide this identity by the total expenditure exp(***x***), then we obtain the household budget share function for households of any type *n* as follows:

$$W_{n}^{k}(x,\mathbf{z}) = \sum_{i\in\varphi_n} \eta_{i,n}(\mathbf{z}) \cdot \left(\varepsilon_{i,n}^{k}(\mathbf{z}) + \omega_{i}^{k}\left(x + \log\eta_{i,n}(\mathbf{z}) - \log s_{i,n}(\mathbf{z}), (\mathbf{z}_i)\right)\right) \qquad (2.4)$$

for any good *k*, with φ_n the set of indices for all the persons living in a type-*n* household.

Two important concepts must be clarified, namely *indifference scales* and joint consumption. First, $I_{i,n}(\mathbf{z}) = \eta_{i,n}(\mathbf{z})/s_{i,n}(\mathbf{z})$ indicates *indifference scales*, i.e. the adjustment (applied to total expenditure) which allows a person living in a multi-person household to reach the same indifference curve as if living alone. These scales can be used to compare the welfare of the same individual in two different situations and are particularly useful to measure poverty at the individual level. Second, the level of the scale $s_{i,n}(\mathbf{z})$ cannot be interpreted directly; it must be compared to the level of the corresponding share $\eta_{i,n}(\mathbf{z})$, i.e. the fraction of total expenditure which is consumed by individual *i*. Thus, a normalized indicator of the 'individual' scale economies for each person living in a household of type $n \geq 2$ is defined as:

$$\sigma_{i,n}(\mathbf{z}) = \frac{\eta_{i,n}(\mathbf{z})\left(1 - s_{i,n}(\mathbf{z})\right)}{s_{i,n}(\mathbf{z})\left(1 - \eta_{i,n}(\mathbf{z})\right)}, \qquad (2.5)$$

which is equal to 0 in the purely private case and to 1 in the purely public case. The purpose here is to identify the main structural components of the model, $s_{i,n}(\mathbf{z})$ and $\eta_{i,n}(\mathbf{z})$, for $i = w,m,c$ and $n = 1,2,3$, from the knowledge of the deterministic components $W_{n}^{k}(x,\mathbf{z})$. Finally, the fact that young children are never observed living alone (i.e., they are always observed living with their parents) implies that the terms

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each individual in the household and represents the economies from joint consumption (LEWBEL; PENDAKUR, 2008; BARGAIN et al., 2014).

[11] See Bargain and Donni (2012a) and Lewbel and Pendakur (2008) for recent discussions in detail on this intuition.

[12] The price elasticity $\varepsilon_{i,n}^{k}$ is a translation function specific to good *k* and it is related to the differences that may exist between goods with respect to the possibility of joint consumption. Bargain and Donni (2012a, p. 797) point out that scale economies may have a wealth effect and a substitution effect represented by log $s_{i,n}$ and $\varepsilon_{i,n}^{k}$, respectively. This latter effect can be positive or negative depending on the nature of good *k*, i.e. if good *k* is essentially public or private.

representing economies of scale in the budget share equations of children are meaningless in our analysis. That is why the factors corresponding to scale economies for children are normalized: $\varepsilon^k_{c,3}(\mathbf{z}) = 0$ and $s_{c,3}(\mathbf{z}) = 1$ for any good k.

2.1. Identification strategy

In this section, we offer a brief nontechnical description of how we identify each person's resource share in the collective household. Technical discussion and formal identification proofs are in Bargain and Donni (2012a). The main identification result arises from the fact that we observe at least one adult-specific good for each adult living in the household and utility functions of all the children are aggregated into a single representative index. Furthermore, under some regularity conditions (including the non linearity of budget share equations with respect to x and the constant prices) and normalization, the main parameters (i.e., $\eta_{i,n}(\mathbf{z})$ and $s_{i,n}(\mathbf{z})$ for $i = m, w$ or c and $n = 1,2,3$) can be identified from the estimation of the budget share equations $W_n^{k_i}(x,\mathbf{z})$. To account for unobserved factors, we add error terms to the household budget shares: $\tilde{W}_n^k(x,\mathbf{z}) = W_n^k(x,\mathbf{z}) + e_n^k$ which is the stochastic extension of the deterministic component $W_n^k(\cdot)$ for n=1,2,3 and k=1, …, K; and where e_n^k can be interpreted as optimization or measurement errors. Alternatively, the stochastic component of the budget shares could be seen as resulting from unobservable heterogeneity in the individual budget share equations, in the scales or in the resource shares (BARGAIN; DONNI, 2012a).

Our identification strategy consists of three steps: (1) the basic budget share equations can be identified from a sample of single women and another of single men since preferences are stable across household types n; (2) once basic budget share equations are recovered, the sharing functions and scaling functions for $n = 2$ can themselves be identified from a sample of couples without children; (3) using expenditure on adult-specific goods, the adults' sharing and scaling functions for $n = 3$ can also be identified with the same method as in step 2 from a sample of couples with children. Since the basic budget share equations of children are unknown, the adding-up condition of sharing functions, given by $\sum_i \eta_{i,n}(\mathbf{z}) = 1$, has to be exploited to identify the children's share. In this light, the share of total expenditure devoted to the child is then obtained as $\eta_{c,3}(\mathbf{z}) = 1 - \sum_i \eta_{i,n}(\mathbf{z})$ where i=m,w and the function $s_{c,3}(\mathbf{z})$=1 for children.

3. Empirical Approach

3.1. Functional forms

For our empirical application, we introduce an index h for households observed in the data. The specification of the model includes the basic budget share equation for the different demographic groups. The individual preferences are assumed to be consistent with a generalization of the PIGLOG indirect utility functions, proposed by Banks et al. (1997). In particular, the specification adopted is:

$$\omega^k_{i,h,n}(x_{i,n,h}, \mathbf{z}_{i,h}) = a_i^k + b_i^k \mathbf{z}_{i,h} + c_i^k \cdot (x_{i,n,h} - \mu_i \mathbf{z}_{i,h}) + d_i^k \cdot (x_{i,n,h} - \mu_i \mathbf{z}_{i,h})^2, \qquad (3.1)$$

where $x_{i,n,h} = x_h + log\eta_{i,n,h} - logs_{i,n,h}$ represents the log resources for individual i in household h of type n; a_i^k b_i^k c_i^k d_i^k, and μ_i are parameters and $\mathbf{z_{i,h}}$ are socio-demographic variables. Specifically, the socio-demographics variables include, in the adults' case, age and level of education and dummies for house ownership, women's work participation and urban and regional residency, and in the children's case, the number of children in the household, their average age, the proportion of boys and dummies for home ownership, urban resident and state of residence. Following Bargain et al. (2014), the socio-demographic variables enter the specification through the translation of budget share equations (b_i^k), and through the translation of log resources (μ_i). In the case of multi-person households $n \geq 2$, and non-adult-specific goods, the household budget share equations is expressed as

