Intra-household Resource Allocation and Poverty: The Ghanaian Case

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Abstract

Most standard poverty indices are determined using per-capita calculations and hence ignore intra-household inequality. Using the largest and most recent household survey data set available for Ghana, we investigate power dynamics in the household by estimating the share of total resources allocated to each member of the household using a collective model developed by Dunbar, Lewbel, and Pendakur (2013). These resource shares are used to compute individual poverty rates for household members. Our findings indicate that while fathers command a significantly larger share of household resources than mothers, mothers bear a higher proportion of the cost of children, resulting in a higher incidence of poverty in Ghana for women and children. The results also indicate that poverty in Ghana is mostly overstated when standard poverty measures are used. Finally, we discuss the implications of the results for the LEAP programme, a social cash transfer scheme aimed at reducing extreme poverty in Ghana.

JEL Codes: D12, D13, I31, I32, J12, J13

Keywords: intra-household inequality, resource shares; collective model, poverty measures, LEAP

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1 Introduction

Although advances have been made in estimating resource shares within the household, most measures of poverty implicitly assume that resources are shared equally amongst household members. Using health measures such as weight, height, and calorie intake, studies such as Haddad and Kanbur (1990) have shown that with fewer resources to go round, intra-household inequality is likely to be particularly high in poor regions. Therefore, accessing the share of resources that each household member commands is indispensable in understanding the nature of poverty in these deprived areas. Moreover, this kind of study makes available crucial information that policy makers need in the planning and execution of effective redistributive policies. According to the World Bank (2016), over half of the extreme poor live in sub-Saharan Africa making this region the poorest in the world. Studies of intra-household inequality in sub-Saharan African countries are however, relatively, few.

This paper contributes to the literature on sub-Saharan Africa by investigating intra-household resource allocation in Ghana, a lower-middle income country located along the West African coast. With a per capita GDP of US$3,940 (2011 PPP) in 2013, about a quarter of its population of roughly 26 million is estimated to be poor. The economy of Ghana is largely an agriculture-based one with 52% of households owning farms and 45% of the economically active population working in the agricultural sector (Ghana Statistical Service, 2014b). Ghana is suitable for an analysis of this kind for two reasons. First, although poverty rates are declining in Ghana, poverty reduction is dampened significantly by increasing inequality in household consumption. According to Cooke et al. (2016), the Gini index for the country increased from 37.5 to 40.8 between 1992 and 2013. Identifying the household members that are disproportionately poor is therefore crucial if this trend is to be reversed. Second, we exploit the largest and most recent household survey data set for Ghana, the Ghana Living Standards Survey Round 6 (GLSS 6). This data set is suited to the kind of analysis we carry out in this paper because the household expenditure module is highly disaggregated and particularly rich.

By applying a collective household model originally developed by Dunbar, Lewbel, and Pendakur (2013) (DLP hereafter) to a sample drawn from GLSS 6, we propose estimates of resource shares for individual household members and compute poverty rates that are adjusted for unequal resource allocation within the household. To the best of my knowledge, this paper is the first to estimate resource shares for Ghanaian households and one of the rare applications of collective models to developing countries in sub-Saharan Africa. Other applications of collective models in sub-Saharan Africa include DLP and Bargain, Donni, and Kwenda (2014) (BDK hereafter), which estimate resource shares for nuclear households in rural Malawi and Côte D'Ivoire, respectively. Although these papers use slightly different identifying assumptions, both papers are very similar in their conclusions for poverty, in that, they find that standard poverty indices underestimate child poverty and overestimate poverty among adults. The findings of this paper indicate that the results of DLP and BDK may not be completely generalizable to other sub-Saharan African countries.

Our results show that fathers have the highest bargaining power in the household as they command the largest share of household expenditures. Although mothers command a smaller share of household resources, they bear a higher proportion of the cost of children. This result is in line with the findings of Duflo (2003) and Duflo and Udry (2004), who show that an increase in a woman's income leads to increased expenditure on goods which favour children, such as education and health care, in South Africa and Côte D'Ivoire, respectively. Compared to DLP and BDK, children in Ghana command a relatively large share of total household resources, beginning at 29% for one-child households and reaching 43% for households with four children. Additionally, this study shows that, on average, the resource share of mothers is approximately 10 percentage points lower than those of fathers and children. This is also in contrast to DLP and BDK, who find that children receive the lowest share of household resources on average.

With regard to poverty, there are a lot more households with poor women and children than there are with poor men. Assuming equal shares within households overstates the incidence of poverty in Ghana, except for women who have less than three children. The results also show that the incidence of child poverty rises as the number of children in the household increases. On average, per capita calculations yield a poverty rate of 36% for the entire sample while unequal shares yield poverty rates of 15% for fathers, 34% for mothers and 31% for children.

Unlike DLP and BDK, women and not children tend to have the highest poverty rates in Ghana. Lastly, we illustrate the importance of this kind of study for development policies by discussing the implications of the results for the Livelihood Empowerment Against Poverty (LEAP) programme in Ghana, a social cash transfer scheme that is aimed at alleviating extreme poverty in Ghana.

The rest of the paper is organized as follows. Section 2 presents a survey of the literature on collective models and gives a brief overview of the DLP model. Section 3 describes the data set by providing summary statistics, and discusses the specification of the model we estimate. Section 4 presents the main results of the paper. Section 5 discusses the implications of the main findings for LEAP and section 6 concludes.

2 Theoretical Framework

This section presents the theoretical framework on which the empirical analysis is based. The first part of the section provides a brief survey of the literature on collective household models and the second part gives a more detailed overview of the DLP framework we apply in this paper.

2.1 The Collective Household Model

The collective household model is currently the most popular framework for modelling household decision making. It was first developed by Chiappori (1988, 1992) and Apps and Rees (1988) following the rejection of many of the predictions of the unitary model.[1] Chiappori (1988) generalized the work of Manser and Brown (1980) and McElroy and Horney (1981) who modelled household decision-making processes using tools from cooperative game theory. Collective household models recognize that the household is made up of different individuals, each characterized by his or her own preferences. They also assume that these individuals collectively take Pareto-efficient decisions. A number of studies such as Bourguignon et al.

[1]See Alderman et al. (1995) and Doss (1996) for a detailed discussion on the rejection of the predictions of the unitary model.

(1993), Browning and Chiappori (1998), Chiappori and Ekeland (2006) and Bourguignon et al. (2009) have since further elaborated the model.

In earlier applications of the collective model, a series of papers show how changes in distribution factors help to identify *changes* in resource shares but not the actual *levels* of resource shares (see Chiappori and Ekeland, 2009 for a formal proof of this). Browning et al. (1994), Chiappori et al. (2002) and Vermeulen (2002) are examples of such papers. Distribution factors are observed socio-demographic factors that affect the sharing rule within the household but not the preferences of household members or the household's budget constraint. Although they are still used in the literature, it can be difficult to test the validity of some commonly used distribution factors such as relative wage and relative age.

Fortunately, recent variants of the collective model not only identify the *levels* of resource shares, but also do not require distribution factors in the identification process. For instance, Cherchye et al. (2011) and Cherchye et al. (2015) identify resource shares by applying revealed preference theory. The more popular approach, pioneered by Browning, Chiappori, and Lewbel (2013) (BCL hereafter), identifies resource shares by imposing additional restrictions on individual preferences of household members and also allows for general forms of scale economies to consumption. In particular, BCL imposes the identifying assumption that childless couples generally have the same preferences for goods as their single counterparts. This allows for the identification of resource shares since the demand functions of single men and women can be observed directly from households consisting of only one individual. However, the BCL model is very complex and difficult to estimate because it does not assume any structure for its parameters. Lewbel and Pendakur (2008) simplify the BCL model by imposing an additional restriction that provides some structure on some parts of the model. This allows for the identification of resources shares from Engel curves (demand curves keeping prices constant) rather than the complex nonlinear system that BCL use. Bargain et al. (2010), Bargain and Donni (2012) and BDK further extend the BCL model to identify the resource shares of children.

