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# Intra-Household Inequality and Child Welfare in Argentina*

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**Abstract**

Are two parents and single parents allocating household resources to children in the same way? Which factors affect intra-household inequality? Do mothers re-distribute more income to children as they are more empowered? We focus on child welfare in the context of two parent and single parent families, which is relevant for policy recommendation. We model households behavior in a collective framework, which allows us to understand the rule governing the allocation process between adults and children. Using consumption data from Argentina from three consecutive expenditures surveys (1996, 2004 and 2012) we analyze intra-household behavior over three different socio-economic contexts. We estimate a collective quadratic demand system following a structural approach to identify the fraction of total household expenditure that is devoted to children and adults, exploiting the observability of assignable goods. We provide the first evidence of intra-household inequality and individual poverty levels for Argentina. Our results indicate that family structure matters in the intra-household distribution. We find a positive gender bias in expenditure when children are females for both types of families, and we document that children fare better when mothers have a higher bargaining power in the allocation process, measured by their employment status. Further, we find several features of intra-household behavior which are persistent in time.

Key words: Collective model, Demand system, Sharing rule, Intra-household resource distribution, Child welfare

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# 1 Introduction

There is a broad consensus that childhood is likely the most powerless and vulnerable component of the family. Since the effects on their development during early ages are difficult to reverse, the way in which resources are dedicated to them is a socially relevant concern. The well-being of children critically depends on what happens inside the household. Family resources are often not equally distributed between parents and children, because they have different bargaining power, preferences and behavioral responses conditional on each specific living situations.

Some family types are more vulnerable than others, and the proportion of household resources that children receive may differ according to the family structure. This could be the case of single parent households, which are disadvantaged in many areas, such as income, education, health and career opportunities. The children of single parents are more likely to live in poverty, and less likely to do well at school (Calder, 2018).

It is commonly accepted that mothers devote more resources to children than fathers. Could be that it is not female headedness *per se* that is associated with child welfare, but the absence of a potential female decision maker within the household (Handa, 1994). Even though women do not always have influence in the intra-household decision process, it is expected that their bargaining power increases when they become income recipients because they have different preferences over expenditures from men. There is evidence for developing countries that an increment in the wife's income relative to the husband's is associated with an increase in the budget share of food and a reduction of adult goods (Hoddinott and Haddad, 1995) or an improvement in child health and nutrition (Thomas, 1990; Haddad and Hoddinott, 1994). Further, in the context of program evaluation, sizeable cash transfers made to mothers are associated with constant or higher shares of expenditure on food, probably explained by the increase in the share of resources held by mothers (*e.g.* Schady and Rosero, 2008; Attanasio and Lechene, 2010; Armand *et al.,* 2016; Tommasi, 2018).

Our objective is twofold. First, to identify the intra-household distribution of resources in Argentina and to compare how two parent and, more fragile, single parent families assign their resources to children, and investigate their determinants. Second, to understand the role that working mothers play in the allocation process and to what extend they devote more economic resources to children than fathers. To address this, we model households behavior in a *collective* framework, where individual preferences are taken into account and the resulting intra-household allocation of resources is Pareto efficient (Chiappori, 1988, 1992). We use three consecutive household budget surveys (1996, 2004 and 2012) in order to compare intra-household behavior and distribution of these two types of families over three different socio-economic contexts, and to evaluate what is the effect on child economic welfare when mothers contribute to household income. We use a structural approach and estimate a collective quadratic demand system following the methodology and identification strategy proposed by Chavas *et al*. (2014, 2018), and applied in Caiumi and Perali (2015), Menon *et al*. (2017) and Mangiavacchi *et al*.

(2017). Our identification strategy relies on the observation of assignable goods. This enables us to estimate the sharing rule that governs the intra-household distribution between adults and children and, then, retrieve the total share and amount of the household's resources devoted to children and adults. We also illustrate the effects of accounting for intra-household inequality on welfare measures, such us child poverty.

Argentina is particularly suitable for this analysis. On one hand, we can exploit the major socio-economic fluctuations that households experienced over the last two decades by using three budget surveys to compare intra-household inequality in two parent and single parent families. During the 1990s, there was a process of economic liberalization, price stability and increase of poverty and income inequality. After the 2001 devaluation and crisis, a process of inflation began and households experienced a lower real incomes and expenditures. To cope with the negative effects of the crisis and reduce poverty, the government implemented a robust plan of social interventions. During the last years, the macroeconomic setting was more complex, stressed by an upward trend in consumer prices and poverty rate. At the same time, wages began to recover (Lustig *et al.*, 2013). Single parents households are significantly vulnerable in Argentina: 83% are female-headed, 70% are in the lowest two quintiles of the national income distribution (INDEC, 2010), and they suffer more during macroeconomic crisis because they are more likely to decrease consumption and have more difficulties accessing services (Gaviria, 2002). Given the specific situation and socio-economic characteristics of these families, UNICEF (2017) has recommended to apply a segmentation in the implementation of welfare policies to single parent households in order to reduce child poverty more effectively. Over the last decades there has been a notable increase in the female labor participation in Argentina from 36.8% in 1990 to 48.1% in 2017 (Ministerio de Trabajo, 2017). This change is particularly remarkable among mothers compared to women without children (UNDP, 2014).[5] This allows us to explore the effect of increasing women labor participation over intra-household distribution of resources and child well-being.

Our results show that two parents and single parents assign their household resources to children differently, and this allocation changes over time but in different directions according to the family structure. On average, intra-household distribution in Argentina is pro-child, and single parents devote a higher proportion but of a much lower household expenditure to children than couples. We also identify characteristics of intra-household behavior that are persistent in time. Additionally, we show direct evidence that when the mother works, in two parent households, more resources (in relative and absolute terms) are allocated to children. We argue that working mothers are able to favor their children. Female labor participation, and its increase over time, reflect a strengthened bargaining position of the mother inside the household. This, in turn, acts as a channel that allows working mothers to devote more economic resources to their children in comparison to households with non-working mothers. We also find systematic evidence, and robust over time, of a pro-female gender bias in child expenditure.

[5]Martinoty (2015) shows that the added worker effect played an important role in coping against aggregate shocks during the 2001 economic crisis.

Our contributions are several. First, the majority of applications of the collective household theory have focused on the bargaining process, and estimation of the sharing rule, between spouses. We contribute to the scarce but still growing evidence on how household resources are shared between adults and children, identifying the level of resource shares (Dunbar *et al*., 2013; Bargain *et al*., 2014; Mangiavacchi *et al*., 2017; Bargain *et al*., 2017; Bargain *et al*., 2018). Further, we analyze the sharing rule over very distinct periods of time, distinguishing which behaviors did change and which still persist. Second, there is extremely scarce evidence of how resources are distributed within households for Latin American countries (Iglesias and Coelho, 2018),[6] even though inequality is still a distinctive and pervasive characteristic of the region with a non-stable trajectory over time (Gasparini *et al.,* 2009). In this sense, knowledge about intra-household inequality may contribute to the understanding of its level, tendency as well as the mechanisms behind its evolution. Even more, many of these countries typically share some other common characteristic, such us the increase in female labor participation during the last decade and its deceleration during the last years (Gasparini and Marchionni, 2015). Our results could be a starting point to analyze the general situation of these societies and their welfare policies towards mothers and children. Third, the inclusion of single parent households is highly relevant for policy recommendations. However, in the literature there is a paucity of empirical work on the extent and nature of resource sharing in households with just one parent. We provide evidence of it and exploit the comparison of the intra-household distributive behavior of these two types of families during different economic and social contexts. Bargain *et al.* (2014) find that children in single mother families receive a slightly larger share of the household resources than in two-parent families, but they cannot conclude that mothers are more altruistic towards children than fathers. We also provide robust evidence over time that children fare better when mothers have more influence over family resources. Unlike the evidence previously mentioned, we associate a higher bargaining power of the mother in the allocation process (measured by their working status) to a direct increase in the proportion of economic resources that children receive. We explicitly contribute to the evidence showing that there is an the improvement of child well-being due to women empowerment through labor participation, measuring a labor market effect on the sharing rule.

Relevant policy implications may be drawn from this analysis. Understanding the process of household allocation is important for both policy design and program evaluation.[7] Our evidence may suggest that those cash transfers aimed to reduce poverty among children could be more effective if targeted towards women. These types of programs have increased in Latin American countries during the last decade. Moreover, not only the identity and gender of the recipient is likely to have welfare effects (Duflo, 2000; 2003; Yoong *et al.*, 2012, Armand *et al.,* 2016; Tommasi, 2018) but also the response of non recipients, since the impact of public transfers is conditional upon the behavior inside the household. It seems crucial to be able to anticipate their

[6]Other studies have analyzed different features of intra-household behavior (Inchauste, 2001; Thomas, 1990, 1994; Emerson and Souza, 2007), but without identifying the proportion of household resources devoted to children.

[7]In general, the literature interested in assessing the differences in the way fathers and mothers allocate resources in developing countries is related to the literature on cash transfer programs.

responses when such policies are focused on improving child welfare. Additionally, the effect that an increase in female labor participation may have over the distribution of resources inside the households and the well-being of children is non trivial in terms of policy interventions. It is also relevant to account for the family structure when developing a social policies, since there are important differences in their characteristics and their intra-household behavior. Finally, intra-household inequality should be considered when measuring child poverty and evaluating the impact of those public policies specifically designed to reduce it.

The rest of the paper is organized as follows. Section 2 describes the general conceptual framework of collective models, some related literature and our structural model. Section 3 presents the specification of the sharing rule and the demand system. Section 4 outlines Argentinean data and the estimation strategy. Section 5 presents and discusses results, and in Section 6 final remarks and policy implications are drawn.

## 2 Collective Framework

Traditional models of consumption assume that the household acts as one entity. The household is a single decision unit characterized by a single utility function that is maximized under a budget constraint with pooled resources. Alderman *et al.* (1995) label such models as the "unitary" approach.[8] In the unitary model of the household, resources are equally distributed among members according to their needs, so that all members are assumed to have the same level of welfare. Thus, resource allocation processes is omitted by construction.

However, there is consensus that decisions should be modeled at the individual level, and that household behavior should be analyzed in terms of the interactions among its members. The unitary framework has been extended by the seminal works of Chiappori (1988, 1992), whom introduced a theoretical household model, the *collective model,* that explicitly recognizes the existence of several decision-making units in the family, with potentially different preferences.[9] Under this framework, households are characterized as a *collection of individuals*, each of whom has a well defined objective function and who interact to generate household level decisions. Decisions are assumed to be Pareto efficient allocations, in the sense that, for a given choice, it is not possible to increase one member's welfare without reducing that of the others - if individual utility functions are well-behaved and the budget sets are convex. Pareto-efficiency implies that the consumption equilibrium will be on the Pareto frontier of the family. The rationale of this assumption is that efficient allocations are likely to emerge when agents are able to make binding commitments and have full information, as it is reasonably the case of a household setting.

Collective models are based mainly on the sharing rule, that is, a function describing interactions between household members and the decision making process regarding the intra-

[8]These models are also referred to as the "common preferences" model, the "altruism" model, or the "benevolent dictator" model, referring to different hypothesis of why the household is considered to act as one entity.

[9]Donni and Chiappori (2011), Chiappori and Mazzocco (2017), and Donni and Molina (2018) provide the most recent reviews of the theoretical and empirical advances in this literature.

household distribution of resources. The sharing rule depends on exogenous variables that affect the bargaining power of family members in allocation decisions but without affecting individual preferences. These variables are called in the literature *distribution factors*.

Browning *et al.* (1994) implemented Chiappori's collective model in a consumption framework with expenditure data, opening up the possibility of making welfare comparisons at the individual level, rather than at the household level. Bourguignon (1999) later established how to derive the sharing rule between parents and children, arguing that children have bargaining power. In this way, children are not longer considered public goods for parents, but agents with their own preferences, utility and, hence, welfare. This allows to capture the child–adult bargaining process that exists within the household.

We model the sharing rule governing the intra-household allocation of consumption expenditures between adults and children, following the structural approach proposed by Chavas *et al*. (2014, 2018), and applied in Caiumi and Perali (2015), Menon *et al*. (2017) and Mangiavacchi *et al*. (2017). In our set up, households are comprised of two different members of type $k$: adults $a$, and children $c$. We assume that the two member-type purchase $N$ non-assignable private goods $\boldsymbol{x} = (x_1, ..., x_N)$, and $n$ assignable private goods $\boldsymbol{x^k} = (x_1^k, ..., x_n^k)$.[10] Private goods can be assigned to a specific family member (adults or children), while for non-assignable goods one can observe only consumption at the household level.[11] The associated vectors of market prices for assignable and non-assignable goods are $\mathbf{p_{x^k}} = (p_{x_1^k}, ..., p_{x_n^k})$, and $\mathbf{p_x} = (p_{x_1}, ..., p_{x_N})$, respectively. Market prices of non-assignable goods are observed at the household level. Observed heterogeneity is captured by a set of demographic characteristics $\mathbf{d} = d_a, d_c, d_h$ comprising the vector $\mathbf{d_k} = (d_{k_1}, ..., d_{k_R})$ specific to each type of member $k$, with $R$ elements and the vector of household characteristics common to the family $\mathbf{d_h} = (d_{h_1}, ..., d_{h_H})$ with $H$ elements. The family faces a linear and convex budget constraint.[12]

Given the results provided in Chiappori (1988, 1992) and Browning and Chiappori (1998), the collective model is formally equivalent to a model of family income sharing in which the decision-making process can be decentralized into two stages. In the first stage, household members decide how to share household total expenditure (or income) $y$, by assigning to each type $k$ a given amount $\phi_k$ of the household resources. Thus, the sum of these individual resources is equal to total household expenditure, $y = \phi_a + \phi_c$, where $\phi_k$ represents the shadow individual incomes for each member-type. In a consumption model it must be greater than zero, since it represents a expenditure. In the second stage, each member-type chooses its own optimal consumption bundle maximizing its utility function given its budget constraint. Formally, in the primal representation of the decentralized program,

[10] Superscript $k = a, c$ is associated with endogenous variables and subscript $k = a, c$ with exogenous variables.