$$W^k_{n,h}(x,\mathbf{z}) = \sum_{i\in\varphi_n} \eta_{i,h,n}\left[\varepsilon^k_{i,n,h} + \omega^k_i\left(x_h + \log\eta_{i,n,h} - \log s_{i,n,h}, \mathbf{z}_{i,h}\right)\right] + e^k_{n,h}, \qquad (3.2)$$

where $e^k_{n,h}$ is the error term, $\omega^k_i(\cdot,\mathbf{z}_{i,h})$ individual functions as already specified and three other components that are defined as follows. First, the *sharing functions* are specified using the logistic form:

$$\eta_{i,n,h} = \frac{\exp\left(\alpha^\eta_i + \beta^\eta_i \mathbf{z}^\eta_{i,h}\right)}{\sum_{j\in\varphi_{n,h}} \exp\left(\alpha^\eta_j + \beta^\eta_j \mathbf{z}^\eta_{j,h}\right)}, \qquad \text{for } i = m,w,c, \qquad (3.3)$$

where α^η_i and β^η_i represent parameters and $\mathbf{z}^\eta_{i,h}$ denotes socio-demographic variables. These latter consist of all the variables in $\mathbf{z}_{i,h}$ for adults. In the children's case, socio-demographic variables comprise all the variables in $\mathbf{z}_{i,h}$ plus a dummy for mother's work participation. For the constants and the parameters of the variables that enter several individual indices of the logistic function, normalization is required and the corresponding coefficients are simply set to zero. We specify $\sigma_{i,n}$ rather than $s_{i,n}$ from the inversion of Eq. (2.5) in the previous section, the log scaling functions that translate expenditure within the basic budget shares are specified as:

$$s_{i,n,h} = \frac{\eta_{i,n,h}}{\sigma_{i,n,h} + \eta_{i,n,h} - \sigma_{i,n,h}\eta_{i,n,h}}, \qquad \text{with } \sigma_{i,n,h} = \alpha^\sigma_i + \beta^\sigma_i \mathbf{z}^\sigma_{i,h} \qquad \text{for } i = m,w, \qquad (3.4)$$

where α^σ_i and β^σ_i are parameters and $\mathbf{z}^\sigma_{i,h}$ are socio-demographic variables (here, they include only the number of children, with the restriction that $\sigma_{i,n,h} \in [0,1]$). The function that translates the basic budget shares $\varepsilon^k_{i,n,h}$ is price elasticity. In order to attempt measuring price effects and their interaction with demographics, we restrict the derivative of $\sigma_{i,n}$ with respect to log price of good *k* to be a constant and that of $\eta_{i,n}$ to be zero. We then compute $\varepsilon^k_{i,n,h}$ as the derivative of the log of $s_{i,n}$ with respect to p_k.

3.2. Estimation method

Our estimation method corresponds to the iterated Seemingly unrelated regressions (SUR) method. In order to account for the likely correlation between the error terms $e^k_{n,h}$ in each budget share function and the log total expenditure, each budget share equation is augmented with the 'Wu–Hausman residuals' as in Banks et al. (1997), Blundell and Robin (1999), Bargain and Donni (2012a) and Bargain et al. (2014). According to Bargain et al. (2014), these residuals can be calculated from reduced-form estimations of *x* on all exogenous variables used in the model plus some excluded instruments, precisely, a polynomial of a convenient degree in household disposable income. Given the budget shares sum up to one, equation for good *K* is unnecessary. The household budget share equations for the *K*-1 goods and for the three demographic groups are estimated simultaneously. Once corrected for endogeneity of log total expenditure, the error terms are supposed to be uncorrelated across households and with the demographic structure of the household, but correlated across goods within households (BARGAIN; DONNI, 2012a; BARGAIN et al., 2014). The perturbation terms are also assumed to be homoskedastic for each type of household (and covariance matrices are supposed to be different for single males and females).

3.3. Measures of intra-household inequality and individual poverty

We compute inequality within the household using the resource shares $\eta_{i,n}(\mathbf{z})$ estimated for each adult member and for the children as a whole. Specifically, we calculate the amount of household expenditure accruing to each adult as:

$$x_{a,n} = \exp\left(x + \log\eta_{a,n}(\mathbf{z})\right), \qquad \text{for } a = w,m \text{ and } n = 1, 2\ 3 \qquad (3.5)$$

with $\log\eta_{i,n}(\mathbf{z}) = 0$ for single individuals. In the children case, the individual expenditure per child, i. e., child resources divided by the number of children in the household:

$$x_{c,n} = \frac{\exp\left(x + \log\eta_{c,n}(z)\right)}{number\ \ of\ children}, \qquad \text{for } n = 3 \qquad (3.6)$$

To measure poverty at individual level in Brazil, we aggregate the individual resources calculated for each person in the sample and compare it to a poverty line that may depend on the size and the composition of the household. Following Dunbar et al. (2013) and Bargain et al (2014), we use the World Bank's poverty threshold of US$2 per adult and day and US$1.20 per child and day applied to the entire household. These poverty levels arising here are "unadjusted" poverty measures of adults. To test the hypothesis that parents are highly compensated by joint consumption, the measure of adult poverty is adjusted for economies of scale:

$$\tilde{x}_{a,n} = \exp\left(x + \log I_{a,n}(z)\right), \qquad \text{for } a = w, m \text{ and } n = 1, 2\ 3 \qquad (3.7)$$

Based on these measures of individual poverty, poor persons are redefined as poor because the resources they receive in the household are below the aforementioned poverty lines (BARGAIN et al, 2014).

4. Data and sample selection

We use Brazilian household expenditure and demographic data. The information comes from the microdata of *Pesquisa de Orçamentos Familiares* (POF) conducted by *Instituto Brasileiro de Geografia e Estatística* (IBGE). This is a high-quality household survey that is also used in poverty and inequality research (DE SOUZA, 2012). The POF is a cross sectional national survey which gathers information on household expenditures, incomes and socio-demographics for 55,970 representative households. In our empirical analysis, we make use of the most recent available survey for Brazil, namely POF of 2008-2009 (IBGE, 2010a). Our selection criterion is as follows. To begin with, we restricted the sample to monogamous, nuclear household (i.e., either adults living alone or married couples with or without children). Specifically, the family types that we included are single men, single women, childless couples and couples with one to four children. This selection drops 25% of the initial sample. These households satisfy the following additional sample restrictions: (1) we select households where adults are aged between 20 and 65 years; (2) households with more than one family or unit consumption are excluded; (3) we drop households where children are aged 15 or more in order to differentiate children's clothing expenditures from adults ones in the data (since clothing is the central good used in the identification of our model)[13]; (4) single parents living with children are excluded in our baseline estimations; (5) Since leisure is not modeled here, but is likely endogenous to consumption (and hence savings) decisions, we restrict our sample to households where men are economically active; (6) observations with any missing data on the age or education of members are excluded; (7) we finally exclude households with zero food expenditure together with obvious outlying observations. The final sample is composed of 9,771 households (about to 18% of the initial sample)[14].

