Poverty among the Elderly: an application of a collective consumption model in Brazil[1]

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Abstract: The growth of the elderly population and the changes in the household composition raise important questions regarding the level of well-being of elderly in developing countries. Traditional analyzes of poverty often ignore the question of intra-household distribution of resources. This paper is the first to apply a collective consumption model to analyze the level of well-being of the elderly in Brazil. Our results indicate considerable economies of scale associated with living in a couple and a husband's share that is increasing in total expenditures. We find that the decrease in material well-being due the wife's death is rather significant for elderly men and the opposite was observed for elderly women in Brazil. Finally, we conclude that disregarding the intra-household distribution of resources generally means underestimating the poverty of the elderly in Brazil.

Keywords: Elderly Poverty**;** Collective Consumption; Intra-household Allocation; Brazil

Resumo: O crescimento da população idosa e as mudanças na composição dos domicílios levantam questões importantes sobre o nível de bem-estar dos idosos nos países em desenvolvimento. As análises tradicionais de pobreza muitas vezes ignoram a questão da distribuição intra-domiciliar de recursos. Este trabalho é o primeiro a aplicar um modelo de consumo coletivo para analisar o nível de bem-estar dos idosos no Brasil. Nossos resultados indicam consideráveis economias de escala associadas à vida em casal e à participação de um marido que aumenta em relação aos gastos totais. Além disso, a diminuição do bem-estar material devido à morte da esposa é bastante significativa para os idosos e o oposto foi observado para idosas no Brasil. Finalmente, concluiu-se que desconsiderar a distribuição intra-domiciliar de recursos geralmente significa subestimar a pobreza dos idosos no Brasil.

Palavras-chave: Pobreza dos Idosos; Consumo Coletivo; Alocação intra-domiciliar; Brasil

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1. Introduction

The population ageing process all over the world is a well-acknowledged fact. Whereas the demographic transition lasted over a century in developed countries, these changes are occurring much more quickly in developing countries. This is due to the controlling of fertility and the reducing of mortality rates. According to Kinsella and He (2009), France had 115 years to duplicate its elderly population from 7 percent to 14 percent; this relatively slow process was common in other European nations and in North America. Japan, the oldest country today, was unusual case in that this same transition took place in only 26 years, from 1970 to 1996. According to the authors, most of developing countries are aging in the same rate or even faster than Japan. In LAC – Latin America Countries, for example, Chile is transitioning at the same pace as Japan; Brazil is projected to do it in 21 years; and Colombia in 19 years. In LAC the share of the elderly in the population increased from around 6% in 1950 to more than 8% in 2000, while it is expected to reach 24% at the end of this century. This ageing process implies an estimate of around 200 million people older than 60 in LAC by 2050.

In addition to the increase in the number of elderly people in developing countries, the composition of households in this segment of the population has also changed. There is a big increase in the number of elderly people living alone, especially among women. According to Gasparini *et al.* (2010), elderly people tend to live in households of smaller size than younger people. On average in LAC, for example, the elderly live in households with 1.5 persons less than the rest of the population. This gap varies from 1 person in Colombia and Venezuela to around 2 in Guatemala, Argentina and Bolivia. According to data from the IBGE (2016), the proportion of Brazilian elderly people living alone in 2013 was 15.1% for men and 17.8% for women. It should be noted that in 1970 this proportion was approximately 5% for men and 8% for women. This phenomenon, due to improved health and greater independence of the population, tends to increase in the coming decades.

Both the growth of the elderly and the changes in the household composition raise important questions regarding the level of well-being of elderly in developing countries, like Brazil. There is great concern about their vulnerability, their potential state of poverty and the possible permanence in a low level of economic well-being by the elderly. This is justified because older people are generally less likely to recover from a decrease in income and have difficulties to (re)enter the labor market, since characteristics such as productivity and employability decline with age from a certain moment of life that often occurs around the age of 60. Therefore, the difficulty of recovering from negative income shocks implies that poverty among the elderly tends to be more permanent than in other groups of society (Hurd, 1991).

However, most studies that tried to understand poverty among elderly people did not consider the distribution of resources within the household. The understanding of how individual preferences on private and public consumption behave, as well as who holds greater power over intra-household consumption, is crucial in analyzing the implications of welfare policy reforms and understanding issues such as poverty among the elderly. Although common, the use of the unitary consumption model[2] may underestimate poverty in some cases and overestimate in others, depending on issues such as household composition, sharing of goods, and bargaining power within household.

Traditional analyzes of poverty often ignore the question of intra-household distribution of resources, assuming that all household members consume the same amount of goods. While there is an extensive literature on poverty in many household settings, the intra-household implications of poverty have received little attention. Thus, the present study will be related to a growing empirical literature on collective consumption model, intra-household distribution and individual poverty measures. Based on the collective consumption model, it is possible to analyze poverty among the elderly, taking into account the potential difference in the distribution of resources between an elderly couple and an elderly person living alone, an approach ignored in the traditional analysis of poverty among this segment. Thus, it is

[2] The so-called unitary consumption model is the one that considers the household as the unit of decision, not taking into account the allocation within the household (Haddad and Kanbur, 1990).

essential to reach estimates that show an alternative approach to traditional welfare and poverty analysis among elderly.

This alternative approach is the so-called collective consumption model, whose definition would be that a household is formed by a group of individuals, each of them having a well-defined utility function, and interacting to generate decisions in household level. In these models, household consumption data is used to retrieve information about family members. We must emphasize that the international literature on intra-household allocation clearly shows that resources are not equally shared within families[3], justifying the use of the collective consumption model.

Therefore, the application of a collective consumption model will allow answering a number of important questions related to the poverty analysis such as: on average, how much income an elderly person living alone would need to get the same living standards as when he was married? What is the percentage of the couple's expenses that benefits the elderly men or the elderly women? How much money does an elderly couple save on consumption by living together compared to being in a single arrangement? These issues are fundamental to analyze the economic well-being and poverty among the elderly.

Although few studies have analyzed poverty among the elderly in Brazil, internationally several recent studies have been carried out to analyze the well-being and poverty among this segment in developed countries (Engelhardt and Gruber (2004), Sevak *et al*. (2004), McGarry and Schoeni (2005), Zaidi (2006) and Cherchye *et al*. (2012)).We will try to follow closely Cherchye *et al*. (2012) analysis to Netherlands data and adapt it to the Brazilian case, giving that the demographic, economic and social characteristics of both countries are very different. Due to its characteristics, the collective consumption model used by Cherchye *et al*. (2012) is able to analyze important themes for the formulation of public policies and income transfer for the elderly in Brazil, such as the calculation of life insurance and death pensions. One possible result of this work, for example, is to show how much a widow(er) should receive to be as well (materially) as she(he) was when married. Thus, this application becomes relevant in the Brazilian context, since the vast majority of the elderly survive from income transfer programs, such as death pensions and retirement, for example. In addition, the above model will provide poverty rates different from those used by traditional analysis, allowing a comparison with those used by the World Bank. Such an approach highlights the importance of the theme for both the public sphere and economic agents. We must emphasize that the present work is the first to analyze poverty among elderly using a collective consumption model in a developing country, and uses a different and more representative basket of consumption than that used in Cherchye *et al*. (2012).