The DLP model is also an extension of BCL. This model currently offers the most attractive model for the study of intra-household resource distribution because, compared to other BCL-type models, it imposes relatively milder assumptions on individual preferences, has lower data requirements and is easier to implement empirically. DLP identifies resources shares by making two identifying assumptions. First, resource shares are assumed to be independent of household expenditure. Second, the DLP model imposes at least one of two semi-parametric restrictions on the shape of Engel curves. The SAP (Similar Across People) restriction assumes that in certain limited ways, the preferences of individuals within households with a particular number of children are similar. This would imply that individuals in one-child households for instance, have similar tastes. The SAT (Similar Across Types) restriction, on the other hand, assumes that the preferences of individuals are similar across household types so that fathers for example, have similar preferences irrespective of the number of the children they have. Hence, unlike the other BCL-type models, the DLP model does not impose that fathers and mothers have the same tastes as single men, single women, and childless couples, and therefore does not require data on these household types. Also, the DLP model imposes these restrictions only on the Engel curves of a set of private assignable goods. This is also in contrast to the other BCL-type models which impose their identifying restrictions on all goods.

2.2 The DLP Framework

As already indicated, the DLP model allows for parents' bargaining and the joint consumption of goods that gives rise to economies of scale. Let the subscripts t and s represent individual and household types, respectively. In this application of the DLP model, four household types are investigated. Household types are determined by the size of the household; $s = 1, 2, 3, 4$ indexes couples with one, two, three, and four children, respectively. Each household consists of three individual types: an adult male or father denoted by $t = m$, an adult female or mother denoted by $t = f$ and children denoted by $t = c$. Good types are denoted by the superscript $k = 1, ..., K$. A household of type s purchases the vector of quantities of goods $z_s = (z_s^1, ..., z_s^K)$ at market prices $p = (p^1, ..., p^K)$, while each household member consumes $x_t = (x_t^1, ..., x_t^K)$, the vector of private good equivalents of z_s. Let y denote total household expenditure. Demographic variables such as age and education are suppressed in this section to simplify notation. They are defined explicitly in the following section where they are allowed to affect preference parameters and resource shares.

DLP assume economies of scale of a linear technology type where $x_m + x_f + x_c = x = A_s^{-1} z_s$. A_s is a K by K matrix which converts z_s into x, a vector of private good equivalents where $\sum x_t$ is strictly larger than z_s when goods are shared (Gorman, 1976). In this model, the existence of private assignable goods for each individual type is crucial to the identification of resource shares. A private assignable good is a good which is consumed only by a particular household member that is known to the researcher from the data. In other words, these goods do not have any scale economies in consumption. In this study, men's, women's, and children's clothing and footwear are used as the private assignable goods because expenditures on these goods are observed separately in GLSS 6.

Each individual possesses a utility function denoted by $U_t(x_t)$ that is monotonically increasing, strictly quasi-concave, continuous, and twice differentiable. In principle, an individual's utility function may depend on the utilities of other members of the household. However, to simplify the model, we will assume that each individual's total utility is weakly separable over the sub-utility functions for goods. Also, due to data limitations, children are characterized by a single utility function. The identification of resource shares for each child is possible only if each child can be assigned a different private assignable good. Unfortunately, this is not possible from the GLSS 6.

Pareto efficiency implies the following maximization problem for the household:

$$\max_{x_m, x_f, x_c, z_s} \tilde{U}_s[U_m(x_m), U_f(x_f), U_c(x_c), p/y] \quad \text{such that}$$
$$z_s = A_s[x_m + x_f + x_c], \quad y = z_s' p \tag{1}$$

where $\tilde{U}_s$ represents a monotonically increasing social welfare function. According to BCL, Equation (1) can also be interpreted as a two-stage process. In the first stage, total expenditure is allocated to household members according to resource shares. Each individual then maximizes his/her utility subject to his/her shadow budget constraint in the second stage. A shadow budget constraint in this context is an individual budget constraint that has been adjusted for both the individual's resource share and economies of scale. Economies of scale are characterized by the household shadow prices $A'p$, which differ from market prices for goods which are shared. Heating and furniture are common examples of such goods. Unlike resource shares, the same shadow prices are faced by all household members. Solving Equation (1) above yields the resource shares or Pareto weights for each member of the family.[2] Let η_{ts} denote the resource share of individual t in household type s.

The household demand functions for private assignable goods derived from solving Equation (1) have the following simple forms:

$$\begin{aligned} W_{ms}(y,p) &= \eta_{ms}(y,p)\, w_m(\eta_{ms}(y,p)y, A_s'p) \\ W_{fs}(y,p) &= \eta_{fs}(y,p)\, w_f(\eta_{fs}(y,p)y, A_s'p) \\ W_{cs}(y,p) &= s\eta_{cs}(y,p)\, w_c(\eta_{cs}(y,p)y, A_s'p) \end{aligned} \tag{2}$$

where W_{ts} represents the household budget share of individual t's private assignable good and w_t represents individual t's budget share of his private assignable good from his own maximization process (in the second stage). Equation (2) defines the household budget share of individual t's private assignable good as the product of his individual budget share and his resource share. However, η_{ts} cannot be identified from Equation (2) because even though W_{ts} is observed, w_t is not; and unlike BCL, DLP does not identify w_t from single households.

As mentioned previously, DLP circumvents this problem by making two identifying restrictions. First, resource shares η_{ts} are assumed to be independent of household expenditures y (at least at low levels of y). Although this can be a strong assumption, studies such as Menon et al. (2012) and Cherchye et al. (2012) find that this assumption holds in Italian and Dutch data, respectively. Moreover, resource shares are allowed to depend on variables that are closely related to household expenditures such as income or wealth. This restriction allows us to rewrite the model so far in an Engel-curve framework where prices are taken to be constant (Lewbel and Pendakur, 2008). Equation (2) can be rewritten in Engel-curve form as

[2] Browning et al. (2013) provide a detailed discussion on the relationship between resource shares and Pareto weights.

$$W_{ms}(y) = \eta_{ms}\, w_{ms}(\eta_{ms} y)$$

$$W_{fs}(y) = \eta_{fs}\, w_{fs}(\eta_{fs} y) \tag{3}$$

$$W_{cs}(y) = s\eta_{cs}\, w_{cs}(\eta_{cs} y).$$

The next step is to invoke either the SAP restriction or SAT restriction on the individual Engel curves for private assignable goods. These semi-parametric restrictions allow for the identification of resource shares across household types (SAP) or across people within a household (SAT). It is also possible to invoke both restrictions simultaneously. Assuming PIGLOG preferences (Muellbauer, 1976) for household members, the model takes the following form:

$$W_{ms}(y) = \eta_{ms}(\delta_{ms} + \beta_{ms} \ln \eta_{ms}) + \eta_{ms}\, \beta_{ms} \ln y$$

$$W_{fs}(y) = \eta_{fs}(\delta_{fs} + \beta_{fs} \ln \eta_{fs}) + \eta_{fs}\, \beta_{fs} \ln y \tag{4}$$

$$W_{cs}(y) = s\eta_{cs}(\delta_{cs} + \beta_{cs} \ln \eta_{cs}) + s\eta_{cs}\, \beta_{cs} \ln y$$

for $t = m, f, c$ and $s = 1, 2, 3, 4.$[3] While δ_{ts} represents the intercept preference parameters, β_{ts} represents the latent slope preference parameters. β_{ts} is specified according to which restriction is applied to the shapes of the Engel curves. If SAP is imposed, $\beta_{ts} = \beta_s$ for all t. If SAT is imposed, $\beta_{ts} = \beta_t$ for all s. If both SAP and SAT are imposed, $\beta_{ts} = \beta$ for all t and s. After imposing these restrictions, resource shares (η_{ts}) of household members can be identified by observing how household expenditures on each member's private assignable good (W_{ts}) vary with total household expenditure (y).[4]

In appendix A, we carry out tests to confirm that the assumptions necessary for the identification of resource shares discussed in this section, hold in our data set. In spite of data restrictions, the results show that these assumptions largely hold in our data set.