[11] A good is non-assignable when a private good is consumed without rivalry in unobserved proportions by all or some non identifiable household members (*e.g.* food). Conversely, a good is assignable when a private good is consumed by only one identifiable member and its price is different from the price of the other exclusive goods consumed within the family (*e.g.* clothing for adults and children).

[12] The proposed model assumes that there are no externalities within families and abstracts from the consumption of domestically produced goods.

$$\max_{\mathbf{x},\mathbf{x^k}}\{u^k(\mathbf{x},\mathbf{x^k};\mathbf{d_a},\mathbf{d_c},\mathbf{d_h}) \ : \ \mathbf{p}_{\mathbf{x}}^{'}\mathbf{x}+\mathbf{p}_{\mathbf{x^k}}^{'}\mathbf{x^k}=\phi_k\} \qquad for\ k=a,\ c \tag{1}$$

The solution of this problem yields the following individual Marshallian demand functions $\hat{\mathbf{x}}^{\mathbf{k}} = \mathbf{x}^{\mathbf{k}}(\mathbf{p_x}, \mathbf{p_{x^k}}, \phi_k, \mathbf{d})$ and $\hat{\mathbf{x}} = \mathbf{x}(\mathbf{p_x}, \mathbf{p_{x^k}}, \phi_k, \mathbf{d})$ where optimal consumption of the non-assignable good is observed at the household level as a function of the sharing rule, prices and demographic attributes.

In the next section, we specify the identification strategy for the sharing rule and derive the collective quadratic demand system used in the empirical application.

# 3 Identification Strategy

## 3.1 Specification of the Sharing Rule

Our objective is to econometrically identify the unobservable sharing rule $\phi_k$ - the shadow expenditure that each member-type of the household receives. The challenge is how to use available information on observed expenditures consumed at the individual level. When exploited properly, this information is a sufficient condition to identify how economic resources are shared within the household. In particular, the minimal information required for identification of the resource share[13] is the observability of at least one assignable good, or two exclusive goods (Browning *et al.*, 1994; Bourguignon, 1999).

Our source of identification relies on the observation of consumption of assignable goods across family members that, if income is fixed, must be associated with a redistributive transfer of resources within the household. For example, the presence of a child induces a redistribution of consumption within the household (Rothbarth 1941, 1943). If income remains unchanged before and after a child arrival, the associated new demand for children goods is met by reducing the expenses on adult goods and, to a less extent, on all other goods. Our empirical identification strategy intends to capture these income reallocation effects.[14] The end result is that we identify how total household expenditures on all goods are divided up among household members.

The identifying assumption is that we can recover a *partially observable* individual expenditure $(y_a,\ y_c)$ exploiting the information on exclusive or assignable goods $(x^a,\ x^c)$. Those goods, which are neither exclusive nor assignable, are assumed to be equally distributed between the types of members, so that the non-assignable expenditure of each member type is equal to $0.5\boldsymbol{x}$.[15] Under this procedure we construct the best possible approximation of total observable individual expenditures using the available information, given by

[13]The terms sharing rule and resource share are used interchangeably, indicating the proportion of household expenditure consumed by the adults and the children.

[14]Exclusive goods for children may produce economies of scales if, for example, the same clothes are used by more than one child. In that case, the sharing of children's clothes probably mitigates the income reallocation effect.

[15]Chavas *et al.* (2014) show that the assumption of fair division of the non-assignable expenditures between household members is neutral since it does not affect the identification of the sharing rule parameters.

$$y_k = p_{x^k}^{'} x^k + p_x^{'} 0.5\, x \qquad for\ k = a,\ c \tag{2}$$

Let us define $s_k = y_k/y$ with $\sum_k s_k = 1$ so that $y = s_a\, y + s_c\, y$.

The econometric strategy is built from an analogy of the technique used to include demographic variables or exogenous variables into demand functions (Pollak and Wales, 1981; Lewbel, 1985). In our case, the partially observable individual expenditure, $y_k$, is modified by an income scaling function $M_k(\psi)$ *a la* Barten (Barten, 1964), where $\boldsymbol{\psi}$ is a vector including the distribution factors and the relative price of assignable goods[16]

$$\phi_k(y,\, \boldsymbol{\psi}) = y_k * M_k(\boldsymbol{\psi}) \qquad for\ k = a,\ c \tag{3}$$

The modifying scaling function $M_k(\boldsymbol{\psi})$ can be interpreted as a correction factor. Given that individual expenditures are known with measurement error because of the limited information about assignable goods, we correct this imprecision by scaling the partially observed individual expenditure $y_k$ with a latent linear function $M_k(\boldsymbol{\psi})$ depending on background exogenous variables that predict the unobserved income transfer.[17] $M_k(\boldsymbol{\psi})$ is a function describing the transfer between adults and children in the households, with $0 < M_k(\psi) < y/y_k$. It explains both the amount and direction of the allocation of resources to household members. If $M_k(\boldsymbol{\psi}) < 1$, then, adults reallocate expenditure towards children.

As shown in equation (3), and noted before, the sharing rule is constructed and defined as a function of observational data: expenditures in assignable goods, prices of assignable goods and exogenous variables explaining the intra-household allocation process (distribution factors).

Since by definition $ln\, \phi_a(.) + ln\, \phi_c(.) = ln\, y$ holds, the logarithm of the intra-household transfer from adults to children must be the same. That is, the following constraint on $ln\, M_k$ must hold:

$$ln\, M_a(\boldsymbol{\psi}) = -ln\, M_c(\boldsymbol{\psi}) \tag{4}$$

This allows us to set,

$$ln\, M_a(\boldsymbol{\psi}) = ln\, M(\boldsymbol{\psi}) \quad and \quad s_a = s \tag{5}$$

In this way we are able to estimate the same scaling function $M_k(\boldsymbol{\psi})$ for both member-types and identify both individual scaling functions by changing its sign.

[16] We do not scale total expenditure at the household level because it would capture demographical differences across households and would not identify the allocation decision process between family members, since total household expenditures provide no information about the distribution of resources within the household.

[17] The estimation challenge is similar to that of estimating a regression containing unobservable independent variables (Goldberger, 1972). However, since our objective is to estimate the unobservable sharing rule $\phi_k$ which represents the best estimate of the unobserved individual income, we have both an unobserved independent and dependent variable.

### 3.2 Collective Quadratic Demand System

The chosen demand system is the Quadratic Almost Ideal Demand System (QUAIDS), an extension of the originally linear in income AIDS system (Deaton and Muellbauer, 1980) proposed by Banks *et al.* (1997).[18] The model is extended in two ways. First, we incorporate household demographic characteristics interacting with income in a theoretically plausible way (Pollak and Wales, 1981). Second, we incorporate our proxy of individual incomes (Equation (3)) for the two type of members of the household, introducing the sharing rule and allowing us to estimate a *collective* model (Chavas *et al.,* 2018).

The budget share specification of the QUAIDS for good *i* is

$$w_i(y,\, \mathbf{p}) = \alpha_i + \sum_j \gamma_{ji}\, ln\, p_j + \beta_i(ln\, y - ln\, a(\mathbf{p})) + \frac{\lambda_i}{b(\mathbf{p})}(ln\, y - ln\, a(\mathbf{p}))^2 \tag{6}$$

where $w_i(y,\, \mathbf{p})$ is the good *i* budget share, $\alpha_i, \gamma_{ij}, \lambda_{ij}$ are parameters, $p_j$ is the price of good *j* and $y$ is total household expenditure. $a(\mathbf{p})$ and $b(\mathbf{p})$ are prices indexes defined as

$$ln\, a(\mathbf{p}) = \alpha_0 + \textstyle\sum_i \alpha_i ln\, p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ji}\, ln\, p_i ln\, p_j$$
$$ln\, b(\mathbf{p}) = \textstyle\sum_i \beta_i ln\, p_i, \qquad \text{or} \qquad b(\mathbf{p}) = \prod_i p_i^{\beta_i}$$

First, the quadratic system is extended in order to incorporate socio-demographic observed heterogeneity across households, since these variables are major determinants of household consumption patterns. Budget shares are demographically modified according to the translating technique,

$$w_i(y,\, \mathbf{p}) = w_i(y,\, \mathbf{p},\, t_i(\mathbf{d}))$$

where $t_i(\mathbf{d})$ is an income translating function and $\mathbf{d}$ is a vector of demographic variables or household characteristics. This demographic specification models household characteristics as if they were fixed costs deflating income (*i.e.* translating the budget line).

Applying this linear demographic translating transformation to equation (6), the demographic modified budget share equation is obtained[19]

$$w_i(y,\, \mathbf{p},\, \mathbf{d}) = \alpha_i + t_i(\mathbf{d}) + \sum_j \gamma_{ji}\, ln\, p_j + \beta_i(ln\, y^* - ln\, a(\mathbf{p})) + \frac{\lambda_i}{b(\mathbf{p})}(ln\, y^* - ln\, a(\mathbf{p}))^2 \tag{7}$$

where

$$t_i(\mathbf{d}) = \textstyle\sum_{ir} ln\, d_r$$

[18] There is enough evidence indicating that the quadratic functional form is an adequate fit for Argentinean data (Pizzolitto, 2007; Pace Guerrero, 2013; Echeverría and Berges, 2015).

[19] The asterisk denotes that the variable is demographically modified.

$ln\, y^* = ln\, y - \sum_i t_i(\mathbf{d})\, ln\, p_i$

Secondly, the system is extended to the collective case introducing the sharing rule, which determines (the natural logarithm of) the amount of resources that each member-type of the household receives. Thus, the following equation shows the budget share equation for good *i* according to the specification of the collective quadratic almost ideal demand system,

$$w_i(y,\, \mathbf{d},\, \mathbf{p},\, \boldsymbol{\psi}) = \alpha_i + t_i(\mathbf{d}) + \sum_j \gamma_{ji}\, ln\, p_j + \beta_i^a (ln\, \phi_a^* - ln\, a(\mathbf{p})) + \frac{\lambda_i^a}{b^a(\mathbf{p})}(ln\, \phi_a^* - ln\, a(\mathbf{p}))^2 + \beta_i^c (ln\, \phi_c^* - ln\, a(\mathbf{p})) + \frac{\lambda_i^c}{b^c(\mathbf{p})}(ln\, \phi_c^* - ln\, a(\mathbf{p}))^2 \tag{8}$$

where $ln\, \phi_a^*$ and $ln\, \phi_c^*$ are member-type (total) individual expenditures modified by a translating household technology, defined as

$$\begin{aligned} ln\, \phi_a^* &= ln\, \phi_a(y,\, \boldsymbol{\psi}) - \sum_i t_i(\mathbf{d})\, ln\, p_i \\ ln\, \phi_c^* &= ln\, \phi_c(y,\, \boldsymbol{\psi}) - \sum_i t_i(\mathbf{d})\, ln\, p_i \end{aligned} \tag{9}$$

The demographically scaled sharing rules in (9) can be re-write as

$$ln\, \phi_a^* = ln\, y_a + ln\, M_a(\boldsymbol{\psi}) - \textstyle\sum_i t_i(\mathbf{d})\, ln\, p_i = s\, ln\, y + ln\, M(\boldsymbol{\psi}) - \sum_i t_i(\mathbf{d})\, ln\, p_i$$
$$ln\, \phi_c^* = ln\, y_c + ln\, M_c(\boldsymbol{\psi}) - \textstyle\sum_i t_i(\mathbf{d})\, ln\, p_i = (1-s)\, ln\, y - ln\, M(\boldsymbol{\psi}) - \sum_i t_i(\mathbf{d})\, ln\, p_i$$

The empirical specification of $M(\boldsymbol{\psi})$ is a Cobb-Douglas function, so that the logarithmic specification is linear in the parameters,

$$ln\, M(\boldsymbol{\psi}) = \phi_{p_r} ln\, p_r + \textstyle\sum_l \phi_l\, ln\, z_l$$

where $l = 1, ..., L$ is the dimension of the vector of distribution factors $\boldsymbol{z}$, and $p_r$ is the relative price of the assignable goods. In an analogy to $t_i(\mathbf{d})$ function, $M(\boldsymbol{\psi})$ is identified if there is sufficient variation in the price of assignable goods and distribution factors.

In order to comply with homogeneity properties of the demand system (adding-up, linear homogeneity in $\boldsymbol{p}$, and the Slutsky symmetry), the budget shares must hold under a number of restrictions on the parameters[20]

[20]The last restriction on the demographic parameters ensures that the modified cost function maintains the homogeneity property (Perali, 2003).

$$\sum_i \alpha_i = 1; \quad \sum_i \beta_i = 0; \quad \sum_i \lambda_i = 0; \quad \sum_i \gamma_{ij} = 0; \quad \sum_j \gamma_{ij} = 0; \quad \gamma_{ij} = \gamma_{ji}; \quad \sum_i \tau_{ir} = 0 \tag{10}$$

The use of distribution factors incorporates an additional restriction, which is that distribution factors must differ from the demographic variables, in order for the parameters of $ln\, M(\boldsymbol{\psi})$ and $t_i(\mathbf{d})$ to be identified.