Our private assignable goods are based on clothing expenditures (i.e., one adult male-specific good and one adult female-specific good). These goods, as well as a residual good, are just what we need to identify the main components of the model. However, we also consider other non-durable goods to improve the efficiency of the estimations and to generate tests, namely, food, transport, personal goods and services, household operation and communications or 'housing', leisure goods and services, footwear and paraphernalia, and a children-specific good (i.e., child clothing). Table 1 presents a description of the variables and goods that we use in the estimations. Specifically, we use observations for K=9 non-durable commodities: food, transport, leisure goods and services, male, female and child clothing, footwear and paraphernalia, personal goods and services, and household operation and communications (being this latter commodity the omitted good in the Engel curve system). The system estimation comprises a total of 20 individual Engel curves, that is, 3 private assignable goods (men, women, and children clothing) and 6

[13] In POF of 2008-2009, children's clothing expenditures are defined as the acquisition and rental of children's clothing up to 14 years (IBGE, 2010a).

[14] This selection can potentially distort our measures of poverty. However, we have some reasons to believe that our results will not be significantly affected. Indeed, the aggregate poverty rate at the level of our study sample using a traditional poverty line (the exact definition of which is given below) amounts to 5.7%, which is of the same order of magnitude as the poverty rate in the extended sample including all family types (8.7%). Of course, our results could still be misleading if the distribution of resources among selected households is very different compared to the rest of the population.

non-assignable goods, with three individual budget shares. We include 15 demographic variables in our models: region of residence (North, Northeast, Southeast and South with Central-West as the left-out category); the ages and education levels of the household head and spouse; the average age of children less 15; the proportion of children who are boys; binary indicators for women's work participation, house ownership, residence in an urban location and ethnicity (reference category: non-white). All demographic factors are allowed to affect both the preferences of each household member and the allocation of resource across individuals in the households.

Table 1 — Description of Variables

Variable	Description
Location of Household	
Urban dummy	Household located in urban area = 1; otherwise = 0
North dummy	Household located in the North region = 1; otherwise = 0
Northeast dummy	Household located in the Northeast region = 1; otherwise = 0
Southeast dummy	Household located in the Southeast region = 1; otherwise = 0
Central-West dummy	Household located in the Central-West region = 1; otherwise = 0
Household composition	
Men's age	Age of adult male in the household
Women's age	Age of adult female in the household
Men's education level	Years of schooling of the adult male in the household
Women's education level	Years of schooling of the adult female in the household
Women's participation	Dummy variable, 1=If adult female works, 0= Otherwise
White	Dummy variable, 1=If person is white, 0= Otherwise
House ownership	Dummy variable, 1=If adult is house owner, 0= Otherwise
Male children	Proportion of male children in the household
Children's age	Average age of children in the household
Household expenditure	Household total expenditure per week
Goods	
Food	Aggregated household expenditures on food products and beverages
Transport	Aggregated household expenditures on transportation (public transport, gasoline, etc., but no purchase of transportation means)
Personal goods and services	Aggregated household expenditures on personal goods and services ((hair care, body care, manicure, hair dressers, medical expenditures not covered by insurance, etc.)
Household operations and communications	Expenditures on housing (composed of maintenance costs, rental costs and imputed housing costs for house owners) and telecommunication
Leisure goods and services	Aggregated household expenditures on goods and services related to leisure, entertainment and recreation (film, theater, hobbies, sports, books, DVD's, etc.)
Footwear and paraphernalia	Aggregated household expenditures on footwear, bags and belts, and jewelry.
Total clothing	Aggregated household expenditures on clothing
Women's clothing	Household expenditures on adult female's clothing
Men's clothing	Household expenditures on adult male's clothing
Children's clothing	Household expenditures on children's clothing

Source: Own elaboration based on Bargain et al. (2014) and information from POF (2008-2009).

5. Empirical Results

Table 2 provides summary statistics of our sample by household type and number of children. We observe that the average education level across family types ranging from 7.1 to 8.4 (8.5) years between men (women), where 8 years is the modal education level for both. The representative households are composed of adults aged over 30. Single women are older than single men, but married women are younger than married men according to the average ages of men and women in the subsamples. In general, household structures analyzed here are constituted by urban residents, with a lower frequency of couples with four children in urban areas. Budget shares, in turn, show that household operations and communications are the main items, representing more than 40% of household expenditures. Another important item is food, which comprises of more than 20% of expenditures in households. These descriptive statistics are consistent with previous analysis using POF (2008) data (see, e.g., IBGE, 2010b).

Table 2 — Summary statistics of the sample, by family type

Family type	Single men	Single women	Childless couples	Couples with			
				1 child	2 children	3 children	4 children
Budget shares							
Food	0.278	0.217	0.239	0.257	0.272	0.312	0.351
Transport	0.152	0.099	0.187	0.178	0.170	0.142	0.106
Personal goods and services	0.036	0.058	0.047	0.046	0.045	0.043	0.041
Household operations and communications	0.433	0.528	0.439	0.418	0.410	0.402	0.402
Leisure goods and services	0.024	0.017	0.015	0.020	0.020	0.016	0.013
Footwear and paraphernalia	0.019	0.019	0.018	0.020	0.021	0.020	0.021
Budget share(assignable goods)							
Women's clothing	—	0.062	0.028	0.022	0.020	0.020	0.017
Men's clothing	0.058	—	0.024	0.019	0.018	0.019	0.017
Children's clothing	—	—	—	0.018	0.024	0.026	0.032
Total clothing	0.058	0.062	0.052	0.060	0.062	0.065	0.066
Demographic variables							
Men's schooling (years of education)	7.8	—	7.8	8.4	8.1	7.5	7.1
Women's schooling (years of education)	—	7.9	7.8	8.5	8.2	7.6	7.1
Men's age (in years)	37.9	—	40.8	34.4	35.5	35.2	34.9
Women's age (in years)	—	42.8	38.3	30.8	31.5	30.8	30.8
Women's participation dummy	—	0.762	0.557	0.531	0.503	0.461	0.462
Urban dummy	0.770	0.917	0.770	0.795	0.779	0.703	0.665
North	0.172	0.125	0.115	0.120	0.140	0.212	0.275
Northeast	0.247	0.297	0.246	0.305	0.325	0.346	0.386
Southeast	0.310	0.273	0.296	0.263	0.249	0.192	0.131
South	0.100	0.130	0.149	0.154	0.117	0.090	0.056
Central-West	0.172	0.175	0.195	0.158	0.169	0.159	0.151
House owner dummy	0.414	0.558	0.580	0.561	0.597	0.622	0.590
White dummy	0.393	0.457	0.492	0.479	0.463	0.335	0.295
Proportion of male children	—	—	—	0.511	0.516	0.487	0.518
Average age of children	—	—	—	5.529	6.815	7.163	7.131
Proportion of positive values							
Women's clothing	—	0.928	0.858	0.726	0.691	0.638	0.665
Men's clothing	0.946	—	0.800	0.675	0.668	0.669	0.637
Children's clothing	—	—	—	0.779	0.805	0.800	0.793
Total expenditure per month (in BRL- Brazilian real)	1,274	1,210	1,778	1,675	1,784	1,359	1,011
Total expenditure per month (in USD- US dollar)	550.3	522.8	767.9	723.6	770.7	586.9	436.8
Sample size	1,137	787	2,406	3,510	2,701	979	251

