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# Intrahousehold Distribution and Poverty: Evidence from Côte d'Ivoire

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**Abstract**

Poverty measures in developing countries often ignore the distribution of resources within families and the gains from joint consumption. In this paper, we estimate the allocation process and adult economies of scale in households from Côte d'Ivoire using a collective model of household consumption. Identification relies on the observation of adult-specific goods, as in the Rothbarth method, and a joint estimation on couples and singles. Results show that children's shares are small and decline quickly with household size. It results that child poverty, measured on the basis of individual allocations within families, is much larger than in traditional measures ignoring intrahousehold inequality. Adult poverty is smaller because parents are highly compensated by the scale economies due to joint consumption.

**Key Words** : Collective Model, Engel Curves, Rothbarth Method, Sharing rule, Scale Economies, Equivalence Scales, Indifference Scales.

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

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# 1 Introduction

The ultimate object of concern of redistributive policies, in developing or developed countries, is the welfare of individuals. Yet the literature has mainly focused on measuring inequality and poverty among households. In particular, attempts to assess how much of the family resources are dedicated to each member, and to evaluate individual poverty in this way, are relatively rare. In some occasions, researchers have used anthropometric information (e.g., caloric intake or body mass indexes) to proxy individual nutrition in very low-income countries. This type of research has revealed a very substantial level of intra-household inequality (Haddad and Kanbur, 1990) or strong effects of economic policy on child poverty (Thomas et al., 1996). Yet, individual allocations within households are rarely observed and economists must often rely on strong assumptions to retrieve the sharing process.

In the present paper, we propose estimates of the share of total expenditure accruing to children and adults in Côte d'Ivoire using a new method consistent with economies of scale and parental bargaining. This method, originally developed in Bargain and Donni (2012a)[1], is a generalization of the traditional Rothbarth approach.[2] Identification relies on the existence of adult goods in the data as in the initial Rothbarth idea. However, while the Rothbarth approach does not take into account the fact that the consumption of some goods is partly joint, or fully joint in the case of household public goods, the method used here accounts for the existence of scale economies and allows estimating indifference scales.[3] Following the suggestion of Lewbel and Pendakur (2008), an 'independent of base' (IB) scaling of consumption is used, i.e., a function, independent of total expenditure, scales the expenditure of each individual in the household and represents the economies from joint consumption. Moreover, the method used here explicitly grounds intra-household allocation in the collective model framework, allowing for the possibly diverging opinions of the parents, and deals with the fact that data sets typically contain total purchases at household levels but not the allocation of goods between household members. This method is applied to estimate the resource shares of adults and children in a household survey from Côte d'Ivoire, and compute a direct measure of *individual* poverty, whereby poor persons

[1] See also Bargain et al. (2010) for an earlier application of the method on the data of Ireland and an extensive comparison with results from the standard Rothbarth approach.

[2] The Rothbarth approach is a method that allows retrieving how household resources are allocated between parents and children. It consists in examining the extent to which the presence of children depresses the household consumption of adult-specific goods (Rothbarth, 1943; Gronau, 1988, 1991; Lazear and Michael, 1988). 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.

[3] Indifference scales are scalars, suggested by Lewbel (2003) and Browning et al. (2008), used to compare the welfare of individuals living in families with different demographic structures.

are poor because the resources they receive in the household are below some poverty line. As far as we know, the present paper is the only attempt to incorporate scale economies and to use indifference scales to reassess individual poverty among adults.

The Côte d'Ivoire is the second largest economy in West Africa. In this country, almost half the population is poor, i.e., lives on less than $2 per day, and the question of child poverty is particularly acute. With such a large group of poor households, the question of whether all household members are equally poor or whether some individuals (e.g., the children) are disproportionately poor is crucial. Due to the quality of the data available and because of some evidence of unequal distribution within households, the Côte d'Ivoire has already been the subject of studies by Deaton (1989), Haddad and Hoddinott (1994), Haddad et al. (1994), Mammen (2009) and many other articles referenced in Deaton (1997). Another key point of our contribution is then the conciliation of our results with the existing literature on intra-household inequality in Côte d'Ivoire and more generally in developing countries.

Our results indicate that men's and women's shares of total expenditure in couples are of the same order of magnitude and positively related to spouses' education. In particular, we do not observe a systematic grabbing of resources by men or women (even if the distribution is slightly more favorable to the latter). Children's shares are small but reasonable. Estimates with the baseline model go from around 19% of total household expenditure for one child to 26% 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. On the other hand, we find evidence of substantial economies of scale, in particular for men, implying that men in couples are likely in a better situation in terms of poverty than women. More generally, we note that adults in couples, who are apparently poorer than singles using measures simply based on per capita expenditures, are in fact greatly compensated by the gains from joint consumption (i.e., economies of scale). We also find a much larger incidence of poverty among children, and lower among adults. Our results compare well to those of Dunbar et al. (2012), whose estimates of children's share for Malawi rely on a relatively similar approach.

The paper is structured as follows. In Section 2, we present some facts about Côte d'Ivoire as well as empirical studies. In Section 3, we describe the model and the identification results. In Section 4, we present the functional form, the estimation method and the data. In Section 5, we report and discuss the main results. Section 6 concludes.

## 2 The Côte d'Ivoire in Perspective

The present paper is easily positioned in the vast literature on the measurement of child welfare in developing countries and, more specifically, in Côte d'Ivoire. 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, our objective here is to integrate these measures into a more structural framework and allow for more flexibility than the original Rothbarth approach.

The Côte d'Ivoire is one of the poorest countries in the world. It is ranked 164th out of 177 countries in the Human Development Index (OECD, 2008). Following a period of economic growth in the 1960s driven by coffee and cocoa exports, the country experienced an economic downturn triggered by unexpected drop in world prices of these goods at the beginning of the 1980s (Bourguignon and Berthélemy, 1996). This economic crises lead to increases in the incidence of poverty in the early 80s and late 90s. In addition the civil conflict that broke out in 2002 brought the country's economic activities to a standstill and disrupted basic social services delivery (World Bank, 2012) According to anti-poverty strategy document of the IMF (2009), the poverty rate has increased from 10% in 1985 to 48.9% in 2008. In 2008, the poverty ratio among men and women was 48.4% and 49.5% respectively, compared to 38.1% for men and 38.7% for women in 2002. The problem of child poverty is particularly severe. Sarbib et al. (1997) reports that many children live in very difficult and vulnerable conditions because of parental poverty.

Standard unitary models view households as behaving like a single unit, making decisions in the best interest of each member's well-being. However, there is overwhelming evidence that in Côte d'Ivoire household economies are much more complex. At any given time, a household is composed of several economic units, each with varying degrees of access to resources and diverse activities to which these resources are allocated (Sarbib et al., 1997). Consistent with this, Duflo and Udry (2004) find that different sources of income are allocated to different uses depending upon both the identity of the income earner. Hoddinott and Haddad (1995) also found that doubling women's share of cash income within Ivorian households raises the budget shares of food and lowers the budget shares of alcohol and cigarettes. Thus, it appears that economic decisions are made by sub-units of the household. In support of this idea, Haddad and Hoddinott (1994) show that income from 'male crops' tends to be put to different uses than income from 'female crops' which is at odds with a unitary model of the household. Such findings are more consistent with a general collective model based on the hypothesis of household efficiency[4] or a less conventional model in which the propensity to consume on specific goods depends on the income source according to social norms (as suggested by Duflo and Udry,

[4] See Chiappori and Donni (2011) for a survey of the literature on collective models.

2004, and anthropologists' studies). If the allocation of household resources is the outcome of a bargaining among spouses, as in collective models, women may be put in a weaker position because they lag behind men in key social indicators. According to the Strategy for Relaunching Development and Reducing Poverty (2009), women are concentrated in low productivity food production, informal and domestic activities. They earn lower wages than men in every sector of employment. For instance, in the informal sector where the average wage is one sixth that of the formal sector women earn an average of 33% as men. Given that at least 95% of the female labor force is employed in the informal and food sectors, these earnings differentials translate into wide gender disparities in access to and control of economically productive resources. Therefore women may well be disadvantaged in the bargaining process with their partner and be in difficult position within households. It is from this background that this study attempts to closely examine the mechanisms by which resources are allocated among household members and assess the implications of these decisions on individual poverty levels.

Finally, previous studies on Côte d'Ivoire concerned with resource allocation within households have focused primarily on examining if there is parental gender discrimination in the allocation of resources between children. Hoddinott (1992, 1994) and Deaton (1989) found no significant differential treatment between boys and girls. Deaton (1995) suggests that the failure to find 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. From a cultural point of view, Haddad et al. (1994) 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. More generally, evidence on boy-girl discrimination in developing countries often pertains to long-term expenditure ('productive' investments) on children, notably education and health (Sen, 1981). The advantage of the framework we suggest is that it allows testing directly for this type of discrimination, or the effect of other characteristics (like children's age) on child resources and boy-girl inequality. These tests were already available in the approaches suggested for instance by Deaton (1989, 1997). However, testing for determinants of child resources and gender discrimination is allowed here within a structural and very general model of household decision-making. Other studies have used direct anthropometric measures to study poverty among specific family members in Côte d'Ivoire and notably children. Thomas et al. (1996) examine the impact of public policies on child height, weight and BMI, in particular following 1980s economic adjustment programs, which were accompanied by reduced availability and quality of health care services and increases in relative food prices. Intra-household resource allocation in the context of polygamous households in Côte d'Ivoire is studied by Jacoby (1995) and Mammen (2009). The former notably finds that men have more wives when women are more productive in agriculture, controlling for men's wealth, due to lower shadow prices for wives as cheap labor. He assumes, however, that there are no productivity premiums on the share of family income a wife receives. The latter shows that the mother's rank in the polygamous household influences her child's school enrollment, school expenditures, work activities, and educational attainment in early adulthood. Her empirical results are consistent with a collective representation of the household.

# 3 Theoretical Framework

## 3.1 Collective Decisions, Preferences and Consumption Technology

We examine household consumption decisions for three types of households indexed by $n = 1$ 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 we suppose that $i = m$ indicates men, $i = w$ women and $i = c$ the children. The log household expenditure is denoted by $x$ and the vector of log prices by $\boldsymbol{p}$.

