Intrahousehold Distribution and Child Poverty: Theory and Evidence from Côte d'Ivoire*

Olivier Bargain, Olivier Donni, Prudence Kwenda

September 2011

Abstract

Poverty measures in developing countries often ignore the distribution of resources within families and joint consumption. In this paper, we extend the collective model of household consumption to recover mother's, father's and children's shares together with economies of scale, using the observation of adult-specific goods (as in the Rothbarth method). An application on data from Côte d'Ivoire shows that children command a reasonable fraction of household resources, though not enough to avoid a very large extent of child poverty compared to what is found in traditional measures based on per capita expenditure. We find no significant evidence of discrimination against girls, and educated mothers have more command over household resources. Baseline results on children's shares are robust to using alternative identifying assumptions, which consolidates a general approach grounded on a flexible version of the Rothbarth method. Individual measures of poverty show that parents are highly compensated by the scale economies due to joint consumption.

Key Words : Collective Model, Consumer Demand, Engel Curves, Rothbarth Method, Cost of Children, Bargaining Power, Sharing rule, Scale Economies, Equivalence Scales, Indifference Scales.

JEL Classification : D11, D12, D36, I31, J12

* **Acknowledgements**: Bargain and Kwenda are affiliated to UC Dublin and the Geary Institute. Bargain is also affiliated to IZA and CHILD. Donni is affiliated to the University of Cergy-Pontoise, THEMA and IZA. We thank Martin Browning for useful comments. All errors or omissions remain ours. Corresponding author: O. Bargain, UCD, Belfield, Dublin 4, Ireland, olivier.bargain@ucd.ie

1 Introduction

Assessing the share of family expenditure accruing to children, i.e., the cost of children, is key to calculating equivalence scales and hence making income comparable across households when measuring financial poverty. Evaluating how much resources are dedicated to children is also crucial to directly measure child poverty. Two well-known problems, however, pertain to the fact that (i) individual allocations within households are rarely observed, and that (ii) measures of individual welfare rarely account for the fact that some of the consumption is actually joint in the household. In rare occasions, researchers have used anthropometric information (e.g., caloric in-take) to proxy individual nutrition in very low-income countries. This type of research has revealed a very substantial level of intra-household inequality (e.g., Haddad and Kanbur, 1990). In more general cases, economists must rely on indirect methods to retrieve the share of household resources commanded by specific individuals and in particular by children. Among the different techniques available, the Rothbarth method is possibly the most theoretically sound approach. As clearly exposed in Gronau (1988, 1991), it consists in examining the extent to which the presence of children depresses the household consumption of adult-specific goods. The method has been used in the context of developing countries to measure the cost of children and the extent of gender discrimination among children (see Deaton, 1989, 1997).[1] A notable drawback with this approach, however, is that it assumes purely private consumption. Obviously, the consumption of some goods is partly joint – or fully joint, in the case of household public goods like housing – and generates economies of scale in multi-person households. This is a central concern in the construction of equivalence scales and the measurement of welfare. In addition, the Rothbarth-Gronau model is not grounded in a microeconomic framework that respects individualism and accounts for the possibly diverging opinions of the parents.

The present paper brings the literature forward by suggesting a measure of resource allocation in a multi-person model with economies of scale and parental bargaining. Using data from Côte d'Ivoire, we particularly focus on the share of total expenditure accruing to children and on an original measure of child poverty based on individual resources. The sharing rule and scale economies are identified using an extended version of the Gronau-Rothbarth approach within a structural collective model, i.e., a model that only assumes the efficiency of consumption decisions within the household (Chiappori, 1988).

The approach explicitly deals with the fact that datasets typically contain total purchases at household levels but not the allocation of goods between household members, even when con-

[1] See Gronau (1989, 1991) and Lazear and Michael (1988) on the Rothbarth approach. See Browning (1992) for a survey of the various techniques used to measure the cost of children. Note that with this method, the direct utility or disutility from living with others (such as love and companionship) is necessarily assumed to be separable from consumption goods and ignored.

sumption is purely private (as in the case of 'personal goods and services', for instance). Identification relies on the existence of adult goods in the data (adult clothing) and on a simple "Russian dolls" logic which extends the Rothbarth idea. That is, by comparing the budget share of adult expenditure for couples with $N-1$ children to that of couples with N children, ceteris paribus, we can retrieve information about how much resources have been allocated to the N^{th} child. The identification of scale economies experienced by adults is completed by the use of data on single individuals (the demographic group of reference). An 'independence of base' (IB) assumption, as suggested in Lewbel and Pendakur (2008), allows us to simplify the approach, i.e., economies of scale have a pure income effect and the empirical application is reduced to the estimation of a system of Engel curves on cross-sectional data.
Once the resource shares of adults and children have been estimated, they can be used to compute a direct measure of individual poverty whereby poor persons are not characterized by living in poor households, according to conventional definitions, but are poor because the resources they receive in the household are below some poverty line. In the empirical application, our aim is to study a country which has received attention in the literature on intrahousehold inequality, which allows comparing our novel approach with past results. For this reason, we choose to focus on Côte d'Ivoire, a relatively poor country of West Africa. Due to the quality of the data available and because of some evidence of unequal distribution within households, this country has received much attention in Deaton (1989), Haddad and Hoddinott (1994), Haddad et al. (1994) and many other studies referenced in Deaton (1997).

Our results point to reasonable magnitudes for children's share, from around 13% of total household expenditure for the first child to a fifth for three children. Shares increase with family size at a decreasing pace, denoting potential economies of scale in child consumption but also the fact that parents are not ready, beyond a certain point, to reduce their own consumption much. Boys receive more than girls but differences are not significant. That is, there is no clear sign of gender discrimination among children as far as expenditure unrelated to health or education are concerned, as also found by Deaton (1989) for the same country or Bhalotra and Attfield (1998) for food allocation among children in Pakistan.[2] Women seem to command a smaller, yet not significantly different, share of resources compared to their husbands. It turns out that mothers' education improves their own share and their children's share. We find evidence of substantial economies of scale, especially for mothers.[3] Using resource share estimates, we find a much larger incidence of poverty among children, and lower among adults, compared to measures simply based on per capita expenditures. Adults are also greatly compensated by large scale

[2] Evidence of gender discrimination is found in Rose (1999) for India and Dunbar et al. (2010) for Malawi. The literature on discrimination in health and education expenditures is vast and beyond the scope of our study.

[3] These terms are not precisely estimated, however, and may, as explained in the paper, capture other dimensions like changes in individual preferences across different household types.

economies from joint consumption. Our results compare well to those of Dunbar et al. (2010), whose estimates of children's share for Malawi rely on a relatively similar approach. We also provide two variants of our model that focus on children's share and do not make use of data on single individual. The first one ignores distribution among parents and the second additionally ignores scale economies (i.e., the traditional Rothbarth approach). Results tend to consolidate a general approach grounded on the Rothbarth's idea.

The paper is structured as follows. In Section 2, we describe the model and the identification results. In Section 3, we present the functional form, the estimation method and the data. In Section 4, we report and discuss the main results. Additional results and a comparison with the literature are presented in Section 5 while Section 6 concludes.

2 Related Literature

The collective model assumes the efficiency of household decisions in a static environment,[4] and posits individual preferences for each household member. The early collective model literature has essentially consisted in testing efficiency (e.g., Browning and Chiappori, 1998). Several authors have also shown how to identify the slope of the resource sharing function in couples, using price variation, distribution factors (Bourguignon et al., 2009) or exclusive goods in a context where all the consumption is private (e.g., Browning et al., 1994). Retrieving the complete sharing rule has been achieved more recently and at the price of additional assumptions. In particular, some authors have combined data on people living alone and in couples to retrieve individual preferences and hence the sharing function (e.g., Couprie, 2007, Lise and Seitz, 2011, Browning et al., 2008, Lewbel and Pendakur, 2008). They implicitly assume the stability of individual preferences across household types, an assumption acknowledged by Gronau (1988) as a necessary condition to retrieve the various structural components of the model and, in particular, the cost of children. Importantly, none of the contributions listed above explicitly model child welfare nor economies of scale.[5]

[4] Even this minimalist assumption, that could be justified by the repeated-game context of a family, is not consensual. Tests of efficiency have actually been rejected in the case of production choices in developing countries (for Côte d'Ivoire, see Duflo and Udry, 2003). We believe, however, that assuming efficiency is more plausible in the case of consumption, characterized by frequently repeated decisions (tests of efficiency in consumption are usually not rejected in the collective model literature, see Chiappori and Donni, 2011, for a survey).

[5] The few papers dealing with children in a collective framework actually treat them as public goods for the parents rather than as having their own utility functions (Blundell et al., 2005, Couprie, 2007). An exception is the theoretical paper of Bourguignon (1999), but the author does not consider economies of scale in the household nor any empirical implementation. Dauphin et al. (2010) suggest a test of collective rationality when three deciders are present in the household, i.e., parents and one child, yet this concerns the specific case of adult children. A recent attempt to identify child costs can be found in Menon and Perali (2007), yet under specific

More recently, Browning et al. (2008) and Lewbel and Pendakur (2008) have suggested the identification of multi-utility models with scale economies. In the former study, joint consumption is modeled using (price) transformations à la Barten. Lewbel and Pendakur simplify this approach by assuming the IB assumption for the technology of production, i.e., they suppose that there exists a single function, independent of total expenditure, that scales the expenditure of each individual in the household and represents the economies from joint consumption. Both studies suggest completing identification of the models by exploiting simultaneously data on couples and single-person households. They recover the resource share of each adult and indifference scales (an individual-based concept of equivalence scale, see Lewbel, 2003). These approaches cannot account for couples with children, as children do not live alone. Nonetheless, these studies have inspired two recent contributions which address the measure of children's shares in presence of economies of scale in a collective framework. The first one, by Bargain and Donni (2009), focuses on one-child families in France and presents original identification results using information on singles and expenditures on adult goods, together with the IB assumption. The second, by Dunbar et al. (2010), suggests a measure of children's resources in Malawi, using another identification method that requires expenditure on assignable goods (adult male, adult female and child clothing) and semi-parametric restrictions close to the IB condition.