Source: Research results.
Notes: (1) Household expenditures for goods selected in the 8 good demand system; (2) The exchange rate is $1 = 2.31 BRL Brazilian real; (3) Men in Brazil typically marry younger women (median difference is 3 years according to: United Nations (2001), World Marriage Patterns; New York, Population Division, Department Of Economic And Social Affairs.

We will now consider a Rothbarth perspective on the variation in consumption when household composition changes. Data reveals that the household budget shares devoted to adult-specific goods tend to decrease with the presence of one additional child. For instance, while childless couples allocate 2.8% (2.4%) of their budget to female (male) clothing, it drops to 2.2% (1.9%) and 2% (1.8%) in couples with one child and two children respectively. The shifts in consumption patterns are in line with notion that children impose economic costs on their parents. The traditional Rothbarth way of thinking then suggests that, on average, when the family size becomes larger the parents' welfare is likely to be declined due to an income effect which re-allocate limited resources of the parents to accommodate children's needs (BARGAIN; DONNI, 2012a; BARGAIN et al., 2014). The budget share of all the public goods (such as household operations and transport) decreases with family size while the budget share of private goods (total clothing and food) increases. These patterns are consistent with the simplest interpretation that the economies of scale are significant and different across goods. In fact, it can be interpreted that, to some extent, economies of scale generate a wealth effect that shifts consumption from public goods to private goods.

Our strategy follows Bargain and Donni (2012a) in assuming that the presence of private assignable goods can aid in the identification of individual welfare. In other words, by observing how expenditures on clothing vary with total expenditures in the sample of single-person households, it is possible to recover how total household expenditures on all goods are divided up among household members. Table 3 presents monthly expenditures on men's, women's and children's clothing. Single women's monthly expenditures on clothing are on average larger than monthly expenditures on clothing

of single men. This may reflects that women likely have a more evident taste for clothing than men. Married women (men) spend around 50 (43) BRL *reais* on clothing per month while mothers (fathers) spend 37.4, 35.5, 27.5 and 17 (32.5, 32.7, 26 and 17.7) BRL *reais* in households with 1, 2, 3 and 4 children respectively. This may implies that, on average, women control a larger proportion of household resources than men, except in couples with 4 children where husband spend more than wife on clothing. However, we cannot rule out the alternative interpretation that wives drop their expenditure on clothing as a consequence of economies of scales. It is imperative to clarify these controversial explanations. More generally, it can be confirmed that children represent a cost for their parents due to the fact that the absolute value of expenditures, as well as the budget clothing shares declines with the number of children.

Table 3 — Monthly expenditure on clothing, by family type (in Brazilian *reais*)

Family type	Single men	Single women	Childless couples	Couples with			
				1 child	2 children	3 children	4 children
Women's clothing	—	74.5	49.8	37.4	35.5	27.5	17.0
Men's clothing	73.8	—	43.4	32.5	32.7	26.0	17.7
Children's clothing	—	—	—	30.8	42.2	34.7	32.1

Source: Research results.

One source of endogeneity in our setting is that total expenditures may suffer from measurement error. This source of bias can arouse either because of recall errors, since total consumption is measured by asking households to recall their past expenditures, or because of the infrequency of purchases create a wedge between total expenditures and actual consumption (DUNBAR et al., 2013). Another important issue is that identification of sharing and scaling functions necessitates that budget share equations are non-linear in log total expenditure (BARGAIN; DONNI, 2012a). To check both endogeneity of total expenditure and non-linearity of budget share equations in log expenditure, we perform a Durbin–Wu–Hausman test on subsamples of each household type. In a preliminary step, we perform reduced-form estimations (not reported here) and directly testing exogeneity of log total expenditure through the significance of the Wu–Hausman residuals in the regressions. The budget shares for male and female clothing are then regressed on age, education, the dummies for white, woman's participation, house ownership and urban residency, as well as the log total expenditure and its squared value. The Wu–Hausman residuals are then sequentially added to the explanatory variables of the regression. For all the subsamples, the results suggest that the budget share equations show a quadratic pattern. The same conclusion is obtained by Banks et al. (1997), Bargain and Donni (2012a) and Bargain et al. (2014). Regarding the coefficients of the Wu–Hausman residual, the estimates are not markedly affected by its introduction and it is negative and significant in almost all subsamples. These results suggest that expenditure is not exogenous. Therefore, the Wu-Hausman residuals must also be included in the structural Engel curve estimations.

5.1. Estimation of the resource shares and the economies of scales

In this section we use a system which incorporates 7 budget share equations into a completely general specification. The specification allows for free variation of the parameters of the functional form discussed in Section 3. Additional equations were used to generate overidentifying restrictions, as in Bargain and Donni (2012a)[15] and Bargain et al. (2014). By estimating this multiple equation system, it is possible to estimate the structural components of the model with significant precision and to check for the stability of preferences over consumption (BARGAIN; DONNI, 2012a). The Wu–Hausman residuals for log total expenditure and its square are included in each budget share equation. The estimates of the coefficients of the sharing and scaling functions as well as indifference scales are reported in Table 4. We essentially consider four variations of the model described above: Model (a) which is the baseline model estimated with the sample described in the previous section; Model (b) in which the *normalized* measures

[15] The model allows testing the hypothesis that preferences over consumption are stable. For this, we perform a simple Breusch-Pagan test for independent equations. The Breusch-Pagan statistic for independence, which follows a Chi-squared distribution under the null hypothesis, is about to 33,015. The null hypothesis is then rejected at the 1% level. Thus, the assumption that the parameters for singles and couples are the same seems to be a reasonable approximation.

of scale economies $\sigma_{i,n}$ are restricted to be the same for both spouses; Model (c) in which the $\varepsilon_{i,n}$ are restricted to be the same for male and female clothing; and Model (d) in which costs of household operations are incorporated in the system of budget share equations[16].