The estimation allows to identify individual income parameters $\beta_i^a$, $\beta_i^c$, $\lambda_i^a$, $\lambda_i^c$ but the intercept $\alpha_i$, price parameters $\gamma_{ij}$ and the parameters of the scaling functions $t_i(\mathbf{d})$ and $ln\, M(\boldsymbol{\psi})$ are estimated at the household level.[21] $\phi_l$ are the main parameters of interest.

# 4 Empirical Strategy

In this section we describe the data used and the econometric approach employed in the empirical application of the collective demand system.

## 4.1 Data

Household data comes from the National Household Expenditure Survey (ENGH) conducted by the National Institute of Statistics and Census (INDEC) of Argentina. The first survey was implemented in 1996-97, the second during 2004-05 and the last one during 2012-13. The surveys are nationally representative and aimed at households located in areas of 5,000 or more inhabitants. In 1996, the survey covered a total of 27,245 households, in 2004 29,111, and in 2012 20,954. The ENGH provides very comprehensive data on household expenditures and quantities for a broad set of consumption categories and with a very high disaggregation level. Expenditure data is collected using recall methods based on the nature of purchased items. Daily expenditures, such as food and beverages, household cleaning products, medication, expenses for personal care, have a recall period of seven days prior to the interview. For semi-durables, as clothing, education and health services, the recall period is the month prior to the interview, and for durables and holiday expenditure the last prior six months. All expenditures are already converted into monthly consumption. The data also records detailed information on housing conditions as well as individual data on socio-demographic characteristics and labor status.

In order to recover the underlying structure of the collective model, we use the available information about private assignable consumption. For adults, we exploit data on clothing and footwear, alcoholic beverages, casino games, newspapers, cigarettes, jewelry and hairdressing, while for children we use the expenditure information of clothing and footwear, games and toys, children's books, education, children's backpacks, daycare centers, diapers, ready-prepared baby

[21] The individual demand equations are summed up to form the household demand equation. Some individual parameters cannot be identified either because of collinearity (two constrains in the same equation cannot be identified) or data construction (since some information, as prices and demographic characteristics, are recorded at the household level).

food and hairdressing. Clothing and footwear are the largest components and, on average, they account for 75% of the total assignable expenditures.

We select two sub-samples of households composed of two parents and a single parent with children. On average, surveyed families have 2 children. We exclude households with more than 3 children (between 3.6% and 8.2%, according to the year and sub-sample).[22] For 1996 and 2004 (2012) surveys, we exclude households with children older than 10 (14) years of age, since assignable information of clothing is asked for members below and above this age.

We define six categories of expenditures: food and beverages, clothing and footwear, housing and maintenance, transport and communications, recreation and education, and health and others. To account for outliers, we eliminate families with expenditures higher than 8 standard deviations from the mean of each aggregated category (1.5% excluded households). We include a set of demographic variables to account for observable heterogeneity across households. We use regional dummies for the Great Buenos Aires, Center, North and South Argentina, and variables of the economic status of the household: indicators for ownership of at least one car, house ownership, and if the household is able to save money. We also specify a set of dummies for health insurance, education level (low, medium, and high)[23] and age groups (18 to 34, and 35 to 64) of the household head. In the case of the two parents sub-sample, these dummies are also constructed for the spouse.

The exogenous variables chosen for the specification of the sharing rule are information associated with characteristics of the children and the parents that likely affect the bargaining power and the allocation of resources between adults and children. It is not possible to test directly whether a variable is a valid distribution factor, however the choice of the variables can be supported by the prevailing literature and previous evidence. Our distribution factors are the following. First, an indicator variable if at least one child is aged above 7. We include this variable to account for the fact that more grown-up children may participate, to some degree, in the resource allocation process. Dauphin *et al.* (2011) find evidence that adolescents influence the household decision-making process. In an experiment, Harbaugh *et al*. (2003) show that children have good bargaining skills since earlier ages. Second, an indicator variable if children are females. Evidence for gender discrimination in the collective framework is both diverse and country-specific. For example, Dunbar *et al.* (2013) document some evidence of gender discrimination against girls in Malawi: if all children are girls, then the mother's resource share rises, and the children's share falls. Bargain *et al.* (2018) find pro-boy discrimination for Bangladesh, meanwhile Bargain *et al.* (2014) find no robust and compelling evidence of gender preference in the allocation of household resources to children for Côte d'Ivoire and neither Bargain *et al.* (2017) for South Africa. For Albanian households Mangiavacchi *et al*. (2017) show that a higher proportion of girls in the household improves their sharing rule. Third, the price ratio of clothing, defined as adults' over children's clothing price, in order to capture how the relative price of assignable goods influence the amount of resources that adults and

[22] This is also done in previous works as in Bargain *et al.* (2014).

[23] We define the categories low education level as elementary education or less, medium as secondary completed or not, and high as university completed or not.

children receive. For the sample of two-parent households, we also add education difference of the parents (years of schooling of the father minus years of schooling of the mother) and age difference of the parents (age of the father minus age of the mother). The age and level of education of the husband and wife affect the bargaining power between adults (*e.g*. Bargain *et al*., 2014; Mangiavacchi *et al.*, 2017; Menon *et al*., 2017). Moreover, there is evidence that this translate into a higher resource share for children (Dunbar *et al.*, 2013). The inclusion of these variables is mainly based on the assumption that mothers may be more in favor of children than husbands. In this sense, it is possible that these two distribution factors reflect the differences in parents "attitudes" towards children. Fifth, we control for whether the mother is employed. It allows us to indirectly include labor information that may modify the way in which expenditures are distributed within the household, in line with mentioned literature that indicates that, when possible, mothers tend to favor their children. When providing additional income to the family, the mother may have more bargaining power as well as more influence on the intra-household decision process. For example, Bargain *et al.* (2017) document for South Africa that mother's employment status translates into a higher share of resources allocated to children. As mentioned before, this could be particularly relevant in the context of Argentina, where there has been major changes over the last decades in the labor market and the female participation.[24]

In the case of single parent households, the last three distribution factors are not considered. Table A.1 and A.2 of Appendix A contains some descriptive statistics for the relevant variables. Throughout our analysis we use weighted observation in order to correct any bias introduced by the sampling design, so that inference is made with respect to the underlying population of interest.

Finally, the estimation of demand systems requires the consideration of many empirical issues, such as the construction of prices, the correction for infrequency of purchases, the correction of assignable information and dealing with potential endogeneity of total expenditure. Data preparation is discussed in more detail in Appendix B.

## 4.2 Final Specification of the Empirical Model

The collective QUAIDS model specified in (8) is modified as to introduce the empirical issues mentioned above (see Appendix B). The vector of parameters $\tau_i$ of the zero expenditure correction is estimated using a Maximum Likelihood Probit estimator to recover the predicted cumulative and probability density functions $\hat{\Psi}(\mathbf{s_i'}\hat{\tau}_i)$ and $\hat{\psi}(\mathbf{s_i'}\hat{\tau}_i)$. The predicted residuals $\hat{\omega}$ of the endogenous regressor (total expenditure) are obtained by OLS estimation of the endogenous variable on all covariates and the instruments. Prices $\hat{p}$ are the household-specific pseudo unit values previously computed. Finally, the system estimates are obtained by Full Information Maximum Likelihood of the demand system in budget share form,

[24]We recognize that the inclusion of labor choices in the sharing rule may be a source of endogeneity.

$$w_i = \hat{\Psi}_i[\alpha_i + t_i(\mathbf{d}) + \sum_j \gamma_{ji} ln\, \hat{p}_j + \beta_i^a(ln\, \phi_a^* - ln\, a(\hat{\mathbf{p}})) + \frac{\lambda_i^a}{b^a(\hat{\mathbf{p}})}(ln\, \phi_a^* - ln\, a(\hat{\mathbf{p}}))^2 + \beta_i^c(ln\, \phi_c^* - ln\, a(\hat{\mathbf{p}})) + \frac{\lambda_i^c}{b^c(\hat{\mathbf{p}})}(ln\, \phi_c^* - ln\, a(\hat{\mathbf{p}}))^2] + \eta_i \hat{\psi}_i + \varsigma_i \hat{\omega} + \varepsilon_i \tag{11}$$

where a spheric error term $\varepsilon_i$ has been added. The system is estimated imposing the conditions specified in (10), and dropping the equation of health and other goods.

# 5 Results

Table 1 shows the parameters associated with the distribution factors for each sub-sample, couples with children and single parents with children. The parameters of the sharing rule are estimated jointly with the demand system, but are reported separately since they are the focus of our work. Tables A.8, A.9 and A.10 of Appendix A present all the estimates of the demand system. The coefficients associated with the residuals of the first stage of the control function are, in general, statistically significant, indicating that total expenditure is endogenous.

Table 1: Adults' Sharing Rule Function Parameters

| **distribution factors** | **1996** | | **2004** | | **2012** | |
|---|---|---|---|---|---|---|
| **Two Parent Families** | | | | | | |
| 1 if at least 1 child is >7 | -0.068 | (0.083) | -0.065 | (0.074) | 0.140 | (0.094) |
| 1 if children are females | -0.299*** | (0.112) | -0.215** | (0.082) | -0.424*** | (0.092) |
| price ratio of clothing | -0.017** | (0.007) | -0.004 | (0.009) | -0.018 | (0.011) |
| age father - age mother | -0.014 | (0.009) | 0.019* | (0.009) | -0.029*** | (0.008) |
| educ father - educ mother | 0.005 | (0.019) | -0.017 | (0.012) | 0.010 | (0.012) |
| 1 if the mother is employed | -0.079 | (0.124) | -0.125** | (0.061) | -0.224** | (0.088) |
| Number of obs. | 3,783 | | 3,633 | | 3,862 | |
| Number of weighted obs. | 1,031,705 | | 1,479,933 | | 2,043,241 | |
| **Single Parent Families** | | | | | | |
| 1 if at least 1 child is >7 | 0.217 | (0.166) | 0.015 | (0.073) | 0.092 | (0.092) |
| 1 if children are females | -0.148 | (0.093) | -0.199** | (0.079) | -0.660*** | (0.093) |
| price ratio of clothing | 0.004 | (0.011) | -0.003 | (0.009) | -0.001 | (0.007) |
| Number of obs. | 304 | | 414 | | 693 | |
| Number of weighted obs. | 84,632 | | 145,806 | | 311,135 | |

Note: These are the parameters of the sharing rule function. They are estimated jointly with the collective QUAIDS demand system specified in Equation (11). All the rest of the system parameters are reported in Tables A.8, A.9 and A.10 of Appendix A. The system estimation is done separately for each type of family and each survey. Standard errors are reported in parenthesis. * p < 0.10, ** p < 0.05, *** p < 0.01.

Our estimations show that the presence of an older child does not affect the sharing rule of adults in neither of both family structures (Table 1). We find robust evidence of gender preference in expenditure over time and for both family types, that holds on a systematic basis, when all kids in the household are females. Thus, there is an unequal treatment regarding allocation of expenditure; adults are diverting more resources to children when there are not male children in the household. The adults' sharing rule is negatively influenced by the price of adults clothing only for couples with children in 1996; when this price increases (or the price of clothing for children is relatively lower) they allocate more resources to children. For two parent families the difference in education of the parents[25] does not have a significant effect on the intra-household allocation process in any period.[26] For 2004 and 2012, the age difference of the parents significantly influences the distribution of resources within the household. However, the direction of the effect changes. For 2004, a decrease in the age gap of the parents decreases the resource share of the adults, while in 2012 it increases.[27] Finally, there is evidence that mother employment status significantly affects the intra-household allocation of resources. If the mother earns labor income the expenditure allocated to adults decreases and, consequently, the resource share of children rises. The magnitude of the effect is larger over time.

### 5.1 Intra-Household Inequality and Family Structure

Table 2 shows the predicted sharing rule, as proportion of household expenditure consumed by the adults and the children in each type of family and period of time. In the case of two parent families, in 1996 the intra-household distribution of resources was pro-child. On average, each child received 36% of household expenditures and each adult 21%.[28] In 2004, in a post-crisis context of lower standard of living and lower real income and expenditure, the distribution of resources became more equal (Figure 1). In contrast, for 2012 the intra-household distribution returned to its pre-crisis values, leaving children in a better relative position - in terms of individual welfare.

For single parent families, the resource shows a different behavior and dynamic through time. The share of total expenditure that each child receives in single parent households increased from 39% in 1996 to 44% in 2004, and 47% in 2012. In this case, children's sharing rule increased on average, even during the period of major economic adjustments and lagged real wages. We find an overall improvement in children welfare of 8 percentage points on average over the last two decades, compared to the 4 percentage points increase in families with

[25]The sign and significance of the parameters of the education and age difference variables are robust to different specifications, such as defining the ratio between husband's age and wife's age, and husband's education and wife's education.

[26]The latter result is in line with evidence for Argentina showing that the relatively high and constant degree of assortative mating during the last decades has not had an impact over income labor inequality (Funes Leal, 2015).

[27]We find that changes in the age difference may relate to intra-household distributional issues. In 2012, parents are older and the age difference between them is smaller than in 2004. The age gap is negatively correlated with income, but less variable through income quintiles in 2012.

[28]The per child (per adult) sharing rule is obtained by dividing the estimated children's (adult's) sharing rule by the number of children (adults) in the household. We assume that within children and adults groups there is an equal distribution of resources. By analyzing in per capita terms we control for family size.

two parents. The direction of these observed changes hold for all family sizes, however they are more pronounced in families with one child, where there is probably more margin to modify the intra-household distribution.

