Health as an Informational Good: The Determinants of Child Nutrition and Mortality During Political and Economic Recovery in Uganda

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Abstract: Uganda suffers from a high rate of child mortality which has improved little if at all in the last twenty years. The paper uses data from the 1992 Integrated Household Survey to model the determinants of child mortality and malnutrition. Parental beliefs about health have a strong and very highly significant influence on child mortality. Education and income also play a role, partly coming through its effect on beliefs, but early primary education seems to have little effect.

1. Introduction

Many children die avoidably. It is now widely understood, thanks in part to the experience of China, that public action can massively reduce mortality even when incomes remain low. However, many poor countries are fiscally highly constrained; priorities within health and educational spending need to be examined carefully in order to see exactly what kind of action will save most lives. Many studies find that education reduces mortality, but few existing economic studies explain why; moreover, most studies impose a linear or at best (Strauss 1990) a quadratic relation between years of schooling and health outcomes. Some studies include interesting interactions between education and public services, and Thomas *et al.* (1991) examine the use that parents make of information as a determinant of child height they find that the effects of education mainly come through more active information-gathering behaviour (for instance, whether mothers read a newspaper or listen to the radio).

The present paper uses data from Uganda, where child mortality (the probability of death before the fifth birthday) is about 20% and has not fallen in twenty years, to shed more light on the channels through which public action could affect child health. Unusually, both nutritional and mortality outcomes are modelled; mortality is modelled with more success. Child mortality turns out to respond very strongly to parental beliefs about the causation of disease. Education and health practices also matter, but early primary education does not seem to make much difference. Use of a very large sample of well-collected data overcomes the problem of multicollinearity which might make these hypotheses seem impossible to distinguish.

The policy implication is strong. To save children, parents need to know more about health. Education certainly has a role to play in this, but it need not be the only tool of public action and its quality may matter as much as its quantity. Also, the advocacy of market solutions for health problems needs to take massive informational failure into account.

Economists studying health have rarely collected or used data on beliefs (an exception is Haddad and Bouis 1990). But medical and anthropological studies provide evidence of their importance: see (among a large literature) Anokbonggo *et al.* (1990), Bukenya *et al* .(1990), Hilderbrand *et al.* (1985), Khan (1986), Linskog and Lundqvist (1989), and Pielemeier (1985). For instance, in Papua New Guinea Bukenya *et al* (1990) used very precise information on the beliefs and practices of a small sample of women; they were able to show that mothers' attitudes towards child faeces, combined with the practice of sweeping the compound, were a critical determinant of child diarrhoea. Similar studies in Uganda are surveyed in Barton and Wamai (1994). However, most of these studies do not construct an economic model and use more limited socioeconomic information than is provided by a household survey. The present paper seeks to develop a link between the medical/anthropological and economic approaches.

2. Data and Context

The data analyzed in this paper come from the Ugandan Integrated Survey of 1992/3, conducted by the Statistics Department of the Ministry of Economic Planning and Development with World Bank support as part of the Social Dimensions of Adjustment project, covering a sample of about 10,000 households from all districts, and about 1,000 communities. The data were carefully collected and checks on its quality are encouraging.

From 1972 to 1986, Uganda experienced two periods of severe political violence, the government of Idi Amin which was overthrown by the Tanzanian army in 1979, and the civil war of the early 1980s which ended when the National Resistance Movement took power in 1986. Incomes collapsed and the economy retreated into subsistence. Although the economy grew from 1986 to 1992 (when the data in this paper was collected) this probably accompanied a widening urban-rural gap and widening inequality. Most Ugandans today are poorer than their parents or grandparents thirty years ago.

The economic collapse accompanied a contraction in real public health spending. GFS figures suggest that over the ten-year period 1977-86 real government spending shows no clear trend, but the share of health in government spending falls from 8% to 2%; as a result real health spending collapses. Symptoms of this collapse were very low medical salaries (nurses at one stage got $4 a month), the emigration of medical personnel, acute drug shortages, widespread illegal charges (see Jitta 1994), and the privatisation of medical care (see Whyte 1991). Dodge and Wiebe (1987) document the collapse. The share of health has recovered somewhat since but all observers agree that primary health remains fiscally very constrained; health is still perceived by the government as a lower priority than security and transport.

In 1992, public services were still seen as inferior. The majority of visits to formal medical facilities reported were in the private sector, and public services were relatively more used by the poor. Public health measures such as the compulsory building of latrines, which were quite important under the colonial authorities, also declined (there is some anecdotal evidence that local authorities are reviving them). It is worth noting that the one indicator which did show some improvement during the period of economic decline was primary school enrolment.

Uganda's aggregate health indicators reflect this grim history. In Africa, the median (across country) probability of dying by the 5th birthday fell from .228 to .155 between 1960 and 1988 (United Nations 1992). In Uganda, this probability fell quite steeply between the 1955 and 1965, falling below .2 by the mid-1960s, but at some point it seems to have stopped falling. Preliminary results from the 1992 Census put under-five mortality in the 1984-8 period at 203 per thousand, and there is as yet no firm improvement of an improvement since (AIDS and malaria are increasingly severe problems in addition to other traditional childhood illnesses).

3. Descriptive Statistics

Table 1 shows the mortality ratios of children born to mothers with different characteristics. (All descriptive statistics are estimated national means based on appropriate weighting of each observation in the sample). Because their children are on average older, older women have lost a higher proportion of their children. There is a strong difference between mothers with post-primary education and those without, and a rather small difference between quartiles of the real expenditure distribution (the construction of this variable is described in Section 5). Rural children are at much more risk than urban children.

