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Effects of household size and composition on consumption in rural households in Matabeleland South, Zimbabwe

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Abstract

This study, using a survey of rural households in Zimbabwe in 1990/91, focuses on the effects of changing household composition on patterns of expenditure and provides estimates of the 'cost of a child' as well as of family members in other age groups. In addition to age differences in the size and direction of responses to changing family composition, the paper highlights significant differences across product groups. These effects are more muted in larger households.

This paper reports the results of a household budget study of Matabeleland South Province, Zimbabwe in 1990–91. The focus of the study is on the effects of household size and composition on household consumption. This type of analysis has particular advantages for policy analysis, notably in designing income supplement and other welfare programmes and in linking future changes in demand to demographic changes. Household budget studies in developing countries have also proved useful in the calculation of consumption linkages in economic growth (Haggblade and Hazell, 1989) and we briefly touch on this aspect of the analysis.

The effect of changes in household composition, say, the addition of a child, with unchanged household income, can be thought of as having two components. Firstly, as the household size increases with income constant, the household is worse off in a monetary sense – its real income has fallen. As a result, expenditure on normal goods will tend to be reduced (this is often termed the 'income effect'). On the other hand, the extra family member will make specific demands for certain goods (known as 'specific effects'): there is another mouth to feed, another body to clothe, etc. For example, the child will have relatively large specific demands for particular foods, such as milk, and baby clothes but not for other goods, such as adult clothing and tobacco. For many goods, the income and specific effects tend to work in opposite directions. The analysis in this paper is an attempt to determine which of these forces dominates. As will be seen, the empirical

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results depend on the nature of the product, as well as the initial size and composition of the household.

This study is based on an analysis of household consumption of four foods: cereals, meat, milk, other food; and three non-foods: clothes, consumer durables, and other goods (education, medical care, fuel, etc.). As the opportunity cost of household time is taken into account, i.e. a 'full income' constraint is used, the demand for leisure is also included in the analysis.

The paper is set out as follows. The next section outlines the model, in which household size and composition are incorporated in Engel functions. Section 2 presents the data, definition of variables and the method of estimation. The econometric results are tabulated in the third section, together with estimates of the impact of changing family composition on five-person and two-person households. The paper concludes with a discussion of the main results.

1. Model

A form of the Engel curve which has performed well in the empirical analysis of cross-section data, expresses budget share as a function of the logarithm of income:

$$W_i = \alpha_i + \beta_i \log y \qquad (1)$$

where in our case W_i $(i = 1, \ldots, 8)$ denotes the share of 'full income' of product i, and y is the household's full income; α_i and β_i are parameters to be estimated. This form, often known as the 'Working-Leser' curve, is consistent with the Almost Ideal Demand System when prices are held constant (Chesher and Rees, 1987).

Household size and composition are introduced by re-defining household income in per caput terms and by re-specifying the intercept to allow for the influence of household composition:

$$W_i = (\alpha_{i1}n_1 + \alpha_{i2}n_2 + \alpha_{i3}n_3 + \alpha_{i4}n_4)/n + \beta_i \log(y/n) + \delta_i \log(n) \qquad (2)$$

where n denotes family size, and four household member types are distinguished, viz. n_1 the number of children less than 6 years old, n_2 the number of children aged between 6 and 11 years, n_3 the number of adolescents aged between 12 and 17 years, and n_4 the number of adults aged 18 years and over; α_{ij}, δ_i and β_i denote parameters to be estimated. The specific form of the model used here (Eq. 2) is similar to that of Chesher (1991), Chesher and Rees (1987) and Deaton (1988, 1989). The family composition variables act as explicit demand shifters. Family size (n) enters as a separate explanatory variable (in log form), as well as in the per caput income term. This is to ensure that the way in which income affects behaviour is unrestricted.