Table 4— Total expenditure shares, scaling factors, and indifference scales

	Model (a) Baseline model		Model (b) Model with identical σ_i		Model (c) Model with identical ε_i		Model (d) Model with housing	
	Est	StdErr	Est	StdErr	Est	StdErr	Est	StdErr
Childless couples								
Shares of women	0.474	0.0000	0.485	0.0000	0.384	0.0425	0.474	0.0000
Shares of men	0.526	0.0000	0.515	0.0000	0.616	0.0425	0.526	0.0000
Scales of women	0.534	0.0003	0.912	0.0001	0.674	0.0309	0.534	0.0003
Scales of men	0.587	0.0002	0.991	0.0000	0.868	0.0407	0.587	0.0002
Indifference scale for women	0.888	0.0005	0.532	0.0000	0.886	0.0005	0.888	0.0005
Indifference scale for men	0.897	0.0003	0.520	0.0000	0.898	0.0003	0.897	0.0003
Couples with one child								
Shares of women	0.388	0.0001	0.388	0.0001	0.348	0.0011	0.388	0.0001
Shares of men	0.411	0.0000	0.411	0.0000	0.461	0.0029	0.411	0.0000
Shares of children	0.201	0.0001	0.207	0.0001	0.189	0.0035	0.201	0.0001
Scales of women	0.598	0.0003	0.401	0.0000	0.537	0.0018	0.598	0.0003
Scales of men	0.488	0.0001	0.419	0.0001	0.545	0.0034	0.488	0.0001
Indifference scale for women	0.650	0.0005	0.962	0.0000	0.650	0.0005	0.650	0.0005
Indifference scale for men	0.844	0.0003	0.974	0.0001	0.844	0.0003	0.844	0.0003
Couples with two children								
Shares of women	0.363	0.0000	0.346	0.0000	0.332	0.0009	0.363	0.0000
Shares of men	0.372	0.0000	0.368	0.0000	0.411	0.0069	0.372	0.0000
Shares of children	0.265	0.0000	0.286	0.0000	0.257	0.0050	0.265	0.0000
Scales of women	0.504	0.0003	0.359	0.0000	0.462	0.0013	0.504	0.0003
Scales of men	0.446	0.0001	0.402	0.0002	0.492	0.0080	0.446	0.0001
Indifference scale for women	0.721	0.0005	0.965	0.0000	0.721	0.0005	0.721	0.0005
Indifference scale for men	0.833	0.0003	0.916	0.0001	0.833	0.0003	0.833	0.0003
Couples with three children								
Shares of women	0.364	0.0000	0.359	0.0001	0.377	0.0077	0.364	0.0000
Shares of men	0.333	0.0000	0.357	0.0000	0.363	0.0011	0.333	0.0000
Shares of children	0.304	0.0000	0.285	0.0001	0.260	0.0045	0.304	0.0000
Scales of women	0.412	0.0002	0.383	0.0000	0.459	0.0081	0.412	0.0002
Scales of men	0.414	0.0002	0.359	0.0000	0.451	0.0014	0.414	0.0002
Indifference scale for women	0.883	0.0005	0.938	0.0002	0.883	0.0005	0.883	0.0005
Indifference scale for men	0.804	0.0005	0.992	0.0000	0.804	0.0005	0.804	0.0005
Couples with four children								
Shares of women	0.318	0.0000	0.336	0.0001	0.328	0.0070	0.318	0.0000
Shares of men	0.259	0.0000	0.271	0.0001	0.308	0.0219	0.259	0.0000
Shares of children	0.423	0.0000	0.393	0.0001	0.364	0.0116	0.423	0.0000
Scales of women	0.328	0.0002	0.337	0.0001	0.343	0.0062	0.328	0.0002
Scales of men	0.270	0.0002	0.277	0.0001	0.374	0.0237	0.270	0.0002
Indifference scale for women	0.969	0.0008	0.996	0.0000	0.969	0.0008	0.969	0.0008
Indifference scale for men	0.958	0.0007	0.977	0.0001	0.958	0.0008	0.958	0.0007

Source: Research results.
Note: Standard errors are heteroskedastic-consistent.

The resource shares $\eta_{i,n}(z)$ are computed at the average point of the sample for each family type. From the Model (a) we see that, for all the family types, the average shares of total expenditure is slightly larger for men than for women, except for couples with more than two children. The average men's share amounts to 0.526 for childless couples while it amounts to 0.411 and 0.372 for couples with one or two children, respectively. These differences between men and women switch in larger families where wife's share of total expenditure is larger than the husband's. In a few words, men seem to have the leading voice in childless couples and households with less than three children while in families with at least three children, women control a larger fraction of household resources than men. Then, a first suggestive point is that the notion created by descriptive data, according to which the fraction of total expenditure received by men is smaller than for women can be rejected here.

[16] We implement a simple test for the IB restriction, following closely Menon et al. (2012, p. 741). In particular, we pool all the household sizes, which would give a test with more statistical power, and estimate coefficients from regressions of each individual resource share on a linear and quadratic models in expenditure which include a categorical variable for each household size and dummies for each federal unit of residence. The results indicate that none of the log expenditure is individually statistically significant. This suggests that the hypothesis that resource shares do not vary with expenditure is not violated in these data and thus that identification of resource shares on the basis of IB restriction is valid.

The estimations of resource shares are comparable to those previously obtained in the literature. In particular, the results for households with at most two children are in line with Dunbar et al. (2013), who found that in Malawi, husband's shares of total expenditure are larger than wife's ones in households with several children. Our estimates for couples with at least three children in which larger shares are found for women are consistent with Browning, Chiappori, Lewbel (2013) on Canadian data, Bargain and Donni (2012a) on French data and Bargain et al. (2014) on Ivorian data. Estimations of the average children's share increase in a plausible way with household size ranging 0.20 to 0.42. Another relevant point to mention when examining Model (a) in Table 4 is that the parameters of the scaling functions are significantly different from 1. This finding may reflect the existence of sizeable economies of scale in the household which invalidates the traditional Rothbarth approach (BARGAIN; DONNI, 2012a). If $\sigma_{i,n}$ are restricted to be the same for husband and wife as in Model (b), it is interesting to note that the difference between men's and women's shares of total expenditure is relatively less marked. This illustrates that taking economies of scales that are specific to both spouses into account may explains notably the differences in women's and men's expenditure on clothing. Overall it seems that the estimates of scales for childless couples are rather large. For instance, women's scale for a representative childless couple is equal to 0.912; so the cost of living for a married woman is 91.2% of the cost he would experience should she live alone. Nevertheless, economies of scale increase (i.e., deflators $s_{i,n}$ decrease) in larger families (with one or more children) compared to childless couples.

One important contributor to household economies of scale may be expenditure on household operations; hence expenditure on housing can hardly be ignored from the analysis (BARGAIN et al., 2014). The estimations of expenditure shares, scaling factors and indifference scales obtained with Model (d) are not significantly or systematically different from those of the other models. In fact, the estimates of Model (d) are practically identical to those obtained from Model (a). In general, models (a) and (b) provide the most precise estimates, judging by the lower magnitude of standard errors. Because of these low standard errors together with the facts that the Model (c) is based on too restrictive assumptions and the similarity of models (a) and (d), we consider that the results given by models (a) and (b) are more consistent.