Table 1:
Ratio of Children who have Died

	All women	<20	21-5	26-30	31-5	36-40	>40
rural	0.24	0.12	0.15	0.18	0.20	0.20	0.31
urban	0.17	0.09	0.11	0.13	0.15	0.17	0.27
Expenditure quartiles							
1st (low)	0.25	0.13	0.17	0.17	0.19	0.19	0.33
2nd	0.24	0.15	0.13	0.16	0.19	0.20	0.32
3rd	0.23	0.07	0.17	0.19	0.20	0.19	0.30
4th	0.22	0.11	0.13	0.16	0.19	0.20	0.30
Maternal education							
None	0.28	0.10	0.17	0.20	0.21	0.22	0.34
Some primary	0.19	0.11	0.15	0.16	0.20	0.18	0.25
Some secondary	0.10	0.04	0.08	0.11	0.09	0.14	0.11
Some further	0.07	0.00	0.03	0.07	0.05	0.08	0.09

Source: author's calculations from the 1992/3 Integrated Household Survey

Table 2 shows the proportion of children at different levels of nutritional status, measured in Z-scores (standard deviations from the mean of the reference population) of height-for-age: Table 3 shows weight-for-height.

Table 2:
Height-for-age: Z-scores
(calculated as distance from the mean of the international reference population,
in terms of standard deviations of that population).

Total	<-3	-3 to -2	-2 to -1	-1 to +1	+1 to +2	Above +2
male	23.0	20.7	24.2	24.7	4.5	2.8
female	19.0	18.7	22.6	31.1	4.3	4.3
urban	13.4	15.3	25.3	36.0	6.9	3.1
rural	22.2	20.4	23.1	26.6	4.0	3.6

cont ...

Table 2 cont ...

Total	<-3	-3 to -2	-2 to -1	-1 to +1	+1 to +2	Above +2
Expenditure quartiles						
1st (lowest)	23.0	21.2	21.5	26.0	4.8	3.5
2nd	22.7	19.3	23.4	27.0	4.1	3.4
3rd	20.1	20.2	24.8	28.2	3.5	3.2
4th (highest)	18.6	18.4	23.8	30.0	5.2	4.0
Age (years)						
Boys						
0	13.4	22.1	26.7	31.4	4.0	2.3
1	29.4	24.8	20.7	18.0	4.3	2.8
2	23.9	18.9	22.0	24.8	4.8	5.5
3	23.1	18.9	24.5	26.2	4.4	2.7
4	23.3	19.6	27.6	24.0	5.0	0.5
Girls						
0	11.0	12.7	27.5	39.6	4.9	4.2
1	20.5	20.4	25.9	26.6	2.5	3.9
2	19.6	19.9	19.1	31.2	4.7	5.5
3	19.0	20.7	22.9	28.9	4.3	4.1
4	23.0	17.8	20.9	29.1	5.2	3.9
Maternal education						
Illiterate	23.4	20.6	22.1	25.5	4.3	4.0
Literate, incomplete prim	21.0	20.2	24.7	27.5	3.6	3.1
Completed prim/some sec	17.0	17.6	22.6	32.9	6.1	3.8
Completed further	-	7.9	12.9	79.2	-	-

Source: author's calculations from the 1992/3 Integrated Household Survey

Tables 2 and 3, which present data on nutrition, have a number of dramatic implications. First, overall levels of wasting in Uganda are not very far from the reference population (this can be seen from the fact that the distribution is nearly symmetrical around a Z-score of 0), but levels of stunting are very high. Secondly, there is one age group where a high incidence of wasting is observed, children between one and two years of age. Height-for-age also worsens dramatically during the second year of life (a finer disaggregation shows deterioration from the age of six months).

Table 3:
Weight-for-height: Z-scores
(calculated as distance from the mean of the international reference population, in terms of standard deviations of that population).

Total	<-3	-3 to -2	-2 to -1	-1 to +1	+1 to +2	Above +2
male	2.0	3.9	13.5	61.3	13.2	6.0
female	1.5	3.6	15.0	60.8	13.1	5.9
urban	3.4	3.2	12.4	58.9	13.7	8.3
rural	1.5	3.9	14.5	61.4	13.1	5.6
Expenditure quartiles						
1st (lowest)	1.9	5.4	17.2	60.9	10.4	4.2
2nd	2.0	4.8	14.2	60.5	12.9	5.5
3rd	1.6	3.0	13.3	64.2	13.6	7.2
4th (highest)	1.6	2.2	12.4	61.6	15.4	6.7
Age (years)						
Boys						
0	3.1	3.4	8.9	48.3	20.6	15.6
1	1.7	7.1	20.9	49.8	14.7	5.6
2	2.0	2.9	10.9	70.1	11.5	2.5
3	2.3	2.3	13.1	67.5	11.7	3.1
4	1.0	4.1	13.2	65.2	10.4	6.9
Girls						
0	2.4	2.7	8.3	46.6	23.0	17.1
1	1.1	8.2	17.4	52.0	13.2	8.0
2	2.5	2.1	17.3	66.4	9.4	2.2
3	1.6	2.8	13.4	68.5	10.6	3.1
4	0.5	2.7	15.8	64.0	13.3	3.5
Maternal education						
Illiterate	1.9	4.0	14.3	62.1	12.1	5.6
Literate, incomplete prim	1.5	3.7	14.3	60.4	13.7	6.4
Completed prim/some sec	2.3	3.5	13.9	60.2	14.3	5.9
Completed further	-	-	-	76.1	10.9	12.9

Source: author's calculations from the 1992/3 Integrated Household Survey

What this seems to suggest is that children in Uganda suffer a nutritional setback in the second year of life which permanently reduces their height. Likely explanations include increased exposure to disease, a loss of the inherited immunity which shields children during the first few months, and inappropriate weaning foods. Food shortage at the level of the household seems a less plausible explanation for such an age-specific pattern of malnutrition (though the economic returns to the survival of a child from the household's point of view increase with the child's age, because of sunk costs, and so we might expect food-scarce households to favour older children). However, the multivariate analysis does not show older children being less exposed to wasting when other factors are controlled for.