In the case of two parent households, the sharing rule for children living in one child family decreases in 14% from 1996 to 2004, but it is higher in the post crisis period than it was before. In contrast, in households with 2 and 3 children, their share of total expenditure is practically the same in 2012 than in 1996. In the case of single parent households, the increase in children's resource share from 1996 to 2012 is higher in families with just one child.[29]

Table 2: Predicted Sharing Rule (resource share)

| | **1996** | | | | **2004** | | | | **2012** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **predicted** | **Two Parents** | | **Single Parents** | | **Two Parents** | | **Single Parents** | | **Two Parents** | | **Single Parents** | |
| **sharing rule** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| adults | 0.43 | 0.10 | 0.45 | 0.12 | 0.50 | 0.12 | 0.40 | 0.09 | 0.40 | 0.13 | 0.36 | 0.12 |
| children | 0.57 | 0.10 | 0.55 | 0.12 | 0.50 | 0.12 | 0.60 | 0.09 | 0.60 | 0.13 | 0.64 | 0.12 |
| per adult | 0.21 | 0.05 | 0.45 | 0.12 | 0.25 | 0.06 | 0.40 | 0.09 | 0.20 | 0.06 | 0.36 | 0.12 |
| per child | 0.36 | 0.14 | 0.39 | 0.12 | 0.33 | 0.12 | 0.44 | 0.13 | 0.40 | 0.17 | 0.47 | 0.18 |
| families with 1 child | | | | | | | | | | | | |
| adults | 0.50 | 0.10 | 0.52 | 0.09 | 0.57 | 0.11 | 0.45 | 0.05 | 0.43 | 0.14 | 0.39 | 0.13 |
| child | 0.50 | 0.10 | 0.48 | 0.09 | 0.43 | 0.11 | 0.55 | 0.05 | 0.57 | 0.14 | 0.61 | 0.13 |
| families with 2 children | | | | | | | | | | | | |
| adults | 0.41 | 0.07 | 0.39 | 0.09 | 0.46 | 0.09 | 0.35 | 0.07 | 0.39 | 0.11 | 0.34 | 0.08 |
| children | 0.59 | 0.07 | 0.61 | 0.09 | 0.54 | 0.09 | 0.65 | 0.07 | 0.61 | 0.11 | 0.66 | 0.08 |
| families with 3 children | | | | | | | | | | | | |
| adults | 0.34 | 0.06 | 0.35 | 0.08 | 0.40 | 0.08 | 0.27 | 0.05 | 0.35 | 0.10 | 0.29 | 0.06 |
| children | 0.66 | 0.06 | 0.65 | 0.08 | 0.60 | 0.08 | 0.73 | 0.05 | 0.65 | 0.10 | 0.71 | 0.06 |

For all years and both family structures, the average resource share for adults decreases with the number of children. When family size increases, adults devote more resources to their children, but not proportionally. This may be related to the fact that there is some degree of inelasticity in adults expenditures and, that despite the increasing number of children, there is a limit for the amount of resources that parents are willing to give up. Besides, there is probably some sharing when there are more children in the household, for example toys or clothing. For both types of family, in 2012 (in a more relax income context) the allocation of resources is less dependent on the number of children.

[29] Our main interest is not to focus on how the sharing rule and intra-household resources have changed over time given that we only use three rounds of the expenditure survey and that we do not consider a dynamic approach.

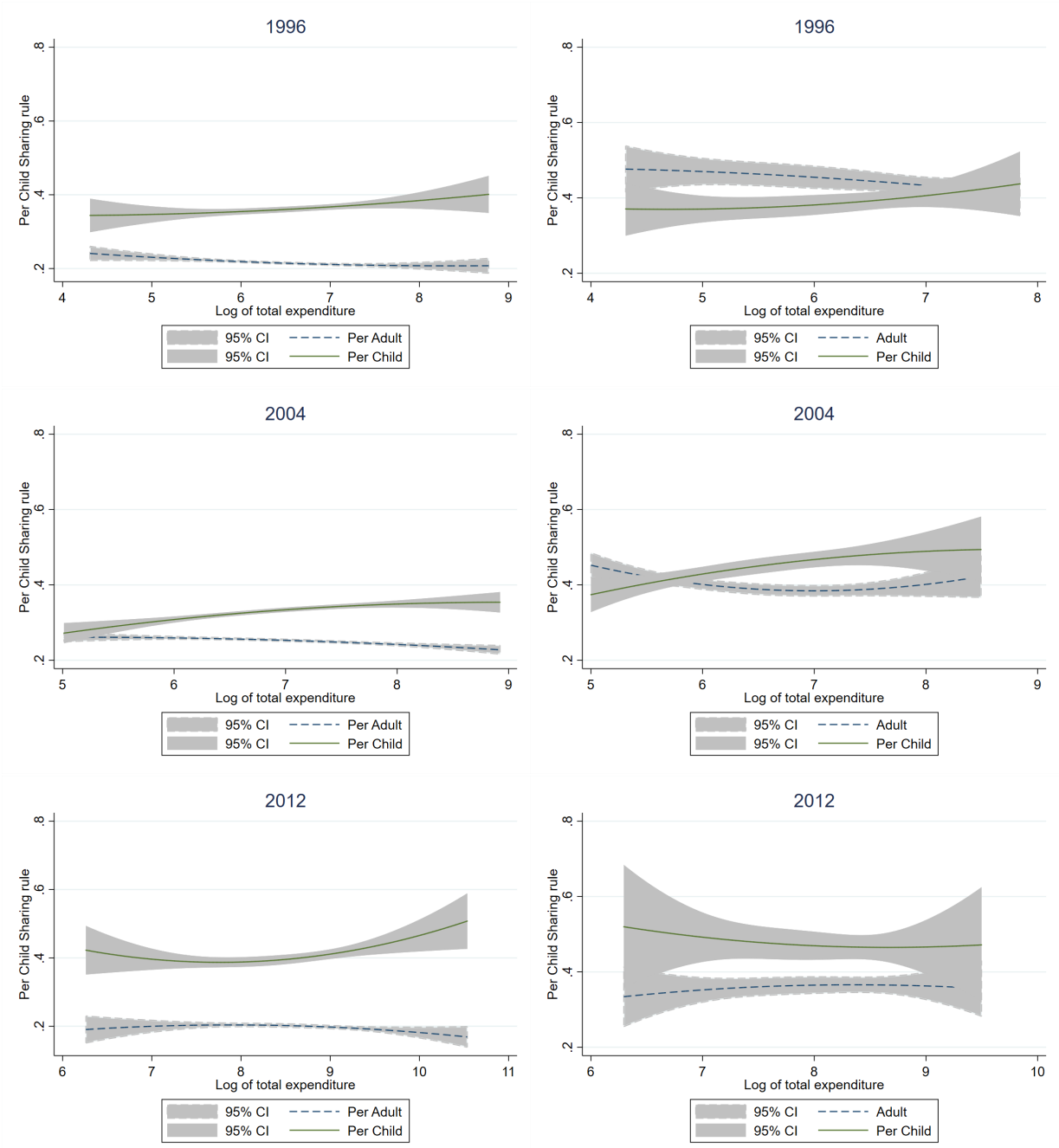
When comparing the two family types in each period of time, we observe a different behavior resulting on a different intra-household *per capita* distribution. For all years, the distribution inside two parent families was on average pro-child regardless of the family size. However, in 2004, where the economic context was more difficult, the intra-household allocation was relatively more equal in families with 2 or 3 children. On the other hand, in single parent households the allocation of total expenditure was pro-adult in 1996, and pro-child only in families with one child in 2004 and 2012.

Interestingly, children's resource share is relatively the same between the two types of families in 1996, but higher in single parent families (and for all family sizes) in 2004 and 2012. In particular, differences are more pronounced in 2004, after the crisis and in a context of lower real expenditure, where children in single parent families get around 12 pp. more of household resources. Thus, in families where there is a sole decision maker, children are better off in terms of individual welfare. At the same time, single adults seem to be doing better than adults in a couples in relative terms. However, this is not true in absolute terms, since single parent families are poorer. The average amount of expenditure in pesos[30] that each child receives in two parent families is 42%, 23% and 16% higher, in each period of time, respectively. Thus, single parents are allocating a higher proportion, but of a much lower household expenditure, to children than couples. Since single parent families live in a more restrictive economic situation and are more vulnerable than two parent households, they are probably just meeting their children most basic needs. In fact, for families in the first quintile of the national income distribution, the level of expenditure in pesos that parents allocate to children is almost the same in both types of families. However, the relevant disparity is that approximately 45% of single parents households are in the first quintile, compare to the 15% of two parent households. It is interesting to note that if single parents were to have a higher income and reverse their poverty situation, children could be specially better off and improve their well-being since their sharing rule is higher than in two parent families.

Figure 1 depicts the behavior of the estimated sharing rule for the two family type across income. In general, the sharing rule is not highly variant in total expenditure. On average, rich and poor families have a similar resource share. However, there are some differences across family types. For two parent families, we find, for all periods, that the divergence between the share of total expenditure allocated to children and adults is larger for households with higher total expenditure. For single parent families, a more diverse behavior and pattern across income is observed; the gap decreases with income in 1996, is reverse for low income levels in 2004, and is constant in 2012.

[30] Argentinean currency.

Figure 1: Per Capita Sharing Rule - Two Parent Families (left) and Single Parent Families (right)




*Note*: expenditures are expressed in current pesos of each period.

The sharing rule is not the same across households. There are heterogeneities driven by the characteristics of the family members or the family situation.[31] The per child sharing rule is higher when parents have a high education level in comparison to parents with low education level, regardless of income. For two parent families, the difference on average is 4 p.p. in 1996, and increases to 8 p.p. in 2004 and 2012. For single parent families, 6 p.p. in 1996, 8 p.p.

[31]Even tough Argentina presents large socio-economic and cultural disparities across regions, on average there are not significant differences in the estimated sharing rule for households living in different geographic locations.

in 2004, and decreases to 1 p.p. in 2012. The age of the parents also modifies the average proportion of total household economic resources that children receive, but the effect is not homogeneous. In two parent families, the per child sharing rule is higher when parents are older, between 50 and 64 years old (but in 2004 it is lower in families with high income levels). In contrast, there are not significant differences in the children's sharing rule according to the parents age in single parent families for any period.

Accounting for intra-household distribution of resources has implications on individual welfare. Traditional measures of welfare, such as poverty and inequality, assume equal distribution of resources among family members, considering the distribution of income (or expenditure) across households but not across individuals. These measures, usually based on *per capita* terms, are at least incomplete and often misleading (Chiappori and Meghir, 2015). Table 3 compares child poverty and inequality indicators (at the household level) for the most recent period (2012) under two different methods: a) the traditional "indirect" method, and b) the refined "direct" method. That is, the Gini index and poverty headcount FGT are calculated over two person-level expenditures: one that assumes an equal distribution of resources within the family (*per capita*) and a more refined measure that accounts for intra-household inequality (sharing rule). The indirect method for computing poverty captures the proportion of poor households with children, while the direct method captures the proportion of households with *poor children* independently of the poverty status of the parents. To define the poverty, we use both a relative threshold (half of the median of each person-level expenditure), and an absolute poverty line (US$4/person/day[32]) adjusted by the intra-household income transfer to children, in the case of the direct method.

Table 3: Child Poverty and Inequality Indicators (2012)

| **Indicators** | **Two Parent Families** | **Single Parent Families** |
|---|---|---|
| Inequality: Gini | | |
| Indirect Method: Per capita expenditure | 0.36 | 0.40 |
| Direct Method: Per child sharing rule | 0.43 | 0.43 |
| Poverty: FGT - (A) | | |
| Indirect Method: Per capita expenditure | 14.5% | 13.1% |
| Direct Method: Per child sharing rule | 15.2% | 17.1% |
| Poverty: FGT - (B) | | |
| Indirect Method: Per capita expenditure | 16.1% | 17.4% |
| Direct Method: Per child sharing rule | 19.4% | 19.5% |

We illustrate how accounting for intra-household distribution of resource modifies child welfare measures. Considering intra-household distribution of resources adds an additional source of inequality, accounting for both inequality *across* households and *within* households. Inequality measures based on collective results are higher compare to those based on an unitary set-

[32]This line is approximately similar to the median value of official poverty lines in Latin American countries (CEDLAS, 2015).

ting. Child welfare is distributed more unequally when the assumption of equal distribution of resources is relaxed.

Poverty results enable us to directly identify the percentage households with children below the poverty line, but admitting the possibility that their parents are non-poor. Accounting for family inequality is relevant in the poverty analysis. Poverty measures differ when using *per capita* expenditures or *per* child sharing rule: child poverty is relatively higher when we consider intra-household allocation of resources for both family structures, indicating that the traditional indirect method may underestimate poverty rates.

### 5.1.1 Gender Preference in Expenditure

Our results show that in both types of families exists a gender bias in expenditure towards children if they are females. This evidence is robust over time and significantly affects the sharing rule. The proportion of total expenditure that is allocated to children when they are girls is higher than in any other case regarding the gender composition of the household, and it is independent of the level of total expenditure.[33]

In two-parent families, if children in the household are girls, then their *per capita* resource share is between 10 (in 2004) and 14 (in 2012) percentage points higher than if the children are all boys, while in single parent families, between 5 (in 1996) and 23 (in 2012) percentage points. The difference between children and adults resource share is larger when children in the households are females.

One possible explanation for this gender preference could be related to a gender investment bias. If the proportion of families with only females is relatively older and more educated they may value more human capital and invest more on their children education. We find that there is a significant difference in the proportion of more educated parents: parents of only girls have a higher level of education in both types of families. However, the magnitude of the differences in the distribution of age and education level between parents of only females or parents with girls and boys is not large. Regarding age, we find that parents of only girls are relatively younger in the case of two parent families. Age and educational differences are not significant in 1996.

