Decomposition of Household Expenditure and Child Welfare in Rural Ethiopia

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Abstract

The methodology by Lazear and Michael (1988) is used to decompose household expenditures into that for adults and children. Some specific estimation procedures are modified and cross section-time series (panel) data are used to control for household level heterogeneity. In addition, a new and approximate test for the estimated ratios is applied. The empirical results indicate that even though per child and total child expenditures are increasing with income the relative expenditure on children falls with it. The ratio of child to adult expenditures for female-headed households is less than for male-headed households. While households with a larger number of children expend more on children in per capita terms, the number of adults is negatively related to expenditures per child. Siblings of the spouses have a significant impact on the expenditures on children; particularly, siblings of the wife seem to compete with her children. The completion of primary education by both spouses positively affects relative expenditures on children. Intergenerational effects, through education and wealth, are also important. Pre-marriage wealth, particularly for the female spouse, positively affects allocations to children. Length of marriage and the existence of a written marriage contract increase relative expenditures on children. Both measures reflect stability of marriage indicating that 'optimal' matching in the marriage market is an important determinant of intra-household allocations. Individual level fixed effects regressions indicate that weight-for-height z-scores of children are more correlated to the estimated expenditures on children than with total household expenditure. This result on the one hand underscores the importance of intra-household allocations, and on the other shows that the estimated expenditures on children and the underlying assumption used to derive them are not off the mark.

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1. Introduction

The importance of intra-household allocations implies that the analysis of the welfare of children can be improved if a measure of the resources allocated particularly to them is used instead of total household expenditures. Because expenditures for particular individuals in the household are not fully observable, identifying assumptions are required to estimate them. In particular, goods consumed by only some members of the household play an important role in this identification.

Different models using expenditures on goods consumed only by some members of the household to examine intra-household allocations have been developed. For example, Deaton, et al. (1989) used expenditures on adult goods to examine if there is gender bias (between boys and girls) in household expenditures. This method is used in Kebede (2003) using data from Ethiopia. Chiappori (1988, 1992, 1997) starting from the assumption of efficiency in the allocation of resources in the household shows that information from the consumption of assignable and excludable goods can be used to identify the 'sharing rule'. Chiappori's method requires measures of individual incomes of household members. It is impossible to get that information for rural areas of Ethiopia due to the dominance of subsistence production and the low level of formal employment (for both men and women). Lazear and Michael (1988) use the assumption of homothetic utility functions to decompose household expenditures into those on adults and on children. This paper uses the methodology of Lazear and Michael (1988). The empirical data is from the Ethiopian Rural Household Survey (see Kebede (2003) for description of the data).

Even though the basic framework of Lazear and Michael (1988) is used, this paper improves on the estimation. In addition to modifying some specific estimation procedures, the use of cross section-time series (panel) data helps to control for household level heterogeneity. Fixed effects panel regressions are employed. In addition, a new test for the plausibility of estimated ratios is applied.

The empirical results indicate that even though per child and total child expenditures are increasing with household income the relative expenditure on children falls with it. The ratio of child to adult expenditures for female-headed households is less than for male-headed households. While households with a larger number of children also expend more on children in per capita terms, the number of adults is negatively related to expenditures per child. The number of close relatives is expected to significantly affect allocations to children due to strong family ties in rural Ethiopia. As expected, siblings of the spouses have a significant impact on the expenditures on children. While the number of siblings of the head are positively related to relative expenditures on children, that of the wife has a negative relationship; siblings of the spouse seem to compete with her children. Like most findings in the literature, the completion of primary education by both spouses positively affects relative expenditures on children. Intergenerational effects also are important. For example, education - both modern and traditional - of the parents of the wife positively affects allocations to children. The material wealth of the parents of the spouses is also an important correlate. Pre-marriage experience like ownership of a house before marriage, particularly for the female spouse, positively affects allocations to children relative to adults. This could be operating either through an income effect or through the 'bargaining' power of spouses. The number of years couples have stayed in marriage and the existence of a written marriage contract increase relative expenditures on children. Both measures reflect stability of marriage indicating that 'optimal' matching in the marriage market is an important determinant of intra-household allocations.

Individual level fixed effects regressions indicate that weight-for-height z-scores of children are more correlated with the estimated expenditures on children - both per capita and total - than with total household expenditure. This result on the one hand underscores the importance of intra-household allocations, and on the other shows that the estimated expenditures on children and the underlying assumption used to derive them are not off the mark.

The paper is organized in the following way. The next section presents the methodology of Lazear and Michael (1988) with a discussion of some problems in identifying intra-household allocations. Estimates of the ratio of observable to total adult expenditures are presented in Section 3. Section 4 discusses the results from an

approximate test for the estimated observable to total adult expenditure ratios. Section 5 looks at the apportionment of total expenditure into that on adults and children. Section 6 examines the correlation between estimated expenditures on children and their weight-for-height z-scores. Section 7 concludes.

2. Decomposing Household Expenditures: Methodology

An examination of the impact of children on household welfare can be approached from different angles. Browning (1992) identifies four different questions: (i) *the positive question*: how do children affect the expenditure patterns of a household? For instance, generally households with children have a relatively higher budget share for food at the same level of income (Kooreman and Wunderink, 1997). (ii) *the needs question*: how much income does a family with children need compared to a childless family? (iii) *the iso-welfare question*: how much income does a family with children require to be as well of as a family with no children? (iv) *the expenditure question*: how much do parents spend on their children? This research uses the methodology of Lazear and Michael (1988) and focuses on the last question.

To examine how much parents spend on their children, household expenditures have to be apportioned into those made for adults and children. At least five factors complicate this (Lazear and Michael, 1988):

1. *Apportionment of private goods*: Generally, information only on the total amount of private goods consumed by household members is available (for example, food expenditures). Disaggregated private consumption of children and adults is not usually available for most private goods.
2. *Apportionment of household pubic goods*: By definition the consumption of household public goods by one individual does not affect the amount available to others further complicating the apportionment of expenditures.
3. *Life cycle effects*: Even when expenditures on children are observable, life cycle effects may exaggerate or understate the share of individuals. For instance, the share of a child who is going to a primary school is understated relative to the share of another attending a more expensive higher education. The expenditures of households with children are affected both by within period changes and inter-

temporal allocations. Household expenditures increase when children are born and reared – a within period change. But households may start saving before children are born – expectation of having children resulting in inter-temporal allocations (Banks, et al., 1994).

4. *Allocation of non-pecuniary resources*: For example, some members of households may be favoured in the allocation of goods but others in terms of leisure. These types of non-pecuniary intra-household allocations cannot be captured from standard surveys; detailed information on both time use of individuals and the allocation of goods is required.
5. *Interdependent utilities*: Even in an ideal situation where all expenditures on individual members of households are observed, relating expenditures to welfare is beset with problems of externalities. The interdependence between the utility of individuals has an important bearing on the relationship between patterns of expenditure and welfare. The degree of 'selfishness' and 'altruism or love' in the utility function of individuals determines the relationship between income and welfare. In the case of a 'selfish' individual, a direct relationship between income and welfare can exist and the identity of the person controlling resources becomes important. In the extreme opposite case with 'perfect love', the control of resources becomes irrelevant; only total household resource determines individual welfare (see Lazear and Michael (1988) for a detailed discussion).