Uganda compares poorly to other African countries in terms of stunting but well in terms of wasting. It is also known to be in aggregate terms much more food-abundant than many African countries. It is particularly striking that these patterns (noted in the 1989 DHS data in Jitta *et al.* 1991) are found in 1992, which was a drought year when acute malnutrition might be expected to be severe.

There is no obvious gender difference (indeed girls seem to do better than boys) confirming the evidence in Svedberg (1990). Strong urban-rural differentials and relatively weak differentials between expenditure groups have been noted in other African data for instance by Alderman (1990).

Although disease, malnutrition and mortality are different things, one would expect them to be related. Tables 4 and 5 show simple correlations. The negative correlations between anthropometric status and illness are as expected, but the correlation coefficients are very small. The negative correlation between height-for-age and weight-for-height is striking; this might reflect measurement error in height, the experience of wasting an stunting at different ages, or a real negative relation between tallness and plumpness at a given age. The correlations between the mortality of a mother's children and the nutritional status of surviving children are negative but very small and barely significant. These results suggest that while nutrition and mortality are sufficiently different phenomena to require separate modelling.

Table 4:
Correlation Coefficients Between Individual Nutritional Indicators and Number of Days Ill: Children below 5

Height-for-age with weight-for height	-0.11***
Weight-for-height with number of days lost to illness	-0.05***
Height-for-age with days lost to illness	-0.05**

*** significant at the 1% level
** significant at the 5% level but not the 1% level.

Source: author's calculations from the 1992/3 Integrated Household Survey

Tables 6 and 7 describe beliefs. People 10 years and over were asked whether they had heard of AIDS, diarrhoea and malaria; if they had heard of the illness, what the source of their information was; and about their knowledge of causation and prevention and their attitude to control. Enumerators graded the quality of understanding shown.

Table 5:

Correlation Coefficients Between Ratio of Deceased Children and Average Indicators for Surviving Household Members under Five

Ratio of deceased children with mean weight-for-height	-0.02
Ratio of deceased children with mean height-for-age	-0.03*
Ratio of deceased children with mean days ill	0.01

* significant at 10% level

Source: author's calculations from the 1992/3 Integrated Household Survey

The vast majority of people had heard of all the illnesses, with family and friends the main source, followed by education (Table 6). Knowledge of causation was very similar to knowledge of prevention (which is therefore not shown) and most people expressed an interest in control, rather than a fatalistic attitude. As expected, urban people are better informed than rural people. Table 7 shows the relation between information, age and gender. There is a concave relation with age; the best informed group are those between 26 and 45. There is no gap between the knowledge of young boys and young girls, but as age increases a widening gender gap emerges. However, this gender difference is not observed when men and women of the same educational level are considered.

Table 6:
Beliefs about Illnesses, by Region

Region	Central		West		East		North	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Proportion who have heard of:								
AIDS	98.5	99.4	96.7	97.3	94.7	96.8	92.8	94.1
Diarrhoea	90.8	95.3	90.1	87.3	88.8	87.8	94.1	92.4
Malaria	93.5	95.6	93.8	96.1	90.2	93.1	94.7	94.1
Information source:								
AIDS								
family and friends	70.8	48.6	67.9	56.8	74.9	58.2	59.5	40.7
education	12.2	14.8	11.5	17.1	9.3	16.7	19.1	29.7
newspaper/poster	3.1	6.8	2.5	3.9	3.6	6.5	3.5	12.9
radio and TV	9.6	27.3	14.7	18.5	7.8	11.7	6.3	10.4
RC/medical profession	3.9	2.5	3.4	3.7	4.2	6.6	11.4	6.2

cont ...

Table 6 cont ...

Region	Central		West		East		North	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Diarrhoea								
family and friends	58.7	35.6	57.7	51.3	57.7	44.1	40.7	26.3
education	25.7	40.1	23.3	33.8	15.1	29.7	33.6	52.3
newspaper	0.8	2.3	0.4	0.1	2.8	3.8	1.0	2.0
radio and TV	2.8	11.5	1.6	0.9	4.2	2.6	0.6	0.3
RC/medical profession	10.8	10.3	11.7	8.4	18.0	19.3	23.7	17.9
Malaria								
family and friends	53.7	33.6	56.2	50.4	48.4	38.3	39.5	25.2
education	26.1	43.9	23.1	33.1	15.5	26.1	31.8	52.4
newspaper	0.9	2.3	0.3	0.3	2.5	4.7	0.8	1.7
radio and TV	2.3	6.4	1.4	1.5	1.5	2.3	0.8	0.5
RC/medical profession	10.3	9.3	12.7	10.8	21.4	21.7	21.5	14.2
Knowledge of causation								
AIDS								
none	9.7	5.8	19.3	12.7	9.2	5.7	20.2	17.8
some	45.8	29.0	47.6	39.1	68.4	52.7	60.3	40.2
good	44.5	65.3	33.0	48.2	22.4	41.6	19.5	41.9
Diarrhoea								
none	33.7	15.8	38.8	24.7	34.0	23.3	31.7	23.9
some	38.5	28.6	39.0	34.8	48.8	43.0	46.7	35.2
good	27.8	55.6	22.1	40.5	17.2	33.4	19.6	40.8
Malaria								
none	32.5	14.8	39.1	25.2	30.1	18.2	36.7	29.3
some	36.3	25.2	36.5	33.6	50.5	45.6	45.3	31.2
good	31.2	60.0	24.4	41.2	19.5	36.2	17.9	39.4

Source: author's calculations from the 1992/3 Integrated Household Survey

4. A Model of the Determination of Health

This paper follows many other recent contributions in treating health as a good demanded by the household, for which a household model is appropriate. However, the causal structure assumed has some complex features which need more careful attention than they often receive.

It is assumed that the household achieves a Pareto-optimal allocation internally. At all times, the household is therefore maximising some implicit additive function of members' utilities. utility function. However, the relative weight placed on the utility of different members depends on those factors which determine bargaining power. For simplicity, it is assumed that these factors can be summarised by a vector of gender differentials, G; this vector can be seen as determining the form of the utility function which the household maximises. Mathematically this is equivalent to making G an argument in the utility function, while imposing no restrictions on functional form.