The model of household behavior is basically the same as that of Bargain and Donni (2012a); in a few words, it consists of three components: a set of utility functions, one for each individual living in the household, a set of scaling functions that characterize economies of scale and scope in consumption, and a set of sharing functions that define the relative allocation of household resources among the household members. In single-person households ($n = 1$), individual log resources are simply coinciding with household log expenditure $x$. In multi-person households ($n > 1$), however, individual log resources are equal to:

$$x + \log \eta_{i,n}(\boldsymbol{p}, \boldsymbol{z}) - \log s_{i,n}(\boldsymbol{p}, \boldsymbol{z}), \tag{1}$$

where $\eta_{i,n} > 0$ is a function representing the share of total expenditure accruing to individual $i$ in a household of type $n$, $s_{i,n} > 0$ the economies of scale that are associated to this individual, and $\boldsymbol{z}$ is a vector of individual and household characteristics. The utility of individual $i$ living in a household of type $n$ is then given by

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

where $v_i(\cdot, \boldsymbol{p}, \boldsymbol{z}_i)$ is a well-behaved indirect utility function and $\boldsymbol{z}_i$ is a vector of individual characteristics, with $\eta_{i,n}(\boldsymbol{p}, \boldsymbol{z}) = s_{i,n}(\boldsymbol{p}, \boldsymbol{z}) = 1$ if $n = 1$ by convention.

We then examine utility, sharing and scaling functions in greater details.

**Utility Functions $v_i(\cdot, \boldsymbol{p}, \boldsymbol{z}_i)$.** Two important points must be made. First, after controlling for the existence of joint consumption and the sharing of total expenditure, the utility function of each family member does not depend on the type $n$ of the household. Hence, differences in expenditure patterns between a person living alone and a person living with others are attributed to scaling and sharing functions only. The stability of individual preferences across household types is the key hypothesis behind our identification result.[5] This is also the case of the traditional Rothbarth method (Gronau, 1988, 1991). Second, 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 is made for the sake of parsimony but does not change the theoretical results. Also, it does not mean that we impose equal sharing among children: the total share 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.

**Sharing Functions $\eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$.** The decision process can be seen as a two-stage budgeting one, as supported by the collective approach (Browning et al., 1994). It is also compatible with social norms if the latter determine how total resources are divided between household members.[6] Whatever it may be, the representation used here is perfectly suited to our main purpose of retrieving individual 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 $\eta_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ of total expenditure $\exp(x)$. In a second stage, expenditures on all goods are chosen *as if* each individual solved her/his own utility maximization problem subject to an individual budget constraint, i.e., spent her/his own resources $\eta_{i,n} \cdot \exp(x)$. The sharing is a function of socio-demographic variables (e.g., age, education, region of residence) and, possibly, variables that capture the relative bargaining position of the parents, which is potentially important to explain the level of expenditure devoted to children. However, we assume that it does *not* depend on household total expenditure. This assumption is made, as in Lewbel and Pendakur (2008), Bargain and Donni (2012a) and Dunbar et al. (2012), for the sake of identification. In addition, as explained below, it implies that the indifference scales derived

[5]The idea of combining data on people living alone and in couples to retrieve the intrahousehold sharing of total expenditure is quite old but it enjoys a new popularity, as illustrated by recent papers by Couprie (2007), Lise and Seitz (2011) and Browning et al. (2008), for instance. Specifically, the contributions of Lewbel and Pendakur (2008) and Dunbar et al. (2012) are very similar to ours, as it will be explained below.

[6]Conversely, the two stage budgeting process is not compatible with social norms that directly interfere with the structure of consumption. Our objective here is not to decide between the alternative theories of the household. Some studies have rejected the efficiency hypothesis in developing countries (Duflo and Udry, 2004, for production choices in Côte d'Ivoire) while other studies tend to accept it (Rangel and Thomas, 2005, for West Africa). Whatever it may be, it is generally accepted that efficiency is more plausible in the case of consumption decisions than in the case of investment decisions.

from the model are independent of the level of utility, a desirable property most often imposed in the traditional literature on equivalence scales. While this restriction is potentially strong, it will fortunately be tested in the empirical section.[7] It will also be mitigated by including measures of household wealth other than total expenditure in individual shares. This point seems very important regarding the interplay between inter- and intra-household inequality.[8]

**Scaling Functions $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$.** The publicness of goods, and hence economies of scale in the household, is represented by a particular technology of consumption. 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 scale $s_{i,n} < 1$ is then interpreted as a measure of the cost savings experienced by person $i$ as a result of scale economies in the household. The so-called 'independent of the base' (IB) assumption refers to the fact that the scale is independent of the base expenditure (and hence utility) level at which it is 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 scaling functions $s_{i,n}(\boldsymbol{p}, \boldsymbol{z})$ may depend on all the individual characteristics of the persons living in the household and on the vector of prices.[9] They 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. Overall, 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. We suppose that these changes in the technology of consumption can be approximated by a variation of prices in the IB scales.

[7] Without this restriction, identification is still possible with strong parametric restrictions. This is the idea which is used to make tests in the empirical section of the paper. More interestingly, it can be shown that identification results still hold, theoretically at least, if expenditures on several adult goods are observable (Bargain and Donni, 2012a, Appendix A). Unfortunately, this is not the case in our empirical application.

[8] In particular, if the goods consumed by children have principally a luxury (necessary) nature by comparison with those consumed by parents, then the children's share should increase (decrease) with household income. This may augment (diminish) poverty among children. Alternatively, it is possible that children's share cannot fall below a certain minimum of resources, which will imply a different relationship between children's share and income. A more detailed discussion of this issue can be found in Bargain and Donni (2012b).

[9] Bargain and Donni (2012a) discuss in greater details the intuition of the IB scales while Lewbel and Pendakur (2008) present them as an approximation of Barten scales.

### 3.2 The Budget Share Equations and Identification

The individual budget share equations can be obtained from expression (2) and the Roy's identity. If we suppose that households are observed in a unique price regime (i.e, $\boldsymbol{p}$ is constant), as provided in cross-sectional data, the budget share equation for good $k$ of person $i$ living in household of type $n$ can be written:

$$\omega_{i,n}^k(x,\boldsymbol{z}) = \lambda_{i,n}^k(\boldsymbol{z}) + w_i^k\left(x + \log \eta_{i,n}(\boldsymbol{z}) - \log s_{i,n}(\boldsymbol{z}), \boldsymbol{z}_i\right) \qquad (3)$$
$$\text{for} \quad i = w, m, c, \quad n = 1,2,3, \quad \text{and} \quad k = 1,\ldots,K,$$

where $\lambda_{i,n}^k(\boldsymbol{z}) = \partial \log s_{i,n}(\boldsymbol{z})/\partial p_k$ is a price elasticity of the scaling function, as explained by Lewbel and Pendakur (2008). The left-hand side of this expression represents the 'reduced-form' budget share on good $k$ of person $i$ in household of type $n$ as a function of household (log) expenditure $x$ and household characteristics $\boldsymbol{z}$. The right-hand side puts some structure on this budget share as a result of the IB restriction, using a *basic* budget share equation $w_i^k(\cdot, \boldsymbol{z}_i)$ which is the same for all the types of household. Then 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 the household budget share function for households of any type $n$ as:

$$W_n^k(x,\boldsymbol{z}) = \sum_{i\in\varphi_n} \eta_{i,n}(\boldsymbol{z}) \cdot \left(\lambda_{i,n}^k(\boldsymbol{z}) + w_i^k\left(x + \log \eta_{i,n}(\boldsymbol{z}) - \log s_{i,n}(\boldsymbol{z}), \boldsymbol{z}_i\right)\right) \qquad (4)$$

for any good $k$, where $\varphi_n$ is the set of the index of persons living in a household of type $n$.

Before examining how the structural components of the model can be identified, we have to clarify two concepts: indifference scales and joint consumption. Firstly, the adjustment applied to total expenditure allowing a person living in a multi-person household to reach the same indifference curve if living alone is equal to $I_{i,n}(\boldsymbol{z}) = \eta_{i,n}(\boldsymbol{z})/s_{i,n}(\boldsymbol{z})$, where $I_{i,n}(\boldsymbol{z})$ is a so-called indifference scale. Indifference scales can be used to compare the welfare of the same individual in two different situations, living alone and living with a partner, with or without children; hence they are particularly useful to measure poverty at the individual level. In Section 5.5, we shall indeed describe an original measure poverty that exploits indifference scales. Secondly, the magnitudes of scaling functions $s_{i,n}(\boldsymbol{z})$ for different household types cannot be compared directly, since household members consume only a fraction of total expenditure. Then a normalized indicator of joint consumption for each individual is defined as:

$$\sigma_{i,n}(\boldsymbol{z}) = \frac{\eta_{i,n}(\boldsymbol{z})\left(1 - s_{i,n}(\boldsymbol{z})\right)}{s_{i,n}(\boldsymbol{z})\left(1 - \eta_{i,n}(\boldsymbol{z})\right)}, \qquad (5)$$

for $n \geq 2$, which is equal to 0 in the purely private case and to 1 in the purely public case. To give the intuition of this indicator, let us suppose that a constant proportion, say $\vartheta_{i,n}(\boldsymbol{z})$, of all the goods consumed by the other members in the household is consumed jointly by individual $i$. Then, $\eta_{i,n}(\boldsymbol{z})/s_{i,n}(\boldsymbol{z}) = \eta_{i,n}(\boldsymbol{z})+\vartheta_{i,n}(\boldsymbol{z})\times\left(1-\eta_{i,n}(\boldsymbol{z})\right)$. From this relationship and (5), it appears that $\sigma_{i,n}(\boldsymbol{z}) = \vartheta_{i,n}(\boldsymbol{z})$. If the proportion that is consumed jointly by individual $i$ is not the same for all the goods, it can be easily shown that $\sigma_{i,n}(\boldsymbol{z})$ is the weighted mean of the proportions for all the goods, with weights equal to budget shares for these goods.[10]

The main structural components of the model, $s_{i,n}(\boldsymbol{z})$ and $\eta_{i,n}(\boldsymbol{z})$, for $i = w, m, c$ and $n = 1, 2, 3$, are identified from the knowledge of the deterministic components $W_n^k(x, \boldsymbol{z})$. Since the terms that represent economies of scale in the budget share equations of children are meaningless in a world where young children always live within the same family structure (i.e., a household with two parents), however, they have to be normalized: $\lambda_{i,n}^k(\boldsymbol{z}) = 0$ and $s_{i,n}(\boldsymbol{z}) = 1$ for $i = c$, $n = 3$ and $k = 1, \ldots, K$. Formally, the main identification result that we use can be stated as follows.