The present paper is easily positioned in this literature. While several studies have estimated systems of Engel curves to retrieve the cost of children or to test for gender discrimination among children, for instance Deaton (1989), Haddad and Hoddinott (1994) or Haddad et al. (1994) for Côte d'Ivoire, we suggest integrating these measures into a more structural framework and allow for more flexibility than the original Rothbarth approach. In the collective model literature on children, we extend the identification results of Bargain and Donni (2009) to households with several children and suggest an application to the measurement of child shares and child poverty in a developing country. As far as we know, the present study is the only attempt, with the independent contribution of Dunbar et al. (2010), to recover intrahousehold resource distribution in developing countries using a structural multi-utility household model. It is also the only attempt to incorporate scale economies and to use indifference scales to reassess the poverty of adults living in couples. Our approach and that of Dunbar et al. (2010), extensively compared in Section 5, both assume that the presence of children can be identified as an income effect that decreases the budget share on adult goods.

assumptions.

3 Theoretical Framework

3.1 Collective Decisions, Preferences and Consumption Technology

We examine household consumption decisions. To begin with, we suppose that there are three types of households. Let n denote the type, with $n = 1$ for single adults, $n = 2$ for childless couples and $n = 3$ for couples with children. Goods are indexed by superscript $k = 1, ...K$. Individual types are indexed by subscript i and, by convention, we suppose that $i = m$ indicates men, $i = w$ women and $i = c$ children. The log total expenditure in a household is denoted by x and the vector of log prices by $\boldsymbol{p}$.

We first consider the case of a single-person household ($n = 1$). We simply suppose that individual i ($= m$ or w) endowed with log resources x is characterized by a well-behaved (monotonic, strictly quasi-convex, and twice-continuously differentiable) indirect utility function, denoted by $v_i(x, \boldsymbol{p}, \boldsymbol{z}_i)$, where $\boldsymbol{z}_i$ is a vector of individual characteristics (such as age, education, region of residence). Then from the Roy's identity, the budget share of individual i for good k is defined by

$$w_i^k(x, \boldsymbol{p}, \boldsymbol{z}_i) = -\frac{\partial v_i(x, \boldsymbol{p}, \boldsymbol{z}_i)/\partial p^k}{\partial v_i(x, \boldsymbol{p}, \boldsymbol{z}_i)/\partial x}, \tag{1}$$

for $i = m$ or w and $k = 1, ..., K$.

In the case of a multi-person households ($n > 1$), we first suppose that each person living in the household has his/her own indirect utility function. For children, however, we only model the utility of all children and c is an index for the representative child. The main idea is that, after controlling for the existence of joint consumption and the sharing of total expenditure, the utility function of each member does not depend on the type n of the household. Precisely, the indirect utility function of individual $i = m, w$ or c living in a household of type $n > 1$ can be written as $v_i(x_{i,n}, \boldsymbol{p}, \boldsymbol{z}_i)$, where $x_{i,n}$ is a measure of (log) individual resources taking into account economies of scale and resource sharing as follows:

$$x_{i,n} = x + \log \eta_{i,n}(x, \boldsymbol{p}, \boldsymbol{z}) - \log s_{i,n}(x, \boldsymbol{p}, \boldsymbol{z}).$$

In this expression, $\eta_{i,n} \in]0, 1[$ represents the resource sharing of total expenditure among household members and $s_{i,n} \in]0, 1[$ the economies of scale associated to belonging to a household of type n. This specification is explained in detail below.

Three important point must be made. First, the intuitive consequence of the specification above is that, after conditioning on observed demographic variables and the level of total resources, differences in expenditure patterns between a person living alone and a person living with others are attributed to joint consumption and resource sharing. Assuming the stability of individual preferences across household types is the key idea underlying the Rothbarth traditional approach to estimate child costs (see Gronau, 1991). As argued by Gronau (1988), it is necessary to allow comparing individuals living in different household types and retrieving the various structural components of the model. In fact, this assumption is mitigated when the model accounts for additional flexibility in the form of scale economies, as discussed in Browning et al. (2008) and Bargain and Donni (2009). Indeed, terms accounting for how the "value" of total expenditure (or the shadow prices of all goods) changes due to publicness and externalities in consumption may well also capture changes in preferences over time and family status. These aspects are further discussed hereafter. Second, to make things easier, note that the children living in the household are characterized by a *unique* indirect utility function, i.e., the children's preferences are aggregated into a unique index. This way of proceeding can be justified by the fact that both parents agree on how the resources must be divided among children.[6]

Sharing Functions $\eta_{i,n}(x, \boldsymbol{p}, \boldsymbol{z})$. As often used in the collective model literature (e.g., Browning and Chiappori, 1998), we adopt a two-stage budget process that conveniently represents any efficient decision-making. This representation is in fact perfectly suited to our main purpose of retrieving children's resource shares and goes as follows. In a first stage, household resources $\exp(x)$ are supposed to be allocated between household members according to some sharing rule, i.e., the outcome of an unspecified decision process. Individual i living in household of type $n > 1$ receives a share $\eta_{i,n}(x, \boldsymbol{p}, \boldsymbol{z})$ of total expenditure $\exp(x)$. In a second stage, expenditures on all goods are chosen *as if* each individual solved his/her own utility maximization problem subject to an individual budget constraint, i.e., spent his/her own resources $\eta_{i,n} \cdot \exp(x)$. The sharing functions $\eta_{i,n}(x, \boldsymbol{p}, \boldsymbol{z})$ are differentiable, comprised between zero and one in such a way that the shares of all members sum up to unity. In the most general context, they depend on prices and total expenditure. For instance, we can imagine that the resources accruing to children vary with the price of child's clothing or toys. They also depend on a vector of household characteristics $\boldsymbol{z}$, which includes individual characteristics $\boldsymbol{z}_i$ and possibly some factors that capture the relative bargaining positions of the parents, which is potentially important to explain the level of expenditure devoted to children.[7] To obtain our main identification results, we adopt the following assumption:

[6] This simplification is not important for the theoretical results. Nonetheless, it will be used in the empirical application of this paper.

[7] In cases where there are more than one child in the household, recall that we are able to identify the children's resource share but not the individual shares of each child. This does not mean, however, that we impose equal sharing among children. The total share $\eta_{c,3}(x, \boldsymbol{p}, \boldsymbol{z})$ of children may possibly depend on characteristics $\boldsymbol{z}$ that include the number of boys versus girls, or the age of children, in order to check for potential discrimination.

A.1. *The shares of total expenditure are differentiable functions that do not depend on total expenditure x, that is, $\eta_{i,n}(x, \boldsymbol{p}, \boldsymbol{z}) = \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ for $i = m$, w or c and $n = 2, 3$.*

While this assumption is potentially strong, it is made essentially for the sake of simplicity, as in Lewbel and Pendakur (2008), Bargain and Donni (2009) and Dunbar et al. (2010). In fact, it can be shown that identification results still hold if expenditures on several adult goods are observable (see Bargain and Donni, 2009). Also, A.1 can be mitigated in empirical applications by including measures of household wealth other than total expenditure in income shares. In addition, notice that this assumption implies that the indifference/equivalence scales derived from the model are independent of the base, a property most often imposed in the traditional equivalence scales literature.

Scaling Functions $s_{i,n}(x, \boldsymbol{p}, \boldsymbol{z})$. The publicness of goods, and hence economies of scale in the household, is represented by a particular technology of production. Following Lewbel and Pendakur (2008), we assume that the "value" of total expenditure is inflated by the presence of several persons in the household (e.g., a couple always riding the car together "consumes" actual car expenditures twice). The deflator $s_{i,n} < 1$ is interpreted as a measure of the cost savings experienced by person i as a result of scale economies in the household. For the purpose of identification, we introduce the following assumption.

A.2. *The economies of scales are differentiable functions that do not depend on total expenditure x, that is, $s_{i,n}(x, \boldsymbol{p}, \boldsymbol{z}) = s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ for $i = m$, w or c and $n = 2, 3$.*

This is the so-called *Independent of the Base* (IB) assumption which refers to the fact that the economies of scale are assumed to be independent of the base expenditure (and hence utility) level at which they are evaluated. This assumption is similar to the IB restriction in the equivalence scale literature (Blackorby and Donaldson, 1993; Lewbel, 1991), but it concerns individual utility functions rather than aggregated household utility functions. The utility function of a person i living in a household of type n can thus be written as:

$$u_{i,n} = v_i(\boldsymbol{p}, x + \log \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z}) - \log s_{i,n}(\boldsymbol{p}, \boldsymbol{z}), \boldsymbol{z}_i). \tag{2}$$

The scaling function $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ generally depends on all the individual characteristics of the persons living in the household, $\boldsymbol{z}$. Indeed, it cannot be excluded that the extent of joint consumption of one person in the household be related to the characteristics of his/her partner or his/her child. Moreover, since the degree of publicness in consumption depends on the type of good, the scaling function must be price-dependent. The idea that some goods are consumed in common (and thereby largely affected by economies of scale) while other goods are not can be represented here, admittedly in a quite restrictive way, by the derivative of $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ with respect to prices.[8] Finally, scaling functions must be individual-specific, since economies of scale may differ between individuals within the same household, depending on how they value the good which is jointly consumed.

The flexibility offered by IB scales is particularly important. The arrival of a child in the household may indeed change consumption patterns and hence the degree of publicness in consumption in the household. Close to the notion of public goods, externalities of consumption, either positive or negative, may also characterize consumptions decisions in families. For instance, parents may decide to stop smoking and to change their leisure activities after the birth of a child. As discussed in Browning et al. (2008), scaling factors $s_{i,n}$ may embody positive/negative externalities within the household or changes in individual preferences across different household types. Admittedly, disentangling the different explanations is hard to achieve empirically. For instance, assume that married men care more about a cozy home than single men. Whether this is due to a change in taste, to the fact that they internalize the positive externality on their partner or to the effect of consuming "housing costs" jointly is a matter of speculation. Importantly, even with the present IB simplification, this extended interpretation gives an additional argument in favor of making scaling factors individual-specific. It also shows that this additional flexibility contributes to mitigate the assumption of preference stability across household types, as previously discussed.