Additionally, in Argentina, the school attendance rate for girls is higher than for boys, and the gender gap is increasing in the age of children (UNESCO, 2016). This could translate into a higher education expenditure by parents of only girls. Public education in Argentina is free, consequently expenditures are frequently zero or very low (confined to text books, extra-curricular courses, for example), but many parents still prefer private schools (Gasparini and Cruces, 2010), increasing the educational costs in their children. In single parent households the average expenditure made by the head in education is higher when children are girls (except in 1996, where the effect on the sharing rule is not significant). In two parent families with

[33]The bias in the expenditure towards girls, and its effect on the sharing rule, is conditional on the fact that children in the household are girls. We do not find a robust effect when considering the proportion of females or the presence of at least one girl. Furthermore, and according to the evidence established in the literature (*e.g.* Ejrnæs and Pörtner, 2004; Jayachandran and Pande, 2017), we also test in unreported estimations if the birth order of children matters in the intra-household distribution of total expenditure, but it does not affect the sharing rule.

only females, the average expenditure in education is not consistently higher (Table A.5 of the Appendix A). One relevant difference is found in 2012, and it is driven by a higher education expenditure in families with just one child. This may be associated with the increase in the sharing rule coefficient for the distribution variable indicating the presence of only females children for 2012 - the same is observed in single parent families. Thus, the gender bias observed in our estimations for two parent and single parent households could be explained by an education investment hypothesis, but only partially since it does not verify for both types of families.

Another argument may be related to a higher clothing expenditure for girls that becomes significant when children are females. On average, parents of only girls spend a relatively similar amount on clothing expenditure than parents of only boys or girls and boys, in each family size and type of family (Table A.5 of the Appendix A). Thus, gender bias in our case seems not be associated with clothing expenditure.

It is also possible that girls are more expenditure-consuming and demanding than boys. Moreover, clothing for girls may be expensive than clothing for boys. There is evidence that in Argentina many goods aimed at women (from backpacks, health care products to haircuts) are on average 13.7% more expensive than those for men (CAME, 2018)[34].

Additionally, the gender bias found could be indicative of a psychological effect, where parents are more altruistic towards their children depending on their characteristics.

## 5.2 Children's Resources and Female Labor Participation

In Argentina, between 1996 and 2012, female participation in the labor market grew from 37% to 50%. Moreover, the relative importance of the mother's income over total household labor income increased by 40%. Given the magnitude of these changes, we analyze which is the relationship between female labor participation and child well-being, and if mothers re-distribute more income to children when they have enough bargaining power inside the household. We assume that if mothers are income recipients, they have more bargaining power and, thus, can influence how total expenditure is allocated within the household.[35]

Figure 2 shows that the share of expenditure that each child receives in the household is higher when the mother is employed than when she is not, regardless of the level of household total expenditure. Additionally, the per child sharing rule of children with working mothers is quite constant over income quintiles.

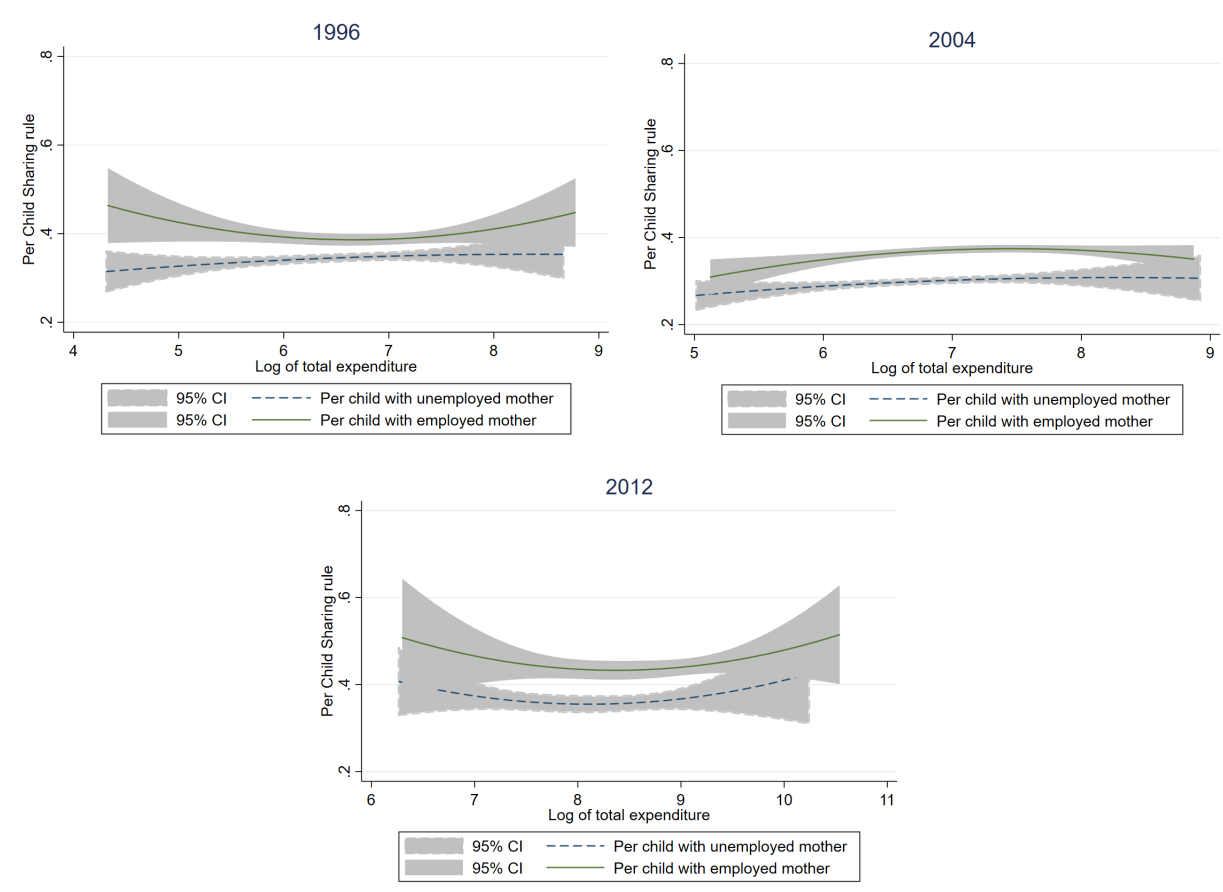
We find a significant and robust effect over children's sharing rule. Households with an employed mother divert more resources to children than households where the mother is not an income recipient, as measured by the coefficient related to the distribution factor indicating

[34]This has been called "pink tax". However, we cannot test this hypothesis since we do not have price data discriminating on child female and male clothing.

[35]Female labor participation may generate many intra-household effects: time allocation effects (*e.g.*, both parents working have less time to allocate to child care or domestic tasks), income effects (*e.g.*, a working adult brings more resources to the household), and a sharing rule effect (*e.g.*, a working mother may have more bargaining power to allocate income to her children). These effects may involve distribution impacts, as for example on the welfare of children. Given our focus of interest and available data and we center on the sharing rule effect.

if the mother is employed (Table 1). This situation has became more pronounced over time, as did the changes in the female labor participation. The difference in the average sharing rule of children living in households with an employed or unemployed mother has increased over time: 59% and 56% in 1996, 52% and 47% in 2004, and 64% and 56% in 2012, respectively. Even more, children with an employed mother receive not only a higher share of income but are also better in absolute terms, since the amount of expenditure allocated to each of them is substantially higher; 50% in 1996, 81% in 2004 and 65% in 2012.

Figure 2: Per Child Sharing Rule if the Mother is Employed or Unemployed




*Note*: expenditures are expressed in current pesos of each period.

Even tough the employment status of the mother is positive and significantly correlated with her level of education, and household total income, we do not find an additional effect on the sharing rule associated with education in any period. Working mothers allocate more household resources to children, but there is no significant difference in the average per child sharing rule if the employed mother has a low or high education level. On the contrary, we find an heterogeneous and relevant effect regarding life cycle. In those households where the mother is employed, per child sharing rule is above the average only if the mother is between 50 and 64 years old. This result is robust over time.

# 6 Conclusions

We analyze intra-household distribution of resources in Argentina comparing how two parent and, more fragile, single parent families assign their resources to children, and investigate their determinants. Further, we seek to understand the role that working mothers play in the allocation process and to what extend they devote more economic resources to children as they are more empowered. To address this, we estimate a collective model, which enables to identify individuals' resource shares (sharing rule), defined as the proportion of household resources allocated to each household member. We use three consecutive expenditures surveys (1996, 2004 and 2012) in order to compare intra-household behavior of these two types of families over three different socio-economic contexts.

We provide the first empirical evidence of intra-household inequality for Argentina and show that the unitary model is rejected, since resources inside the family are not equally distributed between adults and children. On average, intra-household distribution in Argentina is pro-child, but two parent and single parent families assign their economic resources to children differently. This allocation changes over time but in different directions according to the family structure. Further, we observe that children living with single parents have a higher resource share than children in two parent families, however they are relatively poorer. Thus, single parents devote a higher proportion but of a much lower household expenditure to children than couples. If public policies were to strengthen single parent families, in order to have higher income and reverse their poverty situation, children could be specially better off and substantially improve their well-being, and probably their outcomes.

We also identify characteristics of intra-household behavior that are persistent in time and are shared by the two family structures, such us the positive gender bias in child expenditure when children in the household are females, or the additional effect in favor of children if parents are more educated. These results seem to reflect a pattern in behavior, which could be relevant when designing public policies and understanding related phenomenons. Fox example, if less educated parents are less willing to invest in their children it could lower the children's earning ability and capacity when they grow up, intensifying a inter-generational poverty trap.

Analyzing intra-household distribution of resources permits to better account for welfare effects. We illustrate how inequality measures maybe underestimated when intra-household inequality is not considered, and how the traditional definition of child poverty as the percentage of families with children below the poverty line can be refined in favor of a direct measure of the percentage of children below the poverty line. Intra-household inequality in resource allocation could imply that poor children may reside with non-poor parents. This suggests that public and international institutions should consider improving their poverty and inequality evaluation techniques.

Additionally, we measure a female labor market effect on the sharing rule and document that in two parent households where the mother works, more economic resources are devoted to children, in comparison to households with non-working mothers. This effect is robust and

larger over time. Female labor participation, and its increase over time, reflects a strengthened bargaining position of the mother inside the household. However, during the last years there has been a process of deceleration of the female labor participation, particularly documented among more vulnerable, less educated and married women. This poses the question of what could be the effect of this situation in the intra-household context, given that it has a direct impact on child welfare.

Other direct policy implications arise: should cash transfer be given to mothers? Are cash transfers directly increasing the amount of resources allocated to children? The impacts of programs on child poverty strongly depend on the response of the household. We cannot assume that cash transfers given to parents directly translate into child welfare. The collective setting, and intra-household analysis, is of much importance in trying to disentangle theses questions, and presents itself as a powerful framework shedding new lights on the effects of public policies aimed at improving the welfare of household members. The intra-household evaluation of cash transfer programs is the next step in our research agenda.

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# A Appendix A: Tables

Table A.1: Descriptive Statistics - Two Parent Families (1996 - 2004 - 2012)

| Variables | 1996 | | 2004 | | 2012 | |
|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| *Demographic Variables* | | | | | | |
| 1 if the household lives in Great Buenos Aires region | 0.36 | - | 0.33 | - | 0.40 | - |
| 1 if the household lives in the Northern region | 0.14 | - | 0.18 | - | 0.17 | - |
| 1 if the household lives in the Patagonia region | 0.06 | - | 0.05 | - | 0.06 | - |
| 1 if owner a house | 0.51 | - | 0.48 | - | 0.76 | - |
| 1 if owner of at least one car | 0.43 | - | 0.38 | - | 0.48 | - |
| 1 if head has health insurance | 0.66 | - | 0.63 | - | 0.72 | - |
| 1 if age of the head between 35 and 64 | 0.38 | - | 0.38 | - | 0.51 | - |
| 1 if the head has secondary educ. completed or not | 0.41 | - | 0.44 | - | 0.51 | - |
| 1 if the head has universitary educ. completed or not | 0.24 | - | 0.25 | - | 0.28 | - |
| 1 if age of the spouse between 35 and 64 | 0.23 | - | 0.24 | - | 0.37 | - |
| 1 if the spouse has secondary educ. completed or not | 0.41 | - | 0.40 | - | 0.51 | - |
| 1 if the spouse has universitary educ. completed or not | 0.29 | - | 0.32 | - | 0.31 | - |
| 1 if total household expenditure < total household income | 0.60 | - | 0.53 | - | 0.58 | - |
| *Distribution Factors* | | | | | | |
| 1 if at least 1 child is >7 | 0.31 | - | 0.31 | - | 0.46 | - |
| 1 if children are females | 0.32 | - | 0.33 | - | 0.33 | - |
| relative price assignable adults/children | 2.40 | 3.7 | 2.49 | 3.51 | 2.22 | 3.39 |
| age of the father - age of the mother | 2.91 | 4.69 | 3.27 | 4.97 | 3.08 | 5.65 |
| years educ of the father - years educ of the mother | -0.51 | 3.50 | -0.74 | 3.64 | -0.76 | 3.86 |
| 1 if the mother works | 0.38 | - | 0.47 | - | 0.50 | - |
| *Shares of the Demand System* | | | | | | |
| food and beverages | 0.38 | 0.16 | 0.37 | 0.16 | 0.38 | 0.16 |
| clothing and footwear | 0.08 | 0.05 | 0.10 | 0.04 | 0.10 | 0.04 |
| housing and maintenance | 0.20 | 0.14 | 0.20 | 0.13 | 0.17 | 0.12 |
| transport and communications | 0.12 | 0.12 | 0.13 | 0.12 | 0.16 | 0.14 |
| recreation and education | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.09 |
| health and other expenditures | 0.12 | 0.10 | 0.11 | 0.10 | 0.09 | 0.08 |
| Number of obs. | 3,783 | | 3,633 | | 3,862 | |
| Number of weighted obs. | 1,031,705 | | 1,479,933 | | 2,043,241 | |