[3]Utility functions of the Price Independent Generalized Linearity (PIGL) form assume that expenditure is independent of prices but dependent on the distribution of expenditure. The logarithmic form of PIGL preferences, known as PIGLOG preferences, allow Engel curves to be linear in $\ln(y)$ as in Equation (4). The Almost Ideal Demand System (AIDS) is an example of a demand system model that is developed using PIGLOG preferences (Deaton and Muellbauer, 1980).

[4]See the online appendix of Dunbar et al. (2013) for a detailed discussion on the identification of resource shares using this model at http://dx.doi.org/10.1257/aer.103.1.438.

3 Empirical Implementation

The first part of this section briefly describes the data set and presents sample summary statistics. The second part discusses the empirical specification of the model and the method of estimation.

3.1 Data and Sample Selection

The Ghana Living Standards Survey Round 6 (GLSS 6) is the most recent round of the largest nationally representative household survey for the country. It was undertaken by the Ghana Statistical Service with support from the UK-DFID, UNICEF, UNDP, ILO, and the World Bank. This survey covers a period of 12 months, from 18th October 2012 to 17th October 2013. The general aim of the survey is to generate data on the living conditions of Ghanaians. Using questionnaires, well-trained personnel interviewed households on their general demographic characteristics, education, health, employment, time use, housing conditions, migration, agriculture, household expenditure, income, and assets. To ensure that a nationally representative sample was chosen, a two-stage stratified sampling process was used. In the first stage, 1,200 enumeration areas were selected to form primary sampling units. The second stage consisted of systematically selecting 15 households in each primary sampling unit. Out of the 18,000 households selected, 16,772 were successfully enumerated.

Considering the private assignable goods available from the data set, the sample in this paper is restricted to monogamous, nuclear households. We exclude households consisting of children older than 14 and/or retired adults to ensure that only one adult of each gender lives in the household. We exclude households who have economically inactive male heads as well. Female-headed households and single-parent households are also excluded from the sample as this study investigates gender asymmetry in consumption within the household. Finally, other obvious outlying observations such as households with zero food expenditure are also excluded. The final sample is made up of 2,782 households (11,806 individuals) consisting of couples with 1 to 4 children all under the age of 15.

Table 1 presents the summary statistics of the sample by household size. Generally, the

Table 1: Summary Statistics for Sample by Household Size

	Couples with				All
	1 child	2 children	3 children	4 children	
	General Characteristics				
Men's age	33.3	35.5	37.6	39.1	35.9
	(0.29)	(0.25)	(0.27)	(0.33)	(0.15)
Women's age	27.5	29.6	31.4	32.6	29.9
	(0.26)	(0.22)	(0.22)	(0.27)	(0.13)
Men's schooling dummy	0.82	0.79	0.77	0.68	0.78
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Women's schooling dummy	0.72	0.70	0.66	0.58	0.68
	(0.02)	(0.02)	(0.02)	(0.03)	(0.01)
Working women dummy	0.84	0.88	0.91	0.94	0.88
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Working children dummy	0.03	0.06	0.12	0.18	0.11
	(0.01)	(0.01)	(0.01)	(0.01)	(0.003)
Proportion of male children	0.52	0.51	0.52	0.51	0.51
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Average age of children	3.1	4.6	5.8	6.4	5.2
	(0.12)	(0.09)	(0.08)	(0.10)	(0.05)
Rural household dummy	0.54	0.59	0.61	0.70	0.59
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
Per capita expenditure per day in USD*	2.51	1.98	1.72	1.48	2.04
	Budget Shares				
Food	0.523	0.530	0.539	0.552	0.533
	(0.005)	(0.005)	(0.006)	(0.008)	(0.003)
Housing	0.071	0.065	0.062	0.051	0.064
	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)
Transportation	0.064	0.059	0.057	0.049	0.059
	(0.003)	(0.003)	(0.003)	(0.004)	(0.001)
Men's clothing and footwear	0.031	0.028	0.025	0.023	0.027
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Women's clothing and footwear	0.022	0.019	0.016	0.015	0.018
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Children's clothing and footwear	0.013	0.017	0.020	0.021	0.017
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Sample size	786	900	728	368	2,782

Standard errors are in parentheses.

*The exchange rate used is $1= 2.895 GHS (Source: Central Intelligence Agency's World Factbook)

summary statistics conform to what one would expect from a developing country like Ghana. Also, the variables have very little variation as the standard errors are generally small. First, men are generally older than the women. Indeed, United Nations (2000) show that men in sub-Saharan Africa generally marry younger women. We also observe that men are more likely than women to have some education. In addition, the probability of being an uneducated adult increases the more children the adult has. Most women in the sample are economically active and the percentage of working women increases as the household size gets larger. 11% of the children in the sample work. This is disturbing because the average age of a child in this sample is 5. It seems that children from larger families are more likely to work than children from smaller families. Also, almost 60% of the sample live in rural areas. We notice that larger households are more likely to be poor; expenditure per capita per day falls as the household becomes larger.

With regard to budget shares, most households spend more than half of total expenditure on food. Apart from food, the highest proportions of household expenditure are spent on housing and transportation. It is important to note that for a typical private good such as food, budget shares rise as the household size increases. On the other hand, with items such as housing and transportation which are considered public, budget shares fall as the household size becomes larger. This indicates that economies of scale to consumption are likely to exist in the sample and may differ for each good. The budget shares of the private assignable goods are most important for our purposes. As expected, Table 1 shows that the shares of both men's and women's clothing and footwear reduce as the number of children increases as children are known to impose economic costs on parents (Bargain et al., 2010; Bargain and Donni, 2012). Interestingly, the budget share on children's clothing and footwear increases as the household becomes larger but at a decreasing rate. Again, this could indicate the presence of scale economies in consumption among children. Unfortunately, our model is unable to account for this because of data restrictions.

3.2 Model Specification and Estimation Method

Like DLP, we estimate the log-linear Engel curves for private assignable goods in Equation (4) using non-linear Seemingly Unrelated Regression (SUR) to allow for the correlation of errors across equations. The estimators are iterated and the regressors are taken to be exogenous.

The data set allows for the construction of 18 socio-demographic factors. These demographic variables are allowed to affect both resource shares and tastes of household members and hence cannot be classified as distribution factors. As previously indicated, the DLP model does not require distribution factors for the identification of resource shares. These demographic variables include the ecological region of residence (coastal, forest, and savannah, with the Greater Accra Metropolitan Area as the reference variable), dummies indicating an older than average father and mother, the education levels of father and mother, the average age of children in the household minus five, the number of children in the household less than three years old, the proportion of children who are boys, a dummy indicating whether the household owns land, a dummy indicating whether the mother works, a dummy indicating whether at least one child works, a dummy indicating whether the household lives in a rural area, and dummy variables indicating the religion of the father (Christian or Muslim, with other religions as the reference variable).

Let $d = (d1, d2, ..., d18)$ be a vector of these demographic variables and let $b = (b1, ..., b4)$ be a vector of four dummy variables, each indicating a household type s. The vector b generally plays the role of the constant for each household type in η_{ts}, δ_{ts}, and β_{ts}. η_{ts} and δ_{ts} are specified as linear in b and d for a total of 22 coefficients each. As already mentioned, β_{ts} is specified according to the semi-parametric restriction imposed on the Engel curves. For SAP, β_{ts} is specified as linear in b and d for a total of 22 coefficients. For SAT, β_{ts} is specified as linear in a constant and d for each of the 3 individual types for a total of 57 coefficients. When both SAP and SAT are imposed, β_{ts} is specified as linear in a constant and d for a total of 19 coefficients.