Developing a model handling all the above-mentioned problems of measuring individual consumption inside households is impossible. The method developed by Lazear and Michael (1988) focuses on the two problems of apportioning of private and public goods. The life-cycle problem needs long time panel data to net out age-specific effects. Problems in non-pecuniary resources and interdependence in preferences bedevil income distribution studies in general and there is no easy solution for them.

The following paragraphs outline the methodology of Lazear and Michael (1988).

The consumption bundle of households is constituted of private and public goods. Private goods can be divided into *exclusive and non-exclusive goods*. Goods consumed only by a member (or group of members) of a household are called exclusive goods. If members of households are classified into adults and children, goods consumed only by

adults or children are exclusive goods for the respective group. Goods consumed by all members of the household (such as food) but by their private nature are individually enjoyed and in principle can be apportioned to the individuals in the household are non-exclusive private goods. Household public goods (like housing and security) are consumed together by all and the consumption of one does not necessarily exclude the consumption of others.

First let us consider only private goods. Let $\widetilde{C}_A$ and $\widetilde{C}_K$ represent the per capita household expenditure on exclusive adult and children private goods respectively; these goods are directly observable (may include goods like alcoholic drinks and cigarettes for adults and school fees and clothes for children). Similarly, let C_A and C_K be per capita consumption expenditures per adult and child (both exclusive and non-exclusive goods). Define λ_i as the ratio of total to exclusive expenditures for demographic group i ($i=A$ for adult and $i=K$ for children), i.e.,

$$\lambda_A = \frac{C_A}{\widetilde{C}_A}; \lambda_k = \frac{C_A}{\widetilde{C}_K} \qquad \ldots(1)$$

Assume the ratio of expenditure on children to that on adults is affected by demographic and economic characteristics, X, parameterised by the function $\phi(X)$.

$$\frac{C_K}{C_A} = \phi(X) \qquad \ldots(2)$$

If A and K stand for the number of adults and children respectively, total expenditure, T, equals

$$T = AC_A + KC_K \qquad \ldots(3)$$

Using the definitions of λ_A and λ_K and the functional relationship in (2), (3) can be written as

$$T = A\lambda_A\widetilde{C}_A + K\phi(X)\lambda_A\widetilde{C}_A \qquad \ldots(4)$$

Multiplying the last term by $\frac{A}{A}$ and re-arranging

$$T = \lambda_A A\widetilde{C}_A + \frac{K}{A}\phi(X)\lambda_A A\widetilde{C}_A \qquad \ldots(5)$$

In the above equation the only unobservable components are λ_A and $\phi(X)$. In both

parts of the equation, $A\widetilde{C}_A$ stands for total expenditure on exclusive adult goods and $\frac{K}{A}$ for the ratio of the number of children to adults in the household, both of which are observable.

Lazear and Michael (1988) first explore two alternatives. The first eliminates λ_A from the above equation and uses a multiplicative form for $\phi(X)$. Substituting the expression for total expenditures, $T=AC_A+KC_K$, and using the definitions of λ_A and λ_K in the above equation and rearranging,

$$\frac{K\widetilde{C}_K}{A\widetilde{C}_A} \div \frac{K}{A} = \phi(X)\frac{\lambda_A}{\lambda_K} \qquad \ldots(6)$$

Let $\phi(X) = \phi_O X_1^{\phi_1} X_2^{\phi_2} \ldots X_n^{\phi_n}$ and after replacing this value for $\phi(X)$ and taking logarithms, the expression becomes

$$\ln\frac{K\widetilde{C}_K}{A\widetilde{C}_A} - \ln\frac{K}{A} = \ln\frac{\lambda_A}{\lambda_K} + \ln\phi_O + \phi_1 \ln X_1 + \phi_2 \ln X_2 + \ldots + \phi_n \ln X_n \qquad \ldots(7)$$

The intercept (regression constant) of the above equation equals $\ln\frac{\lambda_A}{\lambda_K} + \ln\phi_O$ implying that $\phi(X)$ cannot be known without an estimate of ϕ_O and hence $\frac{C_K}{C_A}$ remains unidentified. This approach also implicitly and unrealistically assumes that $\frac{\lambda_A}{\lambda_K}$ is not affected by the *Xs*.

The second approach identifies ϕ_O but needs the assumption of separability between adult and children goods in the utility function. Let $\overline{C_i}$ represent non-exclusive goods, i.e., $\overline{C_i} = C_i - \widetilde{C}_i$, *i = A, K*. A separable utility function is given by

$$U_A = U_1\left(\widetilde{C}_A, \overline{C}_A\right) + U_2\left(\widetilde{C}_K, \overline{C}_K; K\right) with U_2\left(\widetilde{C}_K, \overline{C}_K; 0\right) = 0 \qquad \ldots(8)$$

Due to separability the ratio of total to exclusive adult goods, $\frac{C_A}{\widetilde{C}_A}$, is independent of the number of children, *K*, and expenditures on children, C_K. If $\frac{C_A}{\widetilde{C}_A}$ is independent of the number of children there will be no systematic difference in the ratio between

households with and without children. But for households without children total *adult* expenditure, AC_A, is total household expenditure, T.

$$\lambda_A = \frac{AC_A}{A\widetilde{C}_A} = \frac{T}{A\widetilde{C}_A} \quad \ldots(9)$$

All the variables in (9) are observable. Suppose λ_A varies with Z demographic and economic variables for households without children - these are characteristics independent of children. Using the information from households without children, the parameters relating λ_A and Z can be identified by the following regression.

$$\lambda_A = \lambda_A(\mathrm{Z}) = \lambda_O + \lambda_1 \mathrm{Z}_1 + \lambda_2 \mathrm{Z}_2 + \ldots + \lambda_m \mathrm{Z}_\mathrm{m} \quad \ldots(10)$$

With the assumption of homotheticity which implies that the λ_A ratios are the same for households with and without children given socio-economic variables, Z, the λ_i parameters can be used to predict the λ_As for households with children. Let $\hat{\lambda}_A$ stand for the predicted values of λ_A for households with children. Using the expression for total expenditures, the ratio of total to exclusive expenditures on children can be estimated by

$$\lambda_K(Z) = \frac{T - \lambda_A(Z) A\widetilde{C}_A}{K\widetilde{C}_K} \quad \ldots(11)$$

If $\lambda_A(\mathrm{Z})$ and $\lambda_K(\mathrm{Z})$ are substituted into equation (7), $\frac{C_K}{C_A} = \phi(X)$ can be identified.