3.2 Economies of Scale and Indifference Scales

The present set-up allows us to define *indifference scales* in the sense of Lewbel (2003), Lewbel and Pendakur (2008) and Browning et al. (2008). Let us denote $\log I_{i,n}(\boldsymbol{p}, \boldsymbol{z}) = \log s_{i,n}(\boldsymbol{p}, \boldsymbol{z}) - \log \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ so that equation (2) can be compactly written as:

$$u_{i,n} = v_i(\boldsymbol{p}, x - \log I_{i,n}(\boldsymbol{p}, \boldsymbol{z}), \boldsymbol{z}_i). \tag{3}$$

The term $I_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ is the indifference scale of member i; it represents the income adjustment applied to this person in a multi-person household that would allow her/him to reach the same indifference curve if living alone. This concept differs from an ordinary equivalence scale, which

[8] For goods that have a large public component (like housing), and hence generate important economies of scale, an increase in their price reduces the purchased quantity and thus has a positive effect on the scale $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ (i.e., a negative effect on economies of scale). Conversely, an increase in the price of purely private goods (like food) will have a negative effect on the scale $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$. In fact, IB scales can be seen as an approximation of Barten scales (used by Browning et al., 2008) in the sense that indirect utility functions can be both IB and Barten scaled if at least one linear restriction exists on the log of Barten scales (Lewbel, 1991). The reader is referred to Lewbel and Pendakur (2008) for a more structural presentation of the model using Barten scales.

attempts to compare the welfare of an individual to that of a household.[9] In contrast, indifference scales can be seen as comparing the same individual in two different situations: living alone and living with a partner (with or without children). Note that with A.1 and A.2, indifference scales as well as equivalence scales are independent of the base, a property which is often imposed in the traditional equivalent scales literature (see Blackorby and Donaldson, 1993).

Finally, the deflator representing economies of scale $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ cannot be interpreted directly. Indeed it generally ranges between $\eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ (all the consumption is public) and 1 (all the goods are purely private). As it must be compared to the level of the individual share, we suggest a normalized indicator of the 'individual' economies of scale for each individual:

$$\sigma_{i,n}(\boldsymbol{p}, \boldsymbol{z}) = 1 + \frac{\eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})\,(1 - s_{i,n}(\boldsymbol{p}, \boldsymbol{z}))}{s_{i,n}(\boldsymbol{p}, \boldsymbol{z})\,\big(1 - \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})\big)},$$

for $n \geq 2$, which is equal to 1 in the purely private case and to 2 in the purely public case.

3.3 The Budget Shares of Total Expenditure

If the Roy's identity is applied to equation (2), and the derivative is developed, then individual i's budget share function for good k is obtained as:

$$\omega_{i,n}^{k}(\boldsymbol{p}, x, \boldsymbol{z}) = \lambda_{i,n}^{k}(\boldsymbol{p}, \boldsymbol{z}) + w_{i}^{k}(\boldsymbol{p}, x - \log I_{i,n}(\boldsymbol{p}, \boldsymbol{z}), \boldsymbol{z}_i), \tag{4}$$

where $\omega_{i,n}^{k}(\boldsymbol{p}, x, \boldsymbol{z})$ is the share of member i's resources $\exp(x) \times \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ that are spent on good k and $\lambda_{i,n}^{k}(\boldsymbol{p}, \boldsymbol{z}) = \partial \log s_{i,n}(\boldsymbol{p}, \boldsymbol{z})/\partial p^k$ is the elasticity of $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ with respect to the k-th price. The consequence of the IB assumption in the present context is that the budget share equations of person i when living in a household of type n differ from when alone in that they are translated over by $\lambda_{i,n}^{k}(\boldsymbol{p}, \boldsymbol{z})$ while log household expenditure x is translated over by $\log I_{i,n}(\boldsymbol{p}, \boldsymbol{z})$. This property is referred to as "shape invariance" by Pendakur (1999). The translation function $\lambda_{i,n}^{k}(\boldsymbol{p}, \boldsymbol{z})$ is specific to good k and related to the differences that may exist between goods with respect to the possibility of joint consumption. Intuitively, economies of scale may have a wealth effect and a substitution effect. The former is represented by $\log s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ and the latter by $\lambda_{i,n}^{k}(\boldsymbol{p}, \boldsymbol{z})$. The substitution effect is positive (negative) if good k is essentially public (private).

To unify our notation, we also introduce the following definitions.

N.1. *For single households* ($n = 1$)*, we have:* $\eta_{i,1}(p, z) = 1$*,* $\lambda_{i,n}^{k}(p, z) = 0$*,* $s_{i,n}(p, z) = 1$ *for* $i = w$ *or* m *and* $k = 1, \ldots, K$*.*

[9] Directly consistent with individualism, it avoids the difficulties related to the ill-defined concept of "household utility" and does not suffers from the fundamental identification problem associated with interpersonal comparisons (see Pollak and Wales, 1979).

This condition is also a normalization. It implicitly means that single individuals are used as the demographic structure of reference. Now, let us suppose that households are observed in a unique price regime, as provided in cross-sectional data, so that the vector of prices $\boldsymbol{p}$ is constant and can be taken out of equation (4). Formally, the implications of the IB assumption in a framework with no price variation are described in the following lemma.

Lemma 1 (Lewbel and Pendakur, 2008). *Assume A.1–A.2 and N.1. If prices are constant, the budget share of good k of person i living in household of type n is written:*

$$\begin{aligned} \omega_{i,n}^{k}(x, \boldsymbol{z}) &= \lambda_{i,n}^{k}(\boldsymbol{z}) + w_{i}^{k}\left(x - \log I_{i,n}(\boldsymbol{z}), \boldsymbol{z}_{i}\right), \\ & \textit{for} \quad i = w, m \textit{ or } c \quad n = 1, ..., 3, \quad \textit{and} \quad k = 1, \ldots, K. \end{aligned} \tag{5}$$

where $\log I_{i,n}(z) = \log s_{i,n}(z) - \log \eta_{i,n}(z)$ is the log deflator of total expenditure which combines scaling $s_{i,n}$ and sharing $\eta_{i,n}$.

The left-hand side of expression (5) represents the 'reduced-form' budget share on good k of person i in household of type n as a function of (log) household resources x and household characteristics $\boldsymbol{z}$. The right-hand side puts some structure on this budget share as a result of the IB restriction: the individual budget share function $w_{i}^{k}(\cdot, \boldsymbol{z}_{i})$ of person i depends on her/his individual resources adjusted by the scaling $s_{i,n}(\boldsymbol{z})$ and on individual characteristics $\boldsymbol{z}_{i}$ (but not on the characteristics of the other individuals in the household); this budget share is then translated by the elasticity $\lambda_{i,n}^{k}(\boldsymbol{z})$.

Household expenditures on each good k can be written as the sum of individual expenditures on that good. Dividing this identity by the total outlay $\exp(x)$, we obtain directly the household budget share function for any good k as

$$W_{n}^{k}(x, \boldsymbol{z}) = \sum_{i \in \varphi_{n}} \eta_{i,n}(\boldsymbol{z}) \cdot \omega_{i,n}^{k}(x, \boldsymbol{z}) \tag{6}$$

for households of any type n, where φ_{n} is the set of the index of persons living in a household of type n. This is simply the sum of individual budget share equations over all household members, weighted by their individual resource shares.

3.4 Identification Results

Our goal here is to identify the important structural elements of the model, namely the sharing functions and the scaling functions, from demand data. To account for unobserved factors, we add error terms to the household budget shares previously defined:

$$\begin{aligned} \widetilde{W}_{n}^{k}(x, \boldsymbol{z}) &= W_{n}^{k}(x, \boldsymbol{z}) + \varepsilon_{n}^{k}, \\ & \text{for} \quad n = w, m \text{ or } c \quad \text{and} \quad k = 1, \ldots, K, \end{aligned} \tag{7}$$

where $\widetilde{W}_n^k(x, \boldsymbol{z})$ is the stochastic extension of $W_n^k(x, \boldsymbol{z})$. Error terms ε_n^k are traditionally interpreted as optimization/measurement errors or, alternatively, as resulting from unobservable heterogeneity in the individual budget share equations (hence assuming random utilities), in the scales or in the resource shares. The equations (7) can be identified from well-known results in non-parametric econometrics provided the sample is sufficiently large and error terms satisfy normalization restrictions (see Matzkin, 2007, for instance). Identification thus concentrates on how to retrieve the structural components $s_{i,n}(\boldsymbol{z})$, and $\eta_{i,n}(\boldsymbol{z})$, for $i = w$ or m or c and $n = 1, 2, 3$, from the knowledge of the deterministic components $W_n^k(x, \boldsymbol{z})$.

The identification result that follows relies on a certain number of normalization conditions. First of all, the condition N.1 previously discussed is obviously necessary. Moreover, the terms that represent economies of scale in the budget share equations of children are actually meaningless in a world where young children always live within the same family structure. Hence, without loss of generality, the following condition is also used.

N.2. *For households with children* ($n = 3$), *we have:* $\lambda_{c,n}^k(\boldsymbol{z}) = 0$, $s_{c,n}(\boldsymbol{z}) = 0$ *for* $k = 1, \ldots, K$.

The main result is then summarized in the following proposition.

Proposition 1. *Assume A.1–A.2 and N.1–N.2. The econometrician observes at least one adult-specific good for each adult living in the household. More precisely, one good* k_1 *is consumed by men but not by women or children and one other good* k_2 *is consumed by women but not by men or children. The budget share equations for these goods satisfy the following conditions:*

1. $\nabla_x w_i^{k_i}(x_{i,n}, \boldsymbol{z}_i) \neq 0$ *and* $\nabla_{xx} w_i^{k_i}(x_{i,n}, \boldsymbol{z}_i) \neq 0$ *almost everywhere for* $i = m$ *or* w,
2. *the function* $\Delta_i^{k_i}(x_{i,n}, \boldsymbol{z}_i) \equiv \nabla_x w_i^{k_i}(x_{i,n}, \boldsymbol{z}_i) \cdot \left[\nabla_{xx} w_i^{k_i}(x_{i,n}, \boldsymbol{z}_i)\right]^{-1}$ *is not periodic in its first argument for* $i = m$ *or* w.