4 Empirical Results

In this section, the key findings of the paper are presented. The section is divided into 3 parts. The first part presents estimated resource shares for reference households. We check for possible endogeneity in the second part and carry out a poverty analysis based on estimated resource shares in the third part.

4.1 Resource Share Estimates

Table 2 presents the estimates of resource shares using each of the three identifying assumptions: SAP, SAT, and the combination of the two. The table lists resource shares for mothers, fathers, children and each child in a reference household and the marginal effects of a number of demographic variables on these estimates (see Table B.1 in the appendix for the marginal effects of all demographic variables on resource shares).[5] A reference household is one where all demographic variables take the value of zero. In this paper, a reference household is an urban household living in the Greater Accra Metropolitan Area. Both parents have the modal level of education, which is high school education, and all children are girls and have an average age of 5. The reference household does not own land and neither the mother nor children work.

We will focus on the rightmost columns of the table which present the estimates when both SAP and SAT are imposed. For the most part, these estimates are the most precise because more identifying assumptions are invoked than with either SAP or SAT alone. Actually, the estimates and standard errors for the SAP restriction only and the combination of both restrictions are quite similar. This may be an indication that the SAT assumption is weak and hence, does not cause significant changes to SAP estimates and standard errors when both restrictions are imposed. DLP acknowledge the fragility of the SAT restriction and admit that one may need a large sample to obtain precise estimates when imposing this restriction only. Nonetheless, the results are reasonably consistent across all three identifying assumptions.

The first four rows of Table 2 present the constant terms in the η_{ts} functions which correspond to the resource shares in reference households. We notice that although fathers command a significantly larger share of household resources than mothers, mothers bear a higher proportion of the cost of children. For example, a mother's share falls by about 9 percentage points while that of a father rises by about 6 percentage points when they have a second child. In fact, at 5% significance level, the hypothesis that the father's share is invariant to the number of children in the household cannot be rejected. Children command 35.5% of

[5] Full estimation results for δ_{ts} and β_{ts} are available upon request.

Table 2: Resource Share Estimates for Ghanaian Households

Household characteristic	Individual type	SAP Estimate	SAP StdErr	SAT Estimate	SAT StdErr	SAP and SAT Estimate	SAP and SAT StdErr
One child	man	0.366***	0.059	0.339***	0.073	0.351***	0.057
	woman	0.292***	0.041	0.324***	0.082	0.294***	0.041
	children	0.342***	0.048	0.337***	0.058	0.355***	0.048
	each child	0.342***	0.048	0.337***	0.058	0.355***	0.048
Two children	man	0.424***	0.064	0.394***	0.076	0.409***	0.061
	woman	0.191***	0.040	0.243***	0.070	0.198***	0.041
	children	0.385***	0.051	0.363***	0.060	0.393***	0.051
	each child	0.193***	0.026	0.182***	0.030	0.196***	0.025
Three children	man	0.370***	0.064	0.349***	0.075	0.345***	0.062
	woman	0.201***	0.040	0.229***	0.066	0.204***	0.041
	children	0.428***	0.053	0.423***	0.062	0.451***	0.052
	each child	0.143***	0.018	0.141***	0.021	0.151***	0.017
Four children	man	0.344***	0.070	0.315***	0.078	0.334***	0.068
	woman	0.191***	0.045	0.220***	0.064	0.201***	0.045
	children	0.465***	0.061	0.466***	0.066	0.465***	0.059
	each child	0.116***	0.015	0.116***	0.017	0.116***	0.015
Rural household	man	0.023	0.022	0.037	0.024	0.022	0.022
	woman	0.041**	0.016	0.010	0.014	0.040**	0.017
	children	-0.064***	0.022	-0.047*	0.026	-0.061***	0.022
Working children	man	0.075**	0.031	0.034	0.033	0.077**	0.031
	woman	-0.005	0.021	0.025	0.023	-0.005	0.021
	children	-0.070***	0.026	-0.059	0.036	-0.072***	0.026
Number of children<3yrs	man	0.035	0.023	0.013	0.024	0.033	0.023
	woman	-0.046***	0.015	-0.035**	0.016	-0.047***	0.015
	children	0.010	0.020	0.022	0.022	0.014	0.020
Man's education	man	-0.002	0.007	0.001	0.007	-0.003	0.007
	woman	0.012**	0.005	0.005	0.005	0.012**	0.006
	children	-0.010	0.006	-0.006	0.008	-0.009	0.006
Woman's education	man	-0.019**	0.007	-0.025***	0.009	-0.019**	0.008
	woman	0.001	0.005	0.000	0.005	0.000	0.005
	children	0.018***	0.007	0.025***	0.009	0.018***	0.007
Proportion of male children	man	0.095***	0.025	0.082***	0.024	0.098***	0.025
	woman	-0.043**	0.020	-0.048**	0.019	-0.045**	0.020
	children	-0.052***	0.021	-0.033	0.029	-0.053***	0.022

Standard errors robust to all forms of heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

household resources in one-child households. This is relatively large in comparison to DLP who find that children in one-child households command 23% of household resources. The results of BDK also show that an only child in Côte d'Ivoire commands just 19% of household resources in their baseline model. We additionally notice the per capita share of each child reducing as the number of children increase. Each child in a household with four children is estimated to command 11.6% of the resources available. This appears to be a substantial amount if children jointly consume goods like toys and books.

Let us now turn to the marginal effects of demographic variables on resource shares. We will focus on six covariates that stand out. First, children's resource shares reduce by 6 percentage points in rural areas. Although children's resource shares may still be considered high even when reduced by 6 percentage points, this result suggests that child poverty in Ghana is more of a rural phenomenon than an urban one. Still on the subject of children, the coefficients corresponding to the working children dummy reveal that resource shares of children in these households are reduced by 7.6 percentage points. The resource shares of mothers with working children also reduce marginally while fathers gain the extra resources. This shows that in terms of consumption, child labour does not benefit the children themselves but benefits parents (especially fathers) instead.

Mothers also tend to command less resources if their children are younger than three years. To be precise, a mother commands 4.7 percentage points less resources, while fathers and children gain. Because infants under three years are not likely to have started school yet, mothers who work in the informal sector or as family labourers may be forced to stay home temporarily to take care of the children. In doing this, they lose a major source of their income and livelihood, leading to a reduction in their bargaining power in the household. This is in line with the findings of Lewbel and Pendakur (2008) and Couprie (2007) for Canada and the United Kingdom, respectively, showing that a woman's income share or relative wage is directly related to the share of household resources she commands.

The next two covariates of interest relate to the education levels of parents in the household. The more educated a father is, the higher the resource share of his spouse. The resource shares of women with more educated husbands are 1.2 percentage points higher. However, these extra resources seem to be mostly diverted from the children and not from the father. On the other hand, a more educated mother diverts resources from her husband to her children. Her own share increases only by negligible amounts. Children with more educated mothers have their resource shares increasing roughly by 2 percentage points. In sum, although a more educated father seems beneficial to a woman in terms of resource shares, the children are negatively affected. On the contrary, a more educated mother is advantageous mainly to the children of the household. Again, this conforms to the idea that mothers are more willing than fathers to sacrifice for their children in terms of their expenditure patterns.