The limitation of this approach is that in addition to identifying some goods consumed by adults, $A\widetilde{C}_A$, it also requires identifying other goods consumed only by children, $K\widetilde{C}_K$. Lazear and Michael (1988) also point out an additional problem in using (7) in regression. Even though all the parameters in the equation are identified, the dependent variable - and possibly that of the error term - is a ratio of two random variables and has a Cauchy distribution. The Cauchy distribution does not have moments and the estimates are usually badly behaved with undesirable finite sample properties.

In the third approach, the predicted values of λ_A generated by using data from households without children, $\hat{\lambda}_A$, are used as before. But instead of a multiplicative form for $\phi(\mathrm{X})$ a linear version is used, $\phi(X) = \phi_0 + \phi_1 X_1 + \phi_2 X_2 + \ldots + \phi_n X_n$. Then the total expenditure equation is directly estimated. Since $T = \lambda_A A\widetilde{C}_A + \frac{K}{A}\phi(X)\lambda_A A\widetilde{C}_A$ from

equation (5), substituting for $\phi(X)$, the total expenditure function becomes

$$T = \lambda_A A\tilde{C}_A + \phi_O \frac{K}{A}\lambda_A A\tilde{C}_A + \phi_1 \frac{K}{A}\lambda_A A\tilde{C}_A X_1 + ... + \phi_n \frac{K}{A}\lambda_A A\tilde{C}_A X_n \quad \ldots(12)$$

Everything, except the parameters of ϕ_i, are observable. To simplify the above expression, let $D_O \equiv \lambda_A A\tilde{C}_A$ and $D_1 \equiv D_O \frac{K}{A}$.

$$T = D_o + \phi oD_1 + \phi_1 D_1 X_1 + \phi_2 D_1 X_2 + ... + \phi nD_1 X_n \quad \ldots(13)$$

The coefficient on D_0 should equal to one and the equation must be estimated without an intercept; these are testable restrictions. The estimated ϕ_i parameters, $\phi o + \phi_1 X_1 + \phi_2 X_2 + ... + \phi nX_n$, can be used to predict the ratio of children to adult expenditures, $\frac{C_K}{C_A}$. This is the relevant ratio for apportioning total expenditures.

Lazear and Michael (1988) further discuss ways of handling household public goods. An alternative they suggest is to start from the assumption that the ratio of utility derived by a child from public goods to that derived by an adult from the same goods is equal to the ratio of private expenditures on children to private expenditures on adults. If Y stands for public goods, this assumption in short says $\frac{U_K(Y)}{U_A(Y)} = \frac{C_K}{C_A}$ where $U_i(.)$ stands for the utility function of *i*. This is intuitively appealing as it implies an allocation rule that has the same degree of concern towards children in relation to public as in private goods. To elaborate on the implication of this formulation, the example given in Lazear and Michael (1988) is given below.

Suppose a household has four members; individuals 1 and 2 are adults and 3 and 4 are children. And assume the following utility function is maximized,

$$U = f(X_1, Y) + f(X_2, Y) + \phi f(X_3, Y) + \phi f(X_4, Y) \quad \ldots(14)$$

X_i represents the consumption of private goods by individual *i* and ϕ is the common weight attached to children's consumption of private and public goods - following the assumption above. First order conditions for optimisation imply

$$\frac{\partial f}{\partial X_i} = 2(1+\phi)\frac{\partial f}{\partial Y} \text{ for i = 1, 2} \quad \ldots(15)$$

$$\phi \frac{\partial f}{\partial X_i} = 2(1+\phi)\frac{\partial f}{\partial Y} \text{ for i = 3, 4} \quad \ldots(16)$$

The ratios of the marginal utilities of the public to the private goods is given by

$$\frac{\frac{\partial f}{\partial Y}}{\frac{\partial f}{\partial X_i}} = \frac{1}{2(1+\phi)} \text{ for i = 1, 2} \quad \ldots(17)$$

$$\frac{\frac{\partial f}{\partial Y}}{\frac{\partial f}{\partial X_i}} = \frac{\phi}{2(1+\phi)} \text{ for i = 3, 4} \quad \ldots(18)$$

Generally for A adults and K children,

$$\frac{MU_Y}{MU_i} = \frac{\frac{\partial f}{\partial Y}}{\frac{\partial f}{\partial X_i}} = \frac{1}{A+\phi K} \text{ for i = 1, 2} \quad \ldots(19)$$

$$\frac{MU_Y}{MU_i} = \frac{\frac{\partial f}{\partial y}}{\frac{\partial f}{\partial X_i}} = \frac{\phi}{A+\phi K} \text{ for i = 3, 4} \quad \ldots(20)$$

C_A and C_K stand for total consumptions of adults and children as before but now they are constituted of private as well as public goods.

$$C_A = X_A + \frac{1}{A+\phi K}Y \quad \ldots(21)$$

$$C_K = X_K + \frac{\phi}{A+\phi K}Y \quad \ldots(22)$$

Expressing the two as a ratio,

$$\frac{C_K}{C_A} = \frac{X_K + \frac{\phi}{A+\phi K}Y}{X_A + \frac{1}{A+\phi K}Y} \quad \ldots(23)$$

Note that $\frac{C_K}{C_A} = \phi$ and substituting that in the above equation, gives us

$$\frac{C_K}{C_A} = \frac{X_K}{X_A} \qquad \ldots(24)$$

This implies that when the ratio of the private consumption of children to that of adults' is known, the same ratio for all goods - including public goods - is also known. This result follows from the assumption that equal weights are given to the consumption of private and public goods. The mean public good consumption of each adult and child respectively is, $Y_A = \frac{1}{A+\phi K} Y$ and $Y_K = \frac{\phi}{A+\phi K} Y$. Correspondingly, the proportions of the consumption of public goods by adults and children are $\frac{AY_A}{Y} = \frac{A}{A+\phi K}$ and $\frac{KY_K}{Y} = \frac{K\phi}{A+\phi K}$ respectively.

The expenditure of households without children equals $T = AX_A + AY_A$. As before, the ratio of total adult to exclusive adult expenditure for households without children is $\lambda_A = \frac{AX_A + AY_A}{A\widetilde{X}_A} = \frac{T}{A\widetilde{X}_A}$, and it is observable and determined by household demographic and economic characteristics, *Z*. Hence, as before regression of this ratio on the determinants gives the parameters for predicting the values of λ_A for households with children. Substituting ϕ and the predicted values of λ_A, denoted by $\hat{\lambda}_A$, for total expenditure of households with children

$$T = \hat{\lambda}_A A\widehat{X}_A + \phi\hat{\lambda}_A A\widehat{X}_A \frac{K}{A} + Y - \frac{A+\phi K}{A} AY_A \qquad \ldots(25)$$

Since $AY_A = \frac{A}{A+\phi K} Y$, the last two terms cancel themselves out and equations (25) reduced to equation (5), the same equation used when only private goods are considered. This means in effect the adults' portion of the public goods is included in the estimated λ_A and attributed the additional expenditure on public goods to the children's portion of the total consumption bundle. Hence, estimation of the previously identified regression equation without public goods is the same as estimating a regression with public goods under the assumption made here. In our case, the consumption data mainly reflects the consumption of private goods. But with the assumption that households use

the same allocation rule for private and pubic goods, the conclusion holds for public goods as well.