Table 7:
Beliefs about Illness: by Sex and Age

Age	10-15		16-25		26-35		36-45		46-55		>55	
Sex	M	F	M	F	M	F	M	F	M	F	M	F
Knowledge of cause:												
AIDS												
none	27.0	29.2	6.2	8.2	4.5	9.0	6.0	12.0	6.8	20.6	19.5	32.7
some	57.4	54.0	52.7	52.7	48.2	50.1	50.1	52.6	55.9	53.9	54.4	49.9
good	15.6	16.8	41.0	39.4	47.3	38.6	43.9	35.4	37.3	25.5	26.1	17.3
Diarrhoea												
none	48.5	49.7	22.0	25.2	19.9	27.0	23.8	34.4	24.0	39.4	41.7	54.5
some	39.0	38.3	45.8	44.2	42.7	44.7	40.5	40.3	44.9	44.0	40.6	36.0
good	12.5	11.9	32.2	30.6	28.3	28.3	35.6	25.2	31.1	16.6	17.7	9.5
Malaria												
none	46.0	46.7	21.0	26.1	19.4	29.2	23.1	35.5	24.9	41.0	42.1	55.3
some	39.0	37.9	43.2	41.9	41.1	42.6	39.8	37.8	41.0	42.0	40.6	34.5
good	15.0	15.4	35.8	32.0	39.5	28.2	37.1	26.7	34.0	16.9	17.3	10.2

Source: author's calculations from the 1992/3 Integrated Household Survey.

Hence the household maximises its expectation of a utility function given by

(1) $$E\,(U\,(D,C,H,L,G,HP)\,|B)$$

Here D is a vector of demographic variables; C is consumption; H is health; and L is labour supplied to the market. HP is a vector of health practices; the practice of hygiene is assumed to affect utility directly, for instance by requiring inputs of non-marketed labour, but the way in which it does so is left flexible.

G is represented in what follows by including community-level data on male-female differentials in the labour market (wages and job availability), because an improvement in the female differentials will increase female bargaining power and hence probably improve child health. However, an alternative possibility is that an increase in female wages will draw female time out of child care. (It is hard to find a usable variable which captures effects on relative bargaining power without also affecting allocation through relative prices: Thomas (1991) in Brazil uses unearned female income, but this depends on the existence of state pensions. An alternative, not explored here, is the share of female income; however, if this is regarded as endogenous, the search for instruments raises the same problems). Finally, the subjective expectation of utility is conditional on the beliefs of household members about illness, B. Note that the maximisation is modelled as taking place ex ante, i.e. before the random component of illness is known.

(1) is maximised subject to the constraints in (2) to (5):

(2) $$PC \leq w(E)L + Y$$

Here Y is unearned income; C is the consumption vector; w is a vector of wage rates which are assumed to depend on the vector of educational levels E; and L is labour supplied to the market. This form of budget constraint assumes either that there is no subsistence production or that the family farm can be modelled as a price-taker in labour and product markets which buys family and outside labour indifferently. While this assumption is not true in Uganda (see Appleton and Mackinnon 1995), the crucial separability in what follows is between production and child health, and this seems a reasonable approximation. Separability between adult health and production would be more problematic, though Pitt and Rosenzweig (1985) find it an acceptable approximation in Indonesia.

(3) $$H = f(HG, HP, V) + e$$

Here health depends in a stochastic fashion on vectors of marketed health goods, HG; these are a subset of consumption C and would include both food and medical services: on HP, health practices within the household, and on V, a vector of environmental variables.

(4) $$C \leq \overline{C}$$

and

(5) $$L \leq \overline{L}$$

(4) and (5) represent quantity constraints on consumption, notably of health services, and on marketed labour supply. Note that since the model can be interpreted intertemporally, the quantity constraints may include a liquidity constraint; this justifies the use of data on informal insurance as a determinant of demand.

The maximisation problem yields demand functions for goods and services as follows:

(6) $$C = C\ (P, w, Y, E, D, G, B, \overline{C}, \overline{L})$$

(7) $$HP = HP\ (P, w, Y, E, D, G, B, \overline{C}, \overline{L})$$

These demand functions and the health production function (3) yield the reduced form model of health:

(8) $$H = H\ (P, w, Y, E, D, G, B, \overline{C}, \overline{L}, V) + e$$

The presence of education in the reduced form is justified, in the above argument, by its effect on the budget constraint (2). There are, however, a number of alternative interpretations of the coefficient of education in the reduced form. (a) Education affects the relative bargaining strength of men and women. In this case the signs of female and male education should be opposite. (b) Education directly inculcates habits connected with health practices such as hand-washing. (c) Children's education affects the household's returns to successfully rearing them. All these effects, in the current model, could be represented by making education an argument in the utility function and hence in the reduced form. (d) Education affects the cost of parental time. Finally, (e) education may affect beliefs; however, if beliefs are adequately measured, this should be picked up by the coefficient on beliefs and does not warrant the inclusion of education in the reduced form one beliefs are included. However, education is in practice likely to pick up some information about any unobserved component of beliefs.

In the estimated model, it is assumed that income in (2) and child health are separable, so that permanent income can be treated as an exogenous variable. Thus Y (unearned income) and E can be replaced in the reduced form by permanent income. For adult health, this would raise problems of exogeneity, but for children's health it seems reasonable. Permanent income is then proxied by current expenditure and by indicators of housing quality - the number of rooms in the household and whether the dwelling is self-standing. Reasons for not instrumenting income with assets (as is often done) are discussed in the next section. The use of income, rather than assets, removes the primary justification for including education in the reduced form, which was that education confers the power to earn income. However, the other justifications listed under (a) to (e) in the last paragraph remain plausible; hence it seems reasonable to retain education in the reduced form.