Our results show considerable economies of scale and a husband's share that is rising in total expenditures. OECD scale underestimates poverty among elderly women in couples and overestimates poverty among elderly men in couples. In the case of widow and widowers, in most of the periods, OECD scale underestimates poverty rates. Finally, we find that the drop in material well-being following the wife's death is rather substantial for men and the opposite was observed for women in Brazil.

2. Theoretical Framework

The collective consumption model recognizes that each member has his individual preferences and the result of the allocation decision is made by the individuals who compose the household. Following many authors[4], the unitary consumer model of household will initially be presented. It will be used in the case of single person households. Next, the collective consumption model and analytical concepts of well-being that emerge from this model will be presented.

[3] For more details on the general collective consumption model, see Browning *et al*. (1994), Lundberg et al. (1997) and Vermeulen (2002).

[4] Cherchye and Vermeulen (2008), Lewbel and Pendakur (2008), Cherchye *et al*. (2009), Bargain and Donni (2012a; 2012b), Cherchye *et al*. (2012), Browning *et al.* (2013), Dunbar *et al*. (2013) and Bargain *et al.* (2014).

2.1.Unitary consumption model

Following Cherchye *et al.* (2012) and Browning *et al.* (2013), we will use the unitary model of consumption for a household with only one individual k, where $k = m$ if the household consists of an elderly man, while $k = w$ if the individual is an elderly woman. We assume that a total expenditure x^k is spent for a given household over a period of time with n goods. These can be purchased in non-negative quantities (q_i^k) with fixed prices (p_i). The budget constraint can be written as follows:

$$x^k = p_i q_i^k, \quad (1)$$

By using the equal sign we assumed that the consumers in the household will always reach the upper limit of its range of possibilities, implying no satiation. In addition, the above equation assumes that the expenditure x^k is determined separately from the decision to purchase.

The unitary consumption model can be constructed by optimizing the utility function, subject to the budget constraint (Deaton and Muellbauer, 1980a). Preferences are represented by a two-times differentiable direct utility function, strictly increasing and strictly quasi-concave as $U^k(q_i^k)$. Therefore, the individual k faces the following problem:

$$\max_{q_i^k} U^k(q_i^k) \text{ subject a } p_i q_i^k = x^k, \quad (2)$$

where $U^k(q_i^k)$ is the utility function; $p_i q_i^k = x^k$, the budget constraint; p_i, the price of good i, $\forall$ i = 1,2, … , n; q_i^k, the amount consumed of good i; e x^k, the total expenditure.

The solution of the first order condition will result in the Marshallian or non-compensated demands for each good:

$$q_i^k = g_i^k(p_i/x^k), \quad (3)$$

2.2.Collective consumption model

Unlike the traditional unitary consumption model that describes the behavior of households, the collective consumption model explicitly recognizes that a household is composed of several members do not necessarily behave as a single decision maker. In other words, the collective consumption model recognizes that each member has his individual preferences and the result of the allocation decision within the household is Pareto efficient. Thus, considering a household consisting of two elderly (m e w)[5] where both individuals do not participate in the labor market, it is possible to write Pareto efficiency decisions of the couple as a constrained maximization of a weighted sum (Cherchye *et al*., 2012):

$$\widetilde{U} = \mu(p'/x, s)U^w(q_i^w) + U^m(q_i^m), \quad (4)$$

where $\mu(p'/x, s)$ is the Pareto efficient weight; and $U^w(q_i^w)$ and $U^h(q_i^m)$ are the elderly individual utility functions, twice continuously differentiable, strictly increasing and strictly quasi-concave. This equation can be interpreted as the welfare function of the household, although the relative effect of individual utility function of household members may vary according to price and distribution factors (s). Alternatively, equation (4) may result from a bargaining model (Nash's model of bargaining, for example), in which distribution factors affect individual decisions. Efficient Pareto weight μ is defined as the spouse bargaining power and can generally depend on the prices, total expenditure and distribution factors vector s, defined as variables without direct impact on preferences, consumer technology or

[5] For simplicity, we will use the words "married" and "spouse", but individuals who make up the household does not necessarily need to be married. In addition, we will not consider households composed by other people beside the elderly due to the need to identify the individual demands in the collective consumption model.

budget constraint, but that can influence the decision-making process by affecting the bargaining power in the household. The model assumes that households do not suffer from money illusion. Possible examples of distribution factors include individual salary (Browning et al., 1994), or income outside work (Thomas, 1990), or individual benefits provided by relatives such as inheritance (Rubalcava and Tomas, 2000). Therefore, if $\mu(p'/x, s)$ increases due to a distribution factor s, then the wife's bargaining position improves following this increase in s. This implies that the wife is able to request greater share of utility than before by an intra-household allocation that is more favorable to her.

According to Browning *et al*. (2013), the economies of scale of living as a couple should be considered in a collective consumption model. Consequently, the aggregate consumption of the elderly couple $q = q^w + q^m$ will not necessarily be equal to the basket of goods z purchased by the household. In this context, according to Vermeulen (2002), some goods are purely private and other purely public, with the added generality that some goods may be public and private. Following Cherchye *et al.* (2012), examples of goods that may have a public nature are rent or heating: consumption of it by one of the spouses does not reduce the supply available for the other spouse, while no individual can be excluded from consuming it. On the other hand, goods like beverages are purely private: every bottle of coke drunk by one of the members cannot be drunk by the other one. However, in reality, the distinction is not necessarily that easy. For example, a car driven alone or in couple could be modeled as two separate goods, purely private ($q = q_j^w + q_j^m$) or purely public ($q = x_j/2$ with an additional restriction that $x_j^w = x_j^m$). As the examples show, many goods will have both a private and a public component[6].