Then, if prices are constant, the sharing functions $\eta_{i,n}(\boldsymbol{z})$ *and the scaling functions* $s_{i,n}(\boldsymbol{z})$, *for* $i = m, w$ *or* c *and* $n = 1, 2, 3$, *can be identified from the estimation of the budget share equations* $W_n^{k_i}(x, \boldsymbol{z})$ *on the adult-specific goods.*

In other words, identification will exploit the existence of adult goods (such as male and female clothing) along the lines of the Rothbarth method. In addition, the budget share equations must be non linear in total expenditure.[10] Note that generic identification can also be obtained theoretically when there is only one adult-specific good (for instance, if adult male and female clothing could not be distinguished in expenditure data), yet it is empirically less robust. Gender-specific clothing expenditure are often available anyway. The proof of Proposition 1 follows in

[10] Recall that a periodic function is a function $f(x)$ such that $f(x) = f(x + t)$ for some scalar t. This is a very particular property that most functions do not satisfy. In particular, a monotonic function is *not* periodic.

three steps. We first discuss how to retrieve the "basic" budget share equations. We then consider identification in the case of couples without child and finally in the case of couples with one child.

Step 1: $n = 1$**.** The "basic" budget share equations are simply retrieved by using information on singles. That is, for $n = 1$ and using normalization N.1, we simply have:

$$W_1^k(x, \boldsymbol{z}) = w_i^k\left(x, \boldsymbol{z}_i\right),$$

for any k, with $i = m$ or w, so that identification of the functions $w_i^k(\cdot)$ can be obtained from a sample of single male and female individuals.

Step 2: $n = 2$**.** The household budget share equations for adult good k_i can be written as:

$$W_2^{k_i}(x, \boldsymbol{z}) = \eta_{i,2}(\boldsymbol{z}) \cdot \left[\lambda_{i,2}^{k_i}(\boldsymbol{z}) + w_i^{k_i}\left(x - \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}_i\right)\right], \tag{8}$$

for $i = m$ or w (this good is specific to only one person in the household). To eliminate the function $\lambda_{i,2}^{k_i}(\boldsymbol{z})$ from equation (8), we compute the first-order derivative of this expression with respect to x and obtain:

$$\nabla_x W_2^{k_i}(x, \boldsymbol{z}) = \eta_{i,2}(\boldsymbol{z}) \nabla_x w_i^{k_i}\left(x - \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}_i\right), \tag{9}$$

where the left-hand side of this expression is identified. Differentiating again this expression with respect to x we obtain the second-order derivative:

$$\nabla_{xx} W_2^{k_i}(x, \boldsymbol{z}) = \eta_{i,2}(\boldsymbol{z}) \nabla_{xx} w_{ii}^{k}\left(x - \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}_i\right). \tag{10}$$

Taking the ratio of (9) and (10), we have:

$$\frac{\nabla_x W_2^{k_i}(x, \boldsymbol{z})}{\nabla_{xx} W_2^{k_i}(x, \boldsymbol{z})} = \frac{\nabla_x w_i^{k_i}\left(x - \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}_i\right)}{\nabla_{xx} w_i^{k_i}\left(x - \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}_i\right)} = \Delta_i^{k_i}\left(x + \log I_{i,2}(\boldsymbol{z}), \boldsymbol{z}\right)$$

where the left-hand side of the first equality and the function $\Delta_i^{k_i}(\cdot, \boldsymbol{z})$ are known from step 1. This condition uniquely identifies the indifference scales $I_{i,2}(\boldsymbol{z})$ for $i = m$ or w, provided the function $\Delta_i^{k_i}(\cdot)$ is not periodic in its first argument. Indeed, let us suppose $\boldsymbol{z} = \bar{\boldsymbol{z}}$ is constant and can be eliminated from the arguments of the functions. Then let us consider another solution $I'_{i,2}$ for the equation above so that:

$$\Delta_i^{k_i}\left(x + \log I_{i,2}\right) = \Delta_i^{k_i}\left(x + \log I'_{i,2}\right).$$

Since $\Delta_i^{k_i}(\cdot)$ is not periodic, this equality is not possible for any value of x. Therefore, the solution $I_{i,2}$ must be unique. Then, for $i = m$ or w, identification of sharing functions $\eta_{i,2}(\boldsymbol{z})$ follows from (9) and identification of translation functions $\lambda_{i,2}^{k_i}(\boldsymbol{z})$ from (8). Finally, the scaling functions $s_{i,2}(\boldsymbol{z})$ can be computed for $i = m$ or w from the definition of $I_{i,2}(\boldsymbol{z})$.

Step 3: $n = 3$. The household budget share equations for adult goods k_i have exactly the same structure as above:

$$W_3^{k_i}(x, \boldsymbol{z}) = \eta_{i,3}(\boldsymbol{z}) \cdot \left[\lambda_{i,3}^{k_i}(\boldsymbol{z}) + w_i^{k_i}\left(x - \log I_{i,3}(\boldsymbol{z}), \boldsymbol{z}_i\right)\right],$$

for $i = m$ or w. Hence, identification of $\eta_{i,3}(\boldsymbol{z})$, $s_{i,3}(\boldsymbol{z})$ and $I_{i,3}(\boldsymbol{z})$ for $i = m$ or w is straightforward. The share of total expenditure devoted to the child is then obtained as:

$$\eta_{c,3}(\boldsymbol{z}) = 1 - \sum_{i=1}^{2} \eta_{i,3}(\boldsymbol{z}),$$

while the scaling function $s_{c,3}(\boldsymbol{z})$ is given by normalization N.2. As explained before, $\eta_{c,3}(\boldsymbol{z})$ is the total share of children' resources in a family of type $n = 3$, whatever the number of children, however we do not identify the exact share of each child. This is feasible when using information on families of different size, but we leave this for future research. □

4 Empirical Implementation

4.1 Functional Forms

We turn to the empirical specification of the complete model, suggesting a parameterization that balances flexibility and empirical tractability. The first component, which appears in the specification of the different demographic groups, is the "basic" budget share equation. We introduce an index h for the observation and adopt the following quadratic specification:

$$w_{i,h}^k = a_i^k \boldsymbol{z}_{i,h} + b_i^k \cdot (x_{i,n,h} - \mu_i \boldsymbol{z}_{i,h}) + c_i^k \cdot (x_{i,n,h} - \mu_i \boldsymbol{z}_{i,h})^2, \text{ for } i = w, m, c \text{ and } k = 1, ..., K,$$

where $x_{i,n,h}$ is defined as previously for observation h, b_i^k, and c_i^k are parameters and $a_i^k \boldsymbol{z}_{i,h}$ and $\mu_i \boldsymbol{z}_{i,h}$ are linear functions of the socio-demographic variables $\boldsymbol{z}_{i,h}$ defined below. For adults, the parameters and functions are gender-specific (with $i = m$ for men, $i = w$ for women) but do not depend on the demographic type n nor on the number of children, since the "basic" adult budget share equations are the same for single women (resp. men) and for women (resp. men) living in a couple. The demographic variables enter the specification both as a translation of budget share equations and as a translation of log scaled expenditure. For adults, the latter characteristics, those entering $\mu_i \boldsymbol{z}_{i,h}$, include age and a dummy for "no education". The former, those entering $a_i^k \boldsymbol{z}_{i,h}$, include the same variables plus a constant, dummies for house ownership and urban resident. For children, the characteristics entering $a_i^k \boldsymbol{z}_{i,h}$ include a constant, the average age of the children and the proportion of male children in the household.

Next, we specify the household budget share equations. For single male and female adults, they coincide with the "basic" budget share equations specified above plus an additive error term, that is,

$$\widetilde{W}_{1,h}^{k} = w_{i}^{k}\left(x_{h}, \boldsymbol{z}_{i,h}\right) + \varepsilon_{1,h}^{k}. \tag{11}$$

For multi-person households $n \geq 2$, and for non-adult-specific goods, the household budget share equations,

$$\widetilde{W}_{n,h}^{k} = \sum\nolimits_{i \in \varphi_n} \eta_{i,n}(\boldsymbol{z}_h)\left[\lambda_{i,n}^{k}(\boldsymbol{z}_h) + w_{i}^{k}\left(x_h - \log I_{i,n}(\boldsymbol{z}_h), \boldsymbol{z}_{i,h}\right)\right] + \varepsilon_{n,h}^{k}, \tag{12}$$

comprise the individual functions $w_i^k\left(\cdot, \boldsymbol{z}_{i,h}\right)$ as already specified and three other components that are defined as follows. First, the *sharing functions* are specified using the logistic form:

$$\eta_{i,n}(\boldsymbol{z}_h) = \frac{\exp(\alpha_{i,n} + \boldsymbol{\beta}_i \boldsymbol{z}_h)}{\sum_{j \in \varphi_n} \exp(\alpha_{j,n} + \boldsymbol{\beta}_j \boldsymbol{z}_h)}, \qquad \text{for } i = m, w, c,$$

where $\alpha_{i,n}$ are parameters and $\boldsymbol{\beta}_i \boldsymbol{z}_h$ are linear functions of the household characteristics. To limit the number of parameters, variables in $\boldsymbol{\beta}_i \boldsymbol{z}_h$ include spouses' age, the "no education" dummy and a urban dummy for each spouse. Normalization is obviously required and we simply set the coefficients of the exponential corresponding to the wife to zero. For the share of children, we include the proportion of male children and the average age of the children in the household. As indicated above, and because we want the share of children to vary with the presence of children in a flexible way, we allow the constant coefficient of this share to vary freely with the number of children. Second, the log *scaling functions* that translates expenditure within the basic budget shares can be written as:

$$\log s_{i,n}(\boldsymbol{z}_h) = A_{i,n} + B_i \boldsymbol{z}_h, \qquad \text{for } i = m, w, c$$

where $A_{i,n}$ are parameters and $B_i \boldsymbol{z}_h$ linear functions of the characteristics. The scaling functions can in principle vary with all the variables entering preferences (i.e., $\boldsymbol{z}_i$ for $i = m, w, c$). In our specification, however, it is restricted to depend only on variables specific to individual i for adults (education and age). To limit the number of parameters, only the constant is indexed by the type of family n. Third, the function that translates the basic budget shares $\lambda_{i,n}^{k}(\boldsymbol{z})$ is a *price elasticity*. Measuring price effects is generally challenging – and it is all the more difficult to capture their interaction with demographics in any plausible way. Therefore we restrict these terms to be constant (and normalized to zero for children in one-child households):

$$\lambda_{i,n}^{k}(\boldsymbol{z}) = D_{i,n}^{k}, \qquad \text{for } i = m \text{ or } w,\ n = 2, 3, \text{ and } k = 1, \ldots, K.$$