The next section presents estimates of the ratios of observable adult to total adult expenditures.

3. Ratio of Observable Adult to Total Adult Expenditures

Households have highly diversified structures. Taking into account all structures will be an impossible task given the size of the data. Husbands and/or wives may be living alone; or they may be living with their own children who may be young or adults. They may also be living with others who are not their own children and are either young or adults. These variations in the structure of households may have a bearing on the intra-household distribution of expenditures. But taking all these variations with a sample covering around 1500 households deprives a lot of degrees of freedom making generalizations impossible.

The methodology employed here requires classifying households into those with and without children. This classification is not as straightforward as it seems. If individuals younger than 16 years are considered as children, it is not clear to which classification a household belongs if it has a child (or children) of the head who is (are) older than 16 years. In our case, there are 611, 589, 608 and 635 households with children of the head older than 16 years in the four survey rounds respectively. These households are excluded from the analysis. Including them as childless households is wrong since the households have children. Including them as households with children is also problematic given that adult children probably play a more important role in household decision-making compared to young children. Hence, households with children in our case are households with only children younger than 16 years.

Whether or not children are off springs of the household head may affect the distribution of resources inside households. In our data, the importance of this should not be exaggerated since on the average 77% of the children are off springs of the household head. In no instance does the percentages of off springs of the household head from all children by survey sites fall below 64% and in some cases it is as high as 92%.

Expenditures on the following items are included in exclusive adult expenditures:

alcohol, *chat*[1], cigarette/tobacco, coffee, soft drinks and *karibo*[2], transport, eating out, men's clothes/shoes/fabric and women's clothes/shoes/fabric.

As indicated in Section 2, the estimation of the ratio of total adult to observable adult expenditures uses the information from households without children. The information from households without children is used to generate the estimates for households with children.[3]

Lazear and Michael (1988) estimated a modified version of equation (10). The ratio of total adult to observable adult expenditures, λ_A, is a function of demographic and economic variables, Z.

$$\lambda_A = \lambda_A(Z) = \lambda_O + \lambda_1 Z_1 + \lambda_2 Z_2 + \ldots + \lambda_m Z_m \qquad \ldots(26)$$

Since $\lambda_A \equiv \frac{AC_A}{A\tilde{C}_A} = \frac{T}{A\tilde{C}_A}$ for households without children, the above equation can be modified into

$$T = \lambda_0(A\tilde{C}_A) + \lambda_1(A\tilde{C}_A Z_1) + \lambda_2(A\tilde{C}_A Z_2) + \ldots + \lambda_m(A\tilde{C}_A Z_m) \qquad \ldots(27)$$

This equation is estimated without an intercept in Lazear and Michael (1988). One problem in this procedure is that the intercept may be significant, as it was for Lazear and Michael (1988) and for us. To avoid this problem, an equation similar to equation (26) above is directly estimated with an intercept. A second problem in using Equation (27) is multicollinearity; the multiplication of all independent variables by $A\tilde{C}_A$ makes them highly collinear.

Instead of λ_A its reciprocal is used to retain observations with zero observable adult expenditures. In addition, since the inverse λ_A is bounded between one and zero - as a budget share – it makes the error terms more homoscedastic. After identifying the parameters of $\hat{\lambda}_i$ (in our case the inverse of $\hat{\lambda}_i$) by using the data from households without children, the ratios between observed and total adult expenditures for households with children are estimated by

$$\hat{\lambda}_{ij} = \hat{\lambda}_0 + \hat{\lambda}_1 Z_1 + \hat{\lambda}_2 Z_2 + \ldots + \hat{\lambda}_m Z_m \qquad \ldots(28)$$

[1] *Chat* is a mildly intoxicating plant extensively used in some of the survey sites (particularly in Adele Keke, Kersa). It is also an important source of cash income for farmers cultivating it.
[2] *Karibo* is home-brewed non-alcoholic drink.
[3] There are 101, 106, 117 and 90 households without children in the respective four rounds of the survey.

Table 1: Panel Household Level Fixed Effects Regression of the Ratio of Observable to Total Adult Goods (Inverse Lambda) for Households without Children (Time-variant variables)

Variable	Panel fixed effects regression coefficients and standard errors No of observations (groups) = 414 (174) R-sq: Within = 0.1962; Between = 0.0923; Overall = 0.0840 F(15,225) = 3.66; Prob > F = 0.0000 Corr (ui, Xb) = -0.8034 Sigma u = 0.2573; Sigma e = 0.1622; Rho = 0.7156 Ui = 0: F (173, 225) = 1.58; Prob > F = 0.0007	
	Coefficient	Std error
Total exp.	-0.0261	0.0121**
Household size	0.0486	0.0559
Age of head	-0.5026	0.5506
Prices		
Food	-0.0183	0.0569
Non-food	-0.0025	0.0594
Alcohol	0.0598	0.0220***
Coffee	0.0140	0.0436
Transport	-0.0595	0.0259**
Men's cloth	0.0527	0.0501
Women's cloth	0.0456	0.0343
Boys' cloth	-0.0112	0.0352
Girls' cloth	-0.0284	0.0345
Survey rounds		
Round 1	0.0763	0.0690
Round 2	0.0274	0.0650
Round 3	-0.0185	0.0642
Constant	1.8860	2.0617

Note: All continuous independent variables are in natural logarithms. *** Significant at 1%; ** Significant at 5%; * Significant at 10%

The independent variables, Z_i's, which do not include variables directly related to children are: real total expenditure, household size, age of household head, prices of different commodities (food, non-food, alcohol, coffee, transport, men's, women's, girls' and boys' clothes), a variable measuring the influence of nearby cities/towns on the survey sites and dummy variables for primary education of household head and wife, female-headed households, for survey rounds and villages. The variable measuring the influence of nearby urban areas is computed by dividing the population of the nearest town by the distance from the survey site. The parameter estimates from the regressions are given in Tables 1 and 2. Household level fixed effects regressions are used to control for endogeneity as total real household expenditure and unobservable factors influencing the ratios are probably correlated. While some variables change over time others are fixed. In the first stage, time-variant variables are regressed on the ratio of observable to total adult

expenditures by using panel fixed effects model (Table 1). In the second stage, the fixed effects generated from the first stage are again regressed on time-invariant variables (Table 2).

Household size and the age of the household head are not significantly related to the ratio. Total household expenditures significantly and negatively affect it; the budget share of observable adult expenditure decreases with income. Except for alcohol and transport prices, all other prices do not significantly affect the budget share. In addition, that all the round dummies are not significantly different from zero shows that the demand for observable adult goods is not affected by seasonal fluctuations.