Having estimated the system of equations depicted in (2), income elasticities are derived as $1 + \beta_i/W_i$, $i = 1, \ldots, 8$. As the way in which changes in family composition affect demand is quite complex (the addition of a family member of type j increases n as well as n_j), the parameters in (2) are difficult to interpret directly. Rather, for each commodity group, the impact on household expenditures of the addition of a household member of type r to the household, ceteris paribus, may be calculated as follows (Chesher, 1991):

$$\Delta W_i = \frac{\alpha_{ir}}{n+1} - \frac{1}{n(n+1)} \sum_j \alpha_{ij} n_j - (\beta_i - \delta_i) \log\left(\frac{n+1}{n}\right) \qquad (3)$$

where ΔW_i denotes the change in the budget share of good i (or, equivalently, the change in expenditure i as a proportion of household income). It measures the 'total effect' of a change in household composition, i.e. the combined impacts of the 'specific effects' and 'income effect' referred to above.

An alternative way of presenting this information has been suggested by Deaton (1988, 1989). He sets out a procedure for establishing the 'outlay equivalent' of adding an extra person to the household, i.e. calculating how much the total budget would have to be changed in order to generate the same additional expenditure on good i as would the addition of one more person of a

given type. Specifically, he defines dimensionless *outlay equivalent ratios* (π_{ir}) as:

$$\pi_{ix} = \frac{\partial E_i/\partial n_r}{\partial E_i/\partial y}\frac{n}{y} \quad (4)$$

where E_i denotes expenditure on good i; by definition: $W_i = E_i/y$. The outlay equivalent ratios indicate the change in total outlay y that would be equivalent to an additional person of type r, expressed as a ratio of per caput household expenditure. Thus, for example, a value of π_{ir} of 0.2, where i denotes milk and n_r is the number of infants, signifies that the addition of an infant to the household has the same effect on milk consumption as an increase of 20% in total household expenditures per person.

For the specification of the empirical Engel curve used here (Eq. 2), the outlay equivalent ratios are computed as:

$$\pi_{ir} = \frac{\alpha_{ir} - \sum_j \alpha_{ij} n_j/n + \delta_i - \beta_i}{\beta_i + W_i} \quad (5)$$

Both the Chesher (1991) and Deaton (1989) approaches are adopted in the empirical analysis which follows. The two approaches are inter-related as can be seen by noting that the expression (3) for a discrete change in household composition is approximately equal to $(\partial E_i/\partial n_r)/y$, an expression which appears in Eq. (4).

2. Data and estimation

The data used for this analysis were provided by the Central Statistical Office (CSO) in Zimbabwe, which undertook an Income, Consumption and Expenditure Survey (ICES) in 1990/91. The survey was based on a sample of 15 000 households across the country. The fieldwork was conducted in the twelve months from July 1990. Only the data for Matabeleland South Province are used here [1]. These provide a sub-sample of 1117 households, mainly from the Communal Lands. However, the number was further reduced to 1096 households when some missing values and other discrepancies were taken into account.

Table 1
Characteristics of the sample households (sample size 1096)

	Mean	SD DEV
Demographic variables		
Children < 5 years (n_1)	0.988	1.175
Children 6–11 years (n_2)	0.999	1.189
Children 12–17 years (n_3)	0.780	1.055
Adults (n_4)	2.356	1.371
Family size (n)	5.123	3.398
Household income (Zimb.$)		
Full income (y)	35 690.808	48 661.901
Money income (all sources)	34 767.286	48 656.348
Expenditure		
Food	10 919.945	10 450.833
Non-food	23 847.341	43 422.729
Leisure [a]	923.522	934.757

[a] 'Leisure' denotes the implicit outlay on home production activities.

Table 1 presents some summary characteristics of the sample of households. The rather large standard deviations of the principal variables will be noted; the rural population of Zimbabwe is highly heterogenous and this is reflected in the sample. Rural incomes are derived from crops, livestock and off-farm employment, and are rather skewed in favour of a small number of households accounting for a large proportions of total income (Cousins et al., 1992). Whereas the two-adult household was the most common in the sample and 60% of the households have five members or less, there are some very large households. Thirty-four households (3% of the sample) have more than 13 household members, with one household recording 30 members.

As the survey focused on two major areas of interest (CSO, 1990) – household income and consumption – data on income, receipts from household enterprises, consumption and other expenditures were collected on a weekly and for some items on a monthly basis. For our purposes some additional manipulation of the data was necessary.

[1] This study was part of a larger piece of research on sustainable agriculture in this Province.