4.2 Estimation Method

The complete model is estimated by the iterated SURE method. To account for the likely correlation between the error terms $\varepsilon_{n,h}^{k}$ in each budget share function and the log total expenditure, each budget share equation is augmented with the 'Wu-Hausman' residuals (Banks et al., 1997; Blundell and Robin, 1999). Hence we consider six demographic groups indexed by $j = 1, \ldots, 6$ (for single males, single females, childless couples, couples with one to three children respectively) and, for each group separately, the residual is obtained from reduced-form estimations of x on all exogenous variables used in the model plus some excluded instruments. For the latter, we choose the inverse of household disposable income and a fourth order polynomials in its logarithm. Since budget shares sum up to one, equation for good K is unnecessary. The household budget share equations for the $K-1$ goods and for the six demographic groups are estimated simultaneously. The error terms are supposed to be uncorrelated across households but correlated across goods within households. They are supposed to be homoskedastic for each family type j. Observations in the data are indexed by h and the number of observation in each demographic group is denoted by H_j, with $j = 1, ..., 6$. Let $\mathbf{W}_{j,h}$ be the $(K-1)$ vector of observed budget shares for the first $K-1$ goods consumed by household h of type j and let $\hat{\mathbf{W}}_{j,h}(\boldsymbol{\theta})$ be the corresponding $(K-1)$ vector of predicted budget shares for some parameter vector $\boldsymbol{\theta}$. The vector of residuals is thus given by $\boldsymbol{\varepsilon}_{j,h}(\boldsymbol{\theta}) = \mathbf{W}_{j,h} - \hat{\mathbf{W}}_{j,h}(\boldsymbol{\theta})$. If $\hat{\boldsymbol{\varepsilon}}_{j,h} = \boldsymbol{\varepsilon}_{j,h}(\hat{\boldsymbol{\theta}}_0)$, where $\hat{\boldsymbol{\theta}}_0$ is any initial consistent estimation of the vector of parameters, the estimated covariance matrix can be defined by

$$\hat{\mathbf{V}}_j = H_j^{-1} \times (\hat{\boldsymbol{\varepsilon}}_{j,h}) (\hat{\boldsymbol{\varepsilon}}_{j,h})'.$$

The SURE criterion is then:

$$\min_{\boldsymbol{\theta}} \sum_{j=1}^{6} \sum_{h=1}^{H_j} (\boldsymbol{\varepsilon}_{j,h}(\boldsymbol{\theta}))' (\hat{\mathbf{V}}_j)^{-1} (\boldsymbol{\varepsilon}_{j,h}(\boldsymbol{\theta})),$$

which gives a new value $\hat{\boldsymbol{\theta}}_1$ for the estimates. The estimation procedure is then iterated with the new estimates until the covariance matrix converges.

4.3 Data and Sample Selection

The availability and quality of data from Côte d'Ivoire has attracted a large number of empirical studies (Deaton, 1989, 1997; Duflo and Udry, 2003; Hoddinott and Haddad, 1991, 1995, among others). In our empirical analysis, we make use of the most recent available survey for this country, namely the Côte d'Ivoire 2002 Living Standard Survey (CILSS, *Enquête Niveau de Vie des Ménages*) conducted by the *Institut National de la Statistique* between January and December 2002. This is a cross sectional national survey which collects information on household expenditure, incomes and socio-demographics with an initial sample of 10,800 households. While price inflation has been high during the second half of the 2000s, it was relatively small in 2002 (2.5%) so that the sample can be treated as cross-sectional data.

We restrict the sample to monogamous, nuclear households (i.e., either a single adult or a married couple with or without children). This selection drops 50% of the initial sample. We further restrict our sample to households where household heads and or their spouse are aged between $18 - 64$ years, which excludes another 4% of the sample. For households with children, we drop households with children whose age is above 16 years – this selection ensures that we can distinguish children's clothing from adults clothing as they are the central goods used in the identification of our model – and we also drop households with more than three children since they are primarily composed of older children. By this selection we drop 10% of the initial sample. We finally exclude single women living with children (5%), households where men are not economically active (2%) and households with zero food expenditure together with obvious outlying observations (2%). This selection leaves us with us with 2,920 households (27% of the initial sample), described in Table 1.

Formally, a pair of adult-specific goods (i.e., male and female clothing) and a residual good are just what we need to identify children's resource shares, as explained in the previous section. However, we consider other non-durable goods to improve the efficiency of the estimations: food, transport and communication, personal goods and services, leisure goods and services, household operations and housing costs (composed of maintenance costs, rental costs and imputed housing costs for house owners).[11] We also include a child-specific good (i.e., child clothing).[12] Thus, our estimation use observations for $K = 9$ non-durable commodities, housing being the omitted good in the Engel curve system. This system comprises 6 non-exclusive good, with three individual budget shares (two for the adults and one for children), and 3 assignable goods (adult male, adult female and child clothing); hence a total of 21 individual Engel curves.

Budget information is collected via a questionnaire where respondents are asked to report expenditures on various goods. Food expenditures are recorded with a recall period of last seven days and last month while clothing expenditure which is central to our analysis has a recall period of last 12 months. This helps to avoid too many zeros due to infrequency of purchase for the key

[11] Traditionally, expenditures on housing are not modeled (because they may be difficult to evaluate for owners). Nonetheless, we believe that expenditure on housing cannot be ignored in our analysis as they may be an important contributor to household economies of scale. They are also important when addressing poverty issues as we do in the present paper. We must mention, however, that the size of the household may be correlated with housing decisions.

[12] In the dataset, a small proportion of single women and childless couples report non-zero expenditure on child clothing, we set these to zero. Also a small fraction of single women (and men) report expenditures on male (female) clothing, we also set these to zero.

goods in our analysis (the lower part of Table 1 reports reassuringly high proportions of strictly positive values for adult and child clothing).

5 Empirical Results

5.1 A First Look at the Data

Table 1 provides descriptive statistics of our sample by household type n and the number of children. We observe that around half of adult men and up to three-quarter of adult women have no education, which justifies the choice of a simple dummy ("no education") in the aforementioned specification of the empirical model. Other characteristics are line with common wisdom about a developing country like Côte d'Ivoire. In particular, budget shares show that food is the main item, representing around half of household expenditure, which is a similar proportion as in previous surveys using CILSS data (Haddad et al., 1994, Hoddinott and Haddad, 1994, Duflo and Udry, 2003, Udry and Woo, 2006). Importantly for our purpose is the shift in consumption patterns of adult-specific goods as household composition changes. We find that the presence of children in the household reduces the budget shares devoted to parents' clothing. While couples without children allocate 4.3% and 2.3% of their budget to women and men's clothing respectively, this drops to 3.7% and 2.2% (3.6% and 2.0%) respectively in couples with one child (two children). Expenditures in absolute terms also decrease.[13] The pattern uncovered here is in line with the widely accepted notion that children impose economic costs on their parents. According to the Rothbarth intuition, the arrival of a child is similar to an income effect which decreases the welfare parents get out of consumption as they re-allocate their limited resources to accommodate children's needs. At the same time, Table 1 shows that the budget share of the typically private goods (i.e., food, total clothing, and to a lesser extent, leisure expenditure) increases with the size of the household while the budget share of typically public goods (i.e., housing, and to a less extent, transport) decreases.[14] The simplest interpretation of it is that economies of scale are substantial, and not the same for all goods.[15] That is, economies of scale generate

[13] For instance, while the average yearly expenditure on male (female) clothing, expressed in Purchasing Power Parity dollars, is 23.1 (41.3) in childless couples, it drops to 22.1 and 19.3 (35.1 and 32.8) in couples with one and two children respectively.

[14] This is also true when controlling for total outlay.

[15] Economies of scale in food consumption may exist too. This is particularly the case for households with two or more adults relative to single adults living alone (Deaton and Paxson, 1998, Vernon, 2005, Browning et al., 2006). This is confirmed here with a slight decrease of food share in childless couples compared to singles. When children enter the picture, the "privateness" of food and the fact that children are more food intensive than parents prevail and lead to the observed increase in food share. The fact that children's food consumption