Following Browning *et al*. (2013), we assume that a couple is characterized by a consumption technology that transforms the household's purchased quantity vector z into two individual vectors of private good equivalents q_i^w and q_i^m. Often the linear consumption technology used is mathematically identical to Gorman's linear techniques[7] (1976), except that we apply in the context of a collective consumption model. For simplicity, the consumer technology will be restricted to a simple Barten-type:

$$z = Aq, \tag{5}$$

where the technology matrix A is a diagonal *n* by *n* matrix, with entries that are between 0.5 and 1. Diagonal elements associated with purely private goods are equal to 1, while entries associated with purely public goods are equal to 0.5. Remark, however, that purely public goods also imply that $q_j^w = q_j^m$, which is not imposed here. Goods that have both a public and a private component are associated with an entry that is between 0.5 and 1. As discussed by Browning *et al*. (2013), the above consumption technology is similar to Becker's (1965) household production model. The crucial difference is that the goods purchased at the market serve as inputs to produce a greater quantity of the same goods via sharing, and thus are not inputs to produce household goods as in a Beckerian model.

Taking into account that the couple faces a budget constraint $x = p'z$, the elderly couple's consumption behavior is different from the elderly behavior in a one-person household (the unitary consumption model is distinct from the collective consumption model). Given all this, the couple's optimization program can be formulated. This program boils down to the assumption that the spouses maximize the weighted sum of utilities subject to the consumption technology and the household's budget constraint:

$$\max_{q_i^w, q_i^h, z} \mu(p'/x, s)U^w(q_i^w) + U^m(q_i^m) \text{ subject to, } z = Aq, p'z = x, \tag{6}$$

The optimization program results in a set of n household demand functions and two sets of n private good equivalent demand functions:

[6] See Browning and Chiappori (1998) and Cherchye *et al*. (2007) for collective consumption models that explicitly account for different uses (private, public or both) of the purchased consumption bundle.

[7] The Gorman's linear technology demand model of consumption (1976) can be specified as follows: $F(z) = Ah^B\left(\frac{A'p}{x - a'p}\right) + a$. Barten (1964) is the Gorman's model (1976) with $a = 0$ and A as a diagonal matrix.

$$z = g_i^k(p, x), \quad (7)$$

$$q_i^w = h_i^w(p, x), \quad (8)$$

$$q_i^m = h_i^m(p, x), \quad (9)$$

Browning *et al*. (2013) also derived a dual representation of the household's optimization program. This dual representation summarizes into a two-stage budgeting process: in a first stage, household members divide the household's aggregate resources among each other. In the second stage, each individual maximizes her/his own utility function subject to the resulting shares and taking account the personalized prices. Following Cherchye *et al.* (2012), in a collective model with only private consumption, these personalized prices are equal to observed market prices. In a context with public consumption, personalized prices are a vector of Lindahl prices; at these prices and the individual's fraction of the household's aggregate resources, each individual is willing to consume her/his vector of private good equivalents. Hence, the Lindahl type vector of personalized prices are:

$$\pi(p/x) = \frac{A\prime p}{x}, \quad (10)$$

Given these personalized prices and a sharing rule $\eta(p/x, s)$, constrained between 0 and 1, we have:

$$q_i^w = h_i^w(p, x) = g_i^w\left(\frac{\pi(p/x)}{\eta(p/x,s)}\right), \quad (11)$$

$$q_i^m = h_i^m(p, x) = g_i^m\left(\frac{\pi(p/x)}{1-\eta(p/x,s)}\right), \quad (12)$$

$$z = g_i^k(p, x) = Ag_i^w\left(\frac{\pi(p/x)}{\eta(p/x,s)}\right) + Ag_i^m\left(\frac{\pi(p/x)}{1-\eta(p/x,s)}\right), \quad (13)$$

The Lindahl type vector of personalized prices are normalized such that the household's aggregate resources are equal to $\pi'(q^w + q^m) = 1$, whereas the shares η e (1 – η) of the household's resources that are allocated to the wife and husband are respectively equal to $\pi' q^w$ and $\pi' q^m$. Similar to the Pareto weight μ, the sharing rule η is a measure of the wife's weight in the household's decision making process. *Ceteris paribus*, the higher the share η, the higher the utility that will be attained by the wife by means of a higher private consumption q^w[8].

2.2.1. Analytical concepts of well-being

Once the above collective consumption model is identified, three useful welfare-analytical concepts can be derived. They are potential analytical tools of the collective consumption model, in addition to the traditional tools of demand models, such as price and income elasticities.

2.2.1.1.Bargaining power among the elderly

One of this paper's objectives is the analysis of the resource allocation among the elderly and the possible bargaining power within the household. The tool offered by the collective consumption model to make this analysis is the sharing rule $\eta(p/x, s)$, a direct measurement of the intra-household bargaining

[8] For more details about how to identify the individual demand functions, the sharing rule, the consumer technology and the shadow prices, given the observed household demand function, see Browning *et al*. (2013).

power. If all goods are considered private, without economies of scale or scope in consumption (if $q^w + q^m = z$), then η would be exactly equal to that part of x that was used to buy the basket consumed by the husband q^h. Browning and Chiappori (1998), using only household data, showed that this measure of bargaining power can only be identified in very specific situations. In contrast, according to Browning *et al.* (2013), as described above, by combining the household demand function and individual demand function of the elderly, η sharing rule is completely identified.

2.2.1.2.Economy of scale in consumption

Another important analytical concept of well-being that emerges after the identification of the collective consumption model is measure of the economies of scale in consumption within the household. Following Browning et al. (2013), a global measure of economies of scale from living together within the household can be defined as:

$$e = \frac{p\prime(q_i^w + q_i^m)}{x} - 1 = \frac{p\prime\left(g_i^w(\frac{\pi(p/x)}{\eta(p/x,s)}) + g_i^m(\frac{\pi(p/x)}{1-\eta(p/x,s)})\right)}{x} - 1\,, \qquad (14)$$

where given the estimated vector of private good equivalents of the model $q_i = q_i^w + q_i^m$, x is what the household spends to acquire z and $p'(q_i^w + q_i^m)$ is the cost of purchasing the private good equivalents z. In other words, the above equation compares the expenditure required to finance the aggregate private consumption if both individuals lived alone rather than forming a couple, given the expenditure required for the consumption bundle z. It is clear that the more sharing inside the household, the higher economies of scale will also be.

Following Cherchye *et al* (2012), two extreme cases can be distinguished. First, the case when the aggregate private consumption q would be the same to the observed couple's consumption bundle z. In this case, the consumption would be purely private and the measure for the economies of scale e would be equal to zero, reaching its minimum. Second, the case when the aggregate private consumption would be the same of two times the couple's consumption bundle z. In this case, the consumption would be purely public and the measure for the economies of scale e would be equal to 1, reaching its maximum.

