‘The Rich Are Just Like Us Only Richer’ Poverty Functions or Consumptions Functions?

Simon Appleton

WPS/95-4

March 1995

Centre for the Study of African Economies,
University of Oxford,
21 Winchester Road,
Oxford, OX2 6NA.

Direct dial telephone number: +44 (0)1865 274550

KEYWORDS:POVERTY; CONSUMPTION; EDUCATION; UGANDA
JELit classification:914 (Economics of Poverty)

ABSTRACT: The concept of a poverty function is introduced, modelling the shortfall of household consumption from the poverty line as a function of reduced form determinants such as human capital and land holdings. The model is estimated using a tobit and data from Uganda. Parameters from the model are found to be similar to those from consumption functions, indicating that the poor receive comparable rates of return on their assets to the non-poor. Education of both men and women appears to raise the welfare of the poor as well as the non-poor, in both urban and rural areas.

Studies of poverty using household survey data from developing countries have typically concentrated on measurement issues and on describing the characteristics of the poor (see Ravallion, 1992, for a review of the issues and Boateng et al., 1992, for one example of a `poverty profile'). This work is sometimes technically very sophisticated and is a necessary first step for evaluating interventions targeted at the poor (see Anand, 1983, for an illustration). However, there are surprisingly few examples in the literature of multivariate analysis of the determinants of poverty; of estimating what could be termed `poverty functions'. Such poverty functions might give more insight into what type of interventions could reduce poverty. They would also permit more valid inferences about the causes of poverty than are provided by the simple — often bivariate — decompositions of poverty indices presented in conventional poverty profiles.

A common aggregate poverty index is the `poverty gap', that is to say the mean negative deviation of consumption from some minimum acceptable level, the poverty line. Consequently, if one aimed to model household poverty, a natural dependent variable is the household poverty gap: how far, if at all, household consumption falls below the poverty line. Explanatory variables could include those factors which might affect welfare including household variables such as demographics, assets and education together with community-level variables such as prices and local infrastructure. Perhaps the main objection to estimating such poverty functions is that it would be better to model household consumption *per se* on the grounds that censoring the distribution of consumption above the poverty line wastes information. The case for estimating poverty functions rather than consumption functions requires that the information about the consumption of the non-poor is not useful and could be misleading: that the poor may behave differently from the non-poor[1]. If the hypothesised determinants of welfare, such as human capital and physical assets, have different returns for the poor and non-poor, then consumption functions may give misleading results for the analysis of poverty interventions. For example, consumption functions may show schooling to have large returns on average, but if these arise for only the non-poor, then it would be quite inappropriate to advocate expansion of education as a part of a poverty alleviation package. Thus the choice between consumption functions and poverty functions in part depends on whether people are poor just because they have less assets (including human capital) or whether they also receive lower returns on their assets.

This paper compares the results of consumption and poverty functions using data from a recent national survey of Uganda. Section 1 explains the poverty measure adopted and the methods of analysis used. Attention is given to the choice of the appropriate econometric technique for estimating a poverty function, given the censored nature of the dependent variable (the household poverty gap). Section 2 presents the empirical results. Two broad inter-related issues are raised. The first is methodological: is anything gained from modelling poverty *per se* rather than welfare (proxied by consumption) in general? The second is substantive: what are the determinants of poverty and welfare in Uganda? Particular attention is focused on the role of human capital, in view of the current emphasis by many international agencies upon expanding education as one means of reducing poverty (for example, see World Bank, 1990). Section 3 concludes the paper.

[1] In fact, the relevant models of household consumption might be better referred to as `welfare functions', because — unlike orthodox consumption functions — their emphasis is not relations with income but rather on the reduced form determinants of income. Even if poverty is better analyzed by welfare functions than by poverty functions, the earlier point about the lack of multivariate analyses of poverty remains true. Glewwe (1991) provides one of the few examples of such welfare functions.

1. Measuring and Modelling Poverty

In line with most economic studies, this paper uses a money metric measure of welfare; in this case, total consumption. Consumption of home produced food is included, valued at market prices. However, a number of important non-marketed dimensions of well-being are omitted. These include child schooling and health status, both of which appear to be only weakly, if at all, related to consumption in Uganda (see Heyneman, 1979, Kakande and Nalwadda, 1993, and Mackinnon, 1994). More generally, low correlations between a range of different welfare indicators have been found elsewhere in Africa (Glewwe and van der Gaag, 1988). However, total consumption remains arguably the single most comprehensive indicator of ability to meet wants[2].Consumption rather than income is used both because it is likely to be more accurately measured and because, following the permanent income hypothesis, it may better reflect longer term economic status (Johnson et al., 1990). Nonetheless, the consumption measure refers only to the year of the survey and will not fully reflect welfare over the life-cycle (Deaton, 1980). The use of panel data is necessary to determine if households are permanently poor or only temporarily impoverished (see Dercon, Krishnan and Kello, 1994).

The survey measured consumption at the level of the household and consequently the analysis here abstracts from issues of intra-household allocation. Evidence from the Philippines suggests that the use of household level welfare measures may still provide valid inferences about the correlates and patterns of poverty, even though the neglect of intra-household inequality leads to under-estimates of its level (Haddad and Kanbur, 1989). Welfare is proxied by household consumption per adult equivalents rather than per capita, to reflect the lower needs of children[3]. Substantial variations in prices across regions and during the period of the survey necessitate the deflation of nominal consumption[4]. Non-food prices were not available, so nominal consumption was deflated by the cost of a food basket combined with an estimate of `essential' non-food spending[5]. Essential non-food spending was estimated, following Ravallion and Bidani (1994), as that observed amongst those households whose total consumption was only enough to meet the food poverty line[6]. The food basket was based on the expenditure pattern of the poorest half of the population. Food prices which varied by region and with the time of the survey, were estimated as the median unit values of purchases by households in a given region during two month intervals of the survey year. The poor were defined in a relative manner as the bottom half of the population ranked by real consumption per adult equivalent. Sensitivity analysis was carried out by estimating alternative models where the poor were defined as the bottom 25% and 75% of the population.

---

[2] It would be possible to construct more comprehensive welfare indices by augmenting expenditure based measures with non-monetary indicators. However, the weighting involved in aggregating the various elements is likely to be rather arbitrary and controversial. This point has been made regarding the Human Development Index (Kanbur, 1993).

[3] The equivalence scales reflect WHO calorific requirements for males (reported in West, 1987).

[4] The CPI rose by a third during the first four months of 1992, thereafter it was stable (Republic of Uganda, 1994a).

[5] The deflator is in fact the absolute poverty line as given in Appleton (1995a), to which the interested reader is referred for further details of construction. Two limitations arise in using it as a price deflator. Firstly, the food basket is defined by national spending patterns, when in fact there are marked regional differences in staple foods. Secondly, `essential' non-food spending as estimated will only rise with non-food prices if the price elasticity of non-food spending is less than unity.

[6] The rationale for this is that if such households are sacrificing their minimum adequate calorie intake for non-food items, then these non-food items must be essential. The method of estimation allowed for different non-food requirements over time and across regions.

A widely used class of poverty indicators is the $P\alpha$ class of measures (Foster, Greer and Thorbecke, 1984). These can be defined as:

$$(1) \qquad P\alpha \equiv 1/n \, \Sigma_{i=1,m} [(PL-C_i)/PL]^{\alpha}$$

where PL = the poverty line; n = population size; m = number of people below poverty line; and α is a measure of inequality aversion.

The $P\alpha$ measure is admirable as an index of poverty but is subject to two serious limitations for use in analysis. Firstly, as a single summary statistic, it throws away a vast amount of information provided about individual households. Using the information about individual households — for example, by making it the dependant variable in a regression — will allow for a far richer analysis. Secondly, it is typically analyzed using only bivariate decompositions: for example, computing separate $P\alpha$ measures for male and female headed households. This neglects the omitted variables bias that is likely to arise due to a failure to control for other relevant factors. A multivariate analysis would allow the contribution of particular factors to be isolated. For example, poverty profiles often identity female headed households as being poorer than male headed ones. However, the bivariate techniques employed cannot reveal whether this is due to female headed households being disadvantaged in terms of other observable factors, such as a lack of assets, or whether there is a residual (`pure gender') effect.

There are obvious limits to how much can be inferred about the determinants of welfare and poverty from household level cross sectional survey data, even when employing multivariate analysis. Both the range of possible causation which can be explored and the confidence which can be placed in any inferences is restricted. By most accounts, a fundamental cause of Uganda's current poverty is the fifteen years of political conflict and mismanagement experienced from the accession to power in 1972 of Amin (see Hansen and Twaddle, 1988). Such a factor cannot be properly analyzed by examining current inter-household differences in welfare. This is partly because use of a single cross section is likely to give rise to considerable historical measurement error: what determines poverty is not just present conditions, but those prevailing in the past. However, it is also because some political, sociological, psychological and other non-economic factors are often neither quantifiable nor best studied at the household level (Bevan, 1995). Even when hypothesised causes of poverty can be measured in a cross section household survey, the non-experimental nature of the data will always cast doubt on whether the statistical regularities identified reflect causation rather than mere correlation.