Table 1: Summary statistics

	single men	single women	childless couple	couple + 1 children	couple + 2 children	couple + 3 children
Age (male) *	33.4	_	35.1	33.8	36.7	38.6
	(10.0)		(9.8)	(8.3)	(8.9)	(8.2)
Age (female)	_	38.2	27.2	25.5	28.0	30.1
		(13.1)	(9.0)	(6.9)	(7.3)	(7.1)
No schooling (male)	0.49	_	0.47	0.52	0.53	0.58
	(0.50)		(0.50)	(0.50)	(0.50)	(0.49)
No schooling (female)	_	0.54	0.64	0.70	0.73	0.77
	(0.00)	(0.50)	(0.48)	(0.46)	(0.44)	(0.42)
House owner	0.23	0.28	0.38	0.37	0.48	0.54
	(0.42)	(0.45)	(0.49)	(0.48)	(0.50)	(0.50)
Rural	0.48	0.51	0.55	0.54	0.62	0.65
	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)	(0.48)
Household expenditure ($/week) **	14.3	15.3	20.3	20.9	21.0	21.5
	(10.2)	(11.3)	(12.9)	(14.1)	(15.2)	(17.1)
Household expenditure ($/week) ***	37.5	41.2	54.6	56.6	60.0	66.2
	(28.9)	(25.)	(34.3)	(35.3)	(41.5)	(53.1)
Average age of children	_	_	_	3.4	5.0	5.9
				(3.5)	(3.2)	(2.7)
Prop. of male children	_	_	_	0.49	0.51	0.52
				(0.50)	(0.36)	(0.30)
Budget shares:						
Food	0.50	0.51	0.49	0.52	0.53	0.54
	(0.20)	(0.18)	(0.18)	(0.17)	(0.17)	(0.16)
Personal goods and services	0.10	0.10	0.09	0.09	0.09	0.09
	(0.09)	(0.09)	(0.07)	(0.06)	(0.06)	(0.06)
Leisure goods and services	0.04	0.01	0.03	0.02	0.02	0.02
	(0.08)	(0.03)	(0.06)	(0.05)	(0.05)	(0.05)
Household operations	0.07	0.10	0.08	0.08	0.08	0.08
	(0.07)	(0.09)	(0.08)	(0.07)	(0.07)	(0.07)
Housing	0.17	0.19	0.16	0.14	0.14	0.14
	(0.13)	(0.15)	(0.13)	(0.11)	(0.10)	(0.10)
Transport and communication	0.09	0.06	0.09	0.07	0.07	0.06
	(0.12)	(0.08)	(0.11)	(0.09)	(0.10)	(0.08)
Budget shares (exclusive goods)						
Women's clothing	_	0.042	0.043	0.037	0.036	0.036
		(0.041)	(0.037)	(0.029)	(0.030)	(0.029)
Men's clothing	0.040	_	0.023	0.022	0.020	0.019
	(0.043)		(0.019)	(0.023)	(0.022)	(0.020)
Children's clothing	_	_	_	0.020	0.026	0.032
				(0.020)	(0.026)	(0.024)
Total clothing	0.040	0.042	0.066	0.079	0.082	0.086
Proportion of positive values:						
Women's clothing	_	0.73	0.88	0.90	0.87	0.89
Men's clothing	0.83	_	0.82	0.79	0.76	0.80
Children's clothing	_	_	_	0.92	0.94	0.95
Sample size	969	223	335	526	514	353

Notes: standard errors in brackets
* Men in Sub-Saharan Africa typically marry younger women (median difference is 7 years according to: United Nations (2001), *World marriage patterns*; New york, Populaton division, department of economic and social affairs.
** Household expenditures for goods selected in the 9-good demand system
*** Total household expenditures

an effect that incites consumption of private goods (substituting away from public goods).[16]

Among the preliminary inspections of the data, we have also checked for endogeneity of total expenditure and for the non-linearity of budget share equations in log expenditure (especially for adult goods, as explained above). To do so, we have performed reduced-form estimations on the subsample of each household type. Estimates are available from the authors and we simply summarize the main results here. The budget shares for male and female clothing are regressed on age, the dummies for education, house ownership and urban residency, as well as the log total expenditure, its square and the Wu-Hausman residual. The coefficients of log expenditure and its square show a quadratic pattern in most subsamples, implying that on average clothing is a luxury good (see also Banks et al., 1997, Bargain and Donni, 2009 for a similar result). Coefficients are significant in most cases, with the exception of single males, female clothing in childless couples and in couples with two or three children. The coefficient of the Wu-Hausman residual is negative and significant in all subsamples, except single females and male clothing in childless couples. This suggests that endogeneity of expenditure is an issue so that this residual must also be included in the structural Engel curve estimations.

In what follows, we report and discuss the main estimates of our structural model based on $K-1=8$ household Engel curves. Our general specification contains 202 parameters (out of which 98 are significantly different from zero at least at the 10% level). While the complete estimates are available from the authors, we focus on scaling factors, interpreted as economies of scale, and on resources shares for adults and children.

5.2 Economies of Scale

The estimates of the scaling factors $s_{i,n}(\boldsymbol{z})$ are shown in the left panel of Table 2 and the normalized scaling factors $\sigma_{i,n}(\boldsymbol{z})$ in the right panel. We first recall that the terms representing scale economies for children are normalized to 1. If the scales for adults are to be interpreted as reflecting joint consumption, they should in principle lie between $\eta_{i,n}(\boldsymbol{z})$ (complete jointness of consumption) and 1 (purely private consumption) for a childless couple. In this respect, the estimates are reasonable in magnitude, especially given that we have not restricted the size of the coefficients in any way. The fact that these scales are much lower than 1 also underlines

is disproportionately higher makes that the cost of children is usually overestimated when calculated on the basis of variations in food expenditure across household types, i.e., the Engel approach (see Deaton, 1997). The Rothbarth approach based on adult goods avoids this critique.

[16] Instead of total expenditure for couples without children to increase by a factor of 2 (when using the average expenditures of single men and women), it increases by a factor of 1.4, implying 33% savings derived from sharing. This result is also consistent with Lazear and Michael (1980) who find that expenditures of two adults living together are $30-35\%$ lower than combined expenditure for two single-adult households (US data).

the possible existence of sizeable economies of scale in the household, which invalidates the traditional Rothbarth approach. For instance, a scale of 0.597 for a woman with a child suggests that her cost of living is 59.7% of the cost she would experience if living alone. We nonetheless remain cautious with this reading, given the broader interpretation of these scales suggested in section 2. Moreover, the magnitudes of the deflators for different household types cannot be compared directly, since household members consume only a fraction of total expenditure. Hence, the right panel reports the *normalized* measures of scale economies, as previously defined. They amount to 1.31 (resp. 1.79) for a man (resp. woman) living in a couple without children (recall that in the limit case where $\sigma_{i,n}(\boldsymbol{z}) = 2$, all the goods consumed by spouses can be assimilated to purely public goods).[17] One may expect economies of scale to increase in families with children compared to childless couples. Yet this may not always be the case if children bias consumption patterns towards more "privateness".[18] The total effect is undetermined and remains an empirical question. Point estimates show a sharp decrease in scale economies with the first child, suggesting that there is less sharing of goods consumed by adults in this household type. They increase regularly with additional children, indicating economies of scale in larger families. Women seem to gain more than men from joint consumption. However, given the lack of precision of these estimates, the differences between household types are not significant. Finally, while estimates in Table 2 are reported for an average representative household, demographics do not change the picture much.

5.3 Resource Shares and Poverty

We compute resource shares $\eta_{i,n}(\boldsymbol{z})$ for all the individuals in our sample and report statistics for different sub-groups. Table 3 summarizes the results while Table A.1 in the Appendix reports the mean shares for men, women and children in detailed demographic groups and according to parents' education levels. Note that estimations of resource shares are in general much more precise than that of scaling factors. Results indicate slightly larger share for men on average but a more balanced division of resources when women are educated and men are not. The difference

[17]Joint consumption among households is certainly important. On Canadian data, Browning et al. (2008) obtain economies of scale, aggregated over the household using a different methodology, which are in the same order of magnitude (i.e., between 1.27 and 1.41). On US data, Nelson (1989) finds much larger economies of scale. She distinguishes between different goods and note that economies for housing are larger than in the case of pure joint consumption. She explains it by increasing returns in household production.

[18]For goods with a high public component, like housing, economies of scale may partly disappear as the family decides to move to a bigger house to accommodate an additional child. For private goods, we have discussed above the fact that food shares increase with the presence of children (who are more food intensive than adults), which may overall result in an increase in the relative level of private consumption in the household.

Table 2: Estimated economies of scale

	Scaling factors				Normalized scaling factors			
	no children	1 child	2 children	3 children	no children	1 child	2 children	3 children
women	0.457	0.597	0.510	0.449	1.794	1.372	1.514	1.607
	(0.591)	(0.805)	(0.701)	(0.707)	(1.894)	(1.251)	(1.455)	(1.760)
men	0.827	0.881	0.820	0.687	1.312	1.153	1.240	1.447
	(0.405)	(0.429)	(0.415)	(0.384)	(0.887)	(0.626)	(0.674)	(0.800)

Baseline model estimated on 9 goods (one residual: housing costs). Scaling factors are calculated for representative household, but estimates change very little with education or being urban/rural.

between spouses is however not statistically significant.[19] To our knowledge, existing evidence based on the estimation of collective models is limited to developed countries. For instance, the average wife's shares, as estimated by Browning et al. (2008) on Canadian data and by Bargain and Donni (2009) on French data, are in excess of 0.60. An exception is Dunbar et al. (2010) who find larger shares for men in couples with several children in Malawi – they also find that the absolute share of husbands increases in families of several children compared to one-child families, in the spirit of Duflo (2003). Results are less extreme and in fact much more balanced in Côte d'Ivoire.

The resource share of children seems reasonable and increases in a plausible way with household size (recall that we have not imposed any regularity in the sharing function in that respect). The per capita shares becomes smaller with the number of children, as in Dunbar et al. (2010). Mean shares are around 12.6% (first child), 8.3% (second child) and 6.8% (third child). Table A.1 indicates that boys receive more than girls, yet the difference is not significant. Hence, our results are in line with Deaton (1989) who found no evidence of child gender bias in the overall treatment of boys and girls in Côte d'Ivoire, using adult equivalence outlay ratios and data for the year 1985. Deaton (1997) suggests that the absence of child gender bias may be due to the fact that women in West Africa are economically productive and girls are not seen as a burden in their parents, while Haddad et al. (1994) explains this from a cultural perspective.[20] Point estimates show that children receive higher shares when the mother is the educated adult, yet this trend is not statistically significant.

Estimated shares give us a sense of who get how much in the household. Yet it does not tell

[19] Further research should incorporate distribution factors like differences between spouses in terms of exogenous income, which may influence the overall structure of consumption and female and child shares. For instance, Thomas (1990) note that unearned income in the hands of the mother has a bigger effect on child health.