**Identification.** *The econometrician observes at least one adult-specific good for each adult living in the household. More precisely, one good $k_m$ is consumed by men but not by women or children and one other good $k_w$ is consumed by women but not by men or children. The prices are constant. Then, under some regularity conditions (including the non linearity of budget share equations with respect to $x$) and normalizations, 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.*

The complete proof is presented by Bargain and Donni (2012a) in the case of couples with only one child. The result readily applies to the present context with several children for the reason that the utility functions of all the children are aggregated into a single representative index. We give here a simple sketch of the identification strategy, which is in three steps. (i) The basic budget share equations can be identified from a sample of single men and another of single women since preferences are stable across household types $n$. (ii) Once these functions are recovered, the sharing functions and scaling functions for $n = 2$ can be identified themselves from a sample of couples without children. This point is also proved by Lewbel and Pendakur (2008) with a different set of assumptions. (iii) Using expenditure on adult-specific goods, the adult's sharing and scaling functions for $n = 3$ can also identified with the same method as in (ii) from a sample of couples with children. Since the basic budget share equations of children are not known, however, the adding-up condition of sharing functions, i.e., $\sum_i \eta_{i,n}(\boldsymbol{z}) = 1$, has to be exploited to identify the children's share. Note that identification necessitates that regularity conditions be satisfied, namely, the second order derivative of the basic budget share equations with respect to log total expenditure must be different from zero (at least for some values of $x$).

[10] In that case, however, $s_{i,n}$ and $\sigma_{i,n}$ should be a function of $x$ as well. The IB hypothesis is then an approximation.

# 4 Empirical Implementation

## 4.1 Functional Forms

We turn to the empirical specification of the model and introduce an index $h$ for the household observed in the data. The first component, which appears in the specification of the different demographic groups, is the basic budget share equation. We assume individual preferences are consistent with a generalization of the Piglog indirect utility functions (Banks et al., 1997), so we can adopt the following quadratic specification:

$$w_{i,h,n}^{k} = a_i^k + b_i^k \boldsymbol{z}_{i,h} + c_i^k \cdot (x_{i,n,h} - \mu_i \boldsymbol{z}_{i,h}) + d_i^k \cdot (x_{i,n,h} - \mu_i \boldsymbol{z}_{i,h})^2 ,$$

$$\text{for } i = w, m, c \text{ and } k = 1, ..., K,$$

where $x_{i,n,h} = x_h + \log \eta_{i,n,h} - \log s_{i,n,h}$ represents the log resources for individual $i$ in household $h$ of type $n$; $a_i^k$, $b_i^k$, $c_i^k$, $d_i^k$ and $\mu_i$ are parameters and $\boldsymbol{z}_{i,h}$ are socio-demographic variables. The socio-demographic variables enter the specification both as a translation of budget share equations, and as a translation of log resources. For adults, they include age and dummies for no education, house ownership, urban residency and work participation (only for women), and for children, the number of children in the household, as explained in the theoretical section, the average age of these children, the proportion of boys, and dummies for urban residency and home ownership.[11] Other variables have also been used and will be discussed in the empirical section.

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

$$W_{n,h}^{k} = \sum\nolimits_{i \in \varphi_{n,h}} \eta_{i,h,n} \left[ \lambda_{i,n,h}^{k} + w_i^k \left( x_h + \log \eta_{i,n,h} - \log s_{i,n,h}, \boldsymbol{z}_{i,h} \right) \right] + \varepsilon_{n,h}^{k}, \tag{6}$$

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

$$\eta_{i,n,h} = \frac{\exp(\alpha_i^\eta + \beta_i^\eta \boldsymbol{z}_{i,h}^\eta)}{\sum_{j \in \varphi_{n,h}} \exp(\alpha_j^\eta + \beta_j^\eta \boldsymbol{z}_{j,h}^\eta)}, \qquad \text{for } i = m, w, c,$$

where $\alpha_i^\eta$ and $\beta_i^\eta$ are parameters and $\boldsymbol{z}_{i,h}^\eta$ are socio-demographic variables. For adults, the latter include all the variables in $\boldsymbol{z}_{i,h}$. For children, they include all the variables in $\boldsymbol{z}_{i,h}$ plus a dummy

[11] We do not account for children's participation in the labor market as children are young and do not work in our data. The bargaining power of older children who work is considered in Dauphin et al. (2011).

for mother's work participation. For the constants and the parameters of the variables that enter several individual indexes of the logistic function, normalization is required, hence the corresponding coefficients are simply set to zero. Second, from inversion of (5), the log *scaling functions* that translate expenditure within the basic budget shares are specified as:

$$s_{i,n,h} = \frac{\eta_{i,n,h}}{\sigma_{i,n,h} + \eta_{i,n,h} - \sigma_{i,n,h}\eta_{i,n,h}}, \quad \text{with} \quad \sigma_{i,n,h} = \alpha_i^{\sigma} + \beta_i^{\sigma} \boldsymbol{z}_{i,h}^{\sigma} \qquad \text{for } i = m, w,$$

where $\alpha_i^{\sigma}$ and $\beta_i^{\sigma}$ are parameters and $\boldsymbol{z}_{i,h}^{\sigma}$ are socio-demographic variables (here, they include only the number of children, with the restriction that $\sigma_{i,n,h} \in [0,1]$). Third, the function that translates the basic budget shares $\lambda_{i,n,h}^{k}$ is a price elasticity. As measuring price effects is generally challenging – and it is all the more difficult to capture their interaction with demographics in any plausible way – we proceed as follows. We first restrict the derivative of $\sigma_{i,n}$ with respect to log price of good $k$ to be a constant and that of $\eta_{i,n}$ to be zero. We then compute $\lambda_{i,n}^{k}$ as the derivative of the log of $s_{i,n}$ with respect to $p_k$.

### 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). These are obtained from reduced-form estimations of $x$ on all exogenous variables used in the model plus some excluded instruments (a third order polynomials in household disposable income). 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 three demographic groups are estimated simultaneously. The error terms are supposed to be uncorrelated across households but correlated across goods within households and they are also supposed to be homoskedastic for each family type. The method is detailed in Bargain and Donni (2012a).

## 5 Empirical Results

### 5.1 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, 2004; 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 adults are aged between $20-64$ years, which excludes another 6% of the sample. We drop households with children whose age is above 16 years – to ensure that we can distinguish children's clothing from adults clothing, as these are the central goods used in the identification of our model – and those under 16 who work (a marginal number in our sample). 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%) in our baseline estimations, 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 $2,739$ households (25% of the initial sample), described in Table 1.[12]

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 total expenditure shares, as explained in the previous section. In our estimations, however, we also consider other non-durable goods to improve the efficiency of the estimations, namely, food, transport and communication, personal goods and services, leisure goods and services, and household operations, as well as a child-specific good (i.e., child clothing).[13] Thus, our estimation uses observations for $K = 8$ non-durable commodities, 'household operations' being the omitted good in the Engel curve system. This system comprises 5 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 18 individual Engel curves.

Budget information is collected via a questionnaire where respondents are asked to report ex-

[12] This selection can potentially distort our measures of poverty. However, we have some reasons to believe that our results will not be significantly affected. Indeed, the aggregate poverty rate at the level of our study sample using the OECD poverty line (the exact definition of which is given below) amounts to 36%, which is of the same order of magnitude as the poverty rate in the extended sample including all the family types (38%). Of course, our results could still be misleading if the distribution of resources in the households of the study sample is very different from what is made in the rest of the population.

[13] Expenditure on housing cannot be completely ignored in our analysis as they may be an important contributor to household economies of scale and are also important when addressing poverty issues. To check the robustness of our results, we shall thus also consider a variation of the inital model with housing costs (composed of maintenance costs, rental costs and imputed housing costs for house owners). Note, however, that the size of the household may be correlated with housing decisions.

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

## 5.2 A First Look at the Data

Descriptive statistics of our sample by household type and the number of children are provided in Table 1. 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 schooling') in the aforementioned specification of the empirical model. Other characteristics are in 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, 2004, Udry and Woo, 2006).[14] Importantly for our purpose is the shift in consumption patterns 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 5.2% and 2.8% of their budget to women and men's clothing respectively, this drops to 4.4% and 2.6% (4.3% and 2.4%, 4.2% and 2.2%) respectively in couples with one child (two children, three children). 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 income 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., household operations, and to a less extent, transport) decreases. A simple interpretation is then that economies of scale are substantial, and not the same for all goods.[15] Economies of scale generate an effect that incites consumption

[14] The proportion is actually slightly greater than 50% but the list of goods included in our definition of total expenditure is not comprehensive.