Table 2
Estimates of budget shares equations for Matabeleland South Province from ICES 1990/91

Commodity	(n_1/n)	(n_2/n)	(n_3/n)	(n_4/n)	Log (y/n)	Log n
Cereals	0.6418	0.6530	0.6170	0.6069	−0.0504	−0.0240
	(0.046)	(0.044)	(0.045)	(0.038)	(0.004)	(0.007)
Meat	0.0187	0.0277	0.0127	0.0191	0.0080	−0.0110
	(0.025)	(0.023)	(0.024)	(0.021)	(0.002)	(0.005)
Milk	0.0045	−0.0007	−0.0058	−0.0077	0.0027	−0.0010
	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)	(0.001)
Other food	0.2210	0.1922	0.1863	0.2148	−0.0067	−0.0052
	(0.034)	(0.033)	(0.033)	(0.030)	(0.003)	(0.006)
Clothing	0.3667	0.3843	0.3729	0.3348	−0.0170	−0.0356
	(0.036)	(0.036)	(0.040)	(0.034)	(0.003)	(0.007)
Durables	−0.0126	−0.0768	−0.0815	−0.0442	0.0145	0.0114
	(0.038)	(0.034)	(0.037)	(0.031)	(0.003)	(0.006)
Other non-food	−0.6334	−0.5823	−0.5380	−0.5971	0.0945	0.0628
	(0.054)	(0.052)	(0.052)	(0.047)	(0.005)	(0.009)
Leisure	0.4285	0.4281	0.4565	0.5038	−0.0483	−0.0010
	(0.026)	(0.024)	(0.025)	(0.026)	(0.003)	(0.003)

Heteroskedasticity-consistent standard errors in parentheses.

2.1. Household full income

Firstly, household net income was calculated as primary income, property income received, current transfers and other benefits received, less direct taxes paid, social security and pension fund contributions.

Following Becker (1965), the household's 'full income' comprises the household's net money income from all sources, plus the opportunity cost of household time not spent in the labour market. Full income thus measures the household's maximum purchasing power or standard of living: it is "the maximum money income achievable by devoting all the time and other resources of a household to earning income, with no regard for consumption" (pp. 497–498). It thus sets the constraint on expenditure on market goods and the implicit outlay on home production activities, here simply termed 'leisure'.

The opportunity cost of leisure time was calculated assuming the total available time for each (adult) household member as 12 hours/day [2]. Leisure time was defined as the difference between total available time and number of working hours/day in paid or on-farm employment. Leisure was valued at the prevailing market wage rate for agricultural labour in the district (50 cents/hour), reflecting the fact that the rural labour market is dominated by casual labour and piecework, and the prospects for formal sector employment are poor (Cousins et al., 1992). Clearly it is a simplification to assume that all adults have the same total time available and the same opportunity cost of that time, but the data do not permit a more precise specification. In common with other household models, it is also

Table 3
Estimated income elasticities and budget shares

Commodity	Income elasticity	Average budget share
Cereals	0.673	0.154
Meat	1.108	0.073
Milk	1.151	0.017
Other food	0.953	0.144
Clothing	0.891	0.156
Consumer durables	1.157	0.092
Other non-food	1.309	0.306
Leisure	0.182	0.059

[2] The 12 hours/day hypothesis was based on the available time in rural Africa, roughly the time from sunrise to sunset. For more details on this issue, see Lucas et al. (1985). Although children are observed to participate at times (e.g. during harvesting) in casual work, it is assumed here that the opportunity cost of their time is negligible.

Table 4
Rural household expenditure behaviour in Nigeria, Sierra Leone and Zimbabwe

Commodity	Average budget shares			Expenditure elasticities		
	Gusau, Northern Nigeria	Rural Sierra Leone	Matabeleland S., Zimbabwe	Gusau, Northern Nigeria	Rural Sierra Sierra	Matabeleland S., Zimbabwe
Food	0.81	0.74	0.40	0.94	0.92	0.89
Clothing	0.07	0.07	0.16	1.24	1.06	0.90
Durables	0.01	0.02	0.09	1.25	1.00	1.16
Other non-food	0.11	0.17	0.30	1.34	1.75	1.31

Sources: Gusau, Northern Nigeria: Hazell and Roel (1983); Rural Sierra Leone: King and Byerlee (1978); Matabeleland S., Zimbabwe: Authors' calculation.

assumed that all households are price-takers and can sell as much labour as they want at the prevailing wage rate. This is another strong assumption, but, although there was no attempt at formal verification, it may be noted from Table 1 that, at the mean, full income and money income are of similar magnitude, suggesting that the adults in the sample are on average fully employed.