Nonetheless, multivariate associations between welfare and other variables can identify connections that appear to be strong and suggest causation, or at least priorities for further analysis. The $P\alpha$ measure is a summary statistic for a non-linear transformation of consumption. Consequently, when discussing multivariate analysis of the determinants of poverty, Demery (1993) proposes modelling household consumption (citing the example of Glewwe, 1991). For example, household consumption, C_i, could be modelled under a reduced form approach as a function of household characteristics (age and gender of the head and other members), X_i, household assets, A_i, (land, housing, livestock, other productive assets), education (of head and spouse) E_i, and community infrastructure, I_i. Thus one simple regression of real consumption (with U_i as the error term) would be:

$$(2) \qquad C_i = \beta_1 X_i + \beta_2 A_i + \beta_3 E_i + \beta_4 I_i + U_i$$

Such a regression allows one to identify those observable factors which are correlated with household welfare and suggest causal inferences. To try to minimise the danger that right hand side variables are simultaneously determined with welfare, the former were narrowly limited — excluding occupation and many assets such as housing and cattle. Instead, a fairly parsimonious list was used,

comprising household demographics, education, land, parental background, region and season. For example, the education of adults in the households was often acquired a long time before the survey. Consequently, econometric models of household behaviour typically assume that it is exogenous. As such, the coefficient on education in equation (2) could be interpreted as an average rate of return to education. However, caution must be exercised in making such inferences due to the possibility of simultaneous or reverse causation[7].

Modelling the welfare of the whole population as in equation (2) is not the same as modelling poverty *per se*. Instead of using the consumption of all as the dependent variable, one could take the measure of household poverty, P_i, suggested in the $P\alpha$ measure, vis:

$$P_i \equiv [(PL-C_i)/PL]^{\alpha} \quad \text{if } C_i < PL \qquad (3)$$
$$\equiv 0 \quad \text{else}$$

This paper focuses on P_i where $\alpha=1$; the household `poverty gap'[8]. Modelling this would be equivalent to modelling a censored dependent variable, C^*_i, equal to the real consumption of the poor but fixed at the poverty line for the non-poor[9]. That is to say:

$$C^*_i = C_i \quad \text{if } P_i > 0 \qquad (4)$$
$$= PL \quad \text{else}$$

where:

$$C_i = \gamma_1 X_i + \gamma_2 A_i + \gamma_3 E_i + \gamma_4 I_i + \epsilon_i \quad \text{if } P_i > 0 \qquad (5)$$

Under this approach, variations in consumption above the poverty line are not modelled. Such a dependent variable has not been analyzed in the literature on poverty, although some authors have embarked on related exercises. Coulombe and McKay (1993) use a probit to analyze what determines whether a household is poor or not — effectively modelling (3) when $\alpha=0$. Kyreme and Thorbecke (1991) model the gap between a household's calorie intake and its requirements, but differ from the spirit of this paper by including calorie surpluses in the dependent variable rather than setting them to zero.

What could be gained from modelling the poverty gap rather than consumption *per se*? One

---

[7] It is possible to think of reasons why each and every hypothesised determinant of poverty is simultaneously determined with welfare. See Behrman (1991) for discussion of the possible endogeneity of the education of adults in the household. Land holdings are likely to be largely pre-determined by inheritance. However, households will often be able to vary their holdings either through the market or through more traditional communal methods of allocation. Variables for household demographics may be endogenous according to some economic models of life-cycle fertility (see Schultz, 1983). Locational variables may be endogenous either because of household migration or on account of the processes generating local prices and infrastructure (Rosenzweig and Wolpin, 1986, 1989). Even the age and gender of the head may be endogenous: whether someone becomes a head may be influenced by unobserved personal and household characteristics.

[8] The headcount ($\alpha=0$) is less attractive since it discards a lot of information on household welfare. Modelling the severity of poverty (eg $\alpha=2$) is attractive given a concern with distribution amongst the poor. However, it would place greater weight on low outliers who may arise because of under-reporting of consumption rather than intense poverty. The poverty gap has the added benefit of generating coefficients which can be directly compared to those on the consumption function in equation (2).

[9] The only differences would be a reversal in the signs of the coefficients on the independent variables together with an constant additive adjustment to the intercept. The equivalence is useful, since it allows direct comparison of the slope coefficients with those from a general consumption function.

justification might be that the researcher is interested only in the welfare of the poor. However, this response is quite not sufficient. By focusing on the poverty gap, information is lost about the determinants of welfare of the non-poor. Assuming the poor and non-poor behave similarly, this information may be useful. Consequently, the case for modelling poverty *per se* must rest on the premise that the information provided by the behaviour of the non-poor could be potentially misleading: that the poor may behave differently from non-poor. In other words, that the γ parameters in equation (5) may differ from the β parameters in (2).

Formalising this alternative hypothesis is problematic. It is implausible that the poor and non-poor constitute wholly distinct populations, separate from birth. However, it is certainly conceivable that the average returns to assets differ for the poor and non-poor. Consider the role of education. Many of studies have found evidence that education is correlated with higher wages (see Psacharopoulos, 1993) but formal labour market participation is relatively low in Uganda. More important for most people — and especially the poor — is income from agriculture and off-farm business (Appleton and Balihuta, 1994). Very little research has been done on returns to education in these sectors and what is available shows mixed results[10]. Since the poor in many developing countries are often rural people from low status backgrounds, they may have little access to formal employment and hence lower returns to education. More generally, a number of common (`Victorian') attitudes to the poor view them as less intelligent and less industrious, so that any assets they have — such as land — will tend to have lower returns. Different returns to the poor and non-poor could be incorporated within a sufficiently well specified model of household consumption through the inclusion of measures of many personal characteristics that are hard to observe — such as `ability' or `motivation' — together with sufficient interaction terms and non-linear transformations. However, in practice, a single function such as that in (2) may mask these differential returns due to the large number of unobservables and the relatively simple functional forms used. Estimating a poverty function provides a simple test of whether the consumption function is well specified[11].

The limited nature of the dependent variable defined in (4) makes the use of appropriate econometric techniques important. Simply applying ordinary least squares (`censored OLS') would lead to inconsistent estimates. The direction of the inconsistency depends on the distribution of the explanatory variables, although commonly it is found to bias estimates of the parameters in (5) towards zero[12]. Intuitively, the effect of any explanatory variables on the consumption of the poor would be muted by the fact that they are not associated with any changes in value of the dependent variable of the non-poor (which is fixed at the poverty line). An alternative estimation method would be to restrict the sample to the poor (`truncated OLS') and model their consumption. This would also lead to biases whose size and direction is unclear *a priori* but appear empirically to be towards zero (see Hausman and Wise, 1977)[13]. The reasoning here is that modelling the effect of an explanatory variable on a sample of the poor only neglects any effect the variable may have in tipping a household into or out of poverty. The possible biases of inappropriate econometric techniques are illustrated in Figure 1. This uses simulated data, generated on the assumption that

[10] For example, although the authors give a positive interpretation to the evidence, half of the studies of the impact of education on farm productivity reviewed by Jamison and Lau (1982) find insignificant effects.

[11] I am grateful to John Muellbauer for drawing my attention to this point.

[12] Greene (1993) notes an empirical regularity that OLS coefficients of censored models are approximately equal to the `true' coefficients (as estimated by a Tobit) multiplied by the proportion of non-censored observations.

[13] These biases imply that an F-test for the stability of the model parameters across sub-samples of the poor and non-poor would not be valid.

the poor and non-poor behave similarly. Both truncated and censored OLS fit regression lines with much flatter slopes than the true line[14].

An appropriate technique for estimating the poverty function is a right censored Tobit model, since this allows for the kinked nature of any regression line for the poverty gap (Maddala, 1983). Under this formulation, the consumption of the poor is determined as in equation (5), with the error term assumed to be normally distributed with variance σ^2. Nothing is assumed about the determination of the consumption of the non-poor, except that whether it exceeds the poverty line is also determined according to (5). Thus the probability of not being poor equals the probability of C_i, as modelled in (5), exceeding the poverty line. Hence, the process determining whether one is poor or not is assumed to be the same for the poor and non-poor. Estimates of the poverty function are obtained by maximising the log-likelihood function:

$$(6) \qquad L = \Sigma_{Ci<PL} -1/2[\ln(2\pi) + \ln\sigma^2 + ((C_i - \gamma_1 X_i - \gamma_2 A_i - \gamma_3 E_i - \gamma_4 I_i)/\sigma)^2]$$

$$- \Sigma_{Ci\geq PL}\ln[\Phi((PL - \gamma_1 X_i - \gamma_2 A_i - \gamma_3 E_i - \gamma_4 I_i)/\sigma)]$$

This set up is quite consistent with assuming that the consumption of the poor and non-poor are both determined by the same process, as in (2). Indeed, this is the most natural interpretation and is the one illustrated in Figure 1. However, it also allows for the possibility that, up to the poverty line, consumption is determined according to one process but thereafter determined by another. The tobit does not impose the restriction that the γ parameters in (5) equal the β in (2). Indeed, it does not use the information available on the consumption levels of the non-poor. The possibility that there are differences in the effects of given assets on consumption at low levels and high levels can be explored empirically by comparing the tobit coefficients with those from OLS estimates of a consumption function for the whole sample.

2. Empirical Results

The data are from the 1992 Social Dimensions of Adjustment Integrated Household Survey, a survey gathered by the Statistics Department of the Republic of Uganda with funding from the World Bank (see Republic of Uganda, 1994b). It gathered a large, nationally representative sample of 10,000 households from 1,000 different enumeration areas across the country. Many questions were asked, covering consumption, income, time use, household enterprises, health and education amongst other things[15].

---

[14] The censored and truncated regression lines are based on actual regressions on this data; consequently, their exact position is sensitive to the particular data used. The consumption function and tobit lines reflect the true population values to which estimates would converge in the limit.

[15] The advantages of the size and scope of the survey are somewhat offset by indications of some problems with the quality of the data. In particular, a comparison with an earlier survey in 1989 reveals a 35% drop in mean real consumption per household (Appleton, 1995a). It seems likely that
some of this implausibly large fall can be accounted for by recall error in consumption, caused by the use of a rather condensed open format consumption section. This measurement error is the main reason for adopting a relative rather than absolute approach to the measurement of poverty. Although the reported consumption figures would probably over-state the extent of absolute poverty, they should still provide a reasonable ranking of households by economic status. In particular, it seems improbable that recall errors will dramatically over-turn the ranking of households by consumption. A rich household may forget more expenditures than a poor one, but it is unlikely that the difference is so great that it ends up reporting a lower total.