[20] They suggest that parents are reluctant to discriminate against daughters due to the practice of bride-wealth in which parents of a bride receive payment as a compensation for the loss of a valuable worker.

us if resource allocations are premised on the corresponding needs of each individual or reflect inequality in terms of welfare. Hence, we take a step further and examine the implications of these allocations on the poverty of the different household members. To this end, we use the computed resource shares accruing to each individual in the household to construct the actual expenditures for a given individual. We use the World Bank's poverty lines set at US$2 per day to identify poor adults. As in Dunbar et al. (2010), we use a US$1.20 per day poverty line for children, which means that children's are 60% that of adults (as in the modified OECD equivalence scale). The poverty levels arising therefrom are labeled "unequal" in Table 3 while poverty based on per capita expenditure, i.e., a standard measure ignoring intra-household inequality, is reported under the "equal" label. Overall we find that poverty increases with household size when using the per capita measure, from 21.8% of childless households to 50.4% of households with three children (for a comparison, the World Bank reported a general poverty rate of 42% in 2002). When using the "unequal" poverty rate, however, adult poverty rates are smaller and do not change much across household types, which reflects the fact that their resource shares do not decrease proportionnally with the number of people in the household. In contrast, resources in larger households are skewed in favor of adults rather than children. As indicated above, per capita expenditure for children decrease with the number of children. As the per capita measure over-estimates poverty levels for adults, it also severely under-estimates poverty among children. Dunbar et al. (2010) point to very similar results in Malawi. Admittedly, poverty levels depend on the assumption concerning the relative needs of each household members. We have used the modified OECD scale for an illustration, yet child poverty remains greatly understated unless one is ready to assume very small needs for children.[21] In fact, for child poverty to equalize adult poverty, children's need should be as little as 30%, 25% and 17% of adult needs in couples with one, two and three children respectively. If these levels are deemed implausible, this indicates a certain extent of intrahousehold inequality, which, unfortunately, cannot be measured exactly.

Finally, the last column of Table 3 reports poverty rates for adults when gains due to economies of scale are accounted for. While the poverty rate of single women (men) is around 10% (15%), that of individuals in couples is usually larger. When joint consumption is accounted for, however, these poverty rates go down very substantially. For instance, in couples with two children, individual poverty rates are 29.2% (24.5%) for women (men). They decline to 9.5% (15.8%) after accounting for economies of scale. In all cases, the reduction in poverty levels is higher for women, which reflects previous differences in scale economies between men and women. This pattern is consistent across all types of households and shows that for all types, poverty rates of adults living in a family are of the same order as that of single individuals. That is, for adults, joint consumption tends to compensate the fact people must share resources.

[21] If we assume that children needs are only 30% that of adults, their poverty rates go down to 25%, 40% and 59% in couples with one, two and three children respectively.

Table 3: Poverty rates

		Resource shares					Poverty rates		
		mean	std. dev.	min.	med.	max.	Unequal	Equal	Unequal, Adjusted
Couple with no child	woman	0.478	0.051	0.386	0.487	0.586	0.224	0.218	0.051
	man	0.522	0.051	0.414	0.513	0.614	0.218		0.122
Couple with one child	woman	0.411	0.038	0.342	0.422	0.490	0.281	0.329	0.146
	man	0.463	0.050	0.367	0.447	0.553	0.245		0.179
	children	0.126	0.013	0.100	0.126	0.161	0.715		
	each child	0.126	0.013	0.100	0.126	0.161			
Couples with two children	woman	0.402	0.036	0.331	0.414	0.470	0.292	0.442	0.095
	man	0.432	0.053	0.315	0.420	0.533	0.247		0.158
	two children	0.165	0.020	0.129	0.165	0.228	0.877		
	each child	0.083	0.010	0.065	0.083	0.114			
Couples with three children	woman	0.387	0.032	0.321	0.398	0.442	0.263	0.504	0.085
	man	0.408	0.049	0.325	0.392	0.508	0.224		0.108
	three children	0.205	0.017	0.171	0.210	0.235	0.909		
	each child	0.068	0.006	0.057	0.070	0.078			

Note: shares are calculated for each individual and we report statistics for each demographic group. "Unequal" poverty rates are obtained using the share of expenditure that each individual gets in the household. The poverty line is set at $2 per day for an adult and US$ 1.20 per day for a children (World Bank standard definition). "Equal" poverty rates are obtained using per capita expenditure and using a poverty line for the household that accounts for the 2 versus 1.20 for adults and children respectively. "Unequal, adjusted" accounts for the scale economies in couples. Note that for a comparison, the poverty rate of single men (women) is 14.9% (10.0%).

6 Additional Results

6.1 Comparison with Dunbar et al. (2010)

At this stage, it may be interesting to make a comparison with the method suggested by Dunbar et al. (2010). Fundamentally, both studies rely to some extent on the stability of individual preferences across household types and on adult clothing to identify children's share. An apparently important difference is the fact that we are using information on single individuals while the approach of Dunbar et al. simply relies on couples with children.[22] Our approach is, at first glance, more restrictive since we assume preference stability across more household types and, notably, between individuals alone or in a family.[23] Nevertheless, Dunbar et al. (2010) are

[22] The identification result of Dunbar et al. (2010) also exploits child goods. This is not necessary in our case, even if it may improve the precision of the results.

[23] We take single individuals as the reference group as we aim to recover scale economies in multi-person households. To retrieve the gains from joint consumption, it seems natural to compare life when single and when living with others – this is after all the central principle in the construction of equivalence scales. We also recover

incited to make assumptions on the stability of preferences *across* people living in the household to obtain more precise results. In addition, the present approach allows us to recover economie of scale – which is not possible with Dunbar et al. (2010)'s – and, therefore, indifference curves. The latter are required to compare the living standard of singles and persons in couple (with children or not). Finally, and unsurprisingly, our approach uses more structure so that it is possible to recover more elements of the decision process. Identification is also more robust since it does not rely on parametric forms.

The principal objective of both studies is to retrieve resource shares for the most vulnerable family members, i.e., children. Hence, it is important to check that the two approaches do not lead to completely different results in this respect. Comparison is made in Table 4 where we first report our baseline results for the individual resource shares of different household types. For the sake of comparability with Dunbar et al. (2010), we report average and extreme shares for the rural population.[24] We also report the results of these authors on Malawi data. Even though the empirical approaches and the countries are different, the children's shares are strikingly similar across the two studies. As reported above, fathers' shares are very large and increasing in Malawi, so that the cost of children is essentially born by mothers in this country (estimates of adult shares are however less precise than in our estimations and gender inequality among adults is not significant for one-child couples). Although things are more balanced in Côte d'Ivoire, the total share of children shows the same declining pattern, with only 7% more resources for children with the arrival of the third one (8% in Malawi). In fact, the similarity in results is not surprising – and surely reassuring – given that the two studies use the same fundamental principle to recover children's share, i.e., the Rothbarth idea of measuring how the consumption of adult goods vary across different household types.

the allocation of resources not only between adults and children, but between wives and husbands, and it seems consistent to use some of the information from singles in this respect. After all, the collective model literature has been motivated by the observation that individual preferences differ within families, reflecting divergence in tastes and lifestyles between men and women (as seen in Table 1). It makes some sense to use this information together with couples' expenditure precisely to model how couples reconcile these difference tastes in collective decision-making.

[24]Our results do not vary much compared to the overall population in Table 3. Note that in Dunbar et al. (2010), resource shares for representative households are very different from mean shares over all observations. For that reason, and because it is difficult to create a comparable representative household with our sample, we opt for a comparison of the two studies based on average shares, for each household types, calculated over the whole (rural) population.

Table 4: Resource Shares: Estimates from Alternative Models

	Baseline model				Dunbar et al. (2010)				Model with "unitary" parents				Gronau-Rothbarth model			
	(I)				(II)				(III)				(IV)			
Model specification																
# goods (incl. residual)	9				4				3				3			
identifying information*	adult clothing, singles				assignable clothing (man, woman, children)				adult clothing				adult clothing			
household types**	**S**, C0, C1-3				**C1**, C2, C3, C4				**C0**, C1, C2, C3				**C0**, C1, C2, C3			
Identification of:																
adults' scaling factors	Yes				No				Yes				No			
sharing among adults	Yes				Yes				No				No			
Resource shares	Mean	std. dev	Min	Max	Mean	std. dev	Min	Max	Mean	std. dev	Min	Max	Mean	std. dev	Min	Max
Couple with one child																
adults	0.874	0.044	0.355	0.521	0.865	0.079	0.207	0.675	0.841	0.044	0.735	0.938	0.886	0.063	0.341	0.561
woman	0.411	0.038	0.342	0.490	0.402	0.071	0.168	0.587	0.420	0.022	0.367	0.422	0.365	0.054	0.276	0.470
man	0.463	0.050	0.367	0.553	0.463	0.087	0.245	0.762	0.420	0.022	0.367	0.469	0.522	0.071	0.406	0.652
children	0.126	0.013	0.100	0.161	0.135	0.047	0.008	0.260	0.159	0.044	0.062	0.265	0.113	0.022	0.061	0.165
each child	0.126	0.013	0.100	0.161	0.135	0.047	0.008	0.260	0.159	0.044	0.062	0.265	0.113	0.022	0.061	0.165
Couple with two children																
adults	0.835	0.045	0.323	0.501	0.789	0.071	0.179	0.631	0.830	0.043	0.735	0.905	0.859	0.062	0.319	0.545
woman	0.402	0.036	0.331	0.470	0.273	0.063	0.075	0.475	0.415	0.021	0.368	0.452	0.363	0.052	0.259	0.458
man	0.432	0.053	0.315	0.533	0.516	0.078	0.282	0.786	0.415	0.021	0.368	0.452	0.496	0.072	0.380	0.633
two children	0.165	0.020	0.129	0.228	0.211	0.044	0.059	0.326	0.170	0.043	0.095	0.265	0.140	0.021	0.096	0.182
each child	0.083	0.010	0.065	0.114	0.105	0.022	0.029	0.163	0.085	0.021	0.048	0.132	0.070	0.010	0.048	0.091
Couple with three children																
adults	0.795	0.040	0.323	0.475	0.765	0.073	0.111	0.654	0.811	0.035	0.737	0.877	0.837	0.059	0.321	0.521
woman	0.387	0.032	0.321	0.442	0.244	0.065	0.002	0.512	0.405	0.018	0.368	0.438	0.357	0.047	0.265	0.434
man	0.408	0.049	0.325	0.508	0.521	0.081	0.219	0.795	0.405	0.018	0.368	0.438	0.480	0.070	0.377	0.609
three children	0.205	0.017	0.171	0.235	0.236	0.042	0.112	0.374	0.189	0.035	0.123	0.263	0.162	0.024	0.103	0.205
each child	0.068	0.006	0.070	0.078	0.079	0.014	0.037	0.125	0.063	0.012	0.041	0.088	0.054	0.008	0.034	0.068

* in addition, models (I) and (II) assume independence of the base and all models assume that sharing rule functions do not depend on total expenditure.