The vector of environmental variables V includes the prevailing forms of sanitation, water and garbage disposal in the community. However, the exogeneity of these variables is not altogether clear since the choices prevailing in the community reflect the choices of people in the sample. At the same time, individual health practices might themselves be exogenous if, for instance, latrine building is compulsory. Moreover, it is of interest to find out how much of the influence of beliefs and education is coming through identifiable health practices. In view of these difficult issues of causal structure, four versions of each model are estimated: with beliefs, education and community-level practices: with beliefs, education and individual-level data on practices: with education and beliefs: and with only education. A very similar approach to the (slightly different) problem of modelling education and information use is taken by Thomas *et al.* (1991).

A further possible problem of endogeneity concerns beliefs, since one would expect parents whose children have died from a particular condition to have acquired some knowledge as a result. This could produce a spurious negative correlation between beliefs and health. However, the very strong positive link actually found suggests that this form of endogeneity is not important.

5. Measurement Issues

Health is measured by the survival ratio of children ever born and two standard anthropometric measures, height-for-age and weight-for-height. The survival ratio is of acute intrinsic interest and, with the exception of paediatric AIDS where mothers may not long survive their children, is probably fairly well measured. It has the drawback that observations on current clauses of explanatory variables are being used to explain past events. The anthropometric measures do refer to current or recent events, but they are probably measured with more error than mortality, are subject to possibly insignificant short-run fluctuations, and are of less intrinsic interest then mortality.

Income was measured, as mentioned above, by real expenditure and by the quality of housing (number of rooms in the dwelling, and whether the household is self-contained). The measure of real expenditure was constructed for this dataset by Appleton (1994); regional poverty lines were calculated based on the cost of a food basket, and expenditure per adult equivalent using the following scales was divided by the poverty line to get real expenditure per adult equivalent. The measure of housing quality raises the problem that it might be a direct input into the health production function, since malaria in particular may well be carried between people sleeping in the same room. The possibility of instrumenting permanent income with assets (widely used in the literature) was rejected partly because the most important asset, land, may not be exogenous (we have information on land used rather than land owned, and land in some parts of Uganda seems to be 'lent' on criteria of need or personal loyalty): partly because land is missing for a number of households, especially many urban households: and partly because the relation with land is complex; those with no land at all are better off that those with a little land (for more discussion see Appleton and Mackinnon 1995).

The use of a per-adult equivalent measure, whether of income or assets, raises problems of endogeneity, since the denominator of such a measure is automatically reduced by the death of a child. One solution would be to regress separately on income and household size; but this would lead to a confusion between the cost effects of household size and other effects of varying demographic structure. On balance, the use of real expenditure per adult equivalent seemed the simplest and most satisfactory available measure.

Education is measured by separate dummies on each grade achieved, allowing complete freedom in the functional form of the relation between years of schooling and health. One important caveat is selectivity bias; the attainment of a limited level of education may reflect the fact that the person has dropped out and hence be an indicator of low ability or discipline. In the equations for nutrition, parental education was used; the data here is less finely disaggregated.

The data on beliefs were discussed in Section 3; dummies for 'good' and 'some' understanding of the causation of diarrhoea and malaria were used. Paediatric Aids is likely to be relatively unimportant among children of surviving mothers.

A selection of prices for major food items, divided by the regional poverty line, was used; also, charges for some medical services were included. The vector of quantity constraints is proxied by variables which measure the availability of services and markets, and by variables in the community questionnaire on whether long-term support and short-support is available to households in dire need. The availability of services was measured by the distance from the nearest clinic and the nearest hospital and the presence of a nurse and a doctor in the nearest clinic.

Health environment was measured by the health practices (form of sanitation, water and garbage disposal prevalent in the community, and mean age at weaning and the presence of a nursery) and also by the prevalence of fuelwood as the main energy source (this may have a direct impact on children's respiratory systems). As noted above, the community variables on sanitation, water and garbage were used only in one version of the models; in another version household-level data was used instead. Also, a vector denoted by 'Practices' includes the average age at weaning and the number of meals for adults and children; this turned out not to be significant in any model (perhaps because extended breastfeeding is almost universal in Uganda).

A full list of the variables used is given in Table 8. The focus on the mortality equations is on the mother, whereas in the nutrition equations it is on the particular child; so there are some differences between the equations. Also, nutrition is assumed to have a seasonal component.

In a significant proportion of cases, the data do not allow a household to be precisely matched with a community. Rather than halving the sample size or omitting the very valuable community data, a dummy was used for missing observations on particular variables and the relevant variable set to an arbitrary constant in these cases. The effect of this is to remove any influence of these observations on the coefficient on the missing variable, while retaining the other information from the observations.

Table 8:
Variables Used in the Nutrition Equations

WHZ	Z-score, weight-for-height
HAZ	Z-score, height-for-age
ONE etc.	dummy for age of child (12-17 months)
ONE5 etc.	dummy for age of child (18-23 months)
SEX	=0 if male, 1 if female
WELFARE	spending per equivalent adult/regional poverty line
WELFSQ	WELFARE squared
NROOMS	number of rooms
INDDWELL	=1 if independent dwelling, 0 otherwise
GCHILD	=1 if grandchild of head of household
SERVANT	=1 if servant
NOTREL	=1 if not related to head of household
KIDRATIO	proportion of children in household
KIDORDER	=1 if oldest child in household, 2 if second, etc.
FEB92 etc.	seasonal
FLIT/MLIT	father/mother literate but no education
FPRIM/MPRIM	father/mother had lower primary education (but no more)
FP7/MP7	father/mother had upper primary education
FSEC/MSEC	father/mother had lower secondary education (but no more)
FALEVEL/MALEVEL	father/mother had A-levels
FFUR/MFUR	father/mother had further education
MALEMAL/FEMMAL	average score for males/females in HH on knowledge of malaria causation (2=good, 1=some 0=none)
MALEDIA/FEMDIA	average score for males, diarrhoea causation
URBAN	=1 if urban
EAST etc.	region
RMATPR	matooke price
RMZPR	maize price
RCASPR	cassava price
RPOTPR	sweet potato price
RMILPR	millet price
RMLKPR	milk price
RBFPR	beef price
RBNPR	bean price
RSOPPR	soap price
RASPPR	aspirin price
FMFARMW	ratio of female/male farm wage
MFARMW	male farm wage
MALPRICE	price of malaria drugs in clinic
ANTPRICE	price of antibiotics in clinic
CONSPRIX	consultation fee in clinic
DISTCLIN	distance to clinic
SUPPLIES	=1 if regular supplies to clinic
DOCTOR	=1 if doctor regularly present
NURSE	=1 if nurse regularly present
HOSPCOST	cost of hospital stay
GOVHOSP	=1 if hospital is government-owned
INGOHOSP	=1 if hospital is run by international NGO
LNGOHOSP	=1 if hospital is run by local NGO