Table 1: Descriptive Statistics By Welfare Quartile
(Welfare measured by real household consumption per adult equivalent)

	Bottom		Lower Middle		Upper Middle		Top	
Variables	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
LPEXPPA	3.656	(0.31)	4.245	(0.12)	4.645	(0.12)	5.313	(0.41)
FUNMAR	0.012	(0.11)	0.017	(0.13)	0.026	(0.16)	0.040	(0.19)
FMAR	0.086	(0.28)	0.090	(0.29)	0.078	(0.27)	0.095	(0.29)
FCOHAB	0.471E-02	(0.07)	0.709E-02	(0.08)	0.610E-02	(0.08)	0.574E-02	(0.08)
FDIVOR	0.034	(0.18)	0.045	(0.21)	0.042	(0.20)	0.043	(0.20)
FWID	0.129	(0.34)	0.110	(0.31)	0.095	(0.29)	0.081	(0.27)
MMAR	0.656	(0.47)	0.636	(0.48)	0.635	(0.48)	0.558	(0.50)
MUNMAR	0.031	(0.17)	0.041	(0.20)	0.050	(0.22)	0.095	(0.29)
MCOHAB	0.014	(0.12)	0.014	(0.12)	0.016	(0.13)	0.013	(0.11)
MDIVOR	0.021	(0.14)	0.027	(0.16)	0.036	(0.19)	0.047	(0.21)
MWID	0.012	(0.11)	0.013	(0.11)	0.016	(0.13)	0.024	(0.15)
HAGE	45.003	(16.10)	42.562	(15.98)	40.418	(16.10)	38.119	(14.57)
LVEDUCH	2.469	(3.08)	3.021	(3.35)	3.507	(3.54)	4.251	(4.18)
HSEC1	0.149	(0.66)	0.246	(0.84)	0.345	(1.03)	0.722	(1.46)
HSEC2	0.477E-02	(0.09)	0.866E-02	(0.13)	0.012	(0.15)	0.054	(0.32)
HPTRAIN	0.922E-02	(0.10)	0.016	(0.12)	0.017	(0.13)	0.024	(0.15)
HSTRAIN	0.142E-02	(0.04)	0.648E-02	(0.08)	0.015	(0.12)	0.049	(0.22)
HUNIV	0	(0)	0.130E-02	(0.04)	0.120E-02	(0.03)	0.013	(0.11)
LVEDUCW	1.084	(2.13)	1.434	(2.51)	1.899	(2.80)	2.361	(3.45)
WSEC1	0.024	(0.26)	0.052	(0.40)	0.089	(0.50)	0.266	(0.91)
WSEC2	0.335E-03	(0.03)	0.903E-03	(0.04)	0.655E-03	(0.04)	0.010	(0.14)
WPTRAIN	0.300E-02	(0.05)	0.158E-02	(0.04)	0.380E-02	(0.06)	0.010	(0.10)
WSTRAIN	0	(0)	0.122E-02	(0.03)	0.139E-02	(0.04)	0.017	(0.13)
WUNIV	0	(0)	0	(0)	0	(0)	0.672E-03	(0.03)
MISSW	0.326	(0.47)	0.353	(0.48)	0.357	(0.48)	0.470	(0.50)
LVEDUCF	0.315	(1.30)	0.485	(1.65)	0.602	(1.88)	1.019	(2.64)
FHSEC1	0.010	(0.17)	0.034	(0.31)	0.040	(0.34)	0.149	(0.70)
FHSEC2	0.265E-03	(0.02)	0.743E-04	(0.01)	0.147E-02	(0.05)	0.605E-02	(0.11)
FHPTRAIN	0.253E-03	(0.02)	0.287E-02	(0.05)	0.250E-02	(0.05)	0.875E-02	(0.09)
FHSTRAIN	0	(0)	0.179E-02	(0.04)	0.657E-03	(0.03)	0.015	(0.12)
FHUNIV	0	(0)	0.371E-04	(0.01)	0.657E-03	(0.03)	0.132E-02	(0.04)
FLIT	0.287	(0.45)	0.375	(0.48)	0.433	(0.50)	0.532	(0.50)
FPPRIM	0.252	(0.43)	0.331	(0.47)	0.389	(0.49)	0.489	(0.50)
FFPRIM	0.044	(0.20)	0.075	(0.26)	0.093	(0.29)	0.167	(0.37)
FFED	0.784E-02	(0.09)	0.013	(0.11)	0.015	(0.12)	0.055	(0.23)
MLIT	0.096	(0.29)	0.158	(0.37)	0.223	(0.42)	0.323	(0.47)
MPPRIM	0.076	(0.26)	0.129	(0.34)	0.189	(0.39)	0.280	(0.45)
MFPRIM	0.597E-02	(0.08)	0.018	(0.13)	0.026	(0.16)	0.068	(0.25)
MFED	0.242E-02	(0.05)	0.494E-03	(0.02)	0.482E-02	(0.07)	0.016	(0.13)
FENT	0.052	(0.22)	0.064	(0.24)	0.085	(0.28)	0.122	(0.33)
FGEMP	0.052	(0.22)	0.060	(0.24)	0.065	(0.25)	0.103	(0.30)
FPEMP	0.011	(0.10)	0.020	(0.14)	0.020	(0.14)	0.041	(0.20)
AHSIZE	4.698	(2.24)	4.087	(2.18)	3.672	(2.11)	3.089	(2.04)
YDEP	0.398	(0.21)	0.355	(0.22)	0.331	(0.23)	0.253	(0.24)
ODEP	0.104	(0.23)	0.088	(0.21)	0.085	(0.23)	0.072	(0.22)
WOMRAT	0.271	(0.15)	0.297	(0.18)	0.304	(0.20)	0.322	(0.26)
LANDPC	0.510	(0.52)	0.589	(0.66)	0.615	(0.70)	0.694	(0.97)
NOLAND	0.089	(0.28)	0.114	(0.32)	0.175	(0.38)	0.318	(0.47)
MLAND	0.031	(0.17)	0.043	(0.20)	0.032	(0.17)	0.032	(0.18)
ULAND	0.098	(0.30)	0.086	(0.28)	0.080	(0.27)	0.062	(0.24)
NORTHR	0.322	(0.47)	0.225	(0.42)	0.142	(0.35)	0.103	(0.30)
EASTR	0.271	(0.44)	0.254	(0.44)	0.236	(0.42)	0.170	(0.38)
WESTR	0.167	(0.37)	0.208	(0.41)	0.254	(0.44)	0.251	(0.43)
CENTR	0.180	(0.38)	0.221	(0.41)	0.242	(0.43)	0.223	(0.42)
NORTHU	0.785E-02	(0.09)	0.011	(0.10)	0.011	(0.10)	0.018	(0.13)
EASTU	0.021	(0.14)	0.026	(0.16)	0.026	(0.16)	0.037	(0.19)
WESTU	0.854E-02	(0.09)	0.013	(0.11)	0.016	(0.13)	0.029	(0.17)
CENTU	0.021	(0.14)	0.043	(0.20)	0.074	(0.26)	0.168	(0.37)
SEAS1	0.062	(0.24)	0.071	(0.26)	0.065	(0.25)	0.093	(0.29)
SEAS2	0.142	(0.35)	0.151	(0.36)	0.158	(0.36)	0.133	(0.34)
SEAS3	0.143	(0.35)	0.143	(0.35)	0.147	(0.35)	0.135	(0.34)
SEAS4	0.220	(0.41)	0.200	(0.40)	0.184	(0.39)	0.179	(0.38)
SEAS5	0.101	(0.30)	0.104	(0.31)	0.092	(0.29)	0.089	(0.28)
SEAS6	0.189	(0.39)	0.207	(0.41)	0.240	(0.43)	0.263	(0.44)
SEAS7	0.143	(0.35)	0.124	(0.33)	0.113	(0.32)	0.108	(0.31)

S.D. = standard deviation (weighted by population multipliers)