Table 2: Regression of Household Level Fixed Effects on Time-invariant Variables for Households without Children

Variable	No of observations = 414 F (17, 396) = 331.62; Prob > F = 0.0000 R-squared = 0.3544; Root MSE = 0.2067 Coefficient	Std error
Proximity to town	-0.0475	0.0158***
Primary edu-head	-0.1034	0.0310***
Primary edu-wife	-0.0706	0.0705
Female-headed	0.0753	0.0290***
Villages		
Haresaw	0.1214	0.0641*
Geblen	0.4873	0.0418***
Dinki	0.0749	0.0493
Debre Berhan	0.1239	0.0435***
Yetmen	0.1921	0.0650***
Shumsheha	-0.0425	0.0691
Sirbana Godeti	0.1419	0.0436***
Adele Keke	0.1420	0.0447***
Korodegaga	0.1504	0.0515***
Domaa	-0.2337	0.0631***
Aze Deboa	-0.2692	0.0351***
Adado	0.1423	0.0505***
Gara Godo	0.0837	0.0431*
Constant	0.2716	0.1405*

Note: All continuous independent variables are in natural logarithms. *** Significant at 1%; ** Significant at 5%; * Significant at 10%

Even though most of the time-variant variables are not significant, almost all the time-invariant ones are significant. The high percentage of the variance of the error term due to fixed effects - represented by Rho of 72% - indicates the importance of time-invariant variables. Proximity to larger urban centres and the completion of primary school by the household head depress the demand for observable adult expenditures. Female-headed households proportionally expend more on observable adult goods than

male-headed households. The completion of primary education by female spouse does not affect demand. In addition to location vis-à-vis urban areas community level heterogeneity is significant in shaping their demand for observable adult goods; this is reflected by the highly significant coefficients on the village dummies.

Parameters from the regression are used to predict the ratios of observable to total adult expenditures of households with children. The mean, median and standard deviations of these ratios disaggregated by sites are given in Table 3.

Table 3: Mean, Median and Standard Deviation of Ratios of Observable Adult to Total Adult Expenditures (Inverse Lambda) for Households with Children by Survey Villages

Village	Mean	Median	Std deviation
North			
Haresaw	0.2105	0.2200	0.2252
Geblen	0.2513	0.2731	0.1552
Shumsheha	0.1912	0.2076	0.1591
Dinki	0.2091	0.2392	0.1572
Debre Berhan	0.2820	0.3163	0.1951
Yetmen	0.2930	0.3256	0.1758
South			
Sirbana Godeti	0.3075	0.3558	0.1774
Adele Keke	0.3412	0.3731	0.1871
Korodegaga	0.3244	0.3298	0.1409
Domaa	0.3442	0.3354	0.1473
Aze Deboa	0.3711	0.3792	0.1674
Adado	0.2244	0.2583	0.1776
Gara Godo	0.3446	0.3508	0.1266
Imdibir	0.2956	0.3174	0.1281
Terufe Kechema	0.4606	0.4744	0.1162
All	0.3221	0.3083	0.1481

On the average, households with children use around a third of adult expenditures on observable adult goods. But this average glosses over significant variations between villages; the ratio ranges from a low of 19% for Shumsheha to a high of 46% for Terufe Kechema - in terms of the median the ratios range between 20% and 47% for the same villages.

As indicated in the previous section, the estimated ratios are used to derive the expenditures on children and adults. Before doing that, the next section presents a new approximate test based on the relationship between the estimated ratios and the budget shares of observable adult expenditures for households with children.

4. An Approximate Test for the Estimated Ratios

The crucial assumption in the methodology of Lazear and Michael (1988) is the assumption of a homothetic utility function in the ratio of total to observable adult expenditures. A direct test for this assumption cannot be made since adult expenditures of households with children are not directly observable. The next paragraph outlines an approximate test using the predicted ratios and the budget share of observable adult expenditures of households with children. This is a new test that is used to examine if the predicted ratios have values in the expected direction.

The ratios of observable to total adult expenditures from households without children are used to predict similar ratios for households with children. The ratios are observable for households without children because total adult expenditure is total household expenditure, i.e., $\frac{1}{\lambda_A} = \frac{A\tilde{C}_A}{AC_A} = \frac{A\tilde{C}_A}{T}$. Regressing these ratios on the socio-economic characteristics of households without children and predicting the corresponding ratios for households with children gave the required ratios reported in the previous section, i.e., $\frac{1}{\lambda_A} = \frac{A\tilde{C}_A}{AC_A}$. These predicted ratios must be systematically related to the budget shares of observable adult expenditures ($\frac{A\tilde{C}_A}{T}$) for households with children; note that the budget share is observable for even households with children. This is the basis of the approximate test used here.

For households with children, total expenditure, T, is constituted of expenditures on adults and on children, $AC_A + KC_K$. Hence, the budget shares of observable adult expenditures can be written as $\frac{A\tilde{C}_A}{AC_A + KC_K}$. Note that $\frac{1}{\lambda_A} = \frac{A\tilde{C}_A}{AC_A} > \frac{A\tilde{C}_A}{AC_A + KC_K}$ since $KC_K > 0$; in other words, the predicted ratios of observable to total adult expenditures must be greater than the budget shares of observable adults expenditures of households with children.

Table 4 presents results from t-tests comparing the predicted ratios and budget shares for all as well as for each survey village for households with children. While the null hypothesis asserts that the two ratios are equal to each other, the alternative

hypothesis posits that the predicted ratios are greater than the budget shares. The null hypothesis is strongly rejected in favour of the alternative for the pooled data as well as for thirteen out of the fifteen villages. In one of the remaining two cases, the null is rejected at 5% but not at 1% level. Even in the one remaining case the null is rejected at only around 13%. The results strongly support that the predicted ratios of observable to total adult expenditures are systematically greater than the budget shares of observable adult expenditures for households with children.

Table 4: Tests Comparing Predicted Ratios of Observable to Total Adult Expenditure and Budget Shares of Observable Adult Expenditure for Households with Children by Survey Villages

Village	Number of cases	Predicted ratio	Budget share	t-statistics	p-value
North					
Haresaw	177	0.2105	0.1784	1.7807	0.0383
Geblen	93	0.2513	0.2244	1.1725	0.1220
Dinki	178	0.2091	0.1014	8.2505	0.0000
Debre Berhan	308	0.2820	0.0902	16.8653	0.0000
Yetmen	126	0.2930	0.1163	9.0374	0.0000
Shumsheha	303	0.1912	0.1087	7.7029	0.0000
South					
Sirbana Godeti	160	0.3075	0.1694	9.6471	0.0000
Adele Keke	189	0.3412	0.1163	15.3900	0.0000
Korodegaga	230	0.3244	0.1853	12.1766	0.0000
Terufe Kechema	162	0.4606	0.1735	21.2447	0.0000
Imdibir	70	0.2956	0.1845	5.9086	0.0000
Aze Deboa	147	0.3711	0.1174	15.2129	0.0000
Adado	289	0.2244	0.1480	6.7092	0.0000
Gara Godo	162	0.3446	0.1384	16.5168	0.0000
Domaa	150	0.3442	0.1008	15.5807	0.0000
All	2744	0.2879	0.1371	38.3184	0.0000

Note: The two ratios are equal to each other is the null hypothesis. The difference between the predicted ratios and the budget shares is positive is the alternative hypothesis, i.e., the ratios are greater than the budget shares.