Finally, similar to DLP and Rose (1999), this study finds compelling evidence of gender bias in Ghanaian households, but, unlike these other papers, we find gender bias in favour of girls and not boys. Furthermore, this result is robust to changes in the specification of the non-linear SUR model we estimate. In particular, we find that resources are diverted from children as the proportion of boys in the household increases; children's resource shares are about 5 percentage points lower if all the children in the household are boys. A possible reason for this is the matrilineal system practiced by the Akan ethnic group. The Akan ethnic group is the largest in the country; according to the main report for GLSS 6, 50% of household heads in the country are Akan (Ghana Statistical Service, 2014a). Akans practice a matrilineal system of descent, succession and inheritance. Hence, the girl child is preferred to the boy child because women are traditionally viewed as the maintainers of the lineage or clan (Adei, 2003). This contrasts with the tradition in Eastern and Southern Asia for instance, where the boy child is preferred because of a patrilineal system of inheritance (Das Gupta et al., 2003). In a matrilineal system, the external family takes precedence over the nuclear family and conjugal ties are usually weak since husband and wife belong to two different families. Additionally, children in Akan households do not belong to their father's family but to their mother's family. Therefore, matrilinear uncles may exert a greater authority than fathers on the children since male children inherit the wealth of their matrilineal uncles. In the same way, fathers are likely to spend more on their sisters' children than on their own children especially if all his children are male. Nevertheless, an Akan father is still expected to set his children up for life by giving them an education or by teaching them a trade (Takyi and Gyimah, 2007; La Ferrara and Milazzo, 2014). It is important to note that BDK also find some evidence of gender bias in

Table 3: Gender Bias Estimates in Ghanaian Households

Ecological zone	Individual type	SAP Estimate	SAP StdErr	SAT Estimate	SAT StdErr	SAP and SAT Estimate	SAP and SAT StdErr
All households	man	0.095***	0.025	0.082***	0.024	0.098***	0.025
(2,874 hhs)	woman	-0.043**	0.020	-0.048**	0.019	-0.045**	0.020
	children	-0.052***	0.021	-0.033	0.029	-0.053***	0.022
Akan	man	-0.115***	0.024	-0.075	0.064	-0.118***	0.031
(944 hhs)	woman	0.163***	0.032	0.074	0.064	0.052**	0.024
	children	-0.048*	0.028	0.001	0.003	0.066*	0.036
Non-Akan	man	0.152***	0.028	0.000	0.000	0.146***	0.030
(1,838 hhs)	woman	-0.080***	0.021	0.010	0.034	-0.077***	0.021
	children	-0.072***	0.023	-0.010	0.034	-0.069***	0.024
Forest	man	0.076**	0.031	0.079	-	-0.013	0.025
(1,196 hhs)	woman	-0.076**	0.031	0.000	-	0.073**	0.034
	children	0.000	0.000	-0.078	-	-0.060	0.037
Coastal	man	0.000	0.000	0.000	0.000	0.000	0.000
(327 hhs)	woman	0.000	0.000	0.000	0.000	0.000	0.000
	children	0.000	0.000	0.000	0.000	0.000	0.000
Savannah	man	-0.155***	0.037	-0.081*	0.046	-0.160***	0.037
(974 hhs)	woman	0.210***	0.031	0.000	0.000	0.208***	0.031
	children	-0.056*	0.030	0.081*	0.046	-0.047	0.031
GAMA	man	0.003	0.006	0.021	0.017	-	-
(285 hhs)	woman	0.000	0.000	-0.061***	0.022	-	-
	children	-0.003	0.006	0.040	0.028	-	-

Standard errors robust to all forms of heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

favour of girls in Côte D'Ivoire, although insignificant in their case. This is interesting because Côte D'Ivoire is located next to Ghana and 30% of its population is also Akan.[6]

We investigate this bias further by applying the same non-linear SUR model to various sub-samples of the original sample. Table 3 presents the coefficients of the proportion of boys variable for each sub-sample and for each of the three identifying assumptions. Again, we will focus on the results obtained when both SAP and SAT are invoked (the last two columns). The first row presents the coefficients for the total sample, which is the same as row 8 of Table 2. The next two rows present the estimates for Akan households versus non-Akan households. We define an Akan household as one where both adults in the household identify first as belonging to the Akan ethnic group. They could also belong to a second ethnic group if either of their

[6]For a detailed discussion on the matrilineal system of the Akan ethnic group, see Warren (1986); Rattray (1923, 1927); Nkansa-Kyeremateng (1996); Fortes (1960).

parents is not Akan. Surprisingly, we find the resource share of children increasing by 6.6 percentage points in Akan households and reducing by almost 7 percentage points in non-Akan households if all children are boys. This clearly contradicts what one would expect if Akans truly practice a matrilineal system of inheritance. Due to modernisation and the rising number of inter-ethnic marriages in Ghana, it is possible (especially in urban areas) that, the traditional matrilineal system is not fully adhered to in these households that identify as Akan (Awusabo-Asare, 1990). In view of this, we conclude that using the ethnic group that an individual identifies as, may not be the best way to capture matriliny in our case.

Another plausible way to capture matriliny in Ghana is through the four ecological zones of the country namely: forest, coastal, savannah and the Greater Accra Metropolitan Area (GAMA hereafter). Akans are known to have settled in the forest ecological zone comprising mainly of the Western, Central, Ashanti, Eastern and Brong-Ahafo regions (Awusabo-Asare, 1990). According to Ghana Statistical Service (2014a), about 70% of the households in these regions have Akan household heads. We estimate the model separately for each of the ecological zones. The coefficients for the proportion of boys variable are presented in the fourth to seventh rows of Table 3. As expected, we observe that the bias in favour of girls is greatest in the forest ecological zone, with the resource shares of children reducing by 6 percentage points, if all children are male. It is important to note that the coefficient for children for the forest area is greater in absolute value than the coefficient for the entire sample, as this suggests that the forest coefficient may be driving the result for the entire sample. The coefficient for children for the savannah zone also indicates girl-child preference, although this coefficient is not as large as that of the forest zone or the entire sample. Meanwhile, gender bias appears to be non-existent in the coastal ecological zone. Due to data restrictions, we are unable to obtain estimates for GAMA when both SAP and SAT are invoked. However, results from imposing either SAP or SAT alone does not indicate significant girl-child preference in this area. Based on these results, we conclude that the matrilineal system practiced in regions that are traditionally Akan, and not necessarily by parents who identify as Akan, is one of the main reasons for girl-child preference in Ghana. Nonetheless, our results in Table 3 are generally less precise than those presented in 2 due to the relatively small sample sizes. For instance, we are unable to obtain standard errors for the forest ecological zone when the SAT restriction alone is invoked.

4.2 Handling Endogeneity

The basic DLP model can easily be adapted to deal with endogeneity through instrumental variables. In this setting, the two variables that are likely to be endogenous are total expenditure and the number of children in the household (that is, the household size).

Total expenditure may be endogenous because of measurement error between total expenditure and actual consumption. Secondly, endogeneity may also occur because of recall errors, as households are asked to recall consumption from the past. Following DLP, we use wealth measures including farm wealth and household wealth as instruments for total expenditure. Farm wealth is a sum of the value of livestock and farm equipment, and household wealth is a sum of the value of durable items in a household and the household's savings. These variables are less likely to be subject to recall errors as most of these items can be directly observed and counted by interviewers. Farm wealth is more suited to rural households while household wealth is more suited to urban households.

The number of children in the household could also be an endogenous variable because unobserved heterogeneity in the error term of clothing equations may affect fertility decisions. Following DLP, we are able to construct three instruments relating to health and education from the data set that are likely to correlate with fertility decisions but not clothing decisions. First, we use the number of minutes it takes for children to get to school. Since, basic education is free in Ghana, parents with more children have more of an incentive to live closer to a basic school. The second instrument is a dummy indicating whether at least one of the adults in the household is disabled. The third instrument is a dummy indicating whether the couple uses condoms as a means of contraception. This variable is chosen because most adults in Ghana have access to condoms as they are provided free of charge or at very low costs by the government.

Altogether, these instruments are strongly correlated to total expenditure and yield an

F-statistic of 102.10 on the excluded instruments in the first stage. On the other hand, the instruments are not strong in predicting the number of children in the household; they yield an F-statistic of only 2.44. Following DLP, we estimate the model with endogenous variables using Hansen's (1982) generalized method of moments (GMM). Unfortunately, the model we estimate does not converge.[7] Nevertheless, we are able to retrieve the estimates of the last iteration of the GMM estimation and find that the results have the same pattern as the non-linear SUR results (see Table C.1 in appendix C). This suggests that endogeneity is not likely to be a significant issue for our model.