Figure 1:
Biases from Tuncated and Censored OLS

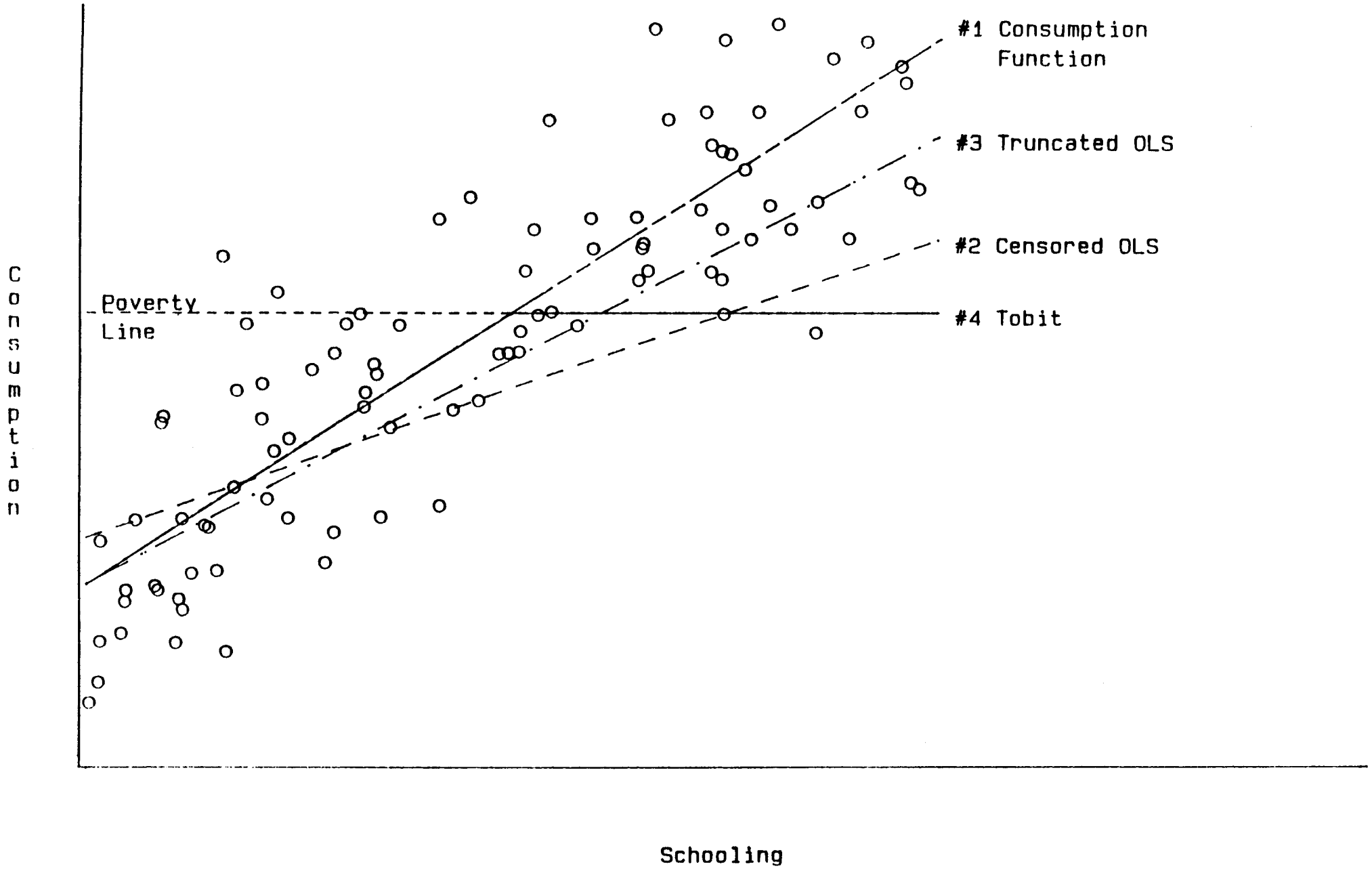

Table 2: Variable Definitions

LPEXPPA	'Log of real household consumption per adult equivalent (welfare measure)'
FUNMAR	'Unmarried female head'
FMAR	'Married female head'
FCOHAB	'Cohabiting female head'
FDIVOR	'Divorced female head'
FWID	'Widowed female head'
MUNMAR	'Unmarried male head'
MCOHAB	'Cohabiting male head'
MDIVOR	'Divorced male head'
MWID	'Widowed male head'
HAGE(2)	'Age of head in years (squared)'
LVEDUCH	'Years of schooling of male head'
HSEC1	'Years of lower secondary schooling of male head'
HSEC2	'Years of upper secondary schooling of male head'
HPTRAIN	'Male head has post primary/junior specialised training or certificate'
HSTRAIN	'Male head has post secondary specialised training or certificate'
HUNIV	'Male head completed University'
LVEDUCW	'Years of schooling of wife of head'
WSEC1	'Years of lower secondary schooling of wife of head'
WSEC2	'Years of upper secondary schooling of wife of head'
WPTRAIN	'Wife of head has post primary/junior specialised training or certificate'
WSTRAIN	'Wife of head has post secondary specialised training or certificate'
WUNIV	'Wife of head completed University'
LVEDUCFH	'Years of schooling of female head'
FHSEC1	'Years of lower secondary schooling of female head'
FHSEC2	'Years of upper secondary schooling of female head'
FHPTRAIN	'Female head has post primary/junior specialised training or certificate'
FHSTRAIN	'Female head has post secondary specialised training or certificate'
FHUNIV	'Female head completed University'
FLIT	'Father of head was literate'
FPPRIM	'Father of head had some primary schooling'
FFPRIM	'Father of head completed primary school'
FFED	'Father of head had some secondary schooling'
MLIT	'Mother of head was literate'
MPPRIM	'Mother of head had some primary schooling'
MFPRIM	'Mother of head completed primary school'
MFED	'Mother of head had some secondary schooling'
FENT	'Father of head ran a non-agricultural enterprise'
FGEMP	'Father of head was a government employee'
FPEMP	'Father of head was a private employee'
AHSIZE(2)	'Number of adult equivalents in household (squared)'
YDEP(2)	'Ratio of adult equivalent children to AHSIZE (squared)'
ODEP	'Ratio of adults aged 60 or more to AHSIZE'
WOMRAT	'Ratio of women aged 16-59 to AHSIZE'
LANDPC(2)	'Cultivable land in acres per adult equivalent (squared)'
NOLAND	'Household owns no cultivable land'
MLAND	'Household owns cultivable land but quantity unknown'
ULAND	'Household owns no cultivable land but uses some'
NORTHR	'Household resides in rural Northern region'
EASTR	'Household resides in rural Eastern region'

WESTR	'Household resides in rural Western region'
NORTHU	'Household resides in urban Northern region'
EASTU	'Houseold resides in urban Eastern region'
WESTU	'Household resides in urban Western region'
CENTU	'Household resides in urban Central region'
SEAS2	'Household surveyed in April-May 1992'
SEAS3	'Household surveyed in June-July 1992'
SEAS4	'Household surveyed in August-September 1992'
SEAS5	'Household surveyed in October-November 1992'
SEAS6	'Household surveyed in December-January 1993'
SEAS7	'Household surveyed in February 1993 or later'

Except in the case of ULAND, the prefix U before a variable name indicates that it has been interacted with a dummy variable for residing in an urban area

Table 3: Poverty and Consumption Functions

	Poverty Function Tobit for Bottom 50%			Consumption Functions OLS			Fixed Effects		
Variables	Coeff	T-ratio		Coeff	T-ratio		Coeff	T-ratio	
FUNMAR	-0.113	(-1.69)	*	-0.244	(-4.56)	***	-0.259	(-5.66)	***
FMAR	-0.121	(-2.28)	**	-0.186	(-4.17)	***	-0.156	(-4.06)	***
FCOHAB	-0.099	(-1.11)		-0.166	(-2.20)	**	-0.184	(-2.85)	***
FDIVOR	-0.157	(-2.71)	***	-0.245	(-5.05)	***	-0.236	(-5.64)	***
FWID	-0.160	(-3.14)	***	-0.238	(-5.63)	***	-0.215	(-5.90)	***
MUNMAR	-0.120	(-2.30)	**	-0.176	(-4.26)	***	-0.116	(-3.24)	***
MCOHAB	-0.046	(-0.89)		-0.024	(-0.53)		-0.044	(-1.11)	
MDIVOR	-0.106	(-1.91)	*	-0.205	(-4.72)	***	-0.174	(-4.64)	***
MWID	0.011	(0.17)		-0.100	(-1.84)	*	-0.110	(-2.35)	**
HAGE	0.355E-02	(1.26)		0.687E-02	(2.71)	***	0.896E-02	(4.11)	***
HAGE2	-.354E-04	(-1.21)		-.688E-04	(-2.58)		-.886E-04	(-3.86)	***
LVEDUCH	0.024	(6.78)	***	0.023	(7.11)	***	0.019	(6.67)	***
HSEC1	0.011	(1.07)		0.011	(1.34)		0.935E-02	(1.28)	
HSEC2	-0.061	(-1.44)		-0.017	(-0.57)		-0.012	(-0.47)	
HPTRAIN	0.136	(2.60)	***	0.164	(3.98)	***	0.160	(4.51)	***
HSTRAIN	0.238	(3.72)	***	0.195	(4.91)	***	0.201	(5.87)	***
HUNIV	0.544	(3.23)	***	0.375	(4.62)	***	0.295	(4.18)	***
LVEDUCW	0.028	(7.50)	***	0.025	(7.59)	***	0.018	(6.32)	***
WSEC1	0.039	(2.29)	**	0.046	(3.96)	***	0.024	(2.44)	**
WSEC2	-0.079	(-0.78)		0.060	(1.04)		0.029	(0.59)	
WPTRAIN	0.128	(1.34)		0.170	(2.57)	**	0.169	(2.97)	***
WSTRAIN	0.042	(0.29)		0.093	(1.34)		0.145	(2.44)	**
MISSW	0.171	(3.79)	***	0.289	(7.95)	***	0.225	(7.19)	***
LVEDUCF	0.036	(6.22)	***	0.035	(7.11)	***	0.027	(6.22)	***
FHSEC1	0.043	(1.81)	*	0.044	(2.56)	**	0.042	(2.85)	***
FHSEC2	0.025	(0.17)		0.099	(1.34)		0.061	(0.98)	
FHPTRAIN	0.339	(3.41)	***	0.359	(5.39)	***	0.334	(5.72)	***
FHSTRAIN	0.071	(0.57)		0.248	(3.42)	***	0.173	(2.71)	***
FHUNIV	0.124	(0.31)		0.287	(1.41)		0.201	(1.15)	
FLIT	0.059	(1.61)		0.028	(0.92)		0.041	(1.53)	
FPPRIM	-0.045	(-1.21)		-0.025	(-0.80)		-0.030	(-1.13)	
FFPRIM	0.033	(1.15)		0.056	(2.50)	**	0.039	(2.00)	**
FFED	0.100E-02	(0.02)		0.011	(0.29)		0.030	(0.92)	
MLIT	0.083	(2.00)	**	0.106	(3.19)	***	0.065	(2.23)	**
MPPRIM	-0.030	(-0.67)		-0.066	(-1.87)	*	-0.039	(-1.26)	
MFPRIM	0.068	(1.34)		0.095	(2.70)	***	0.031	(1.02)	
MFED	0.204	(1.50)		0.023	(0.34)		0.042	(0.74)	
FENT	0.016	(0.46)		0.029	(0.99)		-0.011	(-0.43)	
FGEMP	0.030	(1.12)		0.053	(2.40)	**	0.024	(1.23)	
FPEMP	0.103	(2.33)	**	0.109	(3.19)	***	0.068	(2.32)	**
AHSIZE	-0.131	(-13.55)	***	-0.119	(-14.56)	***	-0.134	(-18.98)	***
AHSIZE2	0.624E-02	(9.45)	***	0.584E-02	(10.64)	***	0.642E-02	(13.66)	***
YDEP	-0.438	(-4.07)	***	-0.535	(-5.92)	***	-0.601	(-7.81)	***
YDEP2	0.412	(2.87)	***	0.417	(3.36)	***	0.565	(5.34)	***
ODEP	-0.189	(-3.58)	***	-0.180	(-3.97)	***	-0.187	(-4.84)	***
WOMRAT	0.078	(1.51)		0.095	(2.22)	**	0.081	(2.24)	**
LANDPC	0.224	(7.15)	***	0.212	(8.02)	***	0.253	(10.54)	***
LANDPC2	-0.028	(-3.44)	***	-0.021	(-3.29)	***	-0.031	(-5.42)	***
NOLAND	0.197	(6.57)	***	0.209	(8.15)	***	0.099	(4.07)	***
MLAND	0.094	(2.10)	**	0.119	(2.91)	***	0.073	(1.99)	**
ULAND	0.105	(3.44)	***	0.106	(3.86)	***	0.101	(3.83)	***
UMUNMAR	0.059	(0.94)		0.165	(3.48)	***	0.073	(1.78)	*
UHAGE	0.011	(1.99)	**	0.016	(3.62)	***	0.971E-02	(2.50)	**
UHAGE2	-.887E-04	(-1.53)		-.142E-03	(-2.89)	***	-.808E-04	(-1.91)	*
UFENT	0.052	(1.03)		0.093	(2.36)	**	0.095	(2.76)	***
ULANDPC	-0.120	(-1.91)	*	-0.147	(-3.06)	***	-0.092	(-2.03)	**
ULANDPC2	0.039	(1.82)	*	0.045	(3.20)	***	0.025	(1.98)	**
UMLAND	0.167	(2.13)	**	0.171	(2.63)	***	0.079	(1.28)	
NORTHR	-0.295	(-12.38)	***	-0.254	(-11.70)	***			
EASTR	-0.100	(-4.39)	***	-0.092	(-4.52)	***			
WESTR	0.175	(7.33)	***	0.187	(9.09)	***			
NORTHU	-0.181	(-1.40)		-0.288	(-2.73)	***			
EASTU	-0.184	(-1.43)		-0.346	(-3.32)	***			
WESTU	-0.039	(-0.30)		-0.200	(-1.93)	*			
CENTU	-0.079	(-0.63)		-0.226	(-2.21)	**			
SEAS2	0.471E-02	(0.14)		-0.032	(-1.10)				
SEAS3	-0.050	(-1.40)		-0.096	(-3.06)	***			
SEAS4	-0.059	(-1.76)	*	-0.092	(-3.12)	***			
SEAS5	0.090	(2.48)	**	0.055	(1.72)	*			
SEAS6	0.097	(2.99)	***	0.063	(2.24)	**			
SEAS7	-0.075	(-2.23)	**	-0.129	(-4.58)	***			
USEAS2	-0.178	(-3.00)	***	-0.129	(-2.82)	***			
USEAS3	-0.257	(-4.82)	***	-0.225	(-5.35)	***			
USEAS4	-0.153	(-2.84)	***	-0.119	(-2.87)	***			
USEAS5	-0.133	(-1.97)	**	-0.116	(-2.19)	**			
USEAS6	-0.164	(-3.19)	***	-0.102	(-2.64)	***			
INTERCEPT	4.556	(55.86)	***	4.481	(63.12)	***			