2.2. *Household consumption*

The survey provided data on household consumption of food, beverages and tobacco; clothing and footwear; gross rent, fuel and power; furniture; medical care and health expenses; transport and communications; recreation, entertainment, education and cultural services; miscellaneous goods and services.

For the empirical analysis these were aggregated into four food consumption items: (1) *Cereals*, (2) *Meat*, (3) *Milk*, (4) *Other Food*; three non-food consumption items: (5) *Clothing and Footwear*, (6) *Durables* (mainly electrical goods), (7) *Other Non-Food* (fuel, transportation, education, medical care, etc.); and one non-market good: (8) *Leisure*.

The corresponding set of eight budget share equations (as in Eq. 2) forms a complete demand system for the household. Since the same set of regressors appear in each equation and there are no cross-equation restrictions, the system is estimated by OLS. However, as the variance of budget shares might vary systematically with household income, robust (heteroscedasticity-consistent) standard errors are computed [3].

3. Results

Table 2 presents the econometric estimates of the model. The importance of household composition on expenditure is confirmed by a Likelihood Ratio (LR) test of this unrestricted form of the model against an alternative in which all household composition variables are omitted [4].

Income elasticities are reported in Table 3. Of the food group, livestock products, meat and milk are income-elastic, and, as would be expected, cereals – the staple food – is an income-inelastic necessity. As the income elasticity of food in the aggregate (0.895) is less than unity, Engel's Law is also verified. Of the other commodities, durables and 'other non-food' are income elastic; clothes and leisure are inelastic. These results are broadly in line with other African studies, as indicated in Table 4.

Using Eq. (3) above, the impact on demand of adding in turn an extra family member of each

[3] See White (1980). The computer program TSP has been used here for all econometric estimation.

[4] The results of estimation of unrestricted and restricted models are as follows: Log of likelihood function unrestricted = 9448.82; Log of likelihood function restricted = 9413.51. This gives a value of 70.62 for the LR statistic. The (95%) critical value of $\chi^2_{21} = 32.67$.

type, ceteris paribus, has been computed. This analysis is first undertaken for a household with five members (two adults, and three children, one in each age group). As Table 1 confirms, this household composition broadly accords with the sample mean. The results are presented in Table 5. For purposes of comparison, the analysis is repeated for a household of two adults only. As already noted, the range of household types is rather broad, including some strikingly large households with up to eight adults and 22 children. However, the two-adult household is the most prevalent (33% of the sample) and its adoption as the baseline allows us to assess the impact on household expenditure of the first child, potentially a particularly significant influence on household welfare.

4. Discussion

Consumption linkages in economic growth result from the expenditure of farm incomes on locally-produced consumer goods and services. As household incomes rise, the demand for local services, housing, durables, livestock products typically increases more rapidly than does the demand for staple foods. The elasticity of consumption of rural products with respect to a rise in household incomes varies between countries and regions. In the African context, of the few household expenditure studies which allow assessment of rural consumption linkages (Hazell and Roell, 1983, for farm households in Gusau, Northern Nigeria; and King and Byerlee, 1978, for rural households in Sierra Leone) provide

Table 5
Effect on expenditure (a) as a % of full income and (b) as an outlay equivalent ratio, when a new member is added to a five-person household