[15] Economies of scale in food consumption may exist too. This is particularly the case for households with two adults relative to single adults living alone (Deaton and Paxson, 1998, Vernon, 2005, Browning et al., 2008). 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. As pointed out by Deaton (1997), the fact that children's food consumption 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 using the Engel approach. The Rothbarth

Table 1 — Summary Statistics of the Sample, by Family Type

| Family Type | Single Men | Single Women | Childless Couples | Couples with 1 child | Couples with 2 children | Couples with 3 children |
|---|---|---|---|---|---|---|
| Food | 0.595 | 0.624 | 0.569 | 0.603 | 0.610 | 0.616 |
| Transport and Communications | 0.106 | 0.067 | 0.109 | 0.085 | 0.081 | 0.071 |
| Personal Goods and Services | 0.126 | 0.124 | 0.115 | 0.103 | 0.102 | 0.103 |
| Household Operations | 0.093 | 0.128 | 0.103 | 0.099 | 0.093 | 0.090 |
| Leisure Goods and Services | 0.047 | 0.012 | 0.033 | 0.024 | 0.025 | 0.026 |
| Total Clothing | 0.049 | 0.053 | 0.080 | 0.093 | 0.099 | 0.102 |
| Women's clothing | _ | 0.053 | 0.052 | 0.044 | 0.043 | 0.042 |
| Men's clothing | 0.049 | _ | 0.028 | 0.026 | 0.024 | 0.022 |
| Children's clothing | _ | _ | _ | 0.024 | 0.032 | 0.038 |
| Men's no schooling dummy | 0.485 | _ | 0.467 | 0.509 | 0.533 | 0.583 |
| Women's no schooling dummy | _ | 0.557 | 0.616 | 0.696 | 0.731 | 0.766 |
| Men's age | 33.8 | _ | 36.2 | 35.0 | 37.0 | 38.7 |
| Women's age | _ | 39.3 | 28.6 | 26.8 | 28.3 | 30.2 |
| Women's participation dummy | _ | 0.849 | 0.522 | 0.444 | 0.479 | 0.580 |
| Urban dummy | 0.522 | 0.481 | 0.464 | 0.477 | 0.391 | 0.346 |
| House owner dummy | 0.231 | 0.283 | 0.370 | 0.387 | 0.473 | 0.543 |
| Proportion of male children | _ | _ | _ | 0.480 | 0.515 | 0.521 |
| Average age of children | _ | _ | _ | 3.813 | 5.040 | 5.889 |
| Total Expenditure per week (in CFA francs)* | 8,533 | 8,961 | 12,581 | 12,807 | 13,093 | 13,205 |
| Total Expenditure per week (in dollars)* | 12.2 | 12.9 | 18.1 | 18.4 | 18.8 | 18.9 |
| Proportion of zeros | | | | | | |
| Men's Clothing | 0.169 | _ | 0.170 | 0.218 | 0.245 | 0.203 |
| Women's Clothing | _ | 0.283 | 0.121 | 0.113 | 0.131 | 0.111 |
| Children's Clothing | _ | _ | _ | 0.086 | 0.060 | 0.054 |
| Sample Size | 945 | 212 | 289 | 444 | 499 | 350 |

Notes: *Household expenditures for goods selected in the 8 good demand system. The exchange rate is $1=697 CFA francs. Men in SubSaharan 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.

Table 2 – Weekly Expenditure on Clothing, by Family Type

| Family Type | Single Men | Single Women | Childless Couples | Couples with 1 child | Couples with 2 children | Couples with 3 children |
|---|---|---|---|---|---|---|
| Men's Clothing Expenditure per week in CFA francs | 344.9 | _ | 320.9 | 296.5 | 261.1 | 234.8 |
| Women's Clothing Expenditure per week in CFA francs | _ | 396.9 | 567.8 | 467.1 | 443.1 | 453.4 |
| Children's Clothing Expenditure per week in CFA francs | _ | _ | _ | 254.2 | 330.8 | 394.8 |

of private goods, substituting away from public goods.[16]

The idea that expenditure on men's, women's and children's clothing can be used as an indicator of individual welfare is illustrated in Table 2. We first observe that what is spent by single women on clothing is larger than what is spent by single men, indicating that the former likely have a more pronounced taste for clothing than the latter. Regarding the level of expenditure by men living in childless couples, it is even lower than when living alone while the level of expenditure by women is larger. On average single women (men) spend 397 (345) CFA francs on clothing per week while married women (men) spend 568 (321) CFA francs. This may suggests that, on average, women control a larger fraction of household resources than men. Alternatively, it cannot be excluded that men reduce their expenditure on clothing as a consequence of economies of scales. We will try to clarify these alternative interpretations in the next pages. We also observe that, not only the budget shares devoted to clothing but also the absolute value of expenditures drops with the number of children, confirming that children represent a cost for their parents. For instance, while the average weekly expenditure on male (female) clothing is 321 (568) CFA francs in childless couples, it drops to 296, 261 and 235 (467, 443 and 453) in couples with one, two and three children respectively.

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

approach based on adult goods avoids this critique.

[16] Instead of total expenditure for childless couples 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. Assuming the level of welfare in single families and in childless couples is comparable implies that savings derived from sharing amount to about 33%. This result is also consistent with Lazear and Michael (1980) who find with U.S. data that expenditures of two adults living together are $30 - 35\%$ lower than combined expenditure for two single-adult households.

for adult goods – a necessary condition for identification as mentioned above). To do so, we have performed reduced-form estimations on the subsample of each household type $n$. The budget shares for male and female clothing are regressed on age, the dummies for education, woman's participation, house ownership and urban residency, as well as the log total expenditure, its square and the Wu-Hausman residual. Estimates are available upon request. In a few words, the coefficient of the Wu-Hausman residual is negative and significant in all subsamples, except for female clothing in singles and for 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. The coefficients on log expenditure and its square are significant and show a quadratic pattern in most subsamples (see also Banks et al., 1997, Bargain and Donni, 2010 for a similar result). To illustrate the non-linearity of Engel curves, nonparametric kernel regressions and quadratic polynomial regressions for the Engel curves of our 8 commodity groups are represented in the Appendix A. Results show clear nonlinear behavior for most goods so that a double humped specification for the Engel curves is warranted. In particular, a highly nonlinear pattern for clothing is observed in our raw data: women's and men's clothing seem to be luxury goods for the smallest levels of total expenditure and a necessary good for the highest levels.

## 5.3 Total Expenditure Shares and Scaling Factors

In what follows we consider four variations of the model described above. The baseline model contains 194 parameters and the more general model 225 parameters. While the complete estimates are available from the authors, we focus here on scales and on total expenditure shares for adults and children. To begin with, we compute resource shares $\eta_{i,n}(\boldsymbol{z})$ at the average point of the sample for each family type and report the main results in Table 3. The model (a) – the baseline model – is estimated with the sample described in the previous section. We remark that, for all the family types, the average share of total expenditure is slightly larger for women than for men. For childless couples, the average women's share amounts to 0.517 while for couples with one, two or three children it amounts to 0.420, 0.401 and 0.380, respectively. However, standard errors are too large to draw clear conclusions about possible differences between men and women. The intuition suggested by descriptive data, according to which women seem to have the leading voice in the household, cannot be confirmed here. This result can be put into the perspective of the existing literature even if evidence is concentrated, to our knowledge, on developed countries. For instance, the average wife's shares, as estimated by Browning et al. (2008) on Canadian data and by Bargain and Donni (2012a) on French data, are in excess of 0.60. An exception is the study by Dunbar et al. (2012) in which larger shares for men in couples with several children are found in Malawi – the absolute share of husbands turns out to increase in families of several children compared to one-child families, in the spirit of Duflo (2003).

Table 3 – Total Expenditure Shares, Scaling Factors, and Indifference Scales

| | Model (a) Baseline Model | | Model (b) Model with identical $\sigma_{i,n}$ | | Model (c) Model with identical $\lambda_{i,n}$ | | Model (d) Model with Housing | |
|---|---|---|---|---|---|---|---|---|
| | Est | StdErr | Est | StdErr | Est | StdErr | Est | StdErr |
| Childless Couples | | | | | | | | |
| Shares of Women | 0.517 | 0.071 | 0.550 | 0.066 | 0.734 | 0.040 | 0.519 | 0.065 |
| Shares of Men | 0.483 | 0.071 | 0.450 | 0.066 | 0.266 | 0.040 | 0.481 | 0.065 |
| Scales of Women | 0.918 | 0.165 | 0.772 | 0.144 | 0.800 | 0.109 | 0.992 | 0.138 |
| Scales of Men | 0.509 | 0.202 | 0.694 | 0.208 | 0.344 | 0.105 | 0.594 | 0.197 |
| Indifference scale for women | 0.563 | 0.124 | 0.712 | 0.158 | 0.918 | 0.094 | 0.524 | 0.092 |
| Indifference scale for men | 0.950 | 0.295 | 0.648 | 0.163 | 0.774 | 0.285 | 0.809 | 0.223 |
| Couples with one child | | | | | | | | |
| Shares of Women | 0.420 | 0.075 | 0.457 | 0.078 | 0.608 | 0.051 | 0.458 | 0.065 |
| Shares of Men | 0.392 | 0.086 | 0.374 | 0.086 | 0.220 | 0.040 | 0.424 | 0.073 |
| Shares of Children | 0.188 | 0.114 | 0.169 | 0.124 | 0.172 | 0.062 | 0.118 | 0.076 |
| Scales of of Women | 0.859 | 0.190 | 0.695 | 0.176 | 0.692 | 0.130 | 0.938 | 0.146 |
| Scales of Men | 0.411 | 0.199 | 0.618 | 0.227 | 0.290 | 0.094 | 0.520 | 0.196 |
| Indifference scale for women | 0.489 | 0.128 | 0.658 | 0.172 | 0.879 | 0.147 | 0.488 | 0.094 |
| Indifference scale for men | 0.955 | 0.351 | 0.605 | 0.179 | 0.759 | 0.302 | 0.815 | 0.256 |
| Couples with two children | | | | | | | | |
| Shares of Women | 0.401 | 0.081 | 0.439 | 0.086 | 0.583 | 0.056 | 0.445 | 0.067 |
| Shares of Men | 0.375 | 0.091 | 0.359 | 0.092 | 0.211 | 0.040 | 0.411 | 0.076 |
| Shares of Children | 0.224 | 0.134 | 0.202 | 0.145 | 0.206 | 0.072 | 0.144 | 0.091 |
| Scales of Women | 0.825 | 0.183 | 0.675 | 0.190 | 0.669 | 0.134 | 0.886 | 0.144 |
| Scales of Men | 0.387 | 0.196 | 0.597 | 0.234 | 0.279 | 0.092 | 0.491 | 0.192 |
| Indifference scale for women | 0.486 | 0.134 | 0.651 | 0.181 | 0.871 | 0.158 | 0.502 | 0.100 |
| Indifference scale for men | 0.968 | 0.369 | 0.601 | 0.192 | 0.757 | 0.306 | 0.839 | 0.271 |
| Couples with three children | | | | | | | | |
| Shares of Women | 0.380 | 0.088 | 0.418 | 0.096 | 0.555 | 0.062 | 0.429 | 0.071 |
| Shares of Men | 0.355 | 0.098 | 0.342 | 0.099 | 0.201 | 0.041 | 0.397 | 0.080 |
| Shares of Children | 0.265 | 0.156 | 0.240 | 0.168 | 0.244 | 0.083 | 0.174 | 0.107 |
| Scales of Women | 0.787 | 0.199 | 0.651 | 0.216 | 0.643 | 0.138 | 0.834 | 0.157 |
| Scales of Men | 0.362 | 0.194 | 0.573 | 0.253 | 0.267 | 0.089 | 0.460 | 0.189 |
| Indifference scale for women | 0.483 | 0.154 | 0.643 | 0.206 | 0.863 | 0.170 | 0.514 | 0.116 |
| Indifference scale for men | 0.982 | 0.394 | 0.596 | 0.221 | 0.754 | 0.309 | 0.863 | 0.292 |

Note: Standard Errors are heteroskedastic-consistent.