Table 1 gives descriptive statistics on households grouped into quartiles of the population ranked by the welfare measure (consumption per adult equivalent deflated by the poverty line). It reports population weighted mean values of the hypothesised determinants of poverty. Variable mnemonics are defined in Table 2. Table 1 can be used to carry out the kind of bivariate analysis employed in conventional poverty studies which decompose summary statistics. Consider, for example, the relation between the gender of the household head and poverty. An equal proportion of households in the poorest and most affluent quartiles are female headed; there are fewer in the middle quartiles. However, the disaggregation by the marital status of the head reveals some more monotonic relationships. Households headed by widows are common in the poorer quartiles; the opposite is true of other types of female headed households. Rather surprisingly, households headed by married men are also more heavily represented in the lower quartiles. On average, the poorest come from households with older heads. This may partly explain why their heads (and their wives) are typically less educated[16]. Similarly, better off households tend to have heads whose parents were more educated. For example, amongst the most affluent quartile, a third of heads had literate mothers; amongst the poorest, the proportion was less than 10%. Affluent heads are also more likely to have fathers engaged in non-agricultural activities, as either employees or as self-employed. On average, poorer households are markedly larger, as measured by the number of adult equivalents; they also tend to have a higher proportion of dependents, both children and adults aged 60 or above. Simple correlations between land and poverty are complicated by the fact that urban people are both less likely to have cultivable land and less likely to be poor. Nearly a third of the most affluent quartile did not own or use any cultivable land; amongst the poorest quartile, the corresponding proportion was less than 10%. However, amongst those owning or using cultivable land, average holdings per adult equivalent were over eighty percent higher in the most affluent quartile of households than in the poorest[17]. There are strong regional differences in the levels of poverty. Northern rural areas account for around a third of the poorest quartile and only 10% of the most affluent. Conversely, 2% of the poorest and 17% of the most affluent live in towns in Central region. These regional differences are in line with poverty profiles based on an earlier survey in 1989 (World Bank, 1993; Tulya-Muhiika *et al.*, 1993), although they maybe sensitive to the specification of the poverty line[18].

In all the models estimated, the dependent variable — real consumption per adult equivalent, sometimes right censored — was expressed in logs. This was after two tests for a log versus linear specification of the dependent variable (only) both failed to reject the use of logs but

[16] Interpretation of these educational variables takes some care, since missing values were set to zero. For example, Table 1 shows that the grades of schooling of male heads, LVEDUCH, averages 2.5. However, this mean is averaged over all the poorest households, including female headed ones for which the variable is missing and thus set to zero. Consequently, the average schooling of poor male heads will be higher than 2.5. Specifically, since 73% of the lowest quartile come from male headed households, the figure will be 2.5/0.73=3.36. Setting missing values to zero is reasonable when a dummy variable is used to identify such cases; this generates the `modified zero-order regression' discussed in Maddala (1977).

[17] The land variables are constructed from data on land recorded as a household asset. Land in Uganda is often communal or held on mailo tenancies (whereby large landowners have some residual claim to ownership and entitlement to low rents). Unfortunately, the survey did not inquire about different types of ownership and usage rights. Although some households ran farms without reporting land assets, the proportions seem too low to regard all land reported as household assets as being freehold.

[18] The poverty line costs a national food basket. However, those in rural areas of the North eat sorghum and millet rather than the more costly matooke consumed in Central and Western regions.

did reject the linear specification[19]. Entering the dependent variable in logs has important implications for the issue previously raised regarding the possibility of different returns to assets for the poor and non-poor. In particular, it parameterises the covariates as having constant proportional effects. This implies that the absolute effects of covariates rise with consumption and that there are pervasive interactions between different explanatory variables. Implicitly, therefore, the log-consumption function imposes higher returns on assets for the more affluent, but equal rates of return as a proportion of welfare. Possible differences in the processes generating incomes in urban and rural areas were explored in preliminary estimates by interacting explanatory variables with a dummy variable for urban residence. Interactions significant at the 10% level were retained in the final version of the models.

Table 3 reports the results of three methods of estimating the determinants of the welfare of the poorest half of the population. The first of these is a `poverty function': a tobit on the consumption of the poorest half of the population, with the dependent variable for the non-poor being set at the poverty line. The other two are consumption functions, estimated for the whole population: one with the same explanatory variables as the tobit; the other allowing for community level fixed effects (discussed below). What is striking is the similarity between the poverty and consumption functions. In the case of most statistically significant variables, they give coefficients of roughly similar size. This is particularly true of the human capital, age, household size and land variables. Where there are marked differences (for example, with WPTRAIN and FHSTRAIN), these often arise with dummy variables for characteristics rarely observed amongst the bottom half of the population. Apparent differences in the coefficients on variables for being in female headed households are considerably reduced when they are combined with that on MISSW, the dummy variable for the absence of a wife of the head[20]. The overall pattern appears to be that the results of modelling the determinants of poverty are fairly close to those from the simple consumption function.

These results are consistent with the hypothesis that the poor respond similarly to the non-poor. They are also robust to the cut-off line used to identify the poor. Table 4 reports poverty functions which define the bottom 25% and 75% as poor; in both cases broadly similar results are obtained to those from the consumption function. Hence, the Ugandan evidence suggests that consumption functions can provide valid inferences about the welfare of the poor; there is little to be gained from modelling poverty *per se*. One corollary is that the returns to assets such as human capital and land are similar — expressed as percentages of consumption — for the poor and the non-poor. To that extent, there is no evidence that the poor use their assets less efficiently; as hypothesised by Schultz, they appear to suffer from a lack of assets rather than lower returns on their assets (Schultz, 1993). However, this conclusion is qualified by the point noted earlier, that the return in shillings on the assets is greater for the more affluent: the proportionate effect on consumption appears roughly equal, but since the non-poor have higher consumption, the incremental effect must be higher[21]. Use of inappropriate estimation techniques would lead to very different conclusions. Table 4 reports the results of modelling consumption using a sample of the poor only (truncated OLS) and modelling the poverty gap without taking into account its non-

[19] The two tests used for logs versus linear models are detailed in Davidson and Mackinnon (1981) and Godfrey and Wickens (1981). A 5% significance level was used.