cont ..

Table 8 cont ...

TAP	=1 if main water supply is tap (Community)
HTAP etc.	=1 if main water supply is tap (Household)
VENDOR	main water supply vendor
RAIN	main water supply rain
PWELL	main water supply protected well
NPWELL	unprotected well
COLLECT	rubbish collected
BURN	rubbish burnt
BURY	rubbish buried
MANURE	rubbish used as green manure
BUCKET	main form of toilet a bucket
FLUSH	main form of toilet a flush
LATRINE	main form of toilet a latrine
SSUPPORT	support available in short term
LSUPPORT	support available in short term
NURSERY	nursery available
WEANAGE	usual age at weaning
ADMEALS	usual number of meals for adults
CHMEALS	number of extra meals for children
WOOD	=1 if wood the main source of fuel
AVAILDIF	index for female-male differential in job opportunities
AVAIL	index for male job opportunities
DISTCMKT	distance to nearest consumer market
DISTMMKT	distance to main consumer market
DISTTRAD	distance to trader
DISTPMKT	distance to product market
NO...	dummies for missing observations on particular variables
Additional variables in the mortality equation:	
RATIO	ratio of children who have died to children ever born
AGE	age of woman
EDUC1	educated but 1st grade not completed
EDUC11-1	primary grade 1-7 completed
EDUCJUN	junior schooling
EDUCSEC	secondary schooling
EDUCFUR	further education
BIRTHG	female births
BIRTHB	male births
GOODDIA	good knowledge of diarrhoea causation
SOMEDIA	some knowledge of diarrhoea causation
GOODMAL	good knowledge of malaria causation
SOMEMAL	some knowledge of malaria causation
SINGLE	=1 if single
COHABHH	=1 if unmarried cohabiting with household head
COHABOTH	=1 if unmarried cohabiting with other
DIVORCE	=1 if divorced
WIDOW	=1 if widow
HEAD	=1 if household head
OTHREL	=1 if relative other than child, grandchild, wife or servant of household head
WIVES	number of wives of household head in the household

6. Results

A general model was estimated in four versions for each dependent variable. For simplicity, OLS was used for the estimation of mortality at this stage. In each model, block F-tests were used on groups of variables to simplify the models. Tables 9 to 11 show the F-tests in each model. The models were then simplified using F-tests to justify the deletion of blocks of variables at each stage. Tables 12, 14 and 15 show the models finally selected, and Table 13 shows a variant of the models for mortality concentrating on married couples to test for the flow of information within the household. Because hypothesis-testing, rather than prediction, is the purpose of the modelling exercise, even the simplified models are large (also further restrictions were rejected by block F-tests).

Mortality is more satisfactorily modelled than nutrition; the hypothesis tests turn out to be more powerful for mortality than for nutrition. The differences in results between the equations, discussed below, may reflect the differences in date of the events being explained or differences between the phenomena of malnutrition and mortality; it is very hard to distinguish these in a cross-section data set. What is clear is that weight-for-height seems to respond most to short-term factors, as one would expect on either view. Weight-for-height is more satisfactorily modelled than height-for-age, somewhat surprisingly.

The block F-tests for mortality, as well as the coefficients in the simplified model, show that mortality, show very clearly that beliefs have a strong causal role even when conditioning on education and on community-level or household-level practices. Moreover, the coefficients are high. Note that about half the observations of mortality are censored at 0 or 1 (4912 were censored at 0 and 298 at 1), so that the effect of improvement in knowledge on mortality is only about half the size of the coefficients. Compared to the control group of mothers with no understanding of the causation of malaria and diarrhoea, mothers with good knowledge have a reduced mortality rate reduced by roughly (.07+.02)/2=.045 ; this compares with an average mortality rate of about .2 and represents a very significant improvement as a result of increased understanding.

In Table 13, the sample is restricted to spouses of the household head (to avoid possibly perverse effects from the death of a spouse on the measure of male education and beliefs) to test for differential effects of beliefs and education of men and women. It turns out to be difficult to distinguish effects by gender; high multicollinearity is not surprising, given that spouses may have been interviewed together. So whereas we can be sure that beliefs do matter, it is not clear from this dataset that women's beliefs matter more than men's.

Education also matters in explaining mortality and height-for-age. However, primary education has relatively weak effects; it becomes significant in explaining mortality only when we remove practices from the equation, and more so when beliefs are removed (see the relevant line of Table 9). This may suggest that the effects of primary education come mainly through beliefs and practices (though the coefficients on education do not change much across the four versions of the model in Table 12). Also, the coefficients on particular grades show that there is no strong evidence of any beneficial effect of education until about the fifth grade of primary schooling. It would be useful to understand more about exactly what is being taught in schools at different grades (Strauss 1990 reports rather similar results in Cote d'Ivoire). The results help to explain why the increase in enrolment rates during a period of economic disruption did not deliver any improvement in mortality.