Table A.2: Descriptive Statistics - Single Parent Families (1996 - 2004 - 2012)

| Variables | 1996 | | 2004 | | 2012 | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| *Demographic Variables* | | | | | | |
| 1 if the household lives in Great Buenos Aires region | 0.33 | - | 0.33 | - | 0.39 | - |
| 1 if the household lives in the Northern region | 0.16 | - | 0.19 | - | 0.18 | - |
| 1 if the household lives in the Patagonia region | 0.08 | - | 0.08 | - | 0.08 | - |
| 1 if owner a house | 0.44 | - | 0.46 | - | 0.69 | - |
| 1 if owner of at least one car | 0.09 | - | 0.07 | - | 0.21 | - |
| 1 if head has health insurance | 0.53 | - | 0.44 | - | 0.60 | - |
| 1 if age of the head between 35 and 64 | 0.36 | - | 0.39 | - | 0.57 | - |
| 1 if the head has secondary educ. completed or not | 0.41 | - | 0.36 | - | 0.46 | - |
| 1 if the head has universitary educ. completed or not | 0.28 | - | 0.31 | - | 0.30 | - |
| 1 if total household expenditure < total household income | 0.52 | - | 0.42 | - | 0.41 | - |
| *Distribution Factors* | | | | | | |
| 1 if at least 1 child is >7 | 0.44 | - | 0.44 | - | 0.67 | - |
| 1 if children are females | 0.35 | - | 0.37 | - | 0.34 | - |
| relative price assignable adults/children | 1.74 | 2.67 | 1.86 | 3.29 | 1.83 | 2.41 |
| *Shares of the Demand System* | | | | | | |
| food and beverages | 0.36 | 0.19 | 0.36 | 0.17 | 0.37 | 0.19 |
| clothing and footwear | 0.12 | 0.15 | 0.12 | 0.10 | 0.12 | 0.06 |
| housing and maintenance | 0.25 | 0.15 | 0.22 | 0.13 | 0.21 | 0.16 |
| transport and communications | 0.08 | 0.11 | 0.09 | 0.10 | 0.11 | 0.12 |
| recreation and education | 0.10 | 0.10 | 0.09 | 0.10 | 0.12 | 0.13 |
| health and other expenditures | 0.09 | 0.10 | 0.11 | 0.11 | 0.09 | 0.08 |
| Number of obs. | 304 | | 414 | | 693 | |
| Number of weighted obs. | 84,632 | | 145,806 | | 311,135 | |

Table A.3: Pseudo Prices (1996 - 2004 - 2012)

| **System Categories** | **1996** | | | | **2004** | | | | **2012** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Two Parents** | | **Single Parents** | | **Two Parents** | | **Single Parents** | | **Two Parents** | | **Single Parents** | |
| | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| food and beverages | 1.23 | 0.22 | 1.18 | 0.20 | 1.72 | 0.23 | 1.70 | 0.24 | 2.43 | 0.22 | 2.42 | 0.22 |
| clothing and footwear | -0.25 | 0.18 | -0.23 | 0.20 | 0.24 | 0.19 | 0.26 | 0.19 | 0.98 | 0.19 | 1.0 | 0.18 |
| housing and maint. | 0.38 | 0.34 | 0.35 | 0.37 | 0.7 | 0.31 | 0.71 | 0.32 | 1.22 | 0.35 | 1.22 | 0.33 |
| transport and comm. | 0.05 | 0.28 | 0.06 | 0.31 | 0.35 | 0.32 | 0.35 | 0.32 | 0.99 | 0.30 | 0.99 | 0.30 |
| recreation and educ. | -0.22 | 0.36 | -0.22 | 0.41 | 0.21 | 0.39 | 0.20 | 0.42 | 1.14 | 0.40 | 1.14 | 0.40 |
| health and others | 0.07 | 0.31 | 0.09 | 0.33 | 0.64 | 0.34 | 0.64 | 0.34 | 1.28 | 0.33 | 1.30 | 0.36 |

*Note*: pseudo prices are expressed in logarithms and are nominal values from prices of each period of time.

Table A.4: Truncation in Expenditure Shares - in Percentage (1996 - 2004 - 2012)

| System Categories | 1996 | | 2004 | | 2012 | |
|---|---|---|---|---|---|---|
| | Two Parents | Single Parents | Two Parents | Single Parents | Two Parents | Single Parents |
| food and beverages | 0.1 | 0.6 | 0.5 | 2.4 | 0.7 | 1.6 |
| clothing and footwear | 0 | 0 | 0 | 0 | 0 | 0 |
| housing and maint. | 0.3 | 0.9 | 0.24 | 1.7 | 0.3 | 0.3 |
| transport and comm. | 17.3 | 27.6 | 14.6 | 20.5 | 6.7 | 14.3 |
| recreation and educ. | 15.9 | 23.0 | 19.2 | 25.4 | 11.0 | 13.41 |
| health and other | 9.5 | 23.0 | 7.5 | 16.7 | 8.8 | 14.6 |

*Note*: there are no zeros in clothing and footwear category because of the imputation made (see Appendix B).

Table A.5: Average Expenditures in Education and Clothing (1996 - 2004 - 2012)

| Average Expenditure | 1996 | | | | 2004 | | | | 2012 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Two Parents | | Single Parents | | Two Parents | | Single Parents | | Two Parents | | Single Parents | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| *Education* | | | | | | | | | | | | |
| only females | | | | | | | | | | | | |
| all families | 31 | 71 | 18 | 46 | 35 | 83 | 39 | 76 | 115 | 283 | 299 | 713 |
| families with 1 child | 26 | 66 | 15 | 39 | 27 | 71 | 38 | 79 | 109 | 275 | 340 | 774 |
| families with 2 or 3 children | 37 | 79 | 25 | 57 | 50 | 102 | 43 | 66 | 125 | 294 | 124 | 305 |
| females and males | | | | | | | | | | | | |
| all families | 32 | 81 | 27 | 52 | 46 | 106 | 22 | 52 | 109 | 293 | 144 | 297 |
| families with 1 child | 25 | 72 | 29 | 51 | 27 | 61 | 30 | 59 | 77 | 227 | 111 | 268 |
| families with 2 or 3 children | 36 | 84 | 26 | 53 | 55 | 122 | 15 | 44 | 125 | 319 | 168 | 315 |
| *Clothing and Footwear* | | | | | | | | | | | | |
| only females | | | | | | | | | | | | |
| all families | 28 | 14 | 23 | 11 | 45 | 22 | 33 | 17 | 231 | 103 | 183 | 95 |
| families with 1 child | 27 | 13 | 24 | 10 | 43 | 21 | 32 | 17 | 227 | 105 | 176 | 96 |
| families with 2 or 3 children | 30 | 15 | 21 | 13 | 49 | 24 | 35 | 19 | 238 | 100 | 215 | 83 |
| females and males | | | | | | | | | | | | |
| all families | 29 | 14 | 21 | 14 | 47 | 24 | 30 | 16 | 236 | 104 | 194 | 87 |
| families with 1 child | 28 | 13 | 19 | 15 | 41 | 20 | 27 | 15 | 232 | 101 | 189 | 80 |
| families with 2 or 3 children | 30 | 14 | 23 | 13 | 51 | 26 | 32 | 16 | 238 | 106 | 197 | 91 |

*Note*: expenditures are expressed in current pesos of each period.

Table A.6: First Stage OLS Regression of Total Expenditure Endogeneity - Two Parent Families (1996 - 2004 - 2012)

| **Explanatory Variables** | **1996** | | **2004** | | **2012** | |
|---|---|---|---|---|---|---|
| 1 if the household lives in Great Buenos Aires region | 0.157*** | (0.028) | 0.071** | (0.027) | 0.062* | (0.033) |
| 1 if the household lives in the Northern region | -0.031 | (0.024) | -0.077*** | (0.023) | -0.052* | (0.027) |
| 1 if the household lives in the Patagonia region | 0.024 | (0.026) | -0.049* | (0.026) | -0.093*** | (0.033) |
| 1 if owner a house | -0.018 | (0.016) | -0.038** | (0.016) | -0.138*** | (0.022) |
| 1 if owner of at least one car | 0.096*** | (0.020) | 0.114*** | (0.018) | 0.145*** | (0.025) |
| 1 if head has health insurance | 0.061*** | (0.020) | 0.082*** | (0.020) | 0.065*** | (0.024) |
| 1 if age of the head between 35 and 64 | 0.025 | (0.021) | -0.002 | (0.021) | -0.008 | (0.023) |
| 1 if the head has secondary educ. | 0.029 | (0.024) | 0.025 | (0.024) | 0.009 | (0.029) |
| 1 if the head has universitary educ. | 0.094** | (0.043) | 0.115*** | (0.030) | 0.058 | (0.044) |
| 1 if age of the spouse between 35 and 64 | -0.005 | (0.022) | 0.015 | (0.023) | 0.058** | (0.023) |
| 1 if the spouse has secondary educ. | 0.004 | (0.024) | 0.049* | (0.027) | 0.029 | (0.027) |
| 1 if the spouse has universitary educ. | 0.065 | (0.040) | 0.122*** | (0.034) | 0.064* | (0.038) |
| 1 if total expenditure < total income | -0.648*** | (0.015) | -0.692*** | (0.016) | -0.729*** | (0.020) |
| 1 if at least 1 child is >7 | 0.033* | (0.017) | 0.020 | (0.016) | -0.010 | (0.021) |
| 1 if children are females | -0.019 | (0.016) | -0.017 | (0.017) | -0.026 | (0.020) |
| relative price assignable adults/children | -0.002 | (0.002) | -0.002 | (0.003) | 0.001 | (0.003) |
| age of the father - age of the mother | -0.001 | (0.002) | 0.001 | (0.002) | 0.001 | (0.002) |
| years educ of the father - years educ of the mother | -0.003 | (0.004) | 0.001 | (0.003) | -0.002 | (0.003) |
| 1 if the mother works | -0.006 | (0.016) | 0.020 | (0.015) | 0.019 | (0.022) |
| price of food and beverages (log) | 0.092* | (0.050) | 0.174*** | (0.043) | 0.216*** | (0.057) |
| price of clothing and footwear (log) | 0.400*** | (0.073) | 0.131** | (0.056) | 0.231*** | (0.077) |
| price of housing and maintenance (log) | -0.125*** | (0.030) | -0.036 | (0.034) | -0.129*** | (0.035) |
| price of transport and comm (log) | 0.010 | (0.036) | -0.027 | (0.034) | -0.089** | (0.043) |
| price of recreation and education (log) | -0.075** | (0.034) | 0.013 | (0.035) | 0.024 | (0.044) |
| price of health and others (log) | -0.059* | (0.035) | -0.109*** | (0.035) | -0.086** | (0.039) |
| total household income (log) | 0.734*** | (0.036) | 0.666*** | (0.024) | 0.632*** | (0.027) |
| constant | 1.885*** | (0.198) | 2.259*** | (0.150) | 2.953*** | (0.209) |
| F-Statistic | 344 | | 340 | | 193 | |
| Prob > F | 0.0000 | | 0.0000 | | 0.0000 | |
| F-Statistic: variable total household income (log) | 414 | | 684 | | 539 | |
| Prob > F | 0.0000 | | 0.0000 | | 0.0000 | |

*Note*: Dependent variable is the log of total household expenditure. Standard errors are reported in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.7: First Stage OLS Regression of Total Expenditure Endogeneity - Single Parent Families (1996 - 2004 - 2012)

| **Explanatory Variables** | **1996** | | **2004** | | **2012** | |
|---|---|---|---|---|---|---|
| 1 if the household lives in Great Buenos Aires region | 0.168 | (0.193) | 0.072 | (0.092) | 0.246** | (0.105) |
| 1 if the household lives in the Northern region | -0.015 | (0.089) | -0.134* | (0.075) | -0.154** | (0.077) |
| 1 if the household lives in the Patagonia region | -0.050 | (0.128) | -0.109 | (0.102) | -0.196 | (0.162) |
| 1 if owner a house | 0.021 | (0.076) | -0.025 | (0.048) | -0.075 | (0.058) |
| 1 if owner of at least one car | 0.144 | (0.135) | 0.250*** | (0.071) | 0.252*** | (0.083) |
| 1 if head has health insurance | 0.088 | (0.087) | 0.169*** | (0.056) | 0.103* | (0.059) |
| 1 if age of the head between 35 and 64 | 0.001 | (0.081) | 0.042 | (0.054) | -0.095 | (0.072) |
| 1 if the head has secondary educ. | -0.036 | (0.087) | 0.047 | (0.052) | 0.062 | (0.080) |
| 1 if the head has universitary educ. | 0.234** | (0.114) | 0.121* | (0.067) | 0.106 | (0.088) |
| 1 if total expenditure < total income | -0.610*** | (0.072) | -0.760*** | (0.041) | -0.774*** | (0.052) |
| 1 if at least 1 child is >7 | 0.058 | (0.064) | -0.027 | (0.053) | 0.039 | (0.052) |
| 1 if children are females | 0.037 | (0.064) | -0.038 | (0.048) | -0.051 | (0.063) |
| relative price assignable adults/children | 0.006 | (0.011) | 0.006 | (0.005) | -0.008 | (0.007) |
| price of food and beverages (log) | 0.200 | (0.195) | 0.129 | (0.129) | 0.175 | (0.166) |
| price of clothing and footwear (log) | 0.296 | (0.290) | 0.302 | (0.198) | 0.639*** | (0.215) |
| price of housing and maintenance (log) | -0.204 | (0.162) | -0.103 | (0.099) | -0.083 | (0.117) |
| price of transport and comm (log) | -0.016 | (0.179) | 0.197* | (0.117) | -0.173 | (0.162) |
| price of recreation and education (log) | 0.098 | (0.127) | 0.038 | (0.106) | -0.142 | (0.110) |
| price of health and others (log) | -0.225 | (0.195) | -0.091 | (0.115) | -0.045 | (0.144) |
| total household income (log) | 0.619*** | (0.131) | 0.508*** | (0.058) | 0.605*** | (0.053) |
| constant | 2.332*** | (0.791) | 3.215*** | (0.360) | 2.947*** | (0.456) |
| F-Statistic | 43 | | 76 | | 38 | |
| Prob > F | 0.0000 | | 0.0000 | | 0.0000 | |
| F-Statistic: variable total household income (log) | 22 | | 96 | | 127 | |
| Prob > F | 0.0000 | | 0.0000 | | 0.0000 | |