[20] MISSW controls for missing values for the education of the wife of the head (as occurs the head is female).

[21] This was underlined by preliminary estimates using a linear rather than log specification of consumption. These generated consumption functions with much larger coefficients in absolute size than those from the poverty functions. The differences in absolute effects seemed to be due to the most affluent quartile; tobits using three alternative definitions of poverty (for 25%, 50% and 75%), did not have markedly different coefficients.

linearity (censored OLS). As predicted, the coefficients on these models tend to be closer to zero than those of either the tobit or the consumption function. For example, they show that an extra grade (year) of schooling of male household heads is associated with a 1.3–1.5% rise in real consumption per adult equivalent *ceteris paribus*. With the tobit and consumption function estimates, the corresponding increase is 2.3–2.4%.

One practical advantage of modelling consumption rather than poverty *per se* is that the dependent variable is continuous and can be estimated by OLS. This makes it feasible to estimate a fixed effects model to control for unobservables common to the local community[22]. In this model, all variables are in deviations from the mean for the enumeration area. This will allow for the diversity in prices, local infrastructure, environment and culture across the many enumeration areas sampled by the survey. Whether fixed effects models are preferable is unclear *a priori* because, although they reduce omitted variables bias, they will tend to magnify the effect of any measurement errors (see Ashenfelter and Krueger, 1994, for a discussion in the context of sibling fixed effects). In practice, however, they are frequently regarded as providing better estimates (Behrman and Deolalikar, 1993). Consequently, the following discussion of the determinants of poverty and welfare refers to the fixed effects model in Table 3 unless otherwise stated. In fact, the results appear fairly robust to control for fixed effects. Although the absolute size of the coefficients and t-ratios tend to fall somewhat, the reductions are generally modest.

The fixed effects model reinforces the impression created by the descriptive statistics that there is not a close relation between poverty and the gender of the household head. As noted previously, inferences are complicated by the logical connection between the dummy variable for there not being a wife of the head in the household (MISSW) and the variables for the gender and marital status of the head. Taken together, the results indicate no `pure' effect of gender. Only the negative coefficient on the dummy for the head being a female divorcee outweighs the positive effect of MISSW and even then, the net effect is very small. Even the net effect of residing in a household headed by a widow is non-negative. This indicates that the poverty of households headed by widows can be explained by other factors included in the model, such as lower education or land. This is rather surprising, given the large literature arguing that women suffer discrimination such as not being able to own land or being neglected by extension agents (see Tinker, 1990). One possibility is that there is a sample selection effect concerning headship. Widows who cannot cope may tend to join other households and hence cease to be heads (Buvinić et al., 1992). For this reason, one cannot infer the effect of widowhood on women from comparisons based on headship and household welfare. A more detailed analysis of gender issues using the data is provided by Appleton (1995b).

The age of the head has the inverse U-shape effect conventionally assumed in life-cycle models of income. It is not surprising that these effects carry over to consumption; consumption smoothing is likely to be limited in an economy such as Uganda where saving has been impeded by inflation, direct expropriation and the large transactions costs involved in delivering financial services to poor rural areas. Age of the head was amongst the variables with significant interactions with urban residence. In rural areas, household welfare appears to peak when the head is fifty; in urban areas, the turning point comes five years latter.

The coefficients on the education variables suggest substantial gross returns, even after

[22] Fixed effects tobits can be estimated (Honoré, 1992) but not on standard econometrics packages; they require special programming.

controlling for location[23,24]. What is new about these findings is that the close correspondence between the estimates from the poverty and consumption functions suggests that the rates of return to education are comparable for the poor as well as the non-poor. This is important given that the poor in Uganda and most of sub-Saharan Africa receive relatively little income from employment earnings, where most of the rate of return literature has focused. This issue was explored further in preliminary estimates by interacting the educational variables with locational dummy variables to see if there were variations in returns between rural and urban areas and across regions. Perhaps surprisingly, there were no significant differences. Education appears to raise welfare by a similar proportion in the rural areas of the rather arid Northern Province as in the booming towns and cities of Central Province. This is in contrast to Glewwe's (1991) findings for the Côte d'Ivoire, where education was associated with higher economic welfare only in urban areas, not rural ones.

Female education appears to have returns comparable to those for male education. For male heads, seven years of primary school and four of secondary is associated with a 17% increase in welfare *ceteris paribus*. The corresponding effect of the education of the wife of the head is even larger, at 22%. For female heads, the rise is highest of all, at 36%. Some caution is required due to the possibility of assortive mating and the likelihood that the education of female heads partly captures the

[23] One might expect part of the returns to education to involve changing location: in particular, by enabling those in rural areas to take up urban employment.

[24] The possibility of returns diminishing with educational expansion was explored by interacting the human capital variables with the age of the household head. There were indications of a slight decline overtime, but it was not statistically significant.