Practices associated with sanitation, water source and garbage disposal matter more for current nutrition than for past mortality. Some of these variables, for instance the dummy for having garbage collected, may pick up unmeasured aspects of wealth. Since practices are measured currently and may change more over time than beliefs, it is understandable that they should be more powerful in the nutrition than the mortality equations. (The control groups are households or communities which have no toilet, dump their garbage at will, and get their water from the river).

The coefficients have the expected signs and are quite large. The use of fuelwood as the main source of energy at a community level worsens health outcomes; once again, this might be a measure of wealth at the community level, but it may also reflect a direct effect on health.

Economic status, measured by real expenditure and housing, matters in most cases. The long-run indicator, the number of rooms in the house, affects mortality (as noted above this could reflect a direct environmental effect) whereas weight-for-height responds to the short-run indicator, real expenditure (WELFARE). The effects of expenditure they seem to be concave (so that a more equal distribution would improve health) but the quadratic term is not significant in most cases. Similarly, relative food prices matter only in the equations for weight-for-height (they became significant in block F-tests as the size of the model was reduced), though even here many coefficients are insignificant and price effects do not seem to be very convincingly modelled, perhaps because observations are missing in many cases.

Gender differentials in the labour market were not found to be significant (as noted above, their sign is theoretically ambiguous but higher female wages were expected to benefit child health). However, the sex of the child does matter, both in mortality (where the coefficient on BIRTHB is much bigger than that on BIRTHG) and in weight-for-height; girls do better than boys. The age of the child matters as expected for nutrition, but in contrast to the bivariate data presented earlier there is no sign that weight-for-height is worse in the second year of life than in subsequent years. The reason for this is not clear. The marital status of the mother matters a great deal for mortality; children from polygamous households, or whose mothers are divorced or widowed, are at much greater risk (though some of these variables might be endogenous). The relations of children to the household head, however, do not show specific problems for children who are not being looked after by their parents; this is of great interest given the large number of orphans in the population. It is often anecdotally suggested that orphans are discriminated against within the household; these results do not support this view. However, orphans do suffer because their mothers are widowed, and they may suffer when their mothers die because they move to poorer households.

Some aspects of services do seem to matter, more for nutrition than for mortality. In particular, the presence of a doctor has a powerful positive effect on weight-for-height. Prices for services, in some cases, seem to have perverse effects; there is no support here for the view that user charges are damaging to health. However, the official prices reported in the dispensary may be a poor proxy for actually imposed charges. Isolation has a perverse beneficial effect; distance from traders and from the main market seems to improve nutrition, It is possible this reflects a conflict between commercialisation and nutrition, but this suggestion is highly tentative. The presence of short-term support does seem to benefit the short-term nutritional indicator, weight-for-height.

In the nutrition equations, season is highly significant as a block (even though none of the t-ratios are significant) and the coefficients show a clear pattern across the year of the survey. This may reflect either a normal seasonal pattern or the drought which was at its worst in mid-to-late 1992.

7. Conclusions

The most important results of this paper concern the impact of beliefs and education on mortality. The statistical evidence for the importance of beliefs is stronger than might have ben expected given their close association with levels of education (and is possible to demonstrate partly because of the very large sample size). The evidence in the paper supports the view that public health and education programmes need, above all else, to improve people's own understanding of how they can combat disease. Children die because their parents are not fully informed about the actions they could take to save them. For public health services, this has the implication that the doctor or the nurse should see themselves as communicators rather than technicians. A sign that this is much misunderstood is the widespread observation, in a number of African countries, of very short consultation times (often associated with extravagant drug prescriptions). It also suggests that there is potentially an enormous role for carefully designed public awareness campaigns. In the case of AIDS, public awareness of the existence of the disease is almost universal and this certainly reflects public action to some extent.

Secondly, the results suggest that although education is a powerful way of increasing people's understanding, early primary education has in the past not succeeded in achieving very much benefit. Whether this reflects curriculum design, quality of schools, or the intrinsic difficulty of communicating complicated concepts such as the germ theory of disease in early primary education, is hard to say. The Ugandan authorities are acting on the design of the curriculum, including health education at an early stage for both sexes; the results here strongly support this policy. Educational policymakers also need to think about exactly what a person needs to understand in order to protect their children, or themselves, from disease. To understand health, we need to understand information.

Table 9:
Levels of Significance of Block F-tests in the General OLS Model of Mortality

	(1)	(2)	(3)	(4)
Food prices	.8	.31	.81	.88
Medical prices	.11	.12	.08*	.10*
Education	.0001***	.0002***	.0001***	.0001***
Primary education	.07*	.16	.06*	.02**
Beliefs	.0001***	.0001***	.0001***	.0001***
Facilities	.17	.13	.11	.09*
Water (household)	.6			
Garbage (household)	.24			
Toilet (household)	.08*			
Water (community)		.11		
Garbage (community)		.02**		
Toilet (community)		.23		
Support	.55	.41	.50	.37
Weaning and meals	.75	.82		
Job market	.08*	.10	.10*	.14
Gender differentials	.59	.38	.21	.21
Distance	.12	.06*	.09*	.05*
Economic status	.0001***	.0001***	.0001***	.0001***
Relations	.0001***	.0003***	.0001***	.0001***
Region	.06*	.03**	.01**	.01**

Note: the numbers in each cell give the probability of observing as high an F-statistic under the null that the group of variables has no influence on mortality
*** significant at the 1% level; ** significant at the 5% level
* significant at the 10% level
Source: author's calculations from the 1992/3 Integrated Household Survey

Table 10:
Levels of Significance of Block F-tests in the General OLS Model of Height-for-Age