To understand these results, the model (b) in which $\sigma_{i,n}$ are restricted to be the same for both spouses is also estimated. We note that the difference between women's and men's shares of total expenditure is more marked but still not significant. Overall it seems that incorporating economies of scales that are specific to both spouses as in the baseline model explains only a fraction of the differences in women's and men's expenditure on clothing observed in the raw data in Table 2. The model (c) in with $\lambda_{i,n}$ are restricted to be the same for male and female clothing will shed a new light on the problem. Estimates are now radically different and the average women's share is now much larger than one half. For childless couples, it amounts to 0.734 with a standard error equal to 0.040. The elasticity terms seem to play a major role here to explain the differences between singles' and couples' behavior illustrated in Table 2. Still it cannot be excluded that the $\lambda_{i,n}$'s have an alternative interpretation, independent from economies of scales. Our estimations may indeed be affected by a self-selection problem: for instance, women who marry may have a taste for their appearance and, on average, spend more on clothing. If so, the differences between singles and couples due to self-selection will enter the $\lambda_{i,n}$'s. If these terms are constrained to be the same for men and women, then selection into marriage will imply a significantly larger share of total expenditure for women. For these reasons, we believe that the results given by models (a) and (b) are more reliable; in particular, the restriction on the $\sigma_{i,n}$ in model (b) is, in our opinion, acceptable as an approximation. Finally, since expenditure on housing can hardly be ignored from our analysis as they may be an important contributor to household economies of scale,[17] the model (d) is also estimated. In this model, housing costs are incorporated in the system of budget share equations. Imputing these costs for rural households was a challenging empirical exercise but we have done so in the best possible way using regressions on a variety of dwelling characteristics. For this model, the estimations of women's and men's shares are not substantially different from those of the other models. Overall, if we reject the results of model (c) because based on too restrictive assumptions, the average women's share fluctuates from 0.517 to 0.550 for childless couples.

The estimations of the average children's share seems reasonable in magnitude and increases in a plausible way with household size (recall that we have not imposed any regularity in the sharing function in that respect). For model (d), the estimation of the average children's share is smaller but not inconsistent with those of the other models. They go from 0.118 to 0.188 for one child families, from 0.144 to 0.224 for two-children families, and from 0.174 to 0.265 in three-children families. For one-child families, the average child's share represents about 44% of the resource of the mother in the model (a), which is noticeably smaller than what is supposed in the modified OECD scale for which a child's need represents 60% that of an adult. The per capita shares become smaller with the number of children, as in Dunbar et al. (2012). For the model (a), each

[17] The implicit separability between durable and nondurable goods can be seen as relatively strong.

child receives a share of 0.112 in two-child families and a share of 0.088 in three-child families.[18]

Since goods may have a large public component, inequality at the level of individual shares does not necessarily imply a large difference in individual well-being. Economies of scale are represented by deflators $s_{i,n}(\boldsymbol{z})$, the estimates of which are shown in Table 3 (recall that the factors 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. The fact that these scales are much lower than 1 for men also underlines the possible existence of sizeable economies of scale in the household, which invalidates the traditional Rothbarth approach. For instance, a scale of 0.411 for a man without children in the model (a) suggests that his cost of living is 41% of the cost he would experience if living alone. The ratio of shares and scales defines indifference scales, which are close to 1.0 for men (with quite large standard errors, though) in the model (a) and around 0.5 for women. For instance, the household income, on average, must be multiplied by 0.563 (0.950) in order that a women (men) obtains the same level of welfare as single that she (he) obtains in a childless couple. In the model (b), the indifference scales for both spouses are around $06 - 0.7$. Indifference scales will be used later for measuring poverty at the individual level.

## 5.4 Estimates of the Main Parameters

To have a deeper understanding of the intra-household allocation process, the estimates of the parameters of sharing functions are presented in the upper panel of Table 4 for the four models. The estimates are consistent across all the models.[19] Several variables are explanatory of the intra-household distribution of resources. On the one hand, spouses' education seems to be related to larger fraction of total expenditure they receive (as well as their age but the latter is less significant). This is consistent with bargaining models of household, à la McElroy and Horney (1981), where the location along the efficiency frontier is determined by spouses' utility in the case of divorce. The share of total expenditure devoted to men is also positively related to urban residency, house ownership and woman's participation in the labor market, the interpretation of which is less obvious (for the moment, it worth noting that the three variables are indicators of the wealth/income of the household). On the other hand, the share of total expenditure devoted to children obviously increases with their number and their age. More surprisingly, it

[18] Multi-children families may benefit from large economies of scale which are not explicitly modeled here.

[19] In Appendix B, we also present the estimates of two additional models: the first one exploits information on men's, women's and children's clothing only and the second one exploits information on the other goods only. Interestingly, the estimates of the parameters for these two models are consistent with those for models (a)-(d). This can be seen as a confirmation of the robustness of our results.

Table 4 — Parameters of the sharing functions and the scaling functions

| | Model (a) Baseline Model | | Model (b) Model with identical $\sigma_{i,n}$ | | Model (c) Model with identical $\lambda_{i,n}$ | | Model (d) Model with Housing | |
|---|---|---|---|---|---|---|---|---|
| | Est | StdErr | Est | StdErr | Est | StdErr | Est | StdErr |
| Women's Index | | | | | | | | |
| Constant | – | – | – | – | – | – | – | – |
| Woman's age | 0.011 | 0.007 | 0.013 | 0.009 | 0.015 | 0.008 | 0.004 | 0.007 |
| Woman's no schooling | -0.243 | 0.120 | -0.257 | 0.146 | -0.261 | 0.108 | -0.152 | 0.101 |
| Woman's participation | -0.535 | 0.220 | -0.528 | 0.250 | -0.418 | 0.125 | -0.504 | 0.201 |
| Urban | – | – | – | – | – | – | – | – |
| Income | – | – | – | – | – | – | – | – |
| House owner | – | – | – | – | – | – | – | – |
| Men's Index | | | | | | | | |
| Constant | -0.620 | 0.328 | -0.649 | 0.379 | -1.155 | 0.277 | -0.639 | 0.301 |
| Man's age | 0.004 | 0.006 | 0.005 | 0.007 | 0.001 | 0.006 | 0.003 | 0.005 |
| Man's no schooling | -0.175 | 0.091 | -0.184 | 0.114 | -0.187 | 0.084 | -0.215 | 0.091 |
| Urban | 0.536 | 0.258 | 0.400 | 0.271 | 0.238 | 0.163 | 0.381 | 0.256 |
| House owner | 0.329 | 0.226 | 0.302 | 0.246 | 0.329 | 0.133 | 0.282 | 0.199 |
| Children's Index | | | | | | | | |
| Constant | -2.612 | 1.207 | -2.802 | 1.422 | -2.808 | 0.606 | -3.440 | 1.223 |
| Number of children | 0.221 | 0.086 | 0.220 | 0.088 | 0.221 | 0.038 | 0.226 | 0.068 |
| Proportion of male children | -0.151 | 0.126 | -0.152 | 0.129 | -0.145 | 0.073 | -0.122 | 0.096 |
| Average age of children | 0.022 | 0.016 | 0.021 | 0.016 | 0.020 | 0.009 | 0.020 | 0.013 |
| Urban | 2.769 | 1.136 | 2.828 | 1.314 | 2.400 | 0.512 | 3.446 | 1.178 |
| Woman's participation | 0.428 | 0.171 | 0.405 | 0.156 | 0.300 | 0.067 | 0.363 | 0.138 |
| House owner | 0.152 | 0.187 | 0.129 | 0.174 | 0.099 | 0.079 | 0.140 | 0.161 |
| Women's Scaling Function | | | | | | | | |
| Constant | 0.095 | 0.210 | 0.361 | 0.311 | 0.692 | 0.378 | 0.009 | 0.151 |
| Number of children | 0.023 | 0.066 | 0.009 | 0.088 | 0.000 | 0.000 | 0.047 | 0.052 |
| Men's Scaling Function | | | | | | | | |
| Constant | 0.902 | 0.577 | 0.361 | 0.311 | 0.692 | 0.378 | 0.632 | 0.441 |
| Number of children | 0.023 | 0.066 | 0.009 | 0.088 | 0.000 | 0.000 | 0.047 | 0.052 |

Notes: Standard errors are heteroskedastic-consistent. The men's, women's and children's indexes are the exponential functions entering the logistic function. The estimated parameters and the standard errors indicated by – in the women's index are set to zero for identification purpose.

appears that girls receive more than boys but the effect is not very significant (and not very robust as shown in Appendix B).[20] Our results do not really differ from those of 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.[21] Finally, the share of children increases with woman's participation, house ownership, and urban residency. The last effect, even if standard errors are large, is particularly strong and is also observed in the raw data. We thus observe that women who participates in the labor market (or who live in a urban area or who are houseowner) receive a smaller share of total expenditure while, at the same time, children receive a larger share. One possible interpretation is thus that the former forgo resources in favor of the latter, but the story is perhaps more complicated as the dummies for urban residency, woman's participation and house ownership have also a negative effect on women's share *in childless couples*.[22] Finally, we have also introduced a measure of household income in the explanatory variables of the adults and children's indexes, but it is not significant (t-ratio = 0.66 and −0.93, respectively, for the model (a)).[23] Several variables in our model (such as education, home ownership or even urban residency) can be seen as proxies for household income, though. To illustrate this, we thus divided our sample into two subsamples: the first one includes households with a total income below the median of the sample and the second one those with a total income above the median. For the model (a), the children's share in couples with one, two-child and three children is equal to 0.131, 0.158, 0.190, respectively, at the average point of the first subsample and equal to 0.291, 0.338, 0.389 at the average point of

[20] Nonetheless, the bias in favor of girls is also observed in the raw data. For instance, in three-children families, total expenditure on children's clothing amounts to 351, 404, 400 and 411 CFA francs when there are zero, one, two, or three girls, respectively. The same pattern is observed for one-and-two-children families.