Table 4: Alternative Poverty Functions

	Truncated OLS		Censored OLS		Tobit for Bottom 25%		Tobit for Bottom 75%	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
INTERCEPT	4.014	(57.41) ***	4.206	(112.72) ***	4.623	(43.04) ***	4.510	(62.05) ***
FUNMAR	0.075	(1.25)	-0.020	(-0.73)	0.022	(0.24)	-0.173	(-3.02) ***
FMAR	0.053	(1.12)	-.826E-02	(-0.35)	0.016	(0.22)	-0.152	(-3.24) ***
FCOHAB	0.070	(0.88)	0.011	(0.29)	0.067	(0.54)	-0.115	(-1.44)
FDIVOR	0.053	(1.04)	-0.013	(-0.51)	-0.017	(-0.22)	-0.210	(-4.12) ***
FWID	0.028	(0.61)	-0.025	(-1.14)	-0.055	(-0.82)	-0.190	(-4.25) ***
MUNMAR	0.016	(0.34)	-0.016	(-0.74)	-0.049	(-0.69)	-0.123	(-2.75) ***
MCOHAB	-0.054	(-1.22)	-0.019	(-0.79)	-0.071	(-1.06)	-0.052	(-1.13)
MDIVOR	0.534E-02	(0.10)	-0.016	(-0.72)	-0.041	(-0.53)	-0.168	(-3.57) ***
MWID	0.040	(0.65)	0.036	(1.24)	0.054	(0.60)	-0.034	(-0.59)
HAGE	0.440E-02	(1.90) *	0.208E-02	(1.56)	0.581E-02	(1.63)	0.663E-02	(2.59) ***
HAGE2	-.384E-04	(-1.61)	-.227E-04	(-1.62)	-.521E-04	(-1.43)	-.681E-04	(-2.54) **
LVEDUCH	0.015	(5.05) ***	0.013	(7.82) ***	0.030	(6.45) ***	0.020	(6.21) ***
HSEC1	-.255E-02	(-0.26)	-.383E-02	(-0.85)	0.015	(1.00)	0.019	(2.08) **
HSEC2	-0.053	(-1.20)	-0.027	(-1.68) *	-0.021	(-0.38)	-0.045	(-1.30)
HPTRAIN	0.055	(1.13)	0.036	(1.66) *	0.158	(2.11) **	0.162	(3.64) ***
HSTRAIN	0.120	(1.66) *	0.039	(1.86) *	0.343	(2.89) ***	0.194	(4.06) ***
HUNIV	0.279	(1.23)	0.072	(1.68) *			0.524	(4.57) ***
LVEDUCW	0.795E-02	(2.45) **	0.014	(8.00) ***	0.027	(5.45) ***	0.027	(8.22) ***
WSEC1	0.170E-02	(0.09)	-.550E-02	(-0.90)	0.029	(1.18)	0.039	(2.98) ***
WSEC2	-0.149	(-1.15)	-0.026	(-0.86)	-0.089	(-0.63)	-0.019	(-0.25)
WPTRAIN	0.041	(0.42)	0.021	(0.61)	0.933E-02	(0.07)	0.162	(2.13) **
WSTRAIN	0.145	(0.81)	-.457E-02	(-0.13)			0.077	(0.80)
MISSW	-0.036	(-0.88)	0.033	(1.71) *	0.053	(0.86)	0.216	(5.55) ***
LVEDUCF	0.014	(2.86) ***	0.017	(6.38) ***	0.035	(4.63) ***	0.035	(6.88) ***
FHSEC1	0.018	(0.77)	0.307E-02	(0.34)	0.091	(2.63) ***	0.049	(2.53) **
FHSEC2	-0.149	(-0.81)	-0.024	(-0.61)	-0.118	(-0.79)	0.093	(0.84)
FHPTRAIN	0.232	(2.33) **	0.076	(2.17) **	0.539	(2.78) ***	0.342	(4.38) ***
FHSTRAIN	0.036	(0.25)	-0.015	(-0.38)			0.174	(1.80) *
FHUNIV	0.325	(0.64)	0.052	(0.49)			-0.067	(-0.23)
FLIT	0.029	(0.93)	0.027	(1.66) *	0.042	(0.89)	0.025	(0.79)
FPPRIM	-.536E-02	(-0.17)	-0.017	(-1.02)	-0.017	(-0.34)	-0.020	(-0.62)
FFPRIM	0.108E-03	(0.00)	0.946E-02	(0.80)	0.033	(0.81)	0.041	(1.68) *
FFED	-0.021	(-0.37)	-0.018	(-0.90)	-0.038	(-0.46)	0.031	(0.69)
MLIT	0.045	(1.18)	0.031	(1.79) *	0.116	(2.01) **	0.093	(2.60) ***
MPPRIM	-0.048	(-1.17)	-0.017	(-0.92)	-0.079	(-1.26)	-0.049	(-1.31)
MFPRIM	0.091	(1.75) *	0.018	(0.99)	0.206	(2.35) **	0.088	(2.17) **
MFED	-0.089	(-0.53)	-0.013	(-0.36)	0.018	(0.08)	0.622E-02	(0.07)
FENT	-0.010	(-0.35)	0.738E-02	(0.47)	-.355E-02	(-0.08)	0.024	(0.79)
FGEMP	0.335E-02	(0.14)	0.016	(1.38)	0.020	(0.54)	0.033	(1.39)
FPEMP	0.011	(0.27)	0.030	(1.66) *	0.100	(1.63)	0.119	(3.19) ***
AHSIZE	-0.063	(-8.05) ***	-0.059	(-13.73) ***	-0.162	(-10.97) ***	-0.125	(-14.98) ***
AHSIZE2	0.262E-02	(5.02) ***	0.267E-02	(9.28) ***	0.803E-02	(7.55) ***	0.607E-02	(10.95) ***
YDEP	-.124E-03	(0.00)	-0.069	(-1.45)	-0.295	(-2.05) **	-0.519	(-5.50) ***
YDEP2	-0.041	(-0.33)	0.071	(1.08)	0.216	(1.16)	0.459	(3.59) ***
ODEP	-0.102	(-2.18) **	-0.042	(-1.75) *	-0.248	(-3.60) ***	-0.175	(-3.75) ***
WOMRAT	-0.049	(-1.05)	0.018	(0.80)	0.034	(0.49)	0.093	(2.05) **
LANDPC	0.090	(3.21) ***	0.127	(9.15) ***	0.219	(5.10) ***	0.215	(7.77) ***
LANDPC2	-0.012	(-1.55)	-0.019	(-5.74) ***	-0.023	(-1.92) *	-0.023	(-3.20) ***
NOLAND	0.032	(1.20)	0.088	(6.56) ***	0.166	(4.21) ***	0.195	(7.33) ***
MLAND	0.066	(1.82) *	0.075	(3.48) ***	0.132	(2.30) **	0.115	(2.79) ***
ULAND	0.072	(2.82) ***	0.075	(5.20) ***	0.121	(3.08) ***	0.102	(3.67) ***
NORTHR	-0.152	(-7.70) ***	-0.173	(-15.17) ***	-0.317	(-10.50) ***	-0.269	(-12.37) ***
EASTR	-0.067	(-3.50) ***	-0.053	(-4.97) ***	-0.115	(-3.95) ***	-0.094	(-4.59) ***
WESTR	0.042	(2.02) **	0.069	(6.35) ***	0.175	(5.50) ***	0.183	(8.66) ***
NORTHU	-0.125	(-1.06)	-0.081	(-1.47)	-0.305	(-1.76) *	-0.164	(-1.47)
EASTU	-0.173	(-1.46)	-0.083	(-1.51)	-0.337	(-1.94) *	-0.183	(-1.66) *
WESTU	-0.082	(-0.68)	-0.041	(-0.75)	-0.160	(-0.92)	-0.026	(-0.24)
CENTU	-0.069	(-0.60)	-0.048	(-0.89)	-0.164	(-0.97)	-0.081	(-0.75)
SEAS2	0.014	(0.47)	0.014	(0.92)	-.256E-02	(-0.06)	-0.031	(-1.03)
SEAS3	-0.014	(-0.45)	-0.012	(-0.70)	-0.087	(-1.92) *	-0.084	(-2.61) ***
SEAS4	-0.010	(-0.36)	-0.021	(-1.38)	-0.076	(-1.76) *	-0.082	(-2.71) ***
SEAS5	0.089	(2.87) ***	0.058	(3.46) ***	0.102	(2.17) **	0.067	(2.05) **
SEAS6	0.067	(2.41) **	0.055	(3.76) ***	0.074	(1.76) *	0.062	(2.14) **
SEAS7	-0.041	(-1.41)	-0.047	(-3.15) ***	-0.095	(-2.20) **	-0.108	(-3.64) ***
UMUNMAR	-0.037	(-0.59)	0.011	(0.42)	0.041	(0.45)	0.080	(1.53)
UHAGE	0.477E-02	(0.98)	0.420E-02	(1.76) *	0.012	(1.69) *	0.010	(2.11) **
UHAGE2	-.359E-04	(-0.70)	-.308E-04	(-1.19)	-.103E-03	(-1.36)	-.781E-04	(-1.53)
UFENT	0.790E-03	(0.02)	0.703E-02	(0.34)	0.078	(1.12)	0.065	(1.53)
ULANDPC	-0.019	(-0.29)	-0.036	(-1.43)	-0.109	(-1.17)	-0.141	(-2.65) ***
ULANDPC2	0.011	(0.40)	0.831E-02	(1.12)	0.047	(1.20)	0.041	(2.42) **
UMLAND	0.029	(0.41)	0.044	(1.29)	0.176	(1.58)	0.157	(2.28) **
USEAS2	0.014	(0.24)	-0.051	(-2.10) **	-0.049	(-0.60)	-0.136	(-2.71) ***
USEAS3	-0.019	(-0.39)	-0.072	(-3.23) ***	-0.137	(-1.93) *	-0.227	(-5.01) ***
USEAS4	0.538E-02	(0.10)	-0.031	(-1.43)	-0.053	(-0.73)	-0.139	(-3.07) ***
USEAS5	-0.038	(-0.61)	-0.057	(-2.05) **	-0.045	(-0.49)	-0.128	(-2.23) **
USEAS6	-0.086	(-1.71) *	-0.078	(-3.83) ***	-0.095	(-1.36)	-0.117	(-2.73) ***

omitted effect of the education of non-resident spouses. However, rate of return studies based on earnings data from Uganda and from many other developing countries have also tended to find returns to female education at least as high as those to male education (see Appleton *et al*., 1994, on Uganda; Psacharopoulos, 1993, on other developing countries). In addition, many studies report non-monetary returns to female education (see Behrman, 1991, for a critical survey of the evidence; maternal education also appears to reduce mortality in the data-set used here, Mackinnon, 1995). This combination of significant monetary and non-monetary returns, provides *prima facie* support for the promotion of female education.

Comparing returns by level of education, lower secondary schooling appears to have higher returns than primary. This is indicated by the positive coefficients on the variables for grades of lower secondary schooling despite the presence of variables for grades of all schooling. However, these differences are not significant except in the case of female lower secondary schooling. Nonetheless, the results contradict the conclusion of Psacharopoulos (1993) based on earnings data that primary education has higher returns than secondary education. Instead they reinforce Bennell's (1994) powerful critique of the validity of this conventional wisdom for Africa. Secondary schooling also appears to have higher rates of return in urban earnings functions using the same data-set as that employed here (Appleton et al., 1994). Post-school training qualifications and University attendance have high returns in most cases, although the direct returns to the last two years of secondary schooling seem more modest.

Some evidence of the inter-generational transmission of poverty is provided by the relation between parental background and consumption. Even after controlling for the household's education and land holdings, households appear to be more affluent if their heads had educated parents. However, these effects are amongst the few to be substantially reduced by controlling for unobservable characteristics of the area. For example, households whose heads had literate mothers appear to have 10.6% higher consumption *ceteris paribus* in the O.L.S. estimates. This falls to 6.5% when area fixed effects are controlled for. Having heads whose fathers had complete primary schooling or private sector non-agricultural employment also appears beneficial. In urban areas, heads whose fathers owned non-agricultural enterprises enjoy 9.5% higher consumption.

Many commentators have argued that lack of adult labour within the household is a powerful cause of poverty in Uganda, particularly with the onset of the AIDS epidemic (see Barnett and Blaikie, 1992). However, preliminary estimates with separate variables for numbers of household members in different age-sex groups revealed that having more adults was associated with lower welfare (controlling for land per adult equivalent). This may be partly spurious: average consumption may be subject to greater under-reporting as household size increases. Reparameterising the preliminary model to give that reported in Table 4 shows that higher dependency ratios are associated with lower welfare. This is true when the dependency results from children and when it arises from the presence of the elderly. The variable for the proportion of women of working age had a significant positive coefficient in the fixed effects consumption function (only). Given that the default category was men of working age, this implies that, within this age range, higher ratios of women to men are associated with higher household welfare. Assuming causality, this would imply that women generate more income. This is conceivable, given that women in Uganda are commonly observed to work longer hours than men (see Appleton, 1995b). Against this, women are less likely to obtain formal employment or to run profitable enterprises, both of which have high returns. Instead, it may be that women tend to reside in households that are more affluent due to unobserved factors. Polygamy will tend to facilitate this process; up to one third of marriages in Uganda are polygamous (World Bank, 1993).

Within Uganda, there is currently a large debate on land reform premised on the assumption that fragmentation is generating uneconomically small farms (Republic of Uganda, 1993). However, the analysis here raises question marks over this assumption. Far from land in small holdings being less productive, the extra welfare associated with more land per adult equivalent appears subject to diminishing returns. This is consistent with estimates of agricultural production functions for Uganda and for neighbouring countries (see Midland Consulting Group, 1994, and Bevan et al., 1989). Cultivable land in urban areas is less strongly associated with higher welfare than land in rural areas, presumably reflecting the fact that urban farming is

often a coping strategy of poorer residents. A similar explanation probably accounts for the discontinuity involved in land holdings: having no land is better than having a small quantity. That is to say, households with no land may often have greater opportunities for generating non-agricultural income. These explanations of both the urban interaction and the NOLAND variable suggest that land holdings are partly a choice variable. As such, causal inferences about returns to land must be regarded with caution (see Durbin, 1954).