Rejecting Model (c), the average women's share goes to 0.474 and 0.485 for childless couples. The proportion of resources devoted to children varies between 0.201 and 0.207 for household with one child, between 0.265 and 0.286 for household with two children, between 0.285 and 0.304 for household with three children, and between 0.393 and 0.423 for household with four children. Note that the level of the total share of household resources devoted to children rise as the number of children increases, but the average share allocated to each child declines. One-child families devote, on average, around 20% of its expenditures to children's consumption. With two children, this share rises to roughly 26%, with three children, to approximately 29%, and to four children, to about 42%. The resource share per child in households with three or four children is around 10%. These results are in line with those obtained by Dunbar et al. (2013) and Bargain et al. (2014). Using the Model (a) in Table 4, we compute that for a household with one child, the average fraction of total expenditure received by child represents about 49% of the resource of the mother. This proportion is smaller than the child's need of resources estimated in the modified OECD scale (i.e., 60% of the need of an adult). Similar results are provided by Bargain et al. (2014) on data from Côte d'Ivoire.

However, note that inequality at the level of individual shares does not necessarily mean large difference in individual welfare, since goods may have a large public component, and persons do not generally benefit from the same level of joint consumption in the household (LEWBEL; PENDAKUR, 2008; BARGAIN; DONNI, 2012a; BARGAIN et al., 2014). Indeed, we find substantial scale economies of living together, according to economies of scale deflators $s_{i,n}(z)$ in Table 4, which are considerably lower than 1 in most of the cases with the exception of childless couples in Model (b). Recall that $s_{i,n}(z)$ should lie between $\eta_{i,n}(z)$ (purely public consumption) and 1 (purely private consumption). To take an example, a scale of 0.587 (resp. 0.534) for a man (resp. woman) living in a couple without children in Model (a) indicate that his (her) cost of living in a couple is around 59% (resp. 53%) the cost he (she) would experience if living alone. Hence joint consumption among households is remarkably large. As a consequence, it can be shown the existence of sizeable indifference scales, defined as the ratio of shares

and scales. In Model (a) estimated indifference scales are greater than 0.80 for husband, at least 0.65 for wife, and close to one for both spouses with four children. Thus, given the estimates from Model (a), the household income must be multiplied by no more than (1.54≈1/0.65) for a woman and (1.19≈1/0.84) for man to obtain the same level of welfare in a couple with a child than when alone. Such a woman (man), if living alone, would need a fraction 0.888 (0.897) of the couple's income to reach the same indifference curve as when in couples without children. This implies that single persons would not benefit from these important scale economies. The estimated indifference scales in Model (b) for both spouses are close to one, except for childless couples where they are 0.532 and 0.520 for women and men respectively. Following Bargain et al. (2014), we use later these estimated indifference scales, specifically those of the model (a) as explained below, for compute poverty measures at the individual level.

5.2. Factors associated with the resource shares and the scale economies

We estimate the effect of demographic variables on the resource shares for the four models. Table 5 gives estimated parameters of sharing functions. The estimates are consistent across all models. We note that several variables are explanatory of the intra-household allocation process. We find that spouses' age seems to be related to a larger fraction of the total expenditure they receive. The education level of the woman does not much affect the resource shares, but the education level of the man is positively related to the husband's share. It seems also that the white race, urban residency and house ownership are positively related to the share of total expenditure devoted to each household member. The effect of urban residency on the share of total expenditure devoted to the child, however, is not statistically significant.

On the other hand, woman's participation in the labor market seems to influence the distribution of resources among spouses in the household: an increase in the wife's work participation entails a shift of the distribution of total expenditure from the husband to the wife. If we interpret this as due to a distribution factor, then it can be interpreted that if women have more bargaining power, then their ability to extract within-household resources would be larger. We also included a measure of the household income in the regressors of the sharing functions. This last regressor was dropped due to collinearity with the explanatory variables of the men's and children's indices. We thus observe that, for women, it seems that the level of income of the household has a positive effect on wife's share, but this effect is not very significant across the models. However, other variables in the models (e.g., education, urban residency and home ownership) can be considered as proxies for household income.

Regarding the distribution of resources between children, as the number and the average age of children increases, the total share of household resources devoted to them goes up. These results are consistent with Dunbar et al. (2013) and Bargain et al. (2014). The fraction of total expenditure received by boys is relatively smaller than for girls but the effect is not statistically significant. This result suggests that there is no evidence of discrimination in favor of boys. In contrast, Rose (1999) Bargain and Donni (2012a) and Dunbar et al. (2013) show that discrimination in favor of boys is revealed by the structure of consumption[17]. Our results are in line with those obtained by Deaton (1989) and Bargain et al. (2014) who found no evidence of child gender bias in the overall treatment of boys and girls in Côte d'Ivoire. The effect of the white race, mother's work participation and house ownership on the share of total expenditure devoted to children, on the other hand, is positive and statistically significant.

Table 6 shows the estimated parameters of the scaling functions. In model (a) economies of scale seem to be more favorable to men and dependent of the number of children. In particular, joint consumption for husbands (resp. wives) represents roughly 50% (resp. 45%) of the consumption of the other members in the household. Economies of scale are expected to increase in families with children compared to childless couples.

[17] The presence of child gender bias in these latter studies might be attributed to cultural aspects of such countries. On the other hand, evidence of gender discrimination among children in developing countries often pertains to long-term expenditure on children, especially 'productive' investments on children's education and health (Sen, 1981). However, the literature on differences in education and health expenditures is extensive and beyond the scope of our study.