Supported by the above result the next section uses the predicted ratios of observable to total adult expenditures to estimate expenditures on adults and children.

5. Expenditures on Adults and Children

The coefficients of the ϕ function that decomposes total expenditure into that for adults and children is estimated by the following function in Lazear and Michael (1988) (this is equation (12) in Section 2):

$$T = \lambda_A A\widetilde{C}_A + \phi_O \frac{K}{A}\lambda_A A\widetilde{C}_A + \phi_1 \frac{K}{A}\lambda_A A\widetilde{C}_A X_1 + ... + \phi_n \frac{K}{A}\lambda_A A\widetilde{C}_A X_n \quad \ldots(29)$$

Like in the previous case there are a number of estimation problems in this equation. First, the equation is estimated without a constant; but the constant is statistically significant. Second, multiplying all the covariates by $D_1 = \frac{K}{A}\lambda_A A\widetilde{C}_A$ introduces multicolinearity in the regression. Third, the coefficient of $D_0 = \lambda_A A\widetilde{C}_A$ is constrained to be one; even though this restriction holds in the case of Lazear and Michael (1988) it does not hold here.

The above-mentioned estimation problems led us to follow another route. Total adult expenditure, AC_A, is estimated by using our estimates of λ_A for households with children. Since $\lambda_A = \frac{AC_A}{A\widetilde{C}_A}$, AC_A can be estimated by multiplying λ_A by observable adult expenditure, $A\widetilde{C}_A$. Deducting the estimated total adult expenditure, AC_A, from total expenditure, T, gives total expenditure on children, $T - AC_A = KC_K$. Multiplying the ratio between total children to total adult expenditures by the ratio of the number of adults to the number of children provides the required ratio of per child to per adult expenditure, $\phi = \frac{KC_K}{AC_A}\frac{A}{K} = \frac{C_K}{C_A}$. These ratios can be interpreted as the first round estimates of ϕ which then are regressed on socio-economic characteristics of households, including characteristics related to children. The predicted values from this regression give us the desired ϕ ratios. In a sense, the estimates of ϕ are updated by including variables that are related to children. Like in the previous case, household level fixed effects regression is used to control for household level heterogeneity.[4] In the first stage of the regression, time-variant variables are included. In the second, the fixed effects from the first stage are regressed on time-invariant variables. In addition to the variables considered in the regression estimating the ratio of observable to total adult expenditures, other variables directly related to children are included here. Fixed effects account for more than half of the variation in the error (Rho = 59%). The results from the regressions are given in

[4] The use of household level fixed effect regression helps to control household level heterogeneity like fertility preferences of households.

Tables 5 and 6.

Households with higher income expend relatively less on children per unit of adult expenditures. But in absolute terms both the per-child and total child expenditures increase with income. If expenditures reflect the welfare of children, this result implies that even though the overall condition of children improves with income, their relative position compared to adults deteriorates with it.

Most prices are not significantly related to relative expenditures on children; while the prices of coffee, transport and girls' cloth are positively correlated that for women's clothes is negative. In addition the proximity of the survey villages to larger urban areas is not significant.

Table 5: Panel Fixed Effects Regression of the Ratio of Child to Adult Expenditures (Variables changing over time)

Variable	No of observations (groups) = 1347 (586); R-sq: Within = 0.1253; Between = 0.0967; Overall = 0.0944; F(17,744) = 6.27; Prob > F = 0.0000; Corr (ui, Xb) = -0.6301; Sigma u = 0.2750; Sigma e = 0.2317; Rho = 0.5848; Ui = 0: F (585, 744) = 1.44; Prob > F = 0.0000	
	Coefficient	Std error
Total expenditure	-0.0746	0.0443***
Age of head	0.5148	0.6945
Years of marriage	0.1341	0.0534**
No of children	0.1154	0.0318***
No of adults	-0.1487	0.0446***
Prices		
Food	0.0569	0.0435
Non-food	0.0088	0.0421
Alcohol	0.0004	0.0196
Coffee	0.1383	0.0373***
Transport	0.0429	0.0196**
Men's cloth	0.0084	0.0358
Women's cloth	-0.0536	0.0273**
Boys' cloth	-0.0405	0.0272
Girls' cloth	0.0442	0.0260*
Constant	-1.5513	2.4880

Note: All continuous independent variables are in natural logarithms; *** Significant at 1%; ** Significant at 5%; * Significant at 10%

Most of the demographic variables are significantly related to the relative expenditures on children. The child-to-adult expenditure of female-headed households is around 13% less than that of male-headed households. The age of the household head is not a significant covariate. The number of children in the household is positively related to the relative expenditure on children; households with a larger number of children expend more on children relative to adults. On the other hand, an increase in the number

of adults in the household is associated with a decline in relative expenditures on children. The coefficients imply that the demographic composition of households significantly influences allocations to children: the more the number of children in a household the higher the relative expenditures on children as compared to adults in per capita terms. Differences in the fertility preferences of households can be cited as a possible explanation. For example, households with more children could be those with stronger preference for children resulting in higher expenditure per child. But since the regression controls for household level fixed effects it also controls for fertility preferences. One possible reason is non-linearity in expenditures on children. For example, per child expenditure may be increasing over time resulting in the later born children getting more and hence with an increase in the number of children the expenditure per child also increases.[5]

In rural Ethiopia the social network between relatives is expected to significantly influence household allocations. To examine an aspect of this issue, the number of siblings of the household head and the wife are entered as explanatory variables; both are highly significant. Interestingly, while the number of siblings of household heads increases the relative expenditure on children, that of wives decreases it. It seems that the siblings of the wife compete with her children. This gives sense since women have presumably a larger say in the management of expenditures towards children compared to other expenditure decisions.

Primary education of both the household head and the wife positively affects the relative expenditures on children. This goes with the general consensus in the intra-household literature. In addition to the education of parents, the control of finance has been shown to be important in determining allocations towards children; the consensus in the literature suggests the more the control of finances by mothers the higher the expenditure towards children. Households during the survey were asked if husband and wife have separate finances. The existence of separate finances may reflect a greater autonomy of women. Contrary to expectation, a dummy variable indicating households where the husband and wife keep separate finances is statistically insignificant in the

[5] If household decision-making is conceptualised as a result of a 'voting' system with 'equal rights' for all members, the larger number of children can increase per child expenditures.

regression. But separate finances could also be a result of discord in the relationship between spouses; if so, the coefficient implies that instability in marriage negatively affects child welfare.