		Child			Adult with y constant	Adult with y increased
		0–5	6–11	12–17		
Cereals	(a)	0.759 **	0.944 **	0.346	0.177	0.724 **
		(0.30)	(0.32)	(0.32)	(0.32)	(0.32)
	(b)	0.416	0.523	0.176	0.078	0.385
Meat	(a)	−0.357 *	−0.209	−0.458 **	−0.352 *	0.122
		(0.20)	(0.21)	(0.21)	(0.21)	(0.21)
	(b)	−0.243	−0.133	−0.318	−0.239	0.068
Milk	(a)	0.066	−0.021	−0.106 *	−0.137 **	−0.014
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
	(b)	0.219	−0.045	−0.305	−0.402	−0.095
Other food	(a)	0.280	−0.199	−0.298	0.176	0.618 **
		(0.23)	(0.24)	(0.25)	(0.24)	(0.19)
	(b)	0.121	−0.088	−0.131	0.076	0.383
Clothing	(a)	−0.206	0.087	−0.102	−0.737 **	0.031
		(0.27)	(0.29)	(0.29)	(0.29)	(0.29)
	(b)	−0.077	0.50	−0.031	−0.306	0.001
Durables	(a)	0.598 **	−0.472 **	−0.552 **	0.070	0.754 **
		(0.23)	(0.24)	(0.24)	(0.24)	(0.24)
	(b)	0.339	−0.263	−0.308	0.042	0.349
Other non-food	(a)	−1.309 **	−0.457	0.282	−0.705 *	1.998 **
		(0.38)	(0.40)	(0.40)	(0.39)	(0.39)
	(b)	−0.189	−0.061	0.050	−0.098	0.209
Leisure	(a)	0.269 *	0.261 *	0.734 **	1.523 **	1.522 **
		(0.14)	(0.15)	(0.15)	(0.15)	(0.15)
	(b)	1.089	1.046	3.689	8.104	8.411

Standard errors are presented in parentheses. Coefficients significantly different from zero (t-test) denoted by * for 90% level and ** for 95% level.

comparable results. Both studies show positive and quite high income elasticities for non-food goods and services mainly produced in rural areas. As stated earlier, these results are broadly in line with our findings (Table 4).

Increased demand for the income-elastic food products can be expected to provide a direct stimulus to the local economy of Matabeleland South. On the other hand, increased demand for the non-food products would mainly be met by the small-scale industries of neighbouring Bulawayo. Given the close proximity of and strong commercial links with the latter, this does not constitute a leakage, in the conventional sense, from the region nor diminish the potential contribution of rural households in the southern province in economic growth.

We now turn to the question: How do children affect the expenditure patterns of households? It has long been recognized that the presence of children affects the allocation of a given household budget and a great deal of effort has gone into modelling these effects (Browning, 1992). In Table 5, we focus on the impact of adding a child to a five-person household, *holding household full income constant*. Household expenditure on cereals expenditure rises, notably where younger age children are concerned. The outlay equivalent ratios are quite large, indicating that adding a child of age 6–11 is equivalent to a rise of 52% in per caput total expenditure. Thus for the food staple, the 'hungry mouths' or specific effect of an additional child dominates the real income effect. But this is the only food product for which this is the case. The impact on meat expenditure is negative; for milk and 'other food', expenditure also falls or the impact is statistically insignificant.

Table 6
Effect on expenditure (a) as a % of full income and (b) as an outlay equivalent ratio, when a new member is added to a two-person household

		Child			Adult with y constant	Adult with y increased
		0–5	6–11	12–17		
Cereals	(a)	2.233 **	2.604 **	1.404 *	1.069 **	1.411 **
		(0.77)	(0.73)	(0.79)	(0.30)	(0.32)
	(b)	0.592	0.700	0.352	0.254	0.377
Meat	(a)	−0.780	−0.482	−0.982 *	−0.768 **	−0.215
		(0.50)	(0.48)	(0.52)	(0.20)	(0.21)
	(b)	−0.238	−0.128	−0.313	−0.234	−0.111
Milk	(a)	0.258 *	0.85	−0.086	−0.149 **	−0.031
		(0.15)	(0.14)	(0.15)	(0.06)	(0.06)
	(b)	0.433	0.169	−0.090	−0.187	−0.064
Other food	(a)	0.269	−0.691	−0.889	0.060	0.914 **
		(0.59)	(0.57)	(0.61)	(0.23)	(0.25)
	(b)	0.056	−0.153	−0.200	0.011	0.134
Clothing	(a)	0.307	0.895	0.516	−0.77 **	−0.029
		(0.69)	(0.66)	(0.72)	(0.27)	(0.29)
	(b)	0.095	0.222	0.140	−0.134	−0.011
Durables	(a)	0.927 *	−1.212 **	−1.372 **	0.127	0.609 **
		(0.57)	(0.55)	(0.60)	(0.23)	(0.24)
	(b)	0.267	−0.335	−0.380	−0.029	0.094
Other non-food	(a)	−2.496 **	−0.792	0.686	−1.287 **	1.512 **
		(0.95)	(0.91)	(0.99)	(0.37)	(0.40)
	(b)	−0.170	−0.042	0.068	−0.079	0.044
Leisure	(a)	−0.592 *	−0.608 *	0.338	1.917 **	1.918 **
		(0.37)	(0.35)	(0.38)	(0.14)	(0.15)
	(b)	−2.609	−2.652	−0.008	4.406	4.529