4.3 Poverty Analysis

Estimating the level of resource shares alone does not tell us whether the needs of an individual are met. In order to gain an understanding into the level of welfare of individual household members, we calculate individual poverty rates based on estimated resource shares and compare these to standard poverty measures.

To begin, columns 3 to 6 of Table 4 present the mean, standard deviation, and the maximum and the minimum values of resource shares for individuals across different household types. These calculations are based on the estimates obtained when both SAP and SAT identifying assumptions are imposed (the rightmost columns of Table 2) and average over all the values of demographic factors. These descriptive statistics (especially the mean values) present a more general picture of how resource shares change across household types. Generally, mean values of resource shares follow the expected pattern. The average shares of fathers are higher than that of mothers for all household types. Indeed, in the penultimate row of the table, which shows average shares when all household types are combined, we notice that women's average resource shares are at least 10 percentage points lower than the average shares for fathers and children. We also observe that standard deviations are consistently lower for women than men and children across all household types. According to DLP, this may suggest that for mothers,

[7]This is not a rare occurrence as most studies are unable to construct strong instruments from available data. Tommasi and Wolf (2016), for example, deal with a similar case of non-convergence in an attempt to control for endogeneity.

Table 4: Average Resource Shares and Poverty Rates

		Resource Shares				Poverty Rates	
Household type	Individual type	Mean	Standard deviation	Minimum	Maximum	Using unequal shares	Using equal shares
One child	man	0.369	0.096	0.075	0.630	0.181	0.207
	woman	0.341	0.055	0.154	0.507	0.205	
	children	0.290	0.081	0.067	0.567	0.146	
	each child	0.290	0.081	0.067	0.567		
Two children	man	0.415	0.093	0.167	0.666	0.116	0.357
	woman	0.233	0.052	0.073	0.383	0.413	
	children	0.352	0.078	0.135	0.580	0.320	
	each child	0.176	0.039	0.068	0.290		
Three children	man	0.347	0.096	0.088	0.623	0.148	0.418
	woman	0.236	0.057	0.066	0.383	0.350	
	children	0.416	0.078	0.149	0.641	0.359	
	each child	0.139	0.026	0.050	0.214		
Four children	man	0.342	0.091	0.106	0.652	0.171	0.552
	woman	0.224	0.054	0.079	0.377	0.397	
	children	0.434	0.073	0.255	0.607	0.500	
	each child	0.108	0.018	0.064	0.152		
All households	man	0.375	0.099	0.075	0.666	0.150	0.356
	woman	0.263	0.073	0.066	0.507	0.336	
	children	0.362	0.095	0.067	0.641	0.305	
	each child	0.189	0.084	0.050	0.567		
All persons	all	0.236	0.117	0.050	0.666	0.302	0.382

the various demographic variables are not as important as the household size in determining the level of resource shares. In other words, women who live in a particular household type tend to have similar socio-demographic characteristics. Also, it is reassuring to see that all minimum and maximum values of resource shares lie between 0 and 1.

The last two columns of Table 4 present estimated poverty rates across household types for our sample. Column 7 presents individual poverty rates based on the resource shares estimated in this paper and column 8, standard poverty rates using per capita calculations or equal shares. We use the poverty threshold calculated by the Ghana Statistical Service using data from GLSS 6.[8] According to Ghana Statistical Service (2014b), an adult needs GHS1,314.00 a year to purchase essential food and non-food commodities. Since children have lower needs

[8]We also estimate individual poverty rates using the World Bank threshold of \$3.10 per person a day (2011 PPP) and arrive at the same conclusions.

than adults, we follow the OECD and estimate that children's needs are 60% of that of an adult. Hence, we compare expenditure on children to GHS788.40 in assessing the incidence of child poverty.

With regard to poverty estimates, there are a number of patterns to take note of. First, it is clear from column 7 that the poverty incidence is much higher for women and children than for men. While women have the highest incidence of poverty in households with one to two children, children have the highest poverty rates in households with four children. In households with three children, poverty rates are roughly the same for mothers and children. In addition to this, the incidence of poverty for children rises consistently with household size. As BDK argues, one reason for this may be the fact that we are unable to account for the large economies of scale to consumption that may exist amongst the children of a household. The figures in the penultimate row of column 7 present the estimates of individual poverty rates for all households in the sample. These figures suggest that mothers particularly and children are the most vulnerable groups to poverty in Ghana. Mothers and children have poverty rates of 33.6% and 30.5%, respectively, while fathers have a poverty rate of 15%. From our results in Table 2 and our discussions in subsection 4.1, we can conclude that one of the main reasons women tend to be the poorest is that they tend to bear most of the cost of having children. In other words, poverty among mothers in Ghana seems to be directly related to the welfare of their children. DLP and BDK do not find this relationship in their studies. Also, these other studies find that per capita calculations overestimate poverty levels for mothers and fathers, but underestimate poverty levels for children. Our results, on the other hand, indicate that the only instances where per capita calculations underestimate poverty levels are for women who have one or two children. For the most part, the incidence of poverty in Ghana is generally overestimated for all groups when equal shares are assumed.

In sum, our findings show that the nature of poverty may vary from country to country in the sub-Saharan African region. More importantly, they show that the study of intra-household resource allocation can be a useful tool for understanding these differences. Knowledge gained from this kind of study has several applications in the targeting and implementation of poverty alleviation policies. In section 5, we discuss the importance of our results for one of such policies in Ghana.

5 Implications for LEAP

The Livelihood Empowerment Against Poverty (LEAP) programme was first implemented in 2008 as the flagship programme of the National Social Protection Strategy and as part of the country's efforts to achieve the UN Millennium Development Goals (MDGs).[9] The programme is funded by the government of Ghana and supported by the World Bank and DFID. The objective of the programme is to alleviate extreme poverty in Ghana by increasing basic household consumption and nutrition, increasing access to health care services, and increasing school enrolment and attendance among the extremely poor and vulnerable. This is done primarily through social cash transfers and the provision of health insurance for eligible households. Currently, LEAP has 213,028 beneficiaries in all 216 districts and all 10 regions of the country. The scheme targets specific social groups including orphans and vulnerable children, severely disabled individuals, the elderly who have no support and, recently, pregnant and lactating women. For the purposes of this section, we will focus on orphans, vulnerable children, pregnant women, and mothers with infants since our sample does not explicitly include the other social groups.

In 2015, the LEAP programme was extended to include pregnant women and mothers with infants under 15 months old. This sub-component of LEAP called LEAP 1000 currently covers only the Northern and Upper East regions of the country and specifically aims at reducing stunting in Ghana. According to UNICEF (2013), stunting can have negative long-term effects on children such as general poor health and diminished cognitive and productive capabilities. Since most stunting is known to occur before a child turns 2 years old (Walker et al., 2007), LEAP 1000 hopes to reduce stunting by supporting children for the first 1000 days of their lives. Based on our results, we know that child poverty is most prevalent in large rural households making it more likely for children in such households to be stunted. LEAP 1000 is likely to be

[9] For more general information on the LEAP programme, see www.leap.gov.gh.

an effective means of reducing stunting and child poverty in Ghana because it effectively targets these households. According to MoGCSP (2016), LEAP 1000 households have 6 members on average compared to the average of 4.5 in rural Ghana. MoGCSP (2016) also finds that LEAP 1000 households have a poverty rate of 91% and a poverty gap of 54%. These poverty measures are also much higher than average rates in rural areas in Ghana. Also, as our results have indicated, the mothers of these poor and vulnerable children are likely to be even poorer and more vulnerable themselves. Our findings show that mothers with younger children (less than 3 years old) have reduced bargaining power in the household; resource shares for these women can be 5 percentage points lower than for other women. This is especially important for LEAP 1000 households as women in these households are either pregnant or have children that are less than 15 months. The Baseline Evaluation Report for the programme released in May 2016 states that over 80% of the women in LEAP 1000 households did not complete primary education and live with spouses that exhibit controlling behaviour. In addition, 20% of these women were married before the age of 18 (MoGCSP, 2016). These factors explain why the women eligible for this programme are likely to be extremely vulnerable and poor. This means that although LEAP 1000 is primarily aimed at reducing stunting in children, the programme is likely to create the positive externality of improving the welfare of some of the most vulnerable women in the country also. This makes LEAP 1000 a potentially effective poverty alleviation scheme for the Ghanaian context. Hence, policy makers need to consider expanding this sub-component of the LEAP programme to cover all the rural regions of the country.