*Note*: Dependent variable is the log of total household expenditure. Standard errors are reported in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Estimated Parameters from the Collective QUAIDS - 1996

| Parameters | food and beverages | | clothing and footwear | | housing and maint. | | transport and comm. | | recreation and educ. | | health and others | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** |
| $\alpha_i$ | 0.933*** | 0.648*** | 0.475*** | 1.306*** | 0.132** | -0.170 | -0.267*** | -0.794*** | -0.052 | -0.272 | -0.221*** | 0.317 |
| | (0.076) | (0.184) | (0.104) | (0.113) | (0.057) | (0.125) | (0.081) | (0.198) | (0.091) | (0.173) | (0.084) | (0.196) |
| $\gamma_{1j}$ | -0.017 | -0.037 | -0.043*** | 0.051 | 0.019* | -0.021 | 0.014 | 0.019 | 0.000 | -0.015 | 0.027*** | -0.000 |
| | (0.017) | (0.064) | (0.009) | (0.128) | (0.010) | (0.038) | (0.011) | (0.065) | (0.009) | (0.035) | (0.010) | (0.041) |
| $\gamma_{2j}$ | | | 0.035** | -0.501** | -0.005 | 0.151** | 0.015 | 0.131 | 0.014 | 0.120 | 0.008 | 0.044 |
| | | | (0.016) | (0.232) | (0.006) | (0.075) | (0.014) | (0.105) | (0.007) | (0.079) | (0.009) | (0.063) |
| $\gamma_{3j}$ | | | | | -0.232*** | -0.257*** | 0.095*** | 0.061 | 0.073*** | 0.084** | 0.051*** | -0.018 |
| | | | | | (0.009) | (0.052) | (0.009) | (0.059) | (0.006) | (0.035) | (0.008) | (0.032) |
| $\gamma_{4j}$ | | | | | | | -0.122*** | -0.228** | -0.001 | -0.059 | -0.001 | 0.084 |
| | | | | | | | (0.018) | (0.092) | (0.010) | (0.047) | (0.011) | (0.061) |
| $\gamma_{5j}$ | | | | | | | | | -0.089*** | -0.210*** | 0.029*** | 0.085** |
| | | | | | | | | | (0.010) | (0.047) | (0.009) | (0.033) |
| $\gamma_{6j}$ | | | | | | | | | | | -0.114*** | -0.195*** |
| | | | | | | | | | | | (0.012) | (0.058) |
| $\beta_i^1$ | -0.125*** | 0.069 | -0.042** | -0.355*** | 0.047* | -0.020 | 0.033 | 0.348*** | -0.032 | 0.078 | 0.120*** | -0.141 |
| | (0.037) | (0.121) | (0.016) | (0.090) | (0.024) | (0.080) | (0.031) | (0.091) | (0.031) | (0.096) | (0.023) | (0.088) |
| $\beta_i^2$ | -0.025 | 0.096 | -0.124*** | -0.479*** | 0.020 | 0.225*** | 0.121*** | 0.036 | 0.003 | 0.048 | 0.003 | 0.073 |
| | (0.038) | (0.071) | (0.047) | (0.085) | (0.022) | (0.051) | (0.028) | (0.083) | (0.023) | (0.056) | (0.030) | (0.051) |
| $\lambda_i^1$ | 0.002 | -0.055* | 0.001 | 0.075** | -0.003 | 0.022 | 0.001 | -0.060*** | 0.007* | -0.011 | -.009*** | 0.032 |
| | (0.005) | (0.033) | (0.001) | (0.030) | (0.003) | (0.019) | (0.004) | (0.023) | (0.004) | (0.020) | (0.003) | (0.020) |
| $\lambda_i^2$ | -0.011* | -0.045*** | 0.014** | 0.079*** | -0.000 | -0.027** | -0.015*** | 0.003 | 0.009*** | -0.001 | 0.003 | -0.009 |
| | (0.006) | (0.015) | (0.007) | (0.023) | (0.003) | (0.012) | (0.004) | (0.016) | (0.003) | (0.009) | (0.004) | (0.009) |
| $\eta_i$ | | | | | | | 0.059** | 0.248*** | 0.034 | -0.011 | | |
| | | | | | | | (0.023) | (0.066) | (0.025) | (0.057) | | |
| $\varsigma_i$ | 0.059*** | 0.086 | 0.017 | 0.137*** | -0.030*** | -0.081** | -0.002 | -0.056 | -0.017 | -0.043* | -0.026** | -0.038* |
| | (0.016) | (0.072) | (0.015) | (0.030) | (0.009) | (0.032) | (0.011) | (0.036) | (0.013) | (0.022) | (0.013) | (0.021) |

*Note*: These are the parameters of the collective QUAIDS demand system specified in Equation (11). The sharing rule parameters, estimated jointly with the system, are reported in Table 1. All estimations have demographic controls at the household level. The correction for infrequency of purchases is made only for those system categories with more than 5% of zero observations. Standard errors are reported in parenthesis. The system estimation is done separately for each type of family and each survey. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.9: Estimated Parameters from the Collective QUAIDS - 2004

| Parameters | food and beverages | | clothing and footwear | | housing and maint. | | transport and comm. | | recreation and educ. | | health and others | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** |
| $\alpha_i$ | 0.750*** | 1.414*** | 0.409*** | 1.267*** | 0.066 | -0.260 | -0.198*** | -0.520** | 0.092 | -0.723*** | -0.120 | -0.176 |
| | (0.068) | (0.208) | (0.031) | (0.129) | (0.051) | (0.163) | (0.069) | (0.220) | (0.107) | (0.234) | (0.074) | (0.217) |
| $\gamma_{1j}$ | -0.010 | -0.195** | -0.040*** | -0.245*** | 0.024*** | 0.101* | 0.003 | 0.146*** | -0.000 | 0.082 | 0.024*** | 0.109** |
| | (0.011) | (0.085) | (0.004) | (0.032) | (0.008) | (0.051) | (0.008) | (0.053) | (0.007) | (0.051) | (0.008) | (0.044) |
| $\gamma_{2j}$ | | | 0.039*** | -0.228*** | 0.000 | 0.124*** | 0.011** | 0.185*** | -0.012** | 0.159*** | 0.001 | 0.004 |
| | | | (0.006) | (0.085) | (0.003) | (0.038) | (0.005) | (0.051) | (0.005) | (0.054) | (0.004) | (0.042) |
| $\gamma_{3j}$ | | | | | -0.134*** | -0.194*** | 0.049*** | -0.061* | 0.043*** | 0.015 | 0.016** | 0.015 |
| | | | | | (0.010) | (0.042) | (0.007) | (0.032) | (0.008) | (0.036) | (0.007) | (0.032) |
| $\gamma_{4j}$ | | | | | | | -0.099*** | -0.138** | 0.019** | -0.104*** | 0.015** | -0.027 |
| | | | | | | | (0.012) | (0.069) | (0.008) | (0.037) | (0.007) | (0.035) |
| $\gamma_{5j}$ | | | | | | | | | -0.099*** | -0.188*** | 0.049*** | 0.035 |
| | | | | | | | | | (0.015) | (0.054) | (0.010) | (0.032) |
| $\gamma_{6j}$ | | | | | | | | | | | -0.107*** | -0.136*** |
| | | | | | | | | | | | (0.012) | (0.036) |
| $\beta_i^1$ | -0.030 | -0.332*** | -0.034*** | -0.156*** | 0.055** | 0.061 | 0.023 | 0.202*** | -0.077* | 0.122 | 0.064** | 0.102 |
| | (0.030) | (0.088) | (0.008) | (0.037) | (0.022) | (0.075) | (0.029) | (0.075) | (0.044) | (0.094) | (0.027) | (0.078) |
| $\beta_i^2$ | -0.039 | -0.173*** | -0.090*** | -0.443*** | 0.042** | 0.203*** | 0.083*** | 0.232*** | -0.023 | 0.189*** | 0.026 | -0.009 |
| | (0.029) | (0.058) | (0.019) | (0.054) | (0.019) | (0.047) | (0.023) | (0.054) | (0.026) | (0.058) | (0.019) | (0.055) |
| $\lambda_i^1$ | -0.008 | 0.030** | 0.001 | 0.019*** | -0.005* | -0.001 | 0.004 | -0.035*** | 0.013** | -0.006 | -0.005 | -0.006 |
| | (0.005) | (0.013) | (0.001) | (0.006) | (0.003) | (0.012) | (0.004) | (0.011) | (0.006) | (0.014) | (0.004) | (0.012) |
| $\lambda_i^2$ | -0.008* | 0.009 | 0.010*** | 0.056*** | -0.006** | -0.022*** | -0.008** | -0.036*** | 0.013*** | -0.011 | -0.000 | 0.004 |
| | (0.004) | (0.008) | (0.003) | (0.010) | (0.002) | (0.008) | (0.004) | (0.006) | (0.004) | (0.008) | (0.003) | (0.008) |
| $\eta_i$ | | | | | | | 0.032 | -0.055 | 0.003 | 0.100* | | |
| | | | | | | | (0.022) | (0.054) | (0.025) | (0.052) | | |
| $\varsigma_i$ | 0.053*** | 0.064 | -0.005* | 0.042*** | -0.034*** | -0.047 | -0.010 | -0.024 | -0.005 | -0.047** | 0.003 | 0.012 |
| | (0.011) | (0.041) | (0.003) | (0.015) | (0.009) | (0.039) | (0.009) | (0.026) | (0.007) | (0.019) | (0.010) | (0.029) |

*Note*: These are the parameters of the collective QUAIDS demand system specified in Equation (11). The sharing rule parameters, estimated jointly with the system, are reported in Table 1. All estimations have demographic controls at the household level. The correction for infrequency of purchases is made only for those system categories with more than 5% of zero observations. Standard errors are reported in parenthesis. The system estimation is done separately for each type of family and each survey. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Estimated Parameters from the Collective QUAIDS - 2012

| Parameters | food and beverages | | clothing and footwear | | housing and maint. | | transport and comm. | | recreation and educ. | | health and others | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** | **Two P.** | **Single P.** |
| $\alpha_i$ | 0.766*** | 1.156*** | 0.452*** | 0.897 | 0.166** | -0.051 | -0.629*** | -0.736*** | 0.213** | -0.271 | 0.030 | 0.005 |
| | (0.109) | (0.228) | (0.079) | (0.091) | (0.064) | (0.142) | (0.104) | (0.207) | (0.108) | (0.218) | (0.109) | (0.180) |
| $\gamma_{1j}$ | -0.056** | -0.143*** | -0.035*** | -0.077** | 0.019* | 0.076* | 0.044** | 0.021 | 0.000 | 0.071** | 0.028* | 0.052* |
| | (0.022) | (0.055) | (0.008) | (0.035) | (0.009) | (0.038) | (0.018) | (0.049) | (0.012) | (0.036) | (0.014) | (0.029) |
| $\gamma_{2j}$ | | | 0.055*** | -0.100** | -0.003 | 0.057** | 0.020* | 0.162*** | -0.030*** | -0.034 | -0.006 | -0.007 |
| | | | (0.008) | (0.049) | (0.004) | (0.026) | (0.012) | (0.044) | (0.008) | (0.036) | (0.009) | (0.027) |
| $\gamma_{3j}$ | | | | | -0.114*** | -0.155*** | 0.038*** | -0.023 | 0.036*** | 0.028 | 0.023*** | 0.016 |
| | | | | | (0.011) | (0.033) | (0.010) | (0.036) | (0.008) | (0.025) | (0.008) | (0.026) |
| $\gamma_{4j}$ | | | | | | | -0.160*** | -0.229*** | 0.060*** | 0.029 | -0.003 | 0.040 |
| | | | | | | | (0.026) | (0.062) | (0.015) | (0.039) | (0.013) | (0.029) |
| $\gamma_{5j}$ | | | | | | | | | -0.097*** | -0.061* | 0.030*** | -0.033 |
| | | | | | | | | | (0.015) | (0.032) | (0.009) | (0.024) |
| $\gamma_{6j}$ | | | | | | | | | | | -0.072*** | -0.068** |
| | | | | | | | | | | | (0.016) | (0.031) |
| $\beta_i^1$ | 0.053 | -0.114 | -0.037*** | -0.085*** | 0.029* | 0.131** | 0.062** | 0.080 | -0.031 | -0.015 | -0.075 | 0.002 |
| | (0.039) | (0.094) | (0.013) | (0.028) | (0.017) | (0.057) | (0.027) | (0.062) | (0.035) | (0.090) | (0.046) | (0.055) |
| $\beta_i^2$ | -0.089** | -0.087 | -0.086*** | -0.280*** | 0.028 | 0.091** | 0.180*** | 0.292*** | -0.085*** | -0.016 | 0.051* | -0.000 |
| | (0.038) | (0.054) | (0.031) | (0.037) | (0.023) | (0.036) | (0.030) | (0.047) | (0.027) | (0.052) | (0.027) | (0.041) |
| $\lambda_i^1$ | -0.019*** | 0.005 | 0.001 | 0.010** | -0.003 | -0.024** | 0.001 | -0.005 | 0.005 | 0.013 | 0.015** | 0.001 |
| | (0.007) | (0.015) | (0.002) | (0.005) | (0.003) | (0.010) | (0.004) | (0.010) | (0.005) | (0.015) | (0.007) | (0.009) |
| $\lambda_i^2$ | 0.000 | -0.000 | 0.006** | 0.029*** | -0.003 | -0.011*** | -0.015*** | -0.033*** | 0.015*** | 0.016** | -0.004 | -0.001 |
| | (0.004) | (0.006) | (0.003) | (0.005) | (0.002) | (0.003) | (0.003) | (0.005) | (0.003) | (0.008) | (0.003) | (0.005) |
| $\eta_i$ | | | | | | | 0.129*** | 0.023 | -0.066 | 0.042 | | |
| | | | | | | | (0.045) | (0.054) | (0.045) | (0.060) | | |
| $\varsigma_i$ | 0.056*** | 0.086*** | -0.005 | -0.032** | -0.012 | 0.034 | -0.032** | -0.049*** | 0.005 | -0.031* | -0.010 | -0.006 |
| | (0.017) | (0.031) | (0.007) | (0.012) | (0.009) | (0.022) | (0.015) | (0.019) | (0.011) | (0.019) | (0.011) | (0.021) |