Standard errors are presented in parentheses. Coefficients significantly different from zero (t-test) denoted by * for 90% level and ** for 95% level.

Table 6 presents the results of a similar analysis for a two-person household, a previously childless couple. Here, the addition of the first child, ceteris paribus, will increase the household's expenditure on food, notably cereals and milk. The overall impact on the food budget is an increase of about 2% of the household's full income which translates to 5% of its original food expenditure. This is our estimate of the 'cost of a child' in terms of the demand on the food budget, and clearly the 'hungry mouths' effect dominates the other demands on (fixed) household income. There is also a reduction in meat expenditure (in keeping with a switch to lower cost sources of nourishment). The rise in food demand is offset by a fall in expenditure on non-food items and leisure.

It will be noted that the magnitude of the impacts is, in general, smaller in the larger household. For example, the addition of an infant increases the food budget by an amount equivalent to 2% of income in the two-person household but by only 0.75% in the five-person household with the same level of income. As Chesher (1991) suggests, this may reflect economies of scale but also a process of economising in the larger household.

When the analysis is extended to examine the effects of changing the number of adults in a household, the 'ceteris paribus' assumption has to be reassessed. Even though money income can be held constant, the point at issue is what to assume about the level of full income. If an adult who is potentially active in the labour market is added to the household, then he/she brings to the household an allocation of non-market time which incurs an opportunity cost, i.e. full income of the household increases. However, if due to ill-health or age, the individual cannot participate in the labour market, then full income would not change. The return of 'spent labour' from employment in mining or on commercial farms would provide an example of the latter. Both cases have been considered here and the results are presented in Tables 5 and 6.

From Table 5, it is evident that, for the five-person household with full income constant, the significant effects on household food expenditure of an additional adult member are negative for meat and milk. Expenditure on clothes and other non-food items would also fall. If, on the other hand, full income is adjusted [5], the effects are very different. Cereals and 'other food' expenditures would rise (the outlay equivalents are about 38% in each case) and there is also a positive impact on the demand for durables. It may also be noted that the negative effects on meat, milk and clothes noted above are dissipated. The results for the two-person household (Table 6) are broadly similar, with the income effect again dominating and expenditure on most goods falling, when full income constant. When full income is increased, the impact on expenditure on the income-inelastic goods is greater than in the larger household.

Finally, it may be noted that the analysis could equally well have focused on an investigation of the effects on household expenditures of the loss of an adult (due to death or migration in search of employment, for example). As the outlay equivalent ratios are symmetric, it would simply be a matter of changing the signs of these coefficients in Tables 5 and 6. Thus, for example, the loss of an adult would have the same effect on cereals expenditure as a 25% loss of per caput total expenditure in a two-person household, with constant income, but would have an insignificant impact on cereals expenditures of the five-person household.

6. Concluding remarks

This study of rural household behaviour in Zimbabwe has taken a well-established specification of the income–consumption relationship and amended it, firstly by augmenting household income to include the value of non-market time, and secondly by incorporating family size and composition variables in an appropriate manner. The results in terms of income responses are

[5] More specifically, the outlay equivalent ratios are augmented by $(\partial y / \partial n_4)/(y/n)$, where n_4 denotes the number of adults in the household.

broadly in keeping with those from other African studies and confirm the potential contribution which the rural household can make to economic growth. This paper has also highlighted significant differences across the product range when family composition changes. These effects are more muted in larger households. There is also evidence of important age differences in the size and direction of the response to changing family composition.

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