Women can also play an important role in the administration of mainstream LEAP to improve the overall efficiency of the programme. Currently, any member of a LEAP household can be nominated to receive payments on behalf of that household. These individuals are known as caregivers. In the spirit of Duflo (2003), our findings indicate that women are more likely to spend the cash they receive on the needs of children than men. This is especially important in Ghana since half of the households in Ghana are matrilineal. This gives mothers an even greater incentive to spend on the needs of their children. Therefore, allowing only for female caregivers is likely to greatly improve the effectiveness of mainstream LEAP.

In order to ensure that the objectives of the programme are achieved, households with eligible children receive payments only if certain conditions are met with regard to children's health and education. In this sense, the scheme is conditional for child beneficiaries. One of the conditions that must be met is that children in LEAP households cannot be involved in child trafficking or in the worst forms of child labour. Our results on working children confirm the importance of this condition. However, our findings indicate that children who are involved in any kind of work at all can have their resource shares reduced by 7 percentage points. Therefore, making this condition a little more stringent than it already is could be a legitimate course of action.

6 Conclusion

Researchers are now able to use collective household models to estimate the proportion of total expenditure that each member of the household commands in spite of data restrictions and joint consumption. Estimating resource shares of individuals is particularly important for developing countries because intra-household inequality is likely to be very high in such countries.

In the present paper, we apply the DLP framework to a Ghanaian data set to estimate resource shares and calculate individual poverty rates. The results show that fathers command a larger share of resources than mothers and children. One of the reasons for this appears to be the fact that mothers bear a significantly larger proportion of the cost of having children, especially when the children are less than three years old. The resource shares of children are quite large compared to similar papers on sub-Saharan Africa although per capita share falls with the number of children. We also find significant gender bias in favour of girls. A likely reason for this is the practice of the matrilineal system of descent and inheritance by the largest ethnic group in the country. Furthermore, unlike educated fathers, educated mothers tend to divert resources from their spouses to favour their children. Finally, children who are involved in any form of work appear to command significantly lower levels of resources in the household. With regard to poverty, the estimates of individual poverty generally show that women and children are the most vulnerable groups of people to poverty in Ghana. Standard poverty indices generally overestimate poverty rates in Ghana except for women who have less than 3 children.

Finally, to illustrate the applicability of our results to development policies, we discuss the implications of our findings for the Livelihood Empowerment Against Poverty (LEAP) programme, a social cash transfer programme that is aimed at alleviating extreme poverty in Ghana. Based on the results, we argue that LEAP 1000 is likely to be very effective at reducing poverty among women and children. We also recognize that allowing for only female caregivers is likely to improve the outcomes of mainstream LEAP. Lastly, we suggest that the condition that children are not involved in child trafficking or in the worst forms of child labour is strengthened.

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Appendix A Testing DLP Model Assumptions

Appendix A discusses the tests carried out to confirm that the four assumptions necessary for the identification of resource shares in the DLP model hold in our data set. The online appendix of DLP provides a detailed discussion on the derivations of these tests. In carrying out some of these tests, additional data on single individuals and childless couples from GLSS 6 is used. In spite of data restrictions, the results show that the assumptions of the DLP model largely hold in our data set.

Do households make Pareto-efficient decisions? DLP, like BCL, assumes that households make decisions in a Pareto-efficient manner and allow for joint consumption among members of the household. Given PIGLOG preferences and the other assumptions of the DLP model, Pareto-efficiency has different implications for each of the semi-parametric restrictions on Engel curves of single households and childless couples. For SAP, Pareto efficiency implies that the slopes of the Engel curves for men's clothing and women's clothing have the same sign. We test this on 462 childless couples using linear SUR regressions and find that on average, the sign of the slope coefficient is the same for both men (-0.005) and women (-0.006). From an observation by observation stance, 75% of the childless couples have the slope coefficients of the man and woman having the same sign.

For SAT, Pareto-efficiency implies that the slopes of Engel curves for men's and women's clothing among childless couples must be proportional to that of single persons with the sum of the proportions equalling 1. Again, we test this using linear SUR regressions on 1,643 single households and 462 childless couples. Out of the 13 slope coefficients, the sum of the proportions for men and women is not statistically different from 1 for 10 of those coefficients. Taken together, the results for both SAP and SAT suggest that households in our data set make Pareto-efficient decisions.

Are resource shares affected by household expenditure? As previously indicated, all BCL-type models impose resource-share invariance to expenditure in order to identify resource shares. Other studies have shown empirically that this restriction may be valid in some data sets (see Menon et al., 2012 or Cherchye et al., 2012). To test the validity of this assumption in our data set, we re-run the non-linear SUR estimation given both SAP and SAT conditions in the last columns of Table 2 including a new dummy variable in η_{ts}, δ_{ts} and β that indicates higher expenditure. This dummy takes the value of 1 when household expenditure is above the median value for the sample. If resource-share invariance holds, we expect this new variable to be statistically insignificant in η_{ts}. A Wald test indicates that the coefficient on this variable is not statistically different from zero with p-values 0.4573 for men's resource shares and 0.9997 for women's resource shares. Therefore, our results show that within our sample, resource shares are unaffected by household expenditure.

Are SAP and/or SAT valid restrictions on individual preferences? Due to data restrictions, we are unable to test these assumptions directly on our sample. However, we are able to test whether SAP holds among single households by comparing the slopes of Engel curves of single men and single women. Assuming PIGLOG preferences for both men and women, SAP implies that the slope coefficients for single men and single women are statistically equal. We estimate separate linear SUR regressions using a sample of 1,161 single men and 482 single women and carry out a Wald test on the slope parameters. With a p-value of 0.5433, we cannot reject the null hypothesis that the slope coefficients for single men and single women are statistically equal. The fact that SAP holds for single households is reassuring, and shows that SAP is likely to hold within our sample as well.

We are unable to test the validity of SAT in single households because such a test would require data from 2 waves of the GLSS. Unfortunately, we do not have access to previous rounds of the GLSS. Moreover, as previously mentioned, SAT requires relatively large samples to produce precise results. Compared to GLSS 6, previous rounds of GLSS cover very few households and hence we are likely to end up with a relatively small sample.

Are clothing and footwear private assignable goods? This restriction can be violated in two ways: through direct sharing among family members and through consumption externalities. To test for direct sharing, we re-estimate the non-linear SUR estimation given both SAP and SAT conditions in the last columns of Table 2 treating clothing and footwear as two separate private assignable goods. This yields a number of overidentifying restrictions.

Similar to DLP, we argue that footwear is more difficult to share than clothing. Hence, if clothing is not shared within the household, the estimates of resource shares obtained from using clothing as the private assignable good should be statistically equal to the estimates obtained from using footwear. Unexpectedly, the results show some evidence of direct sharing. However, it is important to note that footwear budget shares are very small (with a mean of less than 1%). This leads to badly estimated Engel curves for footwear. Indeed, the estimates obtained from clothing are very similar to those obtained when the sum of clothing and footwear are used (last columns of Table 2). This is not the case with footwear. Hence, clothing and footwear may not be comparable in this case. Moreover, we can be quite certain that children do not share clothing and footwear with their parents as our sample excludes households with older children. The mean age of children in our sample is 5. In view of these considerations, we do not consider these results to provide overwhelming evidence of direct sharing in the household. As DLP argues, the previous tests of the other three model assumptions are really joint tests of those assumptions and the privateness and assignability of clothing and footwear. If this assumption were not valid in our data set, all the other tests should have failed. Hence, we can conclude that for our purposes, using clothing and footwear as private assignable goods does not adversely affect the results.