Table 6: Regression of Fixed Effects on Time-invariant Variables for Ratio of Child to Adult Expenditures

Variable	No of observations = 1239 F (34, 1204) = 17.62; Prob > F = 0.0000 R-squared = 0.2395; Root MSE = 0.2182 Coefficient	Std error
Proximity to town	-0.0128	0.0141
Primary edu-head	0.1134	0.0167***
Primary edu-wife	0.0481	0.0178***
Female-headed	-0.1372	0.0288***
Edu.- parent head	-0.0052	0.0195
Edu.- parent wife	0.0588	0.0159***
Church-municipal	-0.0643	0.0215***
Written contract	0.0535	0.0245**
Separate finance	-0.0148	0.0159
House before marriage		
Head	0.0045	0.0139
Wife	0.1401	0.0254***
Head's parents		
Very poor	0.0200	0.0369
Poor	0.0292	0.0204
Rich	-0.0027	0.0188
Very rich	-0.0765	0.0403*
Wife's parents		
Very poor	0.0914	0.0368**
Poor	-0.0011	0.0217
Rich	-0.0032	0.0173
Very rich	0.1715	0.0466***
No of siblings		
Head's	0.0108	0.0022***
Wife's	-0.0063	0.0014***
Constant	0.0752	0.1217

Note: All continuous independent variables are in natural logarithms; *** Significant at 1%; ** Significant at 5%; * Significant at 10%

The family background of spouses can also be an important determinant of allocation of resources inside households. This can operate through many channels. The human capital of parents can affect the human capital of spouses. In addition, the wealth of parents of spouses can affect the wealth of the household; this has an income effect. In addition, the relative wealth of the families of the spouses can also affect their 'bargaining' power inside the household. Information on whether parents of spouses have any type of education - modern or traditional - was collected. While the education of the parents of the household head does not affect allocations towards children, that of wives'

does. Households with female spouses that have educated parents expend around 6% more on children than those with no education. Because the education of the wife is controlled for, this effect is not because daughters of educated parents are also educated. An intergenerational effect that operates independent of this seems to exist.

In addition to the human capital of the parents of spouses, their wealth status can also affect household expenditures. Households were asked to categorise their parents' wealth status into the following five groups: very poor, poor, average, rich and very rich. Dummy variables for each wealth category of the parents of the head and the wife were entered into the regression taking the 'average' as the reference group. In households where the head comes from very rich families relative expenditures on children is lower. On the other hand, in households where the wife comes from either very poor or very rich families relative expenditures on children are higher; even though the coefficient for very rich is higher than that for very poor they are not statistically significantly different from each other. This suggests that the intergenerational wealth effect that operates through mothers may be non-linear. The negative coefficient on the dummy for very rich parents of the head gives sense if parental wealth background reflects 'bargaining' power of spouses and an increase in the power of the head decreases expenditures on children.

Pre-marriage experience of the spouses can affect expenditures on children; dummy variables for heads and wives owning houses before marriage are included. While the coefficient of the dummy variable for ownership of house before marriage by the head was not statistically significant, that for wives was highly significant and positive; households with female spouses that owned their own house before marriage expend around 14% more than the rest. This can reflect both the better 'bargaining' position of females as well as a wealth effect.

Marriage market conditions are important in intra-household allocations because they determine what types of couples are matched to each other. In addition they determine threat points. Three variables related to marriage are included: length of marriage, if spouses are married in church or municipality and if they have a written marriage contract. Years of marriage are significantly and positive related to expenditures on children. The longer spouses stay in marriage the more stable it is expected to be; it is an indication that the marriage market has matched couples that suit each other. The

positive and significant coefficient indicates that this stability increases relative expenditures on children; stable marriages are good for children. A more formal tie between spouses can also help strengthen the stability of marriage. This seems to be confirmed by the positive and significant coefficient on the dummy variable for marriages with written contract. But contrary to expectation, those spouses that married in church or municipality expend relatively less on children. Probably an indicator for more formal marriage, like a written contract, is necessary to identify more stable marriage arrangements.

The overall findings indicate that income, demographic composition of households, education, family background of spouses in terms of human and material capital, experience of spouses before marriage and marriage market conditions are important determinants of allocations to children.

Table 7: Mean, Median and Standard Deviation of Ratios of Per Child to Per Adult Expenditures for Households with Children by Survey Villages

Village	Mean	Median	Std deviation
North			
Haresaw	0.5625	0.5700	0.3146
Geblen	0.5873	0.5986	0.2236
Shumsheha	0.5593	0.5538	0.2652
Dinki	0.4877	0.4729	0.3155
Debre Berhan	0.5093	0.5207	0.2938
Yetmen	0.4701	0.4635	0.2589
South			
Sirbana Godeti	0.4149	0.3899	0.2737
Adele Keke	0.3446	0.3196	0.2739
Korodegaga	0.5467	0.5492	0.2208
Domaa	0.4261	0.4484	0.2485
Aze Deboa	0.3910	0.3664	0.2900
Adado	0.5103	0.5280	0.2670
Gara Godo	0.3402	0.3446	0.2497
Imdibir	0.5879	0.5535	0.1807
Terufe Kechema	0.3205	0.3299	0.2362
All	0.4732	0.4818	0.2808

Table 7 presents the child to adult expenditures - ϕ ratios. On the average households expend on a child around 47% of what they expend on an adult with a median value of 48%. This ratio ranges from 32% (for Terufe Kechema) to 59% (for Geblen and Imdibir). Generally, northern sites have a higher ratio than the southern sites. While the

mean for northern sites is 53% that for the southern sites is 43% and the ratios are significantly different from each other (t-value of –8.8962 with a p-value of 0.0000). These ratios can be interpreted as adult equivalence scales; on the average a child is equivalent to 0.48 of an adult in terms of expenditures.

The ϕ ratios can be used to get estimates of the total amounts expended on children and adults by using the following expressions derived from the total expenditure identity and the definition of ϕ.

$$KC_k = K\frac{\phi T}{A+\phi K} \quad \ldots(30)$$

$$AC_A = A\frac{T}{A+\phi K} \quad \ldots(31)$$

Table 8: Mean and Median of Total Expenditures on Adults and Children for Households with Children by Survey Villages

Village	Adult expenditure		Child expenditure	
	Mean	Median	Mean	Median
North				
Haresaw	222.69	118.94	118.85	85.37
Geblen	162.39	102.33	108.50	79.69
Shumsheha	311.67	243.77	193.89	146.42
Dinki	161.33	109.25	83.99	46.22
Debre Berhan	405.48	303.15	270.75	193.77
Yetmen	284.90	209.07	179.18	114.70
South				
Sirbana Godeti	330.22	241.98	183.65	131.20
Adele Keke	511.99	417.32	235.16	185.08
Korodegaga	176.75	128.23	124.17	80.72
Domaa	300.28	209.42	205.69	148.16
Aze Deboa	519.25	365.33	307.50	197.09
Adado	258.53	171.57	166.71	108.31
Gara Godo	286.23	202.41	119.91	99.32
Imdibir	270.38	184.66	207.61	134.72
Terufe Kechema	395.70	315.36	211.69	145.97
All	309.27	215.45	183.21	120.84

The results by survey villages are given in Table 8. On the average, a household expends Birr 183 and Birr 309 on all children and adults per month respectively. Comparing the rankings of the survey villages either by taking expenditures on adults or on children give similar results. For example, the Spearman rank correlation coefficient for mean expenditure on adults and children is 89% with a p-value of 0.0000; the

corresponding figure for median expenditures is 91% with p-value of 0.0000. There are no dramatic shifts in the composition of adult and child expenditures across the villages. Even though the northern sites showed higher ϕ ratios as indicated above, the absolute amounts of child expenditure are not statistically different from that in the south (t-statistics of 1.1678 and p-value of 0.2430). But adult expenditures are significantly higher in the south (t-statistics of 3.4216 and p-value of 0.0003).