Table 5 — Parameters of the individuals' sharing functions

	Model (a) Baseline model	Model (b) Model with identical σ_i	Model (c) Model with identical ε_i	Model (d) Model with housing
Women's sharing functions				
Constant	—	—	—	—
	—	—	—	—
Woman's age	0.0467***	0.0436***	0.0388***	0.0488***
	(19.66)	(18.65)	(13.68)	(21.80)
Woman's schooling	0.00205	0.00968	0.0117	0.00916
	(0.19)	(1.04)	(1.20)	(0.98)
White	0.372***	0.321***	0.274***	0.407***
	(5.47)	(4.97)	(3.70)	(6.61)
Woman's participation	0.574***	0.583***	0.497***	0.604***
	(6.95)	(8.48)	(7.22)	(7.40)
Urban	0.311***	0.351***	0.389***	0.348***
	(4.69)	(4.43)	(4.93)	(4.63)
Income	0.387**	0.212	0.426	
	(2.34)	(0.90)	(0.03)	
House owner	0.206***	0.190***	0.191***	0.201***
	(3.56)	(2.87)	(3.23)	(3.41)
Men's sharing functions				
Constant	-2.133***	-2.146***	-2.146***	-3.283***
	(-16.88)	(-17.76)	(-16.90)	(-27.72)
Man's age	0.0418***	0.0422***	0.0419***	0.0601***
	(23.52)	(22.33)	(23.65)	(24.90)
Man's schooling	0.0229***	0.0244***	0.0221***	0.0237***
	(3.31)	(3.00)	(3.12)	(2.77)
White	0.425***	0.430***	0.421***	0.636***
	(8.07)	(7.66)	(8.35)	(10.74)
Urban	0.328***	0.333***	0.346***	0.325***
	(3.79)	(4.13)	(3.87)	(5.10)
House owner	0.157***	0.157***	0.164***	0.206***
	(3.41)	(3.35)	(3.63)	(4.09)
Children's sharing functions				
Constant	-2.889***	-2.879***	-2.957***	-2.906***
	(-16.69)	(-15.62)	(-16.73)	(-19.16)
Number of children	0.156***	0.0642*	0.143**	0.161***
	(2.64)	(1.85)	(2.38)	(3.31)
Proportion of male children	-0.0442	-0.0397	-0.0402	-0.0216
	(-0.38)	(-0.38)	(-0.40)	(-0.19)
Average age of children	0.397***	0.400***	0.402***	0.399***
	(25.78)	(25.49)	(25.41)	(25.94)
White	0.146***	0.155**	0.149**	0.134**
	(2.63)	(2.27)	(2.37)	(2.30)
Urban	0.0474	0.0357	0.0583	0.0303
	(0.37)	(0.28)	(0.44)	(0.24)
Woman's participation	0.129*	0.116	0.109	0.145**
	(1.78)	(1.58)	(1.51)	(2.01)
House owner	0.315***	0.344***	0.329***	0.313***
	(6.70)	(7.46)	(6.84)	(6.49)

Source: Research results.

Notes: All calculations use the sample weights. Standard errors are heteroskedastic-consistent and clustered at federal unit level. The individuals' index is the exponential functions entering the logistic function. The estimated parameters and the standard errors indicated by – are set to zero for identification purpose. *t* statistics in parentheses. State fixed effects are included as dummies for state of residence of individual. *** p<0.01, ** p<0.05, * p<0.1.

Table 6 — Parameters of the scaling functions

	Model (a) Baseline model	Model (b) Model with identical σ_i	Model (c) Model with identical ε_i	Model (d) Model with housing
Women's scaling function				
Constant	0.450***	0.446***	0.548***	0.470***
	(60.38)	(59.53)	(464.08)	(1189.51)
Number of children	0.129***	0.0127	0.00317	0.00135**
	(22.17)	(1.65)	(1.69)	(2.49)
Men's scaling function				
Constant	0.503***	0.446***	0.548***	0.543***
	(92.36)	(59.53)	(464.08)	(57.95)
Number of children	0.217***	0.0127	0.00317	0.00877
	(51.23)	(1.65)	(1.69)	(1.01)

Source: Research results.

Notes: All calculations use the sample weights. Standard errors are heteroskedastic-consistent and clustered at federal unit level. *t* statistics in parentheses. State fixed effects are included as dummies for state of residence of individual. *** p<0.01, ** p<0.05, * p<0.1.

Although reasonable in magnitude, these parameters of scale economies are not very precisely estimated because they are not very statistically significant and there is a fair amount of instability in their estimates across models. For these reasons, we believe that the results given by model (a) are more reliable. In particular, the baseline model provides, in our opinion, the most precise scale economy parameter estimates because it is based on less restrictive assumptions and it is more statistically powerful than the other models. Yet, even this model's standard errors are uncomfortably large. Thus, in what follows we only consider model (a) for the analysis of poverty at individual level.

5.3. Individual poverty rates

Considering first the empirical results described so far, we estimated the levels of resource shares and the marginal effects of various demographic factors on them. Although estimated shares tell us how total expenditure is allocated among persons in reference households, they do not automatically reflect needs of each individual or intra-household inequality in terms of welfare. On the other hand, resource allocations could change across household sizes due to the fact that the demographic factors themselves covary with household size (DUNBAR et al., 2013). Thus, to evaluate the implications of our estimations on the distribution of individual consumption for the different family members, it is illustrative to consider the allocation of total expenditure shares in households of different sizes. For the reasons stated in the previous section, we focus on our baseline model.

The upper panel of Table 7 presents a few summary statistics on the sharing of total expenditure for people in households of different composition. It is worth noting that the minima and maxima values of resource shares do not fall outside the range between zero and one for any person in any household in the sample. As Table 13 shows, the dispersion of resource shares is relatively large. To take an example, the total expenditure share of a women living in a childless couple varies between 0.351 and 0.715 depending on the demographic variables. The distribution of shares of men and children are also largely dispersed. Nevertheless, total expenditure shares do not necessarily include unobserved heterogeneity (BARGAIN et al., 2014). One possible interpretation is then that the effects of the demographic variables are important on resource shares. Hence, these factors are as important as the household sizes themselves. This justifies that it is pertinent not only identify the level of resource shares but their response with respect to demographic variables.

Two different approaches have tried to measure poverty at individual level based on the distribution of resources within households, namely the models of Dunbar et al. (2013) and Bargain et al. (2014). In this respect, these two approaches are similar in using the total expenditure shares and comparing them to the World Bank's poverty threshold of US$2 per day for adults and US$1.20 per day for children (according to the OECD estimate of the relative needs of children, i.e., 60 % that of adults). We thus follow these two studies and use such poverty thresholds applied to our sample of households. Firstly, in the lower panel of Table 13 we report under the label of 'household poverty' and based on the standard headcount ratio, the estimated poverty rates for households of different sizes and composition. These measures assume that each household member gets an equal share of household income. In general, we observe that poverty tends to systematically increase with household size or with the number of children. In particular, poverty ranges from 5.6% of single men and 3% of single women to 9.1% of childless households and 18%, 26%, 44% and 64% of households with one, two, three and four children, respectively. Yet it is unclear why singles are remarkably less affected by poverty than couples.

To disentangle these patterns of distribution across households, it may be necessary to account for inequality within the household. For this, we use our estimates of the resource shares $\eta_{i,n}(\mathbf{z})$ to construct individual-level expenditures. Specifically, we calculate the amount of household expenditure accruing to each individual (i.e., household expenditure times the resource share) and compare this to the thresholds of US$2 per day for each adult and US$1.20 per day for each child. We first compute the individual resources for each person in the sample and then aggregate into poverty rates at the individual level. The lower panel of Table 7 provides these measures referred to as men's, women's and children's (unadjusted) poverty levels. We can see that the poverty rates are also lower for singles than for adults in couples with and without children. Table 7 also reports the level of poverty adjusted for scale economies. In all cases, we observe a stunning decrease in poverty levels among adults in couples. For example, for women (resp.

men) in childless couples the poverty rate drops from 17.7% (resp. 11.2%) to 2.4% (resp. 2%). The reduction in poverty rates is larger for married women than for men in couples in almost all cases; couples with 3 and 4 children indicate the contrary. In terms of joint consumption, the poverty decline is compatible across all types of households and with the gender differences in scale economies stated in previous section. These results compare well to those of Bargain et al. (2014), in which the poverty rates of adults living alone and in a family are of the same order of magnitude because the fact that adults in families must share resources is compensated by the gains from joint consumption (i.e., economies of scale).