[21] By comparison, Bhalotra and Attfield (1998) for food allocation among children in Pakistan draw the same conclusion as Deaton (1989). Evidence of gender discrimination is found in Rose (1999) for India and Dunbar et al. (2012) for Malawi. The literature on discrimination in health and education expenditures is vast and beyond the scope of our study. As discussed in Section 2, Deaton (1997) suggests that the absence of child gender bias may be due to women being economically productive in West Africa while Haddad et al. (1994) explains this from a cultural perspective.

[22] If we estimate a more general model where the value of the parameters for these three dummies may change when there is no child in the household, then we can no longer discern any significant effect. Specifically, the estimates of the parameters for the three dummies for a couple without children have the same sign than those for a couple with children, but they are smaller in terms of absolute value.

[23] Differences between spouses in terms of exogenous income may influence the overall structure of consumption and female and child shares. For instance, Thomas (1990) notes that unearned income in the hands of the mother has a bigger effect on child health. Here we cannot split total income between wife's and husband's income, for the reason that a large proportion of women in our selection do not work or are engaged in unpaid work and hence do not have income.

the second subsample. This suggests that the intra-household distribution of resources may be very unfavorable to children, in particular, in the poorest households.[24]

The lower panel of Table 4 shows the estimated parameters of the scaling functions. In the model (a), and even if estimates are not very precise, economies of scale seem to be quite large for men (according to our interpretation, joint consumption for men represents around 90% of the consumption of the other persons in the household) but very limited for women (around 10%), and independent of the number of children. For the model (b), in which $\sigma_{i,n}(\boldsymbol{z})$ are constrained to be the same, the level of joint consumption represents around 36% of the consumption of the other persons, which is very close of what we were expecting.[25] It is worth noting that the constraint on the $\sigma_{i,n}(\boldsymbol{z})$'s is not rejected at usual significance levels. Hence, we shall consider the models (a) and (b) that are two limit cases in the poverty analysis that follows.

## 5.5 Poverty Analysis

Estimated shares give us a sense of who gets how much in the household. Yet it does not tell 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 our estimations on the distribution of individual consumption for the different household members. To this end, we shall save on space and concentrate on the sole models (a) and (b). To begin with, a few descriptive statistics characterizing the distribution of total expenditure shares are presented in the upper panel of Table 5 for these two models. We observe that, in spite of the fact that they do not include unobserved heterogeneity, the dispersion of total expenditure shares is large. According to model (a), the total expenditure share of a man living in a childless couple varies between 0.281 and 0.694 (the lower and the upper bound of the support of the distribution) depending on the variables $\boldsymbol{z}$ while for a woman, it varies between 0.306 and 0.726. The distribution of children's share is positively skewed and largely dispersed as well.

To measure poverty in Côte d'Ivoire, we can use total expenditure $\exp x$ and simply divide it by the number of household members or alternatively by an arbitrary equivalence scale, using single individuals as the reference group. The per capita expenditure is broadly used in the development literature (Deaton, 1997). Poverty rates based on the modified OECD equivalence scales, i.e.,

[24] We have also incorporated some measures of total expenditure (in spite of the fact that our identification result supposes that this variables is exluded from the arguments of the sharing functions). They turn out to be not significant at usual significance level.

[25] 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 0.27 and 0.41). On US data, Nelson (1989) finds even larger economies of scale. See also footnote 16 on this point.

Table 5 — Poverty Rates and the Distribution of Individual Shares

| Family Type | Single Men | Single Women | Childless Couples | | Couples with 1 child | | Couples with 2 children | | Couples with 3 children | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Model I | Model II | Model I | Model II | Model I | Model II | Model I | Model II |
| Women's Shares | | | | | | | | | | |
| Minimum | | | 0.306 | 0.340 | 0.151 | 0.171 | 0.142 | 0.159 | 0.123 | 0.143 |
| | | | (0.074) | (0.085) | (0.045) | (0.051) | (0.043) | (0.048) | (0.041) | (0.046) |
| Median | | | 0.517 | 0.549 | 0.389 | 0.400 | 0.406 | 0.410 | 0.401 | 0.402 |
| | | | (0.060) | (0.066) | (0.057) | (0.075) | (0.062) | (0.090) | (0.065) | (0.100) |
| Maximum | | | 0.726 | 0.753 | 0.673 | 0.674 | 0.668 | 0.662 | 0.646 | 0.640 |
| | | | (0.057) | (0.062) | (0.054) | (0.099) | (0.057) | (0.110) | (0.064) | (0.128) |
| Men's Shares | | | | | | | | | | |
| Minimum | | | 0.281 | 0.247 | 0.190 | 0.162 | 0.172 | 0.146 | 0.139 | 0.123 |
| | | | (0.057) | (0.062) | (0.045) | (0.050) | (0.043) | (0.048) | (0.041) | (0.046) |
| Median | | | 0.482 | 0.451 | 0.331 | 0.313 | 0.349 | 0.325 | 0.356 | 0.333 |
| | | | (0.060) | (0.066) | (0.051) | (0.067) | (0.056) | (0.077) | (0.060) | (0.087) |
| Maximum | | | 0.694 | 0.660 | 0.561 | 0.546 | 0.562 | 0.545 | 0.539 | 0.519 |
| | | | (0.074) | (0.085) | (0.064) | (0.097) | (0.070) | (0.107) | (0.070) | (0.112) |
| Children's Shares | | | | | | | | | | |
| Minimum | | | | | 0.056 | 0.074 | 0.069 | 0.092 | 0.088 | 0.113 |
| | | | | | (0.037) | (0.094) | (0.046) | (0.113) | (0.057) | (0.134) |
| Median | | | | | 0.101 | 0.129 | 0.113 | 0.142 | 0.133 | 0.164 |
| | | | | | (0.064) | (0.141) | (0.070) | (0.156) | (0.081) | (0.175) |
| Maximum | | | | | 0.577 | 0.575 | 0.604 | 0.608 | 0.662 | 0.661 |
| | | | | | (0.081) | (0.096) | (0.078) | (0.092) | (0.076) | (0.093) |
| Aggregate Poverty | 0.144 | 0.104 | 0.211 | 0.211 | 0.318 | 0.318 | 0.439 | 0.439 | 0.506 | 0.506 |
| Women's Poverty Measures | | 0.104 | 0.216 | 0.194 | 0.372 | 0.349 | 0.349 | 0.336 | 0.377 | 0.366 |
| | | _ | (0.056) | (0.058) | (0.082) | (0.097) | (0.085) | (0.116) | (0.081) | (0.125) |
| Women's Poverty Measures, Adjusted | | 0.104 | 0.171 | 0.110 | 0.265 | 0.162 | 0.221 | 0.125 | 0.213 | 0.150 |
| | | _ | (0.059) | (0.066) | (0.095) | (0.099) | (0.098) | (0.110) | (0.115) | (0.172) |
| Men's Poverty Measures | 0.144 | | 0.249 | 0.277 | 0.414 | 0.468 | 0.403 | 0.455 | 0.386 | 0.438 |
| | _ | | (0.052) | (0.067) | (0.105) | (0.136) | (0.099) | (0.142) | (0.100) | (0.151) |
| Men's Poverty Measures, Adjusted | 0.144 | | 0.075 | 0.141 | 0.103 | 0.182 | 0.065 | 0.153 | 0.058 | 0.172 |
| | _ | | (0.061) | (0.076) | (0.088) | (0.117) | (0.063) | (0.137) | (0.085) | (0.192) |
| Children's Poverty Measures | | | _ | _ | 0.498 | 0.459 | 0.652 | 0.618 | 0.740 | 0.713 |
| | | | _ | _ | (0.078) | (0.149) | (0.063) | (0.140) | (0.060) | (0.130) |

Notes: Standard errors are in parenthèses. They are computed by bootstrap with 10000 replications.

the standard measure ignoring intra-household inequality, are reported under the 'aggregate' label in the lower panel of Table 5. More originally, we can also account for inequality *within* the household, that is, to use the resource shares $\eta_{i,n}(\boldsymbol{z})$ estimated for each adult member and for the children as a whole. Precisely, we compute the amount of household expenditure accruing to each adult individual as:

$$y_{i,n} = \exp(x + \log \eta_{i,n}(\boldsymbol{z})), \text{ for } i = w, m \text{ and } n = 1, 2, 3$$

with $\log \eta_{i,n}(\boldsymbol{z}) = 0$ for single individuals. For children, we calculate the individual expenditure per child as

$$y_{c,n} = \frac{\exp(x + \log \eta_{c,n}(\boldsymbol{z}))}{\text{number of children}}, \text{ for } n = 3,$$

i.e., child resources divided by the number of children in the household. The individual resources, calculated for each person in the sample, are then aggregated into a poverty measure, for instance the standard headcount ratio, assuming a certain poverty line $\overline{y}$. We use the World Bank's poverty line set at US$2 per day to identify poor adults. As in Dunbar et al. (2012), we use a US$1.20 per day poverty line for children, which means that children's needs are 60% that of adults (as in the modified OECD equivalence scale). The poverty levels arising therefrom are referred to as men's, women's and children's poverty in Table 5. Overall we find that poverty increases with household size when using the usual per capita measure, from 14% of single men and 10% of single women to 21% of childless households and 51% of households with three children (for a comparison, the World Bank reported a general poverty rate of 42% in 2002). It may be quite surprising that couples with and without children are significantly more affected by poverty than singles. Regarding individual measures, and for both models, we observe that poverty remain higher for persons in couples than for singles but it does no longer tend to systematically increase with the number of children. Indeed resources in larger households are skewed in favor of adults rather than children and, as indicated above, per capita expenditure for children decreases with the number of children. As the per capita measure over-estimates poverty levels for adults, it also under-estimates poverty among children, at least for large families. Dunbar et al. (2012) point to very similar results in Malawi.