** S: single males and females, CX: couples X children. In bold, we indicate the reference household type.

Model (II): estimates from Dunbar et al. (2010) using Malawi data, Table 4, page 30

6.2 Other Models

We finally suggest alternative empirical strategies. Our variants rely on the same fundamental identifying approach, i.e., children's expenditure can be retrieved by checking the variations in adult expenditures across household types. This extends the comparison with Dunbar et al. (2010) and may consolidate the general method based on adult clothing, especially if the measure of children's share is not too sensitive to the other assumptions made on top of the Rothbarth's principle (and in particular the way flexibility is introduced in the Rothbarth model).

Model without Information on Singles. We start with a model which is closer to that of Dunbar et al. (2010) in the sense that we now restrict our estimations to observations on couples only and using expenditure on adult clothing, child clothing and a residual (corresponding to other household expenditures). The parents are treated as a unitary couple, so that we focus only on sharing between parents and children.[25] Childless couples now serve as the reference group to retrieve scale economies (couples with one child in the case of Dunbar et al., 2010). That is, for this group $n = 2$, we suppose that there exists a well-behaved indirect utility function $v_a(x, \boldsymbol{p}, \boldsymbol{z}_a)$, where index a stands for 'adults'. Since the notion of assignability is rather meaningless in the present context, we now model the budget shares for both adults' together (e.g., total adult clothing). Denote k_a the adult-specific goods, the household budget share for that good in a childless couple is:

$$W_2^{k_a}(x, \boldsymbol{z}) = w_a^{k_a}\left(x, \boldsymbol{z}_a\right), \tag{13}$$

so the basic budget shares of parents are identified, this time on childless couples (and not on singles, as we did previously in step 1). For adult specific goods k_a, the household budget shares in couples with children are:

$$W_3^{k_a}(x, \boldsymbol{z}) = \eta_{a,3}(\boldsymbol{z}) \cdot \left[\lambda_{a,3}^{k_a}(\boldsymbol{z}) + w_a^{k_a}\left(x + \log \eta_{a,3}(\boldsymbol{z}) - \log s_{a,3}(\boldsymbol{z}), \boldsymbol{z}_a\right)\right]. \tag{14}$$

The identification is basically the same as in Proposition 1, except that parent's basic share are now recovered from childless couples.

Traditional Rothbarth Model. As in the previous model, we suppose that the chosen reference demographic group is childless couples. Then we ignore scale economies, i.e., assume $\lambda_{a,3}^{k_a} = \log s_{a,3} = 0$. The household budget share for the adult good k_a is:

$$W_3^{k_a}(x, \boldsymbol{z}) = \eta_{a,3}(\boldsymbol{z}) \cdot \left[w_a^{k_a}\left(x + \log \eta_{a,3}(\boldsymbol{z}), \boldsymbol{z}_a\right)\right]. \tag{15}$$

This model is essentially the traditional Rothbarth approach using childless couples to retrieve parents' basic budget shares. Alternatively, it would be possible to use singles for that purpose, as in our baseline model or in Gronau (1991). We stick to the chosen specification so that the Rothbarth model is nested in the "unitary" parent model.

Results. All shares are reported in Table 4. Estimates of children's shares in Dunbar et al. (2010) are relatively close to ours despite the methodological differences highlighted above and country differences. For couples with one, two and three children, shares per child are 13.5 (12.6) , 10.5 (8.3) and 7.9 (6.8) in their (our) case. Given the relatively large standard errors, we can

[25] This is more parsimonious than in the other approaches, but not really costly in terms of realism. Indeed, in the absence of prices and distribution factors in the sharing rule, unitary models cannot be empirically distinguished from collective ones.

conclude that their measures of resource shares are of the same order of magnitude. Inequality between spouses is also similar for childless couples but a notable difference, however, is that it does not increase in our case, i.e., both parents contribute to children expenditure in larger households.

The two other models estimated on our sample of Côte d'Ivoire with couples only show interesting results. The first model with "unitary" parents yields larger shares for the first child compared to our baseline model (and similar results for other groups). This may be related to the fact that these variants only rely on Engel curves for clothing expenditures, or on the fact that childless couples is now use as reference group for normalizing scale economies.[26] With the version of the Rothbarth's model suggested here, children's shares are smaller for all household types. This can be interpreted as parents having larger shares because they are not implicitly compensated by scale economies as in other models (see the similar result on French data, and the related discussion, in Bargain and Donni, 2009). Overall the estimations of children's share are of the same order of magnitude.

7 Conclusion

In this paper, we suggest an estimation of the share of household resources accruing to children in Côte d'Ivoire. Generalizing the more conventional Rothbarth method, the approach is consistent with the existence of economies of scale and parental bargaining in a structural, multi-person model. Importantly, this contribution completes the literature on collective models, which usually ignore children and have been essentially applied on data from developed countries. The model is simply estimated on the basis of Engel curves for typical aggregated commodities including adult-specific goods (clothing). Identification is obtained for three types of people (men, women, and children) in more than three types of households (single men, single women, couples with zero, one, two or three children). The presence of adult goods in these household types permits identification of children's shares even though children are never observed living alone. Empirical results for Côte d'Ivoire show that scaling factors, interpreted as economies of scale in multi-person households, turn out to be very large but imprecisely estimated. Parents' expenditures made for children living in the household range between 13% and a quarter of total resources for couples with one to three children respectively. Poverty calculations suggest that ignoring intra-household distribution of resources leads to a large underestimation of child poverty when using reasonable differentiation in individual needs across household members.

[26] In results that are not reported, it is shown that estimations are very close to those of the model without information on singles when male and female clothing are used separately. This indicates that using assignable goods for men and women respectively, and using this information to recover the share of each adult, has no impact on our measure of children's share.

Interestingly, our results on the resource share of children are very similar to that obtained under different identifying assumptions, and notably when using only assignable goods and observations for couples. Imposing restrictions ("unitary" parents, no scale economies) also lead to similar results. In fact, all these variants rely on the same fundamental identifying strategy, the Rothbarth idea, and help to consolidate the overall approach once additional flexibility is incorporated.

Three limitations of the present paper could inspire further research. Firstly, resource shares could be made dependent of total expenditures given data and models for multiple price regimes. Alternatively, they could depend on another measure of household wealth. This is important to retrieve how children's share does vary with household total resources, which could interestingly affect the measure of child poverty. Secondly, a contribution of the present paper was to introduce more flexibility – in the form of terms accounting for positive externality (publicness of consumption) and possibly negative externalities – in a Rothbarth approach using singles as the reference group for adults. However, as extensively discussed in the core of the paper, scaling factors may capture changes in individual preferences across household types. A lot remains to be done to disentangle these different interpretations.

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		no children	1 boy	1 girl	2 girls	2 boys	1 boy & 1 girl	3 boys	3 girls	2 boys & 1 girl	2 girls & 1 boy
Woman	Average	0.4783	0.4081	0.4143	0.4050	0.3990	0.4024	0.3884	0.3857	0.3891	0.3860
		(0.051)	(0.037)	(0.040)	(0.035)	(0.037)	(0.036)	(0.034)	(0.028)	(0.032)	(0.032)
	Educated woman, uneducated man	0.4907	0.4126	0.4270	0.4146	0.4245	0.4190	0.3836	0.3882	0.4021	0.4007
		(0.055)	(0.039)	(0.040)	(0.041)	(0.035)	(0.036)	(0.030)	(0.035)	(0.035)	(0.035)
	Uneducated woman, educated man	0.4753	0.4086	0.4118	0.4041	0.3977	0.4010	0.3979	0.3950	0.3896	0.3865
		(0.055)	(0.039)	(0.041)	(0.037)	(0.035)	(0.036)	(0.029)	(0.027)	(0.032)	(0.034)
Man	Average	0.5217	0.4598	0.4652	0.4311	0.4350	0.4316	0.4048	0.4124	0.4046	0.4106
		(0.051)	(0.037)	(0.052)	(0.051)	(0.055)	(0.053)	(0.052)	(0.043)	(0.048)	(0.050)
	Educated woman, uneducated man	0.5093	0.4543	0.4493	0.4182	0.4015	0.4095	0.4122	0.4079	0.3849	0.3887
		(0.055)	(0.052)	(0.052)	(0.061)	(0.054)	(0.051)	(0.045)	(0.055)	(0.054)	(0.053)
	Uneducated woman, educated man	0.5247	0.4594	0.4683	0.4337	0.4382	0.4348	0.3902	0.3990	0.4044	0.4098
		(0.055)	(0.052)	(0.053)	(0.051)	(0.051)	(0.053)	(0.045)	(0.041)	(0.049)	(0.052)
Children	Average		0.1321	0.1206	0.1639	0.1659	0.1660	0.2068	0.2019	0.2063	0.2034
			(0.013)	(0.012)	(0.018)	(0.022)	(0.020)	(0.018)	(0.015)	(0.017)	(0.017)
	Educated woman, uneducated man		0.1331	0.1237	0.1673	0.1739	0.1714	0.2042	0.2039	0.2130	0.2107
			(0.013)	(0.012)	(0.021)	(0.021)	(0.019)	(0.015)	(0.019)	(0.019)	(0.018)
	Uneducated woman, educated man		0.1320	0.1199	0.1622	0.1642	0.1642	0.2118	0.2060	0.2060	0.2037
			(0.013)	(0.012)	(0.017)	(0.019)	(0.019)	(0.016)	(0.014)	(0.017)	(0.018)

Baseline model estimated on 9 goods (one residual: housing costs). Resource shares calculated for representative household (sample means), except specific variations based on the rural and education dummies as shown above.

Table A.1.: Shares of Total Expenditure in Couple Households