Table 7 — Poverty rates and the distribution of individual shares

Family type	Single men	Single women	Childless couples	Couples with			
				1 child	2 children	3 children	4 children
Women's shares							
Minimum			0.351	0.278	0.265	0.268	0.236
Median			0.473	0.363	0.317	0.318	0.278
Maximum			0.715	0.593	0.553	0.549	0.478
Men's shares							
Minimum			0.393	0.303	0.273	0.245	0.193
Median			0.526	0.386	0.325	0.291	0.227
Maximum			0.798	0.622	0.562	0.504	0.390
Children's shares							
Minimum				0.142	0.192	0.224	0.317
Median				0.200	0.298	0.341	0.423
Maximum				0.337	0.424	0.471	0.640
Household poverty levels	0.056	0.030	0.091	0.180	0.261	0.448	0.633
Women's poverty		0.030	0.177	0.220	0.210	0.221	0.287
levels (unadjusted)			(0.021)	(0.018)	(0.021)	(0.032)	(0.055)
Men's poverty	0.056		0.112	0.176	0.184	0.256	0.351
levels (unadjusted)			(0.012)	(0.014)	(0.020)	(0.032)	(0.051)
Children's poverty				0.064	0.154	0.453	0.554
levels (unadjusted)				(0.013)	(0.011)	(0.014)	(0.022)
Women's poverty		0.030	0.024	0.062	0.046	0.031	0.036
levels (Adjusted)			(0.017)	(0.014)	(0.016)	(0.025)	(0.044)
Men's poverty	0.056		0.020	0.027	0.031	0.042	0.036
levels (Adjusted)			(0.017)	(0.014)	(0.016)	(0.025)	(0.043)

Source: Research results.
Notes: All calculations use the sample weights or expansion factor provided by the POF 2008-2009. Standard errors (in parentheses) are heteroskedastic-consistent and clustered at federal unit level.

It is worthwhile to note that the per capita measures overstate poverty levels among adults and the incidence of child poverty, mainly for large families[18]. Overall, child poverty level goes up with the number of children and it ranges from 6.4% for one-child household to 55% in households with four children. In particular, for one-child families the incidence of child poverty (6.4%) is of the same order of magnitude as women's poverty with adjustment for scale economies (6.2%). This might either reflect that children's needs are not necessarily those assumed in the OECD scale applied to the poverty line or that there is limited redistribution from parents to their child (BARGAIN et al., 2014). However, poverty rates are dramatically higher for larger families, i.e. more than 10%, 40% and 50% for households with two, three and four children, respectively. Although the high child poverty rates could over-estimate the child needs, we cannot rule out the possibility that the allocation of resources skewed in favor of adults in larger families explains the gap between one-child households and larger households (BARGAIN et al., 2014). This finding underlines that the expenditure per child tends to systematically decrease with the number of children. By comparison, Bargain et al. (2014) find that the per capita children's shares become smaller in families of several children compared to one-child families in Côte d'Ivoire. Dunbar et al. (2013) drew the same conclusion in Malawi. Alternatively, it is possible that larger families may benefit from large economies of scale among children because they can share child specific goods (e.g., food, toys or clothes). For this reason, the increase in child poverty among larger families could be narrowed due to the existence of scale economies induced by joint consumption among children. However, these economies of scale are not modeled here and, therefore, results regarding children's poverty levels in Table 7 must be interpreted with caution. One way to put into a context our results of poverty rates is to

[18] The exception is the case of couples with three children

compare them to previous calculations for Brazil. For example, Osorio et al. (2011) found that in 2009 the income poverty level among adults aged between 19 and 64, and children aged 14 or younger was around 7.2% and 26.4%, respectively. Osorio et al. (2011, p. 26) also found that poverty rate is about 3.5% for childless families, while it amounts to 14.6% (62.8%) for persons living in households with 1-3 (4 or more children).

6. Final Remarks

In this paper we estimate the share of total expenditure accruing to children and adults, as well as poverty at individual level in Brazil using a model consistent with scale economies and parental bargaining. Note that this contribution is one of the rare applications of a collective model that reassess these issues in a developing country. We conducted a joint estimation on pooled sample of single individuals, childless couples and couples with 1-4 children, and we applied it for three types of persons (men, women, and young children). Clearly, we have limited the application of our approach to singles and couples with 0-4 children. In order to measure how our estimations change with the household structure and size, it would be easy to extend our framework to more diversified demographic structures. This constitutes an interesting path for future research. Our main results provide evidence of inequality and economies of scale within Brazilian households, which leads us to the rejection of the unitary model as well as the traditional Rothbarth-Gronau approach for Brazil. Our findings also indicate that men's share of total expenditures is slightly larger than women's shares for almost all the family structures considered here. The magnitude of children's shares, interpreted as the cost of children for the parents, is in turn comparatively smaller. In addition, we find that mothers seem to contribute more resources than fathers to children, and we do not find evidence of gender but age differences in children's resource shares. Also, results provide evidence indicating that women's bargaining power within the household improves with their age, level of education and participation in the labor market.

Overall, the empirical analysis we report suggests that ignoring intra-household inequalities affects the assessment of levels of poverty. In particular, the neglect of unequal distribution of resources among household members leads to a large overestimation of child poverty. However, child poverty levels are computed based on the differentiation in individual needs across household members, but they do not take joint consumption among children into account. Thus, we cannot rule out the possibility that our results might still overestimate the incidence of child poverty. In particular, the levels of child poverty may be apparently high due to two reasons. As noted above, the empirical model does not include scale economies from joint consumption among children in households. Furthermore, with the method we use, the information on the household production is not incorporated in the collective model framework. This may be a source of bias in our estimations. Indeed, omitting the household production would imply that the rate of child poverty in the sample is higher than in the corresponding population. If this is the case, our estimations may be incapable of capturing adequately children's total expenditure shares and may lead us to wrongly ignore if children consume relatively more of the goods produced within the household. These last issues deserve more research work. Given its preliminary nature, the present study allows for many possible extensions. For instance, the incorporation of the scale economies among children in these models is one of the major challenges for future research. On the other hand, we acknowledge that scaling factors, interpreted as economies of scale in households, may capture not only changes in individual preferences but consumption externalities across household types. In order to better understand these different interpretations, it may be important to disentangle exhaustively these scale economies.

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