*Note*: These are the parameters of the collective QUAIDS demand system specified in Equation (11). The sharing rule parameters, estimated jointly with the system, are reported in Table 1. All estimations have demographic controls at the household level. The correction for infrequency of purchases is made only for those system categories with more than 5% of zero observations. Standard errors are reported in parenthesis. The system estimation is done separately for each type of family and each survey. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

# B Appendix B: Data Preparation

## B.1 Pseudo Prices

Our expenditure data does not record information on prices. We compute household specific pseudo unit values according to the theoretical method developed by Lewbel (1989), and applied in Atella *et al.* (2004), Hoderlein and Mihaleva (2008), and Menon *et al.* (2017). The technique captures the spatial and quality variability typical of unit values from household socioeconomic characteristics, using the variability of the budget shares at a high disaggregation level.

We first reproduce the distribution of the unit price variation and, then, we add this variability to the price indexes published monthly and construct nominal unit values. The demographical variability added to the price indexes can be thought as a way of exogenize prices.[36]

Pseudo unit values expressed in levels are constructed in the following way[37]

$$\hat{p}_i = \frac{1}{k_i} \prod_{j=1}^{n_i} w_{ij}^{-w_{ij}} P_{m_i} y_i$$

where $i$ is a good category of the demand system, and $j$ are the sub-category goods within group $i$, $k_i$ is the average of the subgroup expenditure for the $i-th$ group budget share, $w_{ij}$ is the sub-category budget share, and $y_i$ is the average expenditure of group $i$. $P_{m_i}$ is a group-specific price index given by $P_{mi} = \sum_{j=1}^{n_i} P_{m_{ij}} w_{ij}$ , being $P_{m_{ij}}$ the price indexes published monthly by the statistic institute. Descriptive statistics for the estimated pseudo prices for each survey are presented in Table A.3 of Appendix A.

## B.2 Infrequency of Purchases

Cross-section household expenditure data often involve zero purchases. The percentage of zero expenditure in each of the system categories in our data is reported in Table A.4 of Appendix A. Transportation and communications, recreation and education, and health and others, are censored in a non-negligible size, creating a selectivity problem in our data.

This entails both an econometric potential problem and an economic interpretation. The censoring may be due to infrequency of purchase related to the relatively short duration of the recall period of the survey design (see Section 4.1), because of consumer's preferences or because household deliberately decide not to consume particular goods given the prices and income constrains (Pudney, 1989).

If non correction is made, we would obtain biased and inconsistent coefficients. If only observed positive purchase data are used, coefficient estimates would be inconsistent. In order

[36] If prices were not included in the analysis, assuming that all families pay the same prices for homogeneous goods, we would be able to estimate Engel curves. Without accounting for price effects, we cannot implement detailed behavioral and welfare applications.

[37] These prices are based on two main assumptions: an original function homothetically separable and Cobb-Douglas within group sub-utility functions.

to address this econometric problem, we use a generalization of Heckman's two-steps estimator (1979), presented by Shonkwiller and Yen (1999). They propose a consistent estimator, in a two-stage decision process, for a censored system of equations that overcomes the issues which emerge in Amemiya (1978, 1979) and Heien and Wessells (1990).

The Shonkwiller and Yen (1999) approach is general enough to be well suited for a large source of zero expenditures and it is consistent with a two-step estimation procedure. In the first step we estimate the consumption probability of each household with a Probit model for each category and obtain the standard normal distribution density and cumulative function. In the second step, the demand system is augmented by the predicted estimated normal cumulative function, and the density function is added as an explanatory variable.

Consider the following general limited dependent variable system of $i = 1,\ 2,\ ...,\ M$ equations,

$$\begin{gathered} x_i^* = x\left(\mathbf{g},\ \theta_i\right) + \varepsilon_i\ , \qquad h_i^* = \mathbf{s_i'}\tau_i + \upsilon_i\ , \\ h_i = \begin{cases} 1 & if\ h_i^* > 0 \\ 0 & if\ h_i^* \leq 0 \end{cases}\ , \\ x_i = h_i\ x_i^* \end{gathered} \tag{12}$$

where $x(g_i, \theta_i)$ represents the observed collective QUAIDS shares, $h_i$ are the indicator variables, $x_i^*$ and $h_i^*$ are the latent variables, $\mathbf{g}_i$ and $\mathbf{s_i}$ are vectors of exogenous variables, $\theta_i$ and $\tau_i$ are parameters, and, $\varepsilon_i$ and $\upsilon_i$ are random errors. In our application, $x_i$ is replaced by $w_i$, and $x(\mathbf{g}_i, \theta_i)$ by the right hand side of the equations of the demand system.

The equations of system in (12) can be summarized as

$$x_i = \Psi(\mathbf{s_i'}\tau_i)\ x\left(\mathbf{g_i},\ \theta_i\right) + \eta_i\psi(\mathbf{s_i'}\tau_i) + \xi_i$$

where $\Psi$ and $\psi$ are univariate normal standard cumulative distribution and probability density functions respectively. The element $\xi_i = x_i - E\left[x_i|\mathbf{g_i}\right]$ belongs to the vector $\xi \backsim MVN(0; \Omega)$. The set of parameters $\tau_i$ is estimated using a Maximum Likelihood Probit estimator to obtain $\Psi(\mathbf{s_i'}\tau_i)$ and $\psi(\mathbf{s_i'}\tau_i)$. The vector of regressors related to the purchase decisions of the first-stage includes the age of the household head and educational level, total household income and its square, the number of children in the household and regional dummies, household total income, squared of income, household size and an interaction between members and income.[38]

## B.3 Censuring of Clothing Expenditures

Our approach and application exploits the observability of assignable goods. This is crucial information to construct individual total expenditures. Clothing and footwear, for adults and

[38]The results of the first stage regressions of the correction of infrequency of purchases (Probit equations) are available upon request.

children, are particularly important because they are the largest components of the assignable expenditure available. However, many observations report zero expenditures.[39]

Blundell and Meghir (1987) propose a bivariate model as an alternative to the classic univariate Tobit model for censured data. As the authors explain, in the case of clothing, the adequate model is described by a process of infrequency of purchases for semi-durable commodities without corner solutions. Purchase infrequency results in expenditures over the period under survey that may not reflect actual consumption. Since the recall period is too short (one month), zero expenditures are commonly observed. However, it is unlikely that those zeros represent a corner solution, since it is unlikely that people do not buy clothes given it is a necessity commodity. Clothing may not be purchased in the reference period of the survey because they give utility for more than one period, and a household may need to buy them only a few times in a year. Additionally, the recall period may also cause measurement errors.

Following Blundell and Meghir (1987), the relationship between the observation of the dependent variable $y_i$, and its correspondent latent value $y_i^*$ can be written as $P_i\, y_i = y_i^* + v_i = (x_i\beta + e_i) + v_i$, where $P_i$ is the probability of purchase. The censoring rule is given by $y_i = (y_i^* + v_i)P_i$ if $D_i > 0$ and $y_i = 0$ otherwise, where $D_i$ is a latent variable describing the decision to purchase (*i.e.*, $D_i > 0$ if and only if $y_i > 0$). The log-likelihood function proposed by the authors is given by

$$log\, L = \sum_{+} \left[ \frac{1}{\sigma_e} \varphi \left( \frac{\Phi(r_i\alpha)\, y_i - x_i\beta}{\sigma_e} \right) \Phi(r_i\alpha)^2 \right] + \sum_{0} \left[ 1 - \Phi(r_i\alpha) \right]$$

where $\sum_{+}$ and $\sum_{0}$ refer to summation over positive and zero observations for the observed expenditure $y_i$ and $\Phi(.)$ and $\varphi(.)$ refer to the standard normal cumulative and density functions, respectively. Consistent starting values for the parameters $\alpha$ can be obtained by a Probit or OLS estimation among purchases and non-purchases, while for $\beta$ by applying a Tobit model to the equation $y_i = x_i\beta + e_i$, over the entire sample, that is, including the zero values of $y_i$. The bivariate Tobit is done separately for clothing for adults and clothing for children.

### B.4 Endogeneity of Total Expenditure

The estimation of demand systems generally require a correction for potential endogeneity if total expenditure is correlated with the residuals of the demand system equations.[40] The residuals in the demand system equations can be interpreted as the household's unobserved tastes or preferences that affect each budget share. Total expenditure could be endogenous if taste shocks that determine total expenditure are correlated with the unobserved taste shocks to a particular component in the system, or if measurement (or recall) errors in the budget shares

[39] Notice that if a household reports zero expenditure in clothing for adults and/or children, and if the other minor components of the assignable information are as well zero, we would not be able to observe any assignable information and construct individual total expenditures. Thus, if no censoring correction is made, we would need to drop those observations, loosing valuable information.

[40] Total expenditure is uncorrelated with the residuals of the demand equations only when severe restrictions are satisfied (LaFrance, 1991).

are correlated with measurement (or recall) errors in total expenditure.

A valid instrument should provide a source of exogenous variation explaining the cross-sectional variability of total expenditure but without being correlated with taste variables and measurement errors. We choose total household income, as in, for example, Cherchye *et al.* (2012), and Tommasi (2018), as an instrument of total expenditure, assuming that recall errors in household total expenditure are not correlated with measured household income, which is a commonly accepted assumption.[41] We also require that income do not affect spending patterns.[42]

To address the endogeneity problem, we use the control function approach proposed originally by Blundell and Powell (2004), since in non-linear models the use of the first stage prediction in place of the endogenous variable is biased and inconsistent (Terza *et al.*, 2008). The approach consists in a two-stage procedure. In the first stage, we estimate an OLS regression of the endogenous variable on all covariates of the demand system and the instruments and, in the second stage, we estimate an augmented system adding the predicted residuals from the first stage. Thus, in each equation of the demand system, an extra regressor is included to control for endogenous total expenditures Defining $\mathbf{s}$ as the vector of all covariates of the main regression (prices, demographic variables and distribution factors) and the instruments, the first stage regression is given by $ln\, y = \mathbf{s}\pi + \omega$, where $\omega$ is a spherical error term, with $E[\mathbf{s}'\omega] = 0$ and whose prediction is $\hat{\omega} = ln\, y - \mathbf{s}\hat{\pi}$, is used in the demand system as specified in the next section.

The key behind the control function approach is that, conditioning on observables, the only source of dependence is given by the relation between the residuals of the total expenditure, $\omega$, and the residuals of the share equations, $\varepsilon$. Then, the procedure permits to recover some function of $\omega$, via its relationship with the model observables, and condition on it in the main equation of interest solving the endogeneity problem. The control function approach has several advantages, including that it gives a straightforward test for endogeneity, by testing the significance of the coefficients of the estimated residuals (first stage) in the system equations (second stage). A statistically different from zero parameter means the unexplained variation of the endogenous variable also affects the variations in demand, implying endogeneity of the variable. In Tables A.6 and A.7 of Appendix A we report the OLS regression of the first stage. The partial F-statistic on our instrument is high, indicating that the instrument is a good predictor of total expenditure.

[41] We also explore an endogeneity correction using a wealth index as an instrument (Filmer and Pritchett, 2001; World Bank, 2003; Houweling *et al.,* 2003). Total income is a stronger instrument in our setting, although our parameters of interest and main results are robust to the endogeneity correction. Results are available upon request.

[42] If consumption and leisure are not separable in the utility function, income is not valid instrument for total expenditure. However, as noticed by Attanasio and Lechene (2014), if this happen the entire demand system would be is misspecified, given that the amount of hours of work should enter as a determinant of the demand system, allowing for the effect of hours of work on the marginal utility of consumption.