2.2.1.3.Indifference scales

It should be stressed that the measure for the economies of scale assumes that there is no shift in the individual consumption pattern when both spouses would live alone rather than in a couple. If individuals live alone, they are confronted with market prices instead of the individual shadow prices. If both sets of prices do not coincide (as expected), the optimal consumption pattern can be different. Following the application of the collective consumption model of Cherchye *et al* (2012), the indifference scale for the wife and husband in a household composed only by an elderly couple are respectively defined by:

$$S^w = \frac{\min_{q^{w*}}\left(p'q^{w*}|U^w(q^{w*})=U^w(q^w)\right)}{x}, \qquad (15)$$

$$S^m = \frac{\min_{q^{m*}}\left(p'q^{m*}|U^h(q^{m*})=U^h(q^m)\right)}{x}, \qquad (16)$$

The numerators of the equations above represents the minimum expenditure required for an elderly living alone to achieve the same indifference curve as living as a couple, and get the same vector of private good equivalents q^w e q^m, respectively. The denominator is equal to the couple's total expenditure x which is used to support household consumption z. Thus, according Browning *et* al. (2013), the definition of $S^i(p/x, \eta)$ depends only on the household resources and the degree of which the

consumption is shared within the household. So the indifference of scale can be identified without any cardinalization of utility function or assumptions related to interpersonal comparability.

3. Empirical Application

The demand of the single-person elderly households will be estimated by the traditional unitary consumption model. At the same time, assuming equality of preferences, we will estimate individual preferences of the couple via collective consumption model, where the other components of the structural model (specifically the sharing rule and the Barten scale) are identified. Finally, we present the information about the database and the construction of the price index.

3.1.1. Individual's demand system

We used Deaton and Muellbauer (1980b) *Almost Ideal Demand System* (AIDS). The AIDS model brings together almost all the properties theoretically and empirically desirable: it is an arbitrary first order approximation for any demand system; satisfies the axioms of choice; perfectly integrates consumers while still allowing non-linear Engel curves; and the properties of homogeneity and symmetry can be tested and imposed by simple constraints on the parameters. Therefore, the individual indirect utility function is assumed to be of the following form ($k = w, m$):

$$V^k = \left\{\left[\frac{\ln x^k - \ln a^k(p)}{b^k(p)}\right]^{-1}\right\}^{-1}, \tag{17}$$

where:

$$\ln a^k(p) = \alpha_0^k + \sum_{i=1}^{n} \alpha_i^k \ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \tau_{ij}^k \ln p_i \ln p_j, \tag{18}$$

$$b^k(p) = \prod_{i=1}^{n} p_i^{\beta_i^k}, \tag{19}$$

Applying Roy's identity to equation (17), we obtain the AIDS budget share equations for commodity i ($i = 1, \dots, n$) and individual ($k = w, m$):

$$w_i^k = \sum_j \theta_{ij}^k D_{ij} + \alpha_i^k + \sum_j \tau_{ij}^k \, lnp_j + \beta_i^k \ln\left(\frac{x^k}{a^k(p)}\right), \tag{20}$$

where w_i^k is the budget share of the elderly k with the good i; x^k is the total expenditure of the elderly k with all goods; p_j is the price of good j; D_{ij} is a vector of demographic characteristics; and α_i^k, τ_{ij}^k, β_i^k and θ_{ij}^k are the parameters to be estimated.

The constraints derived from the theoretical properties of demand are as follows: Adding-up requires that $\sum_i \alpha_i^k = 1$, $\sum_i \tau_{ij}^k = 0$ and $\sum_i \beta_i^k = 0$; Homogeneity is satisfied if $\sum_j \tau_{ij}^k = 0$; and Symmetry requires that $\tau_{ij}^k = \tau_{ji}^k$ ($\forall\, ij$) (Deaton and Muellbauer, 1980b).

The parameters of the AIDS demand systems were estimated by the programming routine for STATA described in Poi (2008). Due to limited degrees of freedom and thus to improve the efficiency of our estimates the demand restrictions are imposed. The adding up constraint was imposed by treating one of the goods as "residual" and the demand systems were estimated for $n - 1$ goods, and the homogeneity and symmetry constraints were imposed on the demand systems by parameter restrictions (Yen *et al.*, 2003). Using the adding up restriction, it is possible to retrieve the parameters and calculate the elasticities for that good. The demand equations were estimated by a seemingly unrelated nonlinear regression system (SUR), according to STATA's NLSUR command. The method used was IFGNLS (Iterated feasible generalized non-linear least squares), with results similar to the Maximum Likelihood

estimates. Thus, in order to make statistical inference about the values of the elasticities, the so-called "delta method"[9] is applied, which allows to transform the variance-covariance matrix of the estimated parameters into the variance-covariance matrix of the parameters of interest (Durham and Eales, 2010).

Finally, as in Cherchye *et al.* (2012), we can't identify if the elderly is a widow(er) or just an individual living alone. Therefore, the parameters α_i^k, τ_{ij}^k, β_i^k and θ_{ij}^k will be the same across both types of female and male individuals, but real expenditures and prices appearing in the demand equations will differ between widow(er)s and individuals in couples, as we will illustrate next.

3.1.2. Consumption technology

Now we will turn attention to the structural model components that are only associated with elderly couples. As we said earlier, we will assume a Barten type linear consumption technology function. Consequently, given a basket of consumer goods z observed by the couples and the set of private goods equivalents for the two elderly (q^w e q^m), the consumer technology function is given by:

$$z = A_i(q^w + q^m), \tag{21}$$

where A_i is the corresponding diagonal of matrix A (see equation (5)). In the empirical application, A_i will be restricted between 0.5 and 1 (which are respectively purely public and purely private consumption cases), assuming the following functional specification for A_i ($i = 1, \ldots, n$):

$$A_i = \frac{1+\frac{\exp(a_i)}{1+\exp(a_{i)}}}{2}, \tag{22}$$

where a_i is the parameter to be estimated simultaneously in the demand system.

Therefore, the demand system for couples will have the shadow prices according to this equation:

$$\pi_i = \frac{A_i p_i}{x}, \tag{23}$$

in which the elderly couple faces the price p_i and a total expenditure x.

3.1.3. Sharing rule

As we discussed earlier, the sharing rule (η) is a measure of the wife's weight in the household's decision making process, or a direct measurement of intra-household bargaining power. That is, the higher the share η, the higher the utility that will be achieved by the wife due to a higher private consumption q^w. In our empirical application, the sharing rule among elderly will depend on the following distribution factors: the real expenditure of couple (s_1); a dummy variable that indicates whether the female has a strictly higher income than the male (s_2); the education level of the female (s_3); and a dummy variable that indicates if both individuals' contribute to the household income (s_4).