So far starting from the methodology of Lazear and Michael (1988) total household expenditures are decomposed into that for adults and children. In addition factors that affect expenditures on children are analysed. Ultimately the concern in intra-household allocation towards children is related to the expectation that it affects their welfare. The next section examines how expenditures on children are related to a specific measure of child welfare, weight-for-height z-scores. This also helps to ascertain whether or not the expenditure figures generated are really reflecting intra-household expenditure allocations.

6. Expenditures on Children and Short-term Health Status

A child's body responds to nutritional deprivation and/or disease in two ways that can be measured by anthropometrics. If the nutritional deprivation and/or disease have a long-term effect on the health of the child, deceleration or cessation of growth will result; this leads to low height-for-age or stunting. In the short-term the body responds by losing weight resulting in low weight-for-height or wasting. Unlike weight-for-height, weight-for-age does not distinguish between stunting and wasting; the low weight could be either due to low weight or low height. Weight-for-height is now considered as a very important indicator of short-term health and is widely used for screening severely malnourished children (de Onis, 2000).

The weight-for-height z-scores are computed by comparing the sampled children with that of a standard; the standard measurements are derived from healthy children in the US. The z-scores are computed by using the CDC/WHO software Anthro.

Table 9 presents the individual level fixed effects regressions of weight-for-height z-scores of children under the age of ten on some covariates. Since the regressions use panel data on children individual level fixed heterogeneity is controlled for. This includes

such unobserved individual characteristics like the inherent healthiness of the children. In addition, the use of individual level fixed effects helps to mitigate the problem of endogeneity particularly in relation to the expenditure variables.

Three regressions are estimated. While all the other covariates are the same in the three equations, in the first per capita household expenditure, in the second the estimated per child expenditure and in the third total estimated child expenditures are included - all in natural logarithms.

Table 9: Individual Level Fixed Effects Regressions of Weight-for-Height Z-scores on (Natural Logarithms of) Per Capita, Per Child and Total Child Expenditures

Variable	Per capita expenditure Number of obs. (groups) = 3845 (1638) R-sq: Within = 0.0715; Between = 0.0161; Overall = 0.0266 F(17,2190) = 9.91; Prob > F = 0.0000 Corr(ui, Xb) = -0.2347 Sigma u = 1.15660; Sigma e = 1.4849; Rho = 0.5266 Ui = 0: F(1637, 2190) = 1.74; Prob > F = 0.0000		Per child exp. (Ck) Number of obs (groups) = 3845 (1638) R-sq: Within = 0.0754; Between = 0.0162; Overall = 0.0275 F(17,2190) = 10.50; Prob > F = 0.0000 Corr(ui, Xb) = -0.2288 Sigma u = 1.5626; Sigma e = 1.4847; Rho = 0.5265 Ui = 0: F(1637, 2190) = 1.75; Prob > F = 0.0000		Total child exp. (KCk) Number of obs (groups) = 3845 (1638) R-sq: Within = 0.0773; Between = 0.0176; Overall = 0.0287 F(17,2190) = 10.80; Prob > F = 0.0000 Corr(ui, Xb) = -0.2305 Sigma u = 1.5621; Sigma e = 1.4802; Rho = 0.5269 Ui = 0: F(1637, 2190) = 1.76; Prob > F = 0.0000	
	Coefficient	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Per capita exp	0.1428	2.63***				
Per child exp			0.2290	4.02***		
Tot child exp					0.2490	4.57***
Age	-0.6361	-4.87***	-0.6290	-4.83***	-0.6432	-4.94***
Prices						
Maize	-0.0476	-0.31	0.0124	0.08	0.0066	0.04
Barley	-0.4547	-2.38**	-0.4394	-2.31**	-0.4446	-2.34**
Sorghum	-0.0133	-0.09	0.0055	0.04	0.0158	0.11
Teff	-0.4177	-1.54	-0.3316	-1.23	-0.3075	-1.15
Wheat	0.7815	2.67***	0.7085	2.42**	0.6976	2.39**
Millet	0.1925	1.10	0.2338	1.33	0.2366	1.35
Horse bean	-0.3777	-1.86*	-0.4349	-2.13**	-0.4539	-2.23**
Potato	-0.1268	-1.25	-0.1082	-1.07	-0.1117	-1.11
Beef	-0.1380	-0.69	-0.1347	-0.67	-0.1208	-0.61
Butter	0.2738	2.49**	0.3054	2.77***	0.3160	2.87***
Milk	0.1238	1.22	0.1390	1.37	0.1342	1.33
Egg	0.2345	2.17**	0.2642	2.45**	0.2674	2.48**
	Round dummies omitted					
Constant	0.0324	0.04	-0.3356	-0.41	-0.7966	-0.94

Note: All independent variables are in natural logarithms. *** Significant at 1%; ** Significant at 5%; * Significant at 10%.

In all the three regressions, the expenditure variables are highly significant and positive implying income/expenditures have a positive impact on short-term child health. In addition note that the coefficients on the expenditure variables increase when using

estimated per and total child expenditures. The estimated expenditures on children are better correlated with weight-for-height z-scores than with per capita household expenditures. The coefficient on per capita expenditure is statistically significantly different from the other two and is lower. In addition, the coefficient on total child expenditure is significantly higher than that on per child expenditure. This suggests that an individual child gets externality from a higher overall expenditure on children. These results on the one hand indicate the importance of intra-household allocations in determining the welfare of children in the household. On the other hand, the results also support that the estimated expenditures on children indeed reflect intra-household allocations.

The next section concludes.

7. Conclusion

This paper uses the method of Lazear and Michael (1988) to decompose household expenditure into expenditures on adults and children. As a contribution to the method some estimation procedures are modified and tests for estimated ratios are conducted. In contrast to Lazear and Michael (1988) that used cross-sectional data, panel data help to control household level heterogeneity. In addition, the correlation of the resulting estimated expenditures on children with a direct measure of child welfare is examined. The results indicate that the estimated expenditures on children are more correlated to child welfare than per capita household expenditures. This underscores the importance of intra-household allocations on the one hand and gives credence to the estimated expenditures as well as the underlying assumptions on which the method is based.

The method used in this paper requires data available from standard household and income/expenditure surveys. The availability of data from these surveys has substantially improved in developing countries over the last decade. An application of this relatively simple method on the collected data can help the understanding of intra-household allocations in general and expenditures on children in particular in many developing countries.

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