Externalities in clothing consumption occur if one household member derives utility from clothing worn by other members of the household. DLP tests for this by comparing estimates of resource shares for two-parent households and single-mother households. In doing this, they test the dependence of an adult's utility on the consumption of clothing by his or her spouse. Unfortunately, we are unable to carry out this test because of data restrictions.

Appendix B   Estimated Resource Shares - Complete

Table B.1: Resource Share Estimates for Ghanaian Households - Complete

		SAP		SAT		SAP and SAT	
Household characteristic	Individual type	Estimate	StdErr	Estimate	StdErr	Estimate	StdErr
One child	man	0.366***	0.059	0.339***	0.073	0.351***	0.057
	woman	0.292***	0.041	0.324***	0.082	0.294***	0.041
	children	0.342***	0.048	0.337***	0.058	0.355***	0.048
	each child	0.342***	0.048	0.337***	0.058	0.355***	0.048
Two children	man	0.424***	0.064	0.394***	0.076	0.409***	0.061
	woman	0.191***	0.040	0.243***	0.070	0.198***	0.041
	children	0.385***	0.051	0.363***	0.060	0.393***	0.051
	each child	0.193***	0.026	0.182***	0.030	0.196***	0.025
Three children	man	0.370***	0.064	0.349***	0.075	0.345***	0.062
	woman	0.201***	0.040	0.229***	0.066	0.204***	0.041
	children	0.428***	0.053	0.423***	0.062	0.451***	0.052
	each child	0.143***	0.018	0.141***	0.021	0.151***	0.017
Four children	man	0.344***	0.070	0.315***	0.078	0.334***	0.068
	woman	0.191***	0.045	0.220***	0.064	0.201***	0.045
	children	0.465***	0.061	0.466***	0.066	0.465***	0.059
	each child	0.116***	0.015	0.116***	0.017	0.116***	0.015
Coastal	man	0.098**	0.040	0.064	0.039	0.109***	0.039
	woman	-0.048*	0.028	-0.015	0.025	-0.051*	0.029
	children	-0.050	0.037	-0.049	0.045	-0.058	0.038
Forest	man	0.000	0.032	0.013	0.031	0.014	0.031
	woman	0.040	0.025	0.050*	0.026	0.040	0.026
	children	-0.040	0.030	-0.063*	0.037	-0.053*	0.031
Savannah	man	0.021	0.037	0.030	0.038	0.032	0.037
	woman	0.044	0.027	-0.007	0.026	0.044	0.028
	children	-0.065*	0.034	-0.023	0.043	-0.076**	0.035
Rural household	man	0.023	0.022	0.037	0.024	0.022	0.022
	woman	0.041**	0.016	0.010	0.014	0.040**	0.017
	children	-0.064***	0.022	-0.047*	0.026	-0.061***	0.022
Average age	man	-0.008**	0.004	-0.009*	0.005	-0.007	0.004

of children	woman	-0.008**	0.004	-0.001	0.003	-0.008**	0.004
	children	0.014***	0.004	0.010**	0.005	0.015***	0.004
Proportion of male children	man	0.095***	0.025	0.082***	0.024	0.098***	0.025
	woman	-0.043**	0.020	-0.048**	0.019	-0.045**	0.020
	children	-0.052***	0.021	-0.033	0.029	-0.053***	0.022
Owns land	man	-0.020	0.021	-0.062**	0.026	-0.018	0.021
	woman	-0.062***	0.016	-0.071***	0.023	-0.064***	0.016
	children	0.082***	0.022	0.133***	0.028	0.082***	0.022
Working mother	man	-0.041	0.032	0.001	0.030	-0.035	0.032
	woman	0.025	0.023	0.006	0.022	0.024	0.023
	children	0.016	0.024	-0.008	0.031	0.011	0.024
Working children	man	0.075**	0.031	0.034	0.033	0.077*	0.031
	woman	-0.005	0.021	0.025	0.023	-0.005	0.021
	children	-0.070***	0.026	-0.059	0.036	-0.072***	0.026
Number of children<3yrs	man	0.035	0.023	0.013	0.024	0.033	0.023
	woman	-0.046***	0.015	-0.035**	0.016	-0.047***	0.015
	children	0.010	0.020	0.022	0.022	0.014	0.020
Father's age above average	man	-0.002	0.019	0.014	0.023	-0.006	0.022
	woman	0.005	0.016	0.002	0.014	0.007	0.016
	children	-0.002	0.020	-0.016	0.023	-0.001	0.019
Mother's age above average	man	-0.072***	0.026	-0.084***	0.030	-0.072***	0.025
	woman	0.040**	0.017	-0.013	0.016	0.042**	0.017
	children	0.032	0.022	0.097***	0.030	0.030	0.022
Man's education	man	-0.002	0.007	0.001	0.007	-0.003	0.007
	woman	0.012**	0.005	0.005	0.005	0.012**	0.006
	children	-0.010	0.006	-0.006	0.008	-0.009	0.006
Woman's education	man	-0.019**	0.007	-0.025***	0.009	-0.019**	0.008
	woman	0.001	0.005	0.000	0.005	0.001	0.005
	children	0.018***	0.007	0.025***	0.009	0.018***	0.007
Christian father	man	-0.074**	0.037	-0.076**	0.034	-0.077**	0.037
	woman	0.032*	0.019	-0.012	0.017	0.032*	0.019
	children	0.042	0.031	0.088**	0.036	0.045	0.031
Muslim father	man	-0.084**	0.038	-0.079**	0.035	-0.084**	0.038
	woman	0.039*	0.021	0.007	0.018	0.034	0.021
	children	0.045	0.032	0.072**	0.038	0.050	0.032

Standard errors robust to all forms of heteroskedasticity. *p<0.10, **p<0.05, ***p<0.01

Appendix C GMM Estimation

Table C.1: GMM Estimates

		SUR[3]		GMM[4]
Household characteristic	Individual type	Estimate	StdErr[1]	Estimate
One child	man	0.339***	0.054	0.337
	woman	0.301***	0.044	0.301
	children	0.360***	0.049	0.362
Extra child[2]	man	-0.017*	0.010	-0.018
	woman	-0.024***	0.008	0.023
	children	0.041***	0.010	0.041
Rural household	man	0.011	0.022	0.011
	woman	0.027	0.017	0.027
	children	-0.039**	0.021	-0.039
Working children	man	0.096***	0.030	0.097
	woman	-0.007	0.019	0.008
	children	-0.089***	0.026	-0.089
Number of children<3yrs	man	0.018	0.022	0.017
	woman	-0.038**	0.015	-0.038
	children	0.020	0.020	0.021
Proportion of male children	man	0.116***	0.026	0.116
	woman	-0.034*	0.020	-0.034
	children	-0.082***	0.023	-0.082
Man's education	man	-0.001	0.007	-0.004
	woman	0.009	0.006	0.009
	children	-0.007	0.007	-0.007
Woman's education	man	-0.019**	0.007	-0.019
	woman	0.001	0.005	0.002
	children	0.018***	0.007	0.017

[1] Standard errors robust to all forms of heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[2] Household dummies are replaced by a scalar valued number of children variable called the 'extra child' variable.

[3] Columns 3 and 4 present non-linear SUR results which are analogous to estimates presented in the rightmost columns of Table 2. The change from household dummies to the extra child variable does not change the qualitative implications of our results.

[4] Column 5 presents the GMM estimates. The endogenous regressors are extra child and total expenditure. We notice that the GMM estimates are very similar to the non-linear SUR estimates. We also estimate a model where only the extra child variable is treated as endogenous and arrive at the same conclusions. Based on these, we conclude that even if some endogeneity is present in our model, it is not significant enough to affect the qualitative results of our model. The standard errors of the GMM estimators are unknown since the model did not converge.