When joint consumption is accounted for, however, the picture changes dramatically. Poverty of adults in couples goes down very substantially. This can be seen in Table 5, where a measure of poverty for adults adjusted for economies of scale is reported. This measure is based on

$$\widetilde{y}_{i,n} = \exp(x + \log I_{i,n}(\boldsymbol{z})), \text{ for } i = w, m \text{ and } n = 1, 2, 3$$

instead of $y_{i,n}$ as defined above for adults. This measure is original in the literature. With the estimates for model (a), we see that the poverty rate of married men in childless couples drops to

7% while that of married women drops at 17%. In all cases, the reduction in poverty levels is larger for men than for women, which reflects previous differences in scale economies between men and women. With the estimates of model (b) (recall that $\sigma_{i,n}(\boldsymbol{z})$ are constrained to be the same for both spouses), the poverty rates of persons in couples are broadly the same as for singles, which seems to be consistent with intuition. We note for instance that in childless couples, individual poverty rates amount to 19% (28%) for women (men) according to the unadjusted measure and decline to 11% (14%) after accounting for economies of scale. 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 that people must share resources.

## 5.6 Alternative Models

In Table 6, we first provide additional results aimed at checking the sensitivity of our results to alternative modeling strategies.

### 5.6.1 A Model with Single Mothers

The idea that children do better when their mothers control a larger fraction of family resources is prevalent. In developing countries, increases in the wife's income relative to the husband's have been shown to be associated with reduced expenditures on adult goods (for instance on alcohol and tobacco in Hoddinott and Haddad, 1995, or tobacco in Bhalotra, 2004, i.e., a good disproportionately consumed by male adults) or increases in child health, nutrition and survival probabilities (Thomas, 1994; Haddad and Hoddinott, 1994; Rose, 1994; and others). Similar results are obtained by Schluter and Wahba (2010) using PROGRESA in Mexico. Exploiting the expansion of the South African pension system as a natural experiment, Duflo (2003) also finds evidence that grandmothers are altruistic while grandfathers are not.

In the present framework, we are theoretically able to estimate single parents' transfers to children. We however refrain to directly identify male and female differences in altruism toward children in such a way. This would require a larger sample of single parents, including both single mothers and single fathers (who are too rare); it would also require the assumption that single parents are not too specific so that they can be used for the identification of core parameters like a gender-specific altruism parameter (male/female parameter in the children's share). Nonetheless, estimations of the sharing rule in a model with single mothers provide suggestive evidence of how children's resources change when the husband does not enter the picture (the pure 'mother's view' on fair resource allocation). These results do not allow, however, quantifying the relative roles of female bargaining power versus male/female dissonance on altruism toward children.

## Table 6 – Total Expenditure Shares and Scaling Factors for Various Models

| | Model with Single Mothers | | Model with Unitary Parents | | Gronau-Rothbarth Model | | Dunbar-Lewbel-Pendakur Model with Malawi Data | |
|---|---|---|---|---|---|---|---|---|
| | Est | StdErr | Est | StdErr | Est | StdErr | Est | StdErr |
| Single women with one child | | | | | | | | |
| Shares of Women | 0.694 | 0.309 | _ | _ | _ | _ | _ | _ |
| Shares of Children | 0.306 | 0.309 | _ | _ | _ | _ | _ | _ |
| Scales of Women | 0.951 | 0.231 | _ | _ | _ | _ | _ | _ |
| Childless Couples | | | | | | | | |
| Shares of Women | 0.561 | 0.073 | _ | _ | _ | _ | _ | _ |
| Shares of Men | 0.439 | 0.073 | _ | _ | _ | _ | _ | _ |
| Shares of Both Adults | _ | _ | _ | _ | _ | _ | _ | _ |
| Scales of Women | 0.804 | 0.129 | _ | _ | _ | _ | _ | _ |
| Scales of Men | 0.715 | 0.196 | _ | _ | _ | _ | _ | _ |
| Scales of Parents | _ | _ | _ | _ | _ | _ | _ | _ |
| Couples with one child | | | | | | | | |
| Shares of Women | 0.430 | 0.076 | _ | _ | _ | _ | 0.373 | 0.042 |
| Shares of Men | 0.337 | 0.078 | _ | _ | _ | _ | 0.400 | 0.045 |
| Share of Both Adults | _ | _ | 0.781 | 0.384 | 0.889 | 0.040 | | |
| Shares of Children | 0.232 | 0.103 | 0.219 | 0.384 | 0.111 | 0.039 | 0.227 | 0.036 |
| Scales of of Women | 0.708 | 0.173 | _ | _ | _ | _ | _ | _ |
| Scales of Men | 0.620 | 0.228 | _ | _ | _ | _ | _ | _ |
| Scales of Parents | _ | _ | 1.001 | 0.708 | 1.000 | _ | _ | _ |
| Couples with two children | | | | | | | | |
| Shares of Women | 0.408 | 0.081 | _ | _ | _ | _ | 0.221 | 0.043 |
| Shares of Men | 0.319 | 0.081 | _ | _ | _ | _ | 0.462 | 0.051 |
| Shares of Both Adults | _ | _ | 0.724 | 0.578 | 0.857 | 0.045 | _ | _ |
| Shares of Children | 0.273 | 0.119 | 0.276 | 0.578 | 0.143 | 0.045 | 0.317 | _ |
| Scales of Women | 0.688 | 0.182 | _ | _ | _ | _ | _ | _ |
| Scales of Men | 0.601 | 0.234 | _ | _ | _ | _ | _ | _ |
| Scales of Parents | _ | _ | 1.001 | 0.551 | 1.000 | _ | _ | _ |
| Couples with three children | | | | | | | | |
| Shares of Women | 0.383 | 0.088 | _ | _ | _ | _ | 0.176 | 0.044 |
| Shares of Men | 0.300 | 0.085 | _ | _ | _ | _ | 0.466 | 0.053 |
| Shares of Both Adults | _ | _ | 0.659 | 0.795 | 0.817 | 0.056 | _ | _ |
| Shares of Children | 0.317 | 0.136 | 0.341 | 0.795 | 0.183 | 0.056 | 0.358 | 0.050 |
| Scales of Women | 0.665 | 0.192 | _ | _ | _ | _ | _ | _ |
| Scales of Men | 0.578 | 0.240 | _ | _ | _ | _ | _ | _ |
| Scales of Parents | _ | _ | 1.000 | 0.189 | 1.000 | _ | _ | _ |

Note: Shares and Scales are computed at the average point of the sample. The estimates of the Dunbar-Lewbel-Pendakur model are those of Table 2 (SAP&SAT model). The other estimates of the Dunbar-Lewbel-Pendakur model are similar

To be more precise, we estimate a model which incorporates single mothers with one child as an additional family type (the sample of single mothers with one child includes only 95 observations but sample sizes for other types of single parent families are even smaller). The specification of utility functions, sharing functions and scaling functions is the same as in the previous model (with identical $\sigma_{i,n}$ for adults in couples). The individual shares computed at the average point of the sample for this extended model are exposed in the second column of Table 6. We find that, in single mother families, children receive a slightly larger share of the household resources (0.305) than in two-parent families (0.232). Such a difference cannot be justified by a divergence in the average characteristics of children in single mother families and in two-parent families (in particular, the child in single mother families is generally older) because children's share are computed at the same point of the sample. We note also that the scaling factor is close to one – thereby indicating that joint consumption for single mothers with one child is very limited and confirming results in the previous section. Actually what is spent for children by single mothers or by couples is actually of the same order of magnitude (i.e., $2,990$ CFA francs per week for the former and $2,977$ CFA francs for the latter). Hence, we cannot conclude that mothers are more altruistic towards children than fathers. It would seem that, whatever is the family structure, children receive a constant minimum of resources that allows them to meet their needs. Unfortunately, large standard errors do not allow drawing clear conclusions here. It is worth noting also that the share devoted to their child by single mothers increases with the age of the child. It is also larger for girls than for boys, as in the baseline model. Detailed results are available upon request.

#### 5.6.2 Other Models

We also suggest two alternative empirical strategies, relying on the same fundamental identifying principle. The objective is to extend the comparison with Dunbar et al. (2012) and to consolidate the general method based on adult clothing. We check 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).

We start with a model which is closer to that of Dunbar et al. (2012) in the sense that we now restrict our estimations to observations on couples only. The parents are treated as a unitary couple, so that we focus only on sharing between parents and children. This is more parsimonious – the distribution of resources between spouses has not be specified – than in the other approaches, but not really costly in terms of realism. Indeed, in the absence of price variation and distribution factors, unitary models cannot be empirically distinguished from collective ones. Childless couples now serve as the reference group (couples with one child in the case of Dunbar et al., 2012). 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'. Denote $k_a$ an adult-specific good, the household budget share for that good in a childless couple is:

$$W_2^{k_a}(x, \boldsymbol{z}) = w_a^{k_a}(x, \boldsymbol{z}_a), \tag{7}$$

so the basic budget shares of parents are identified 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:

$$W_3^{k_a}(x, \boldsymbol{z}) = \eta_{a,3}(\boldsymbol{z}) \cdot \left[\lambda_{a,3}^{k_a}(\boldsymbol{z}) + w_a^{k_a}\left(x + \log \eta_{a,3}(\boldsymbol{z}) - \log s_{a,3}(\boldsymbol{z}), \boldsymbol{z}_a\right)\right]. \tag{8}$$

The identification principle is basically the same as in Proposition 1, except that parents' basic share are now recovered from childless couples, and the empirical results are exposed in Table 6. We first note that children's shares are of the same order of magnitude as in the model (a), but standard errors are much larger. The conclusion is that it is difficult to obtain precise results without information on single families. We also remark that the scaling factor is close to one, indicating that children does not generate economies of scale.

For the last variation of the model, we again suppose that the chosen reference demographic group is childless couples. Then we ignore scale economies, i.e., assume $\lambda_{a,n}^{k_a} = \log s_{a,n} = 0$. The framework is then very similar to the traditional Rothbarth model using childless couples to retrieve parents' basic budget shares.[26] The household budget share for the adult good $k_a$ in couples with children is then:

$$W_3^{k_a}(x, \boldsymbol{z}) = \eta_{a,3}(\boldsymbol{z}) \cdot \left[w_a^{k_a}\left(x + \log \eta_{a,3}(\boldsymbol{z}), \boldsymbol{z}_a\right)\right]. \tag{9}$$

With this model, we observe that children's shares are notably 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, 2012).