3. Conclusions

This paper explored the possibility of directly modelling the determinants of poverty. The concept of a poverty function was introduced, specifying the reduced form relationship between the household poverty gap and its determinants such as human capital and assets. The methodological issue addressed was whether such functions generated any major insights beyond those gained from modelling the determinants of the welfare of the population as a whole (a reduced form consumption function). In the Ugandan case, the answer to this question was negative, provided appropriate estimation techniques were used. Thus, at least in terms of a very simple reduced form, the welfare of the poor and non-poor in Uganda appear to respond similarly to a number of hypothesised determinants such as land and human capital. This can be interpreted in various ways. Most narrowly, it implies the consumption function passes an informal specification test for parameter constancy. More generally, it is consistent with Schultz's hypothesis that the poor lack resources but are efficient; they receive the same rate of returns on their assets as the non-poor. In part, it may also reflect the pervasiveness of poverty in the country. Most Ugandans — and many outsiders — would say that the vast majority of the population is poor. As such, social and economic differentiation within the country may be of limited importance[25].

The finding that the poor and non-poor appear to receive roughly equal rates of return, as a proportion of consumption, from education is important given the current emphasis on investments in human resources as a means to reduce poverty. Universal state funded primary education is widely advocated, in part because of the progressive nature of its distribution (Colclough and Lewin, 1993). Of its nature, it tends to provide roughly similar services to children whether from poor or non-poor backgrounds[26]. What is less well established is that these services do benefit the poor, who often reside in remote rural areas with little employment opportunities. This paper provides some evidence for the existence of such benefits in Uganda. Taken at face value, education has a positive proportional effect on the economic welfare of those who receive it. Female education appears just, if not more, beneficial than male education. This is in addition to its favourable effects on child health and other non-marketed aspects of welfare. Consequently, this paper provides support for investments in the education of both boys and girls as part of a poverty reduction strategy.

[25] This was illustrated during attempts by the author to pilot test questions on perceptions of poverty. Respondents were asked whether their household was `very poor/poor/quite poor/neither poor nor rich/quite well off/rich'. Interviewers found it difficult to translate and implement this question. Dr Balihuta of Makerere University explained that in Luganda, one was either poor or rich, it being difficult to articulate further distinctions.

[26] In some countries, the non-poor appear to gain more from school, in terms of superior academic achievement (Coleman et al., 1966). However, this was not found to be true of Uganda in one study of primary schools there (Heyneman, 1979).

References

Appleton, S. M. (1995a) `Problems of measuring changes in poverty over time: the case of Uganda, 1989–1992', CSAE Working Paper, 95.1, Oxford University, Oxford.

— (1995b) `Dimensions of gender disadvantage: evidence from the integrated household survey of Uganda 1992/3', Report for the Secretariat for Analysis of Swedish Development Assistance, Gothenburg.

Appleton, S. M. and A. Balihuta (1994) `A note on income sources of the poor in Uganda', mimeo, CSAE, Oxford University, Oxford.

Ashenfelter, O. and A. Krueger (1992) `Estimates of the economic return to schooling from a new sample of twins', *American Economic Review*, Vol. 84, pp. 1157–74.

Barnett, T. and P. Blaikie (1992) `AIDS in Africa: its present and future impact', Belhaven, London.

Behrman, J. R. (1991) `Women's schooling and non-market productivity: a survey and reappraisal' Women in Development Working Paper, 1, World Bank, Washington D.C.

Behrman, J. R. and A.B. Deolalikar (1993) `Unobserved household and community heterogeneity and labour market impact of schooling: a case study of Indonesia', *Economic Development and Cultural Change*, Vol. 41, pp. 461–88.

Bennell, P. (1994) `Rates of return to education: does the conventional pattern prevail in sub-Saharan Africa?' Institute of Development Studies Working Paper, 10, Institute of Development Studies, Brighton.

Bevan, D. L., P. Collier and J.W. Gunning, (1989) *Peasants and Governments*, Clarendon Press, Oxford.

Bevan, P. (1995) `Understanding poverty in Uganda: adding a sociological dimension', CSAE Working Paper, Oxford University, Oxford.

Boateng, E. O., K. Ewusi, R. Kanbur and A. McKay (1992) `A poverty profile for Ghana 1987–88', *Journal of African Economies* Vol. 1(1), pp. 25–58.

Buvinić, M., J.P. Valenzula, T. Molina and E. Gonzalez (1992) `The fortunes of adolescent mothers and their children: a case study on the transmission of poverty in Santiago, Chile', *Population and Development Review*, Vol. 18, pp. 269–297.

Colclough, C. and K. Lewin (1993) *Educating All the Children: the Economic Challenges for the 1990s*, Clarendon Press, Oxford.

The Coleman Report (1966) *Equality of Educational Opportunity*. Summary report, US government printing office, Washington D.C.

Coulombe, H. and A. McKay (1993) `The causes of poverty in Mauritania', In *Poverty, Inequality and Rural Development.* (eds) T.A. Lloyd and W.O. Morrissey, Macmillan, London.

Davidson, R. and J. Mackinnon (1981) `Several tests for model specification in the presence of multiple alternatives'. *Econometrica*, Vol. 49, pp. 781–93.

Demery, L. (1993) `The poverty profile', In *Understanding the Social Dimensions of Adjustment.* (eds) L. Demery, M. Ferroni and C. Grootaert, World Bank, Washington DC.

Dercon, S., P. Krishnan and A.B. Kello (1994) `Poverty in rural Ethiopia, 1989–94', mimeo, CSAE, Oxford University, Oxford.

Durbin, J. (1954) `Errors in variables', *Review of International Statistical Institute* Vol. 22, pp. 23–32.

Foster, J., J. Greer and E. Thorbecke (1984) `A Class of Decomposable Poverty Measures', *Econometrica*, Vol. 52, pp. 761–6.

Glewwe, P. (1991) `Investigating the determinants of household welfare in Côte d'Ivoire', *Journal of Development Economics*, Vol. 35, pp. 307–37.

Glewwe, P. and J. van der Gaag (1988) `Confronting poverty in developing countries: definitions, information and policies', Living Standards Measurement Study Working Paper, 48, World Bank, Washington DC.

Godfrey, L. and M. Wickens (1981) `Testing linear and log-linear regressions for functional form', *Review*

of Economic Studies, Vol. 48, pp. 487–96.
Greene, W. H. (1993) *Econometric Analysis*, Macmillan Publishing Company, New York.
Haddad, L. and R. Kanbur (1990) `How serious is the neglect of intra-household inequality?' *Economic Journal*, Vol. 100, pp. 866–81.
Hansen, H. B. and M. Twaddle (eds) (1988) *Uganda Now: Between Decay and Development* James Currey, London.
Hausman, J. and D. Wise (1977) `Social experimentation, truncated distributions and efficient estimation', *Econometrica* Vol. 45, pp. 919–38.
Heyneman, S. (1979) `Why do impoverished children do well in Ugandan schools?' *Comparative Education*, Vol. 15, pp. 175–85.
Honoré, B. (1992) `Trimmed LAD and least squares estimation of truncated and censored regression models with fixed effects', *Econometrica*, Vol. 60, pp. 533–65.
International Center for Research on Women (1988) `Women-headed households: issues for discussion', *Joint ICRW/Population Council Working Paper*, Population Council, Washington D.C.
Jamison, D.T., and L. Lau (1982) *Farmer Education and Farm Efficiency*, John Hopkins Press, Baltimore and London.
Kakande, M. and R. Nalwadda (1993) `A report on a study of factors influencing access to and attendance of primary education in Uganda', PAPSCA Report, Ministry of Finance and Economic Planning, Kampala.
Kanbur, R. (1993) `Poverty and development: the Human Development Report and the World Development Report 1990', In *Poverty Monitoring: an International Concern.* (eds) R. Van der Hoeven and R. Anker, Macmillan, London.
Kyreme, S. S. and E. Thorbecke (1991) `Factors affecting food poverty in Ghana', *Journal of Development Studies*, Vol. 28, pp. 39–52.
Maddala, G. S. (1977) *Econometrics*, McGraw-Hill, New York.
— (1983) *Limited Dependent and Qualitative Variables in Economics*, Cambridge University Press, New York.
Midland Consulting Group Ltd (1994) `effects of access to land by the rural poor on food production in Masindi district', PAPSCA Report, Ministry of Finance and Economic Planning, Kampala.
Psacharopoulos, G. (1993) `Returns to investment in education: a global update', World Bank Working Paper Series, 1067, World Bank, Washington DC.
Ravallion, M. and B. Bidani (1994) `How robust is a poverty profile?' *World Bank Economic Review* Vol. 8, pp. 75–102.
Republic of Uganda (1993) `Report of the technical committee on land tenure law reform', Agricultural Policy Committee, Agricultural Secretariat, Bank of Uganda, Kampala.
— (1994a) `Background to the Budget, 1994–1995', Ministry of Finance and Economic Planning, Kampala.
— (1994b) `Report on the Uganda National Integrated Household Survey 1992–93', Statistics Department, Ministry of Finance and Economic Planning, Entebbe.
Rosenzweig, M. and K. Wolpin (1986) `Evaluating the effects of optimally distributed public programs', *American Economic Review* Vol. 76, pp. 470–85.
— (1989) `Migration selectivity and the effects of public programs', *Journal of Public Economics*, Vol. 37, pp. 265–89.
Schultz, T. P. (1983) Book review of `Theory of Fertility Decline' by J. Caldwell, *Population and Development Review*, Vol. 9, pp. 161–8.
Schultz, T. W. (1993) *The Economics of Being Poor*, Blackwells, Oxford.
Tinker, I. (1990) *Persistent Inequalities: Women and World Development*, OUP, Oxford.
Tulya-Muhiika, S., G. Kibirige, T. Nyanzi-Makumbi, J. Kanyerezi and T. Emwanu (1993) `Poverty analysis in Uganda', PAPSCA Report, Ministry of Finance and Economic Planning, Kampala.
West, C. (1987) `Food Composition Table', mimeo, Department of Human Nutrition, Wageningen Agricultural University, De Drejien.

World Bank (1990) *World Development Report*, World Bank, Washington D.C.
— (1993) *Uganda: Growing out of Poverty*, World Bank, Washington D.C.