By the definition, we can see that the sharing rule is restricted between 0 and 1. Therefore, we use the following functional specification:

$$\eta = \frac{exp(\delta_0+\delta_1 s_1+\delta_2 s_2+\delta_3 s_3+\delta_4 s_4)}{1+exp(\delta_0+\delta_1 s_1+\delta_2 s_2+\delta_3 s_3+\delta_4 s_4)}, \tag{24}$$

where s_i ($i = 1, 2\ 3, 4$) are the respectively household specific distribution factors and δ_i ($i = 0, 1, 2\ 3, 4$) are the parameters to be estimated.

[9] See Deaton (1997) for a detailed description of the Delta method.

3.1.4. Couple's demand system

By the definition of the Barten type linear consumption technology function (equation 22), the shadow prices (equation 23) and the sharing rule (equation 24), we can define the equation of the elderly couples' demand system in the collective consumption model. Thus, for the individual preferences represented by the AIDS model, the budget of the equation's portion applied to a household k with two elderly people is as follows:

$$w_i^k = \eta\left\{\sum_j \theta_{ij}^w D_{ij} + \alpha_i^w + \sum_j \tau_{ij}^w \, ln\, \pi_j + \beta_i^w \ln\left(\frac{\eta}{a^m(\pi)}\right)\right\} + (1-\eta)\left\{\sum_j \theta_{ij}^m D_{ij} + \alpha_i^m + \sum_j \tau_{ij}^m \, ln\, \pi_j + \beta_i^m \ln\left(\frac{\eta}{a^h(\pi)}\right)\right\}, \quad (25)$$

This equation shows that the budget shares of the couple are equal to a weighted average of the elderlies' budget shares, with weights given by the income sharing rule η and $1-\eta$. Therefore, the parameter η represents both the percentage of resources controlled by the widow and the extent to which the household's demand liken her demand, evaluated at shadow prices.

We emphasize that the parameters of the collective consumption model consist of all parameters of the AIDS model of both the single's budget shares, w_i^w and w_i^m; the Barten scale, A_i; and the parameters of the sharing rule, η. We will use a two-stage procedure to estimate the complete system, where the individual preference parameters are first estimated and then used in equation (25) to estimate the parameters of the Barten scale and the sharing rule. This strategy has the virtue of simplicity of estimation depending on the household arrangement (for example, in a household consisting of a couple, it is enough to estimate two traditional AIDS systems and then a joint system). Therefore, both stages were estimated by SUR, according to STATA's NLSUR command (nonlinear system of equations). The method used was IFGNLS - iterative feasible generalized nonlinear least squares.

3.2. Brazilian Household Budget Survey – POF

We used the microdata of the Brazilian Household Budget Survey - Pesquisa de Orçamentos Familiares (POF) conducted by the Brazilian Institute of Geography and Statistics - Instituto Brasileiro de Geografia e Estatística (IBGE, v) in 1995/96, 2002/03 and 2008/09, which collected households' expenditure on consumption goods/services from 11 metropolitan areas, in the case of POF 1995/96, and all Brazilian territory, in the case of the last two researches, POF 2002/03 and POF 2008/09. The POFs are a cross sectional national surveys which gathers information on household expenditures, incomes and sociodemographic information.

Since the sample of POF 1995/96 was restricted to Brazilian main cities, we restricted our sample accordingly, gathering data from 11 metropolitan areas: 1. Rio de Janeiro; 2. Porto Alegre; 3. Belo Horizonte; 4. Recife; 5. São Paulo; 6. Municipality of Brasília-DF; 7. Belém; 8. Fortaleza; 9. Salvador; 10. Curitiba; and 11. Municipality of Goiânia[10]. For simplicity, we will call all of them metropolitan areas. We also select our sample with only single elderly men and women who are aged 60+ and for couples with no one else in the household and where each individual is aged 60+. This results in a sample that consists of 772 widows, 292 widowers and 680 couples.

[10] According to POF 2008/09 data, there were 12,905,981 households headed by elderly people in Brazil, where 10,744,628 belonged to urban areas (83.3% of all households), 4,539,422 to metropolitan areas (35.2% of all households and 42.3% of urban households) and 4,033,494 to the eleven metropolitan regions analyzed (31.3% of all households, 37.6% of urban households and 88.9% of metropolitan households). In addition, there were 41,620,280 adult-headed households in Brazil, where 35,236,113 belonged to urban areas (84.6% of all households), 15,547,667 to metropolitan regions (37.4% of all households and 44.1% of urban households) and 13,364,201 to the respective metropolitan areas (32.1% of all households, 37.9% of urban households and 86% of metropolitan households). These information shows that the eleven metropolitan areas covered in the study are relevant in relation to the total households, to those located in urban areas and to those located in the metropolitan regions as a whole in Brazil.

Family level monthly expenditures on various detailed commodity groups are available in the POFs surveys. We aggregate them into six broad categories: 1. Food; 2. Housing; 3. Clothing; 4. Transportation; 5. Health care; and 6. Other expenses. Because POF surveys present very disaggregated data with several subdivisions per product, it was necessary to aggregate the various subtypes in order to obtain the desired six categories[11].

The system estimation comprises 5 share equations (25). The residual good chosen was "Other expenses". We included 5 demographic variables inside the vector D_k described on Table 1. All demographic variables are allowed to affect both the preferences of each single's budget shares. Following Asano and Fiúza (2001), price indexes were constructed for the six categories. The price indexes allow for comparisons both across-time and across-region.

Variable	Description
Household head characteristics	
Age	Age of the household head
Education	Education of the household head
Government transfers[1]	Dummy if the household head receives government transfers
Time characteristics[2]	
POF 1995/96	Dummy if household belongs to POF 1996/96
POF 2002/03	Dummy if household belongs to POF 2002/03

Note: 1- Includes all possible government transfers including: retirement and pensions; federal social programs; and other transfers, such as scholarships and grants. 2 - The default variables for the time characteristics were POF 2008/09.

Table 1 - Variables present in vector D_k.

According to equations (20) and (25), since the demand systems will be composed of 5 goods and 5 demographic variables, the AIDS model of individual demand for the elderly will have a total of 50 parameters ($\theta_{ij}^{m} = 5\,x\,5 = 25$; $\alpha_i^m = 6$; $\tau_{ij}^{m} = 6\,x\,6 = 36$; e $\beta_i^m = 6$). We derive 23 parameters from each individual demand system due to the symmetry, homogeneity and adding-up demand restrictions. In addition to the 100 parameters, there are 12 parameters referring to the Barten scale ($a_i = 6\,e\,A_i = 6$), 5 parameters regarding the distribution factors of the sharing rule ($\delta_i = 5$) and 1 parameter referring to the sharing rule itself ($\eta = 1$), resulting in a total of 118 parameters of the AIDS model to analyze the well-being of the elderly.