### 5.6.3 Comparison with Dunbar et al. (2012)'s study

At this stage, it may be interesting to make a comparison with the method suggested by Dunbar et al. (2012), already mentioned in the introduction. Both studies rely to some extent on the stability of individual preferences across household types and on adult clothing to identify children's share. The identification result of Dunbar et al. (2012) also exploits child goods, which is not necessary in our case, even if it may improve the precision of the results. Another difference

[26] Alternatively, it would have been possible to use singles as the base unit, as in our baseline model or in Gronau (1991)'s model.

is the fact that we are using information on single individuals while their approach simply relies on couples. Our approach is, in a sense, more restrictive since we assume preference stability across more household types and, notably, between individuals alone and in a family. Nevertheless, Dunbar et al. (2012) are incited to make assumptions on the stability of preferences *across* people living in the household to obtain precise results, and some of their identification relies on parametric forms. Finally, our approach allows recovering economies of scale and indifference curves. The latter are required to compare the living standard of singles and persons in couple (with children or not). Unsurprisingly, our approach uses more structure so that it is possible to recover more elements of the decision process.

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. Some of the results of Dunbar et al. (2012) are reproduced in Table 6. Even though the empirical approaches and the countries are different, the children's shares are relatively close and perfectly consistent. For couples with one, two and three children, shares are 0.23 (0.19), 0.32 (0.22) and 0.36 (0.26) in their (our) case. The similarity of results concerning children's shares is not surprising – and surely reassuring – given that the two studies use the same fundamental principle to recover them, i.e., the Rothbarth idea of measuring how the consumption of adult goods vary across different household types.

# 6 Conclusion

In this paper, we estimate the share of household resources accruing to adults and children in Côte d'Ivoire. Generalizing the 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 is one of the rare applications of collective models on data from a developing country. 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 for men and can explain the differences in behavior between single and married persons. Parents' expenditures made for children living in the household range between 20% of total resources for couples with one child and 25% for those with three children. 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.

Interestingly, our results on the total expenditure share of children are very similar to that obtained under different identifying assumptions, and notably when using only observations for couples. Imposing the restriction that parents behave as a single unit ('unitary' parents) also lead to similar results while ignoring economies of scale seems to under-estimate children's share. Our results are also similar to those obtained by Dunbar et al. (2012) with a slightly different methodology and data from Malawi. 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.

Several limitations of the present paper could inspire further research. First, a contribution of the present paper was to introduce more flexibility, in the form of terms accounting for publicness in consumption, in a Rothbarth approach using singles as the reference group for adults. However, as previously discussed, scaling factors may also capture consumption externalities or changes in individual preferences across household types. A lot remains to be done to disentangle these different interpretations. Second, individual shares for each child can, in principle, be retrieved by extending the 'Russian dolls' logic of the Rothbarth method. 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. This identification is however more fragile since it may require that the second derivatives of the children's budget shares with respect with expenditure be all different. We keep this for future research. Third, two factors may contribute to explain the apparently high rate of child poverty and deserve further investigation. One is scale economies from multiple children households. This could not be modelled easily in the present framework, as previously discussed, but deserves some attention. The other is domestic production: child poverty from expenditure data would be overstated if children consume relatively more of the goods produced within the household.

# Appendix

## Appendix A: Nonparametric Regressions

In all kernel regressions we use the Gaussian kernel and 0.5 for the bandwidth. In all polynomial regressions a quadratic specification is used with the exception of men-clothing where a cubic specification better approximates our data.

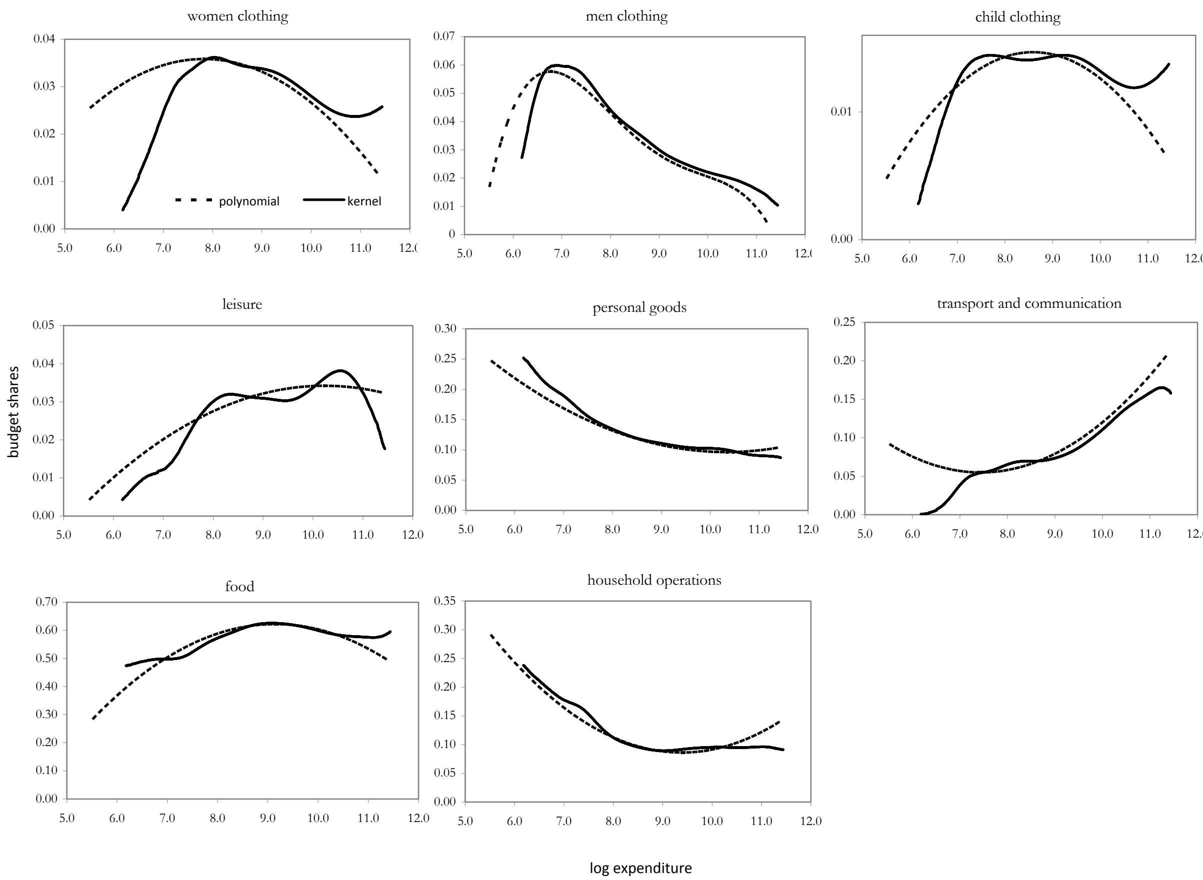


Fig. A.1 Nonparametric Engel Curves

## Appendix B: Further Models

In Table A.1, the estimated parameters for two additional models are presented. The first one – model (e) – exploits information on men's, women's and children's clothing and a residual good while the second one – model (f) – exploits information on food, transport and communication, personal goods and services, and leisure goods and services, and a residual good. To increase the efficiency of the estimators, the specifications used in models of Table A.1 are slightly simplified: the parameters for the translation of resources in budget share equations are set to zero and the joint consumption indicators are constrained to be the same. Note that estimation of these two models relies on completely different information. Moreover, the model (f) does not satisfy the conditions necessary for applying our identification result. Identification is thus partially attained thanks to parametric restrictions (recall that Lewbel and Pendakur (2008) have shown that individual shares can be identified in childless couples). Unsurprisingly, standard errors for this model are much larger and estimates are imprecise. Taking this into account, results are reasonably consistent between them. The only coefficient which is clearly contradictory between model (e) and (f) concerns the effect of the proportion of boys on the share devoted to children.

Table A1 – Parameters of the sharing functions and the scaling functions

| | Model (e) Model with Clothing Only | | Model (f) Model with Other Goods Only | |
|---|---|---|---|---|
| | Est | StdErr | Est | StdErr |
| Women's Index | | | | |
| Constant | _ | _ | _ | _ |
| Woman's age | 0.008 | 0.008 | 0.047 | 0.029 |
| Woman's no schooling | -0.158 | 0.094 | -1.051 | 0.393 |
| Woman's participation | -0.506 | 0.149 | -2.817 | 0.651 |
| Urban | _ | _ | _ | _ |
| Income | _ | _ | _ | _ |
| House owner | _ | _ | _ | _ |
| Men's Index | | | | |
| Constant | -0.864 | 0.402 | -2.938 | 0.952 |
| Man's age | -0.007 | 0.008 | 0.033 | 0.022 |
| Man's no schooling | 0.013 | 0.102 | -1.484 | 0.430 |
| Urban | 0.217 | 0.194 | 1.499 | 0.573 |
| House owner | 0.330 | 0.166 | 1.165 | 0.499 |
| Children's Index | | | | |
| Constant | -2.412 | 1.003 | -2.583 | 0.920 |
| Number of children | 0.262 | 0.058 | 0.090 | 0.158 |
| Proportion of male children | -0.223 | 0.111 | 1.126 | 0.463 |
| Average age of children | 0.024 | 0.014 | 0.020 | 0.038 |
| Urban | 2.042 | 0.974 | 3.800 | 0.817 |
| Woman's participation | 0.364 | 0.108 | 1.409 | 0.582 |
| House owner | 0.110 | 0.124 | -0.623 | 0.503 |
| Women's Scaling Function | | | | |
| Constant | 0.455 | 0.566 | 1.000 | _ |
| Number of children | 0.061 | 0.000 | 0.000 | _ |
| Men's Scaling Function | | | | |
| Constant | 0.455 | 0.566 | 1.000 | _ |
| Number of children | 0.061 | 0.000 | 0.000 | _ |

Notes: The parameters of the scaling functions are imposed to be the same for both spouses. Standard errors are heteroskedastic-consistent. The men's, women's and children's indexes are the exponential functions entering the logistic function. The parameters indicated by – in the women's index are set to zero for identification purpose.

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