4. EMPIRICAL RESULTS

4.1. Descriptive statistics

First, we discuss the main descriptive statistics from our database. Table 2 provides summary statistics from our sample by household type. We can see that the average age is practically the same in the different households, around 70 years, and the average age of elderly couple households is the highest, 71.1 years. The average education level is higher for elderly couple household type, 6.10 years, in view of 4.87 and 5.88 years in widower and widow household type, respectively. The level of education is still relatively low for these household types, since an individual with 6 years of schooling did not complete Elementary School[12].

[11] The products considered in the aggregated demand system are available upon request.

[12] Elementary education is the name given to one of the stages of basic education in Brazil. It lasts for nine years, and enrollment is compulsory for all people between the ages of 6 and 14.

Table 2 - Summary statistics of the sample, by household type in Brazil

Household type		Elderly women	Elderly men	Elderly couple
Budget shares				
	Food	0.241	0.280	0.246
	Housing	0.433	0.409	0.382
	Clothing	0.038	0.031	0.029
	Transportation	0.046	0.089	0.099
	Health care	0.176	0.106	0.163
	Other expensives	0.066	0.085	0.081
Expenditure (montly in BRL)				
	Food	155.00	237.28	290.71
	Housing	485.39	545.88	749.17
	Clothing	32.64	32.53	60.08
	Transportation	75.85	208.97	354.92
	Health care	173.41	154.31	273.77
	Other expensives	76.76	135.57	150.48
	Total	999.05	1314.54	1879.13
Household charactersitcs				
Age		71.05	70.00	71.17
Education (years of education)		4.87	5.88	6.10
Governement transfer		0.841	0.767	0.854
POF 95/96		0.434	0.373	0.193
POF 02/03		0.201	0.199	0.601
POF 08/09		0.365	0.428	0.207
Income (montly in BRL)		1,483.52	2,380.26	2,814.27
Income (montly in USD)		643.15	1,031.91	1,220.07
Sample size		772	292	680

Source: Research results.

Another important statistic is related to Government transfers. Most of the elderly household types receive some kind of government benefit. We can highlight the elderly women households and elderly couple households that almost 84% and 85% of them respectively receive some kind of government transfer. This information can be justified by the increase in the 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 wage for all elderly of 65 years or older and disabled people who are not entitled to social security, cannot work or lead an independent life and receive up to ¼ of the minimum wage as per capita family income (Brasil, 2006).

In relation to the monthly income, we can see that households composed only by elderly men have on average higher income than households composed only by elderly women, US$1,031.91 and US$643.15 respectively, that is, there is still an income inequality between genders in Brazil. This inequality in the distribution of income has a direct influence on the consumption of goods and services, since elderly with higher income have greater purchasing power, which may influence their life quality. As expected, income in couple's elderly households was higher than individual's elderly households.

Data reveals that the expenditure on Housing is the main item on the elderly household representing about 43.3% and 38.2% of the budget shares in elderly women and elderly couple household types, respectively. All the budget shares are similar in the elderly household types, with the exception of Transportation - where the share is lower in elderly women households (4.6%) compared to elderly men (8.9%) and elderly couples households (9.9%) - and Health care - in which the share is lower in elderly men households (10.6%) compared to elderly women (17.6%) and elderly couples households (16.3%).

4.2. Couple's demand results

We focus our attention on the estimation results with respect to the parameters in the elderly couple model: the sharing rule, distribution factors and consumption technology parameters[13]. The main results for our elderly couple model are displayed in Table 3.

Table 3 - Sharing rule and consumption technology parameters in Brazil

Distribution factors	**Sharing rule**	
	Estimate (s_i)	**Std. Error**
Constant	-0.624	0.340
Real expenditures	0.0002	0.000
Income difference	1.247	0.487
Education difference	-0.090	0.034
Income contribution	-0.556	0.285
Sharing rule (η)	0.429	0.079
Consumption technology parameters	**Consumption technology**	
	Estimate (a_i)	**Std. Error**
Food	-0.232	0.219
Housing	0.695	0.549
Clothing	28.822	.
Transportation	-151.628	.
Health care	-1.271	0.344
Other expensives	0.665	0.413
Diagonal of matrix A	**Consumption technology**	
	Estimate (A_i)	**Std. Error**
Food	0.721	0.027
Housing	0.834	0.061
Clothing	1.000	.
Transportation	0.500	.
Health care	0.610	0.029
Other expensives	0.830	0.046

Source: Research results.

The first part of Table 3 shows the estimated parameters for distribution factors (s_i). C*eteris paribus*, higher real expenditures imply a higher share for females. This result is in line with earlier findings in the literature (see Cherchye *et al.* (2012) and Browning *et al*. (2013)). If elderly women in couple have more income than elderly men, this will also contribute to a higher share for females. This result may indicate a greater bargaining power in households where the elderly woman has a higher income than the elderly man, benefiting more the private consumption of the elderly woman. On the other hand, all else equal, the share that is shifted to the woman is slightly lower when she has a higher education level than her husband and if both elderly contribute to the household income. The first result was found in Cherchye *et al.* (2012) too, and the second one can indicate that husbands tend to control the income inside household. To confirm this, we show the results of the sharing rule (η). The average share was close to 0.43 with a minimum of 0.27 and a maximum of 0.58. This implies that the average couple's consumption pattern is more in line with that of husbands, but there is quite some heterogeneity across couples. The sharing rule estimated in Cherchye *et al.* (2012) for Netherland elderly couples was 0.63 with a minimum of 0.54 and a maximum of 0.73, which implies that, unlike in Brazilian elderly

[13] The estimates of the parameters from the individuals demand systems are available upon request

households, the couple's consumption pattern in Netherlands elderly households are more in line with that of wives. Browning *et al*. (2013) on Canadian data of prime age employed individuals obtained a share of 0.63 at the mean of their data (with minimum and maximum shares of respectively 0.47 and 0.75). However, our estimation results are very similar to the shares calculated by Gómes (2017), which used a micro-level dataset from POF 2008/2009 of Brazilian traditional families (married couples with zero to three children). He found a higher resource share for men in all household compositions[14].

The estimation results with respect to the consumption technology are presented in the second and third part of Table 3. The second part of the table shows the consumption technology parameters a_i, while the third part shows the implied entries of the diagonal technology matrix A_i. It turns out that Housing and Other expenses are close to being purely private goods, while Health care are close to be a public good. Food is somewhere in between and, Transportation and Clothing although presented missing standard errors[15], were considered purely public and purely private goods, respectively. With the exception of Housing, our results were very intuitive and agrees with those found in Cherchye *et al.* (2012).

Another useful tool to interpret the couples' demand results is the measure for the economies of scale of living in a couple (see equation 11). We calculate this measure at de mean point in the sample and the result was 0.33, with a minimum value of 0.27 and a maximum value of 0.40. The interpretation of this value is simple: a scale close to zero would refer to a case where most of the consumption is purely private, while a scale close to one would be associated with a case where most of the consumption is purely public. So our model suggest that a large part of elderly couples' consumption has a private nature. This result was close to the one found in Cherchye *et al.* (2012), which found a measure equal to 0.38.

4.3. Poverty among the elderly in Brazil

In this section, we will follow the application of Cherchye *el al.* (2012) to analyze poverty among elderly people in Brazil using the methodology of the collective consumption model. The idea of this section is to illustrate the impact of choosing a different methodology to calculate poverty indexes, comparing our results with those obtained by the traditional analysis based on the OECD modified equivalence scale. Therefore, the difference between our approach and the OECD will be the fact that the collective consumption model allows for household members that have different preferences, unequal sharing of resources in couples and the economies of scale of living in a couple.

4.3.1. OECD versus collective poverty analysis

In Table 4 we present the results for the evolution of poverty rates for individuals, elderly in couples and elderly in total and poverty values in Brazil using the OECD modified and collective consumption approach. The OECD poverty is calculated in three steps: first, equivalent expenditures were calculated by dividing household expenditures by the modified OECD equivalence scale - household expenditures are either divided by 1 (single individuals) or by 1.5 (couples)[16]; second, the resulting equivalent expenditures of elderly women, elderly men and individuals in elderly couples are used to obtain the median of the equivalent expenditures for the three periods; and third, the elderly is considered to be poor if the equivalent expenditures are lower than 60 percent of the time period specific

[14] Velilla-Gómez (2017) found a mean value for men resources shares of 0.53 in childless couple's households, 0.41 in couples with one child, 0.38 in couples with two children and 0.36 in couples with three children. On the other hand, the author found woman resources shares of 0.47 in childless couple's households, 0.406 in couples with one child, 0.35 in couples with two children and 0.34 in couples with three children.

[15] Missing standard errors are usually produced by nearly singular variance covariance matrices. This is usually associated to database and/or model specification issues. We tried to test several model specifications with several estimation procedures, but the results continued to present missing standard errors for these parameters. Therefore, we conclude that this result is due to limitations of the database.

[16] It is important to notice that modified OECD scale follow economies of scale measure of 0.33, the same of our estimated collective model.

median equivalent expenditures (CHERCHYE *et al.*, 2012). The collective consumption poverty is different from the OECD poverty rate: first, we must calculate the expenditures on private good equivalent consumption that may differ across spouses and, as discussed earlier, depend on the economies of scale associated with living in a couple and on the sharing rule; second and third steps are the same as in OECD poverty rate, but using the private good equivalent consumption for individual elderly in couples.

Table 4 - OECD and collective poverty rates and values in Brazil

	POF 1995/96	**POF 2002/03**	**POF 2008/09**
Elderly women in couples			
Collective poverty approach	31.8%	40.8%	29.9%
OECD poverty approach	26.9%	30.0%	23.0%
Elderly women			
Collective poverty approach	42.4%	22.6%	26.2%
OECD poverty approach	40.9%	22.6%	26.6%
Elderly men in couples			
Collective poverty approach	22.0%	22.5%	16.4%
OECD poverty approach	26.9%	30.0%	23.0%
Elderly men			
Collective poverty approach	41.3%	39.7%	27.2%
OECD poverty approach	39.4%	37.9%	27.2%
Elderly in total			
Collective poverty approach	33.6%	29.6%	24.6%
OECD poverty approach	32.9%	28.5%	24.6%
Collective poverty monthly value (R$)	132.68	491.06	609.79
OECD poverty monthly value (R$)	126.70	488.85	612.86
Collective poverty monthly value ($)	129.96	142.85	264.36
OECD poverty monthly value ($)	124.11	142.21	265.70

Source: Research results.

Note: The exchange rate is $1 = 1,02 BRL Brazilian real in September 1996; $1 = 3,44 BRL Brazilian real in January 2003; and $1 = 2,31 BRL Brazilian real in January 2009.

Table 4 demonstrates that the poverty rates for the different elderly groups in Brazil are relatively high between 1995 and 2009. However, the rates in both approaches were declining for all elderly groups if we compare the first and the last period of analysis. In general, if we compare our results to those found in Cherchye *et al.* (2012) for elderly in Netherlands, our poverty rates are more than ten times higher, except for Elderly men in couples. This result is quite worrying, because if you look for the Elderly in total group in our last period, despite in better situation than the elderly in 1995/96, almost 25% of them are still below the poverty line. Our results agree in part with those found in Turra *et al*. (2008), Coetlar and Tornarolli (2009) and Turra and Rocha (2010). These authors state that income transfer programs (especially the *Bolsa Família* Program) and the expansions of the non-contributory social security system explain much of the reduction of poverty and inequality in Brazil during the last years, and we can confirm this poverty reduction using the collective consumption methodology. However, the magnitude of this reduction is much greater in those papers than in our results. For example, Coetlar and Tornarolli (2009) state that the poverty rate among the elderly in Brazil in 2008 fell from 49.3% to 4.2% after taking into account income transfers. Turra and Rocha (2010) confirm that, considering public transfers, less than 5% of elderly in Brazil can be considered poor using the World Bank's poverty line[17].

[17] Turra and Rocha (2010) estimated poverty rates based on the World Bank's poverty line of US$ 2.00 per day in purchasing power parity in 2005 with and without public transfers including contributory and non-contributory retirement benefits, as well as conditional cash transfers from the Bolsa Família program.

If we look for the different groups, poverty was higher in the Elderly women (42.4% and 40.9%) and men (41.3% and 39.4%) groups respectively in both approaches in the first period of analysis. In the last period, the poverty rates were similar on the groups, but Elderly men (27.2% for both) and women (26.2% and 26.6%) were still poorer. However, in the last period, the highest poverty rate was in Elderly women in couples using the collective approach (29.9%), as well of for the period of POF 2002/03 (40.8%). This result can be explained by the fact that an important part of the household's budget is spent on public consumption and that the sharing rule for our collective model is more favorable to men. Therefore, elderly men in couples are able to attract a relatively higher share of private good equivalents, with the obvious consequence that they are less likely to be labelled as poor (and vice versa for women) when households have increasing financial means, as is the case in our data. These results show that much of the poverty among the elderly in Brazil comes from the issue of inequality in the intra-household distribution of resources. Therefore, disregarding this question means greatly underestimating the poverty of the elderly. Lise and Seitz (2011) already showed that traditional measures of consumption inequality only reflect inequality at the household level, when it is assumed that there is no intra-household inequality.

We conclude from our above results that, as well as in Cherchye *et al.* (2012), although OECD and collective poverty rates are of the same magnitude on average, the OECD approach underestimates most of the poverty rates (6 of 12, and the results of 2 of 12 were the same) in the periods and population groups in the analysis, mainly in the case for Elderly women in couples. This difference happens because the OECD poverty measure does not take into account intra-household allocation of resources, unequal sharing of resources in couples and the economies of scale of living in a couple.

4.3.2. Economic consequences of being alone (widow(er)hood)

This subsection reveals another important policy issue that can emerge in the collective consumption model: the economic consequences of being alone, either by having become a widow(er) or divorcee[18]. As emphasized in Cherchye *et al.* (2012), we must make two considerations about the results presented here: first, we only look at the impact on the expenditures on private good equivalents (material goods) of being alone and don't concern about the emotional impact of this event on the indifference curves; and second, the results we show are based on a time series of cross-sections, so we are not able to analyses the impact of being alone on an individual specific basis. Results are presented in Table 5 and 6.

Table 5 shows, for individuals in elderly couples, the average minimum expenditures needed when living alone to reach the same indifference curve as when living in a couple (see the numerator of equations 12 and 13). These expenditures are calculated for the four different quartiles of the distribution of total household expenditures from the couple's households. This table also shows, for elderly women and men living alone, the observed household expenditures. Table 8 further shows the corresponding average indifference scales for elderly women and men in couples (see equations 15 and 16). By definition, the indifference scale for elderly living alone equals 1.

If we look for the results on Table 5, it is possible to compare the individual household expenditure (Elderly men and women) with the minimum expenditures needed when living alone to reach the same indifference curve as when living in a couple (Elderly women or men in couples), to conclude about the material impact of an individual being alone (or become widow(er) or divorced). For a given expenditure quartile and POF period, the material impact to become a widow(er) corresponds to the difference between the actually observed expenditures for elderly men or women and the minimally required expenditures of individuals in couples to be materially equally well off when living as a single (in case a widow(er) or divorced). So the results on Table 5 suggests that men in all expenditures quartiles are materially better off when living in couple than when living alone in each period of POF database. The reverse pattern was observe for women: on average, with the exception of the POF 1995/96 period

[18] We have to be cautious here, because in our database the elderly in individual households, referred here as widows and widowers, are not observed as women or men who are living in couples before the death or being divorced of their partner. However, to interpret the results in Table 5 and 6, we use the assumption that widow(er)s are comparable to individuals in couples who are situated in the same expenditure quartile.

and fourth quartile in POF 2008/09 period, women are materially better off when living as a widow than when living in a couple. Therefore, these results follow our previous subsection suggesting the prevalence of economies of scale and a sharing rule more favorable to men. Cherchye *et al.* (2012) found similar results, but the difference was that elderly women in Netherlands are more favored by the intra-household bargaining power.

Table 5 - Economic of well-being in elderly household in Brazil

	POF 1995/96	**POF 2002/03**	**POF 2008/09**
Elderly women in couples			
First quartile	86.03	319.95	472.09
Second quartile	169.44	474.63	735.95
Third quartile	304.95	891.63	1,079.50
Fourth quartile	671.00	1,579.42	2,281.96
Elderly women			
First quartile	70.41	457.97	532.84
Second quartile	124.71	754.91	809.04
Third quartile	209.55	1,073.62	1,187.46
Fourth quartile	501.51	1,795.01	2,046.72
Elderly men in couples			
First quartile	118.81	441.84	651.93
Second quartile	233.98	655.43	1,016.31
Third quartile	421.12	1,231.31	1,490.74
Fourth quartile	926.62	2,181.11	3,151.27
Elderly men			
First quartile	67.88	365.67	501.32
Second quartile	127.25	500.89	784.73
Third quartile	296.08	897.91	1,207.97
Fourth quartile	829.60	2,050.72	2,419.47

Source: Research results.

Finally, we focus on the average indifference scales by POF periods and quartiles presented on Table 6. Results show that the indifference scales depend on total household expenditures given the time period. Therefore, men in couples that are situated in the first expenditure quartile need 77% of the couple's expenditure to be equally well off as being alone (widower) as when living in a couple. Women in elderly couples in the same quartile need about 56% of the couple's total expenditures. When we look for the fourth expenditure quartile, men need on average 83% of the couple's resources to achieve the same indifference curve as a widower or divorced man, while women only would need about 60%. So, again these results follow our previous subsection result suggesting the prevalence of economies of scale and a sharing rule more favorable to men and, because of this, they need more resources than women to be as well of when they become widower or divorced.

Table 6 - Indifference scales in elderly households in Brazil

	POF 1995/96	POF 2002/03	POF 2008/09	Average IS
Women in couples				
First quartile	0.583	0.565	0.554	0.562
Second quartile	0.594	0.575	0.562	0.575
Third quartile	0.605	0.585	0.568	0.588
Fourth quartile	0.616	0.594	0.582	0.603
Men in couples				
First quartile	0.805	0.781	0.764	0.776
Second quartile	0.820	0.794	0.776	0.794
Third quartile	0.835	0.808	0.785	0.812
Fourth quartile	0.851	0.820	0.803	0.832

Source: Research results.

5. CONCLUSIONS

Our results for the collective consumption model indicate considerable economies of scale associated with living in a couple, and a husband's share that is rising in the elderly couple's real expenditures. We calculated collective consumption model poverty rates and put in contrast to traditional poverty rates, which are based on OECD modified equivalent scales for expenditure. Collective poverty rates explicitly take into account the different intra-household distribution of resources. For most of the time periods in our analysis, collective poverty rates turn out to be higher than traditional poverty rates that are based on the modified OECD equivalence scale. These results show that much of the poverty among the elderly in Brazil comes from the issue of inequality in the intra-household distribution of resources. Therefore, disregarding this question generally means underestimating the poverty of the elderly.

Our last conclusion arise in the analysis of the economic (material) impact of become a widow(er) or being divorced. Our results indicate a considerable drop in material well-being following the wife's death for men. The opposite conclusion holds for women. After becoming a widow, Brazilian women are generally materially better off than when living in a couple and these result can be explained by the economies of scale of living in a couple, in combination with a sharing rule that is favorable to men.

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