	(1)	(2)	(3)	(4)
Food prices	.04**	.02**	.03**	.03**
Medical prices	.09*	.08*	.09*	.08*
Father's education	.38	.25	.19	.19
Mother's education	.32	.27	.20	.16
Parental education	.08*	.03**	.01***	.005***
Beliefs, both	.81	.83	.81	
Male beliefs	.74	.81	.82	
Female beliefs	.53	.55	.52	
Facilities	.49	.44	.35	.36
Water (household)	.01**			
Garbage (household)	.14			
Toilet (household)	.004***			
Water (community)	.07*			
Garbage (community)	.22			
Toilet (community)	.01**			
Support	.71	.47	.41	.41
Weaning and meals	.59	.55		
Job market	.31	.46	.34	.34
Gender differentials	.13	.17	.27	.26
Distance	.83	.96	.87	.85
Economic status	.00***	.0001***	.0001***	.0001***
Region	.01**	.008***	.009***	.008***
Relations	.02**	.04**	.03**	.03**
Season	.04**	.21	.02**	.02

Note: the numbers in each cell give the probability of observing as high an F-statistic under the null that the group of variables has no influence on height-for-age
*** significant at the 1% level; ** significant at the 5% level *significant at the 10% level
Source: author's calculations from the 1992/3 Integrated Household Survey

Table 11:
Levels of Significance of Block F-tests in the General OLS Model of Weight-for-Height

	(1)	(2)	(3)	(4)
Food prices	.20	.17	.19	.16
Medical prices	.04**	.03**	.02**	.02**
Father's education	.82	.83	.80	.89
Mother's education	.08*	.08*	.10	.13
Parental education	.25	.27	.32	.49
Beliefs, both	.01**	.01**	.01**	
Male beliefs	.07*	.06*	.05**	

cont ...

Table 11 cont ...

	(1)	(2)	(3)	(4)
Female beliefs	.42	.43	.48	
Facilities	.02**	.03**	.02**	.03**
Water (household)	.04**			
Garbage (household)	.08*			
Toilet (household)	.86			
Water (community)		.03**		
Garbage (community)		.001***		
Toilet (community)		.003***		
Support	.07*	.13	.06*	.05*
Weaning and meals	.42	.51		
Job market	.28	.31	.15	.12
Gender differentials	.51	.45	.49	.47
Distance	.02**	.04**	.01**	.01**
Economic status	.27	.44	.11	.04**
Region	.0001***	.00***	.00***	.00***
Relations	.0009***	.00***	.00***	.00***
Season	.02**	.01**	.02**	.01**

Note: the numbers in each cell give the probability of observing as high an F-statistic under the null that the group of variables has no influence on weight-for-height
*** significant at the 1% level; ** significant at the 5% level *significant at the 10% level
Source: author's calculations from the 1992/3 Integrated Household Survey

Table 12:
Tobit Estimation of the Simplified Models of Mortality

	(1)	(2)	(3)	(4)
CONST	-.35(.04)***	-.34(.04)***	-.4(.04)***	-.4(.06)***
EDUC1	-.02(.06)	-.05(.07)	-.02(.06)	-.02(.06)
EDUC11	.06(.04)	.06(.05)	.06(.04)	.06(.04)
EDUC12	.006(.05)	.03(.03)	.004(.03)	.002(.026)
EDUC13	.039(.02)*	.02(.03)	.037(.023)	.032(.023)
EDUC14	-.02(.02)	-.03(.03)	-.026(.022)	-.033(.022)
EDUC15	-.046(.02)**	-.06(.03)**	-.048(.022)**	-.06(.022)***
EDUC16	-.01(.02)	-.003(.03)	-.012(.02)	-.027(.02)
EDUCJUN	-.22(.08)***	-.19(.10)**	-.22(.08)***	-.25(.08)***
EDUCSEC	-.14(.02)***	-.14(.03)***	-.15(.025)***	-.17(.02)***
EDUCFUR	-.24(.04)***	-.23(.04)***	-.25(.04)***	-.27(.04)***
GOODDIA	-.02(.02)	.001(.03)	-.02(.02)	
SOMEDIA	.046(.02)***	-.03(.02)	-.05(.02)***	
GOODMAL	-.070(.02)***	-.11(.03)***	-.07(.02)***	

cont ...

SOMEMAL	-.018(.02)	-.04(.02)**	-.02(.02)	
NOMAL	-.05(.02)**	-.063(.03)**	-.06(.02)**	
HBUCKET	-.007(.06)			
HFLUSH	-.07(.03)**			
HLATRINE	-.05(.015)***			
NOHTOIL	-.13(.07)*			
COLLECT		-.053(.03)**		
BURN		-.03(.03)		
BURY		-.05(.02)**		
MANURE		-.05(.02)***		
NOGARB		.05(.20)		
WOOD	.045(.023)**	.05(.025)**	.05(.023)**	.05(.02)**
DISTCLIN				-.001(.0007
SUPPLIE				-.003(.004)
DOCTOR				-.02(.02)
NURSE				.005(.03)
INGOHOSP				.07(.03)**
LNGOHOSP				.006(.03)
PRIVHOSP				.044(.022)**
RMFARMW	-.38(.18)**	-.43(.19)**	-.35(.18)*	-.34(.18)*
AVAIL	.0009(.0006)	.0005(.0006)	.001(.001)	.001(.0006)
NOMFW	-.04(.06)	-.07(.06)	-.03(.06)	-.035(.06)
NOAVAIL		.13(.07)	.12(.08 |	.13(.09)
DISTCMKT			.002(.001)	
DISTMMKT			.0002(.0003)	
DISTTRAD			.0013(.0007)**	
DISTPMKT			-.0005(.0007)	
WELFARE	.03(.01)***	.022(.013)*	.026(.011)**	.023(.011)**
WELFSQ	-.003(.001)**	-.002(.0015)	-.003(.001)**	-.002(.001)*
NROOMS	-.03(.004)***	-.03(.005)***	-.028(.004)***	-.03(.004)***
INDDWELL	.009(.013)	.01(.015)	.003(.01)	.007(.01)
AGE	.007(.0005)***	.007(.0006)***	.007(.0005)***	.007(.0005)***
URBAN	-.017(-.015)	-.006(.02)	-.03(.02)	-.03(.02)*
BIRTHB	.042(.003)***	.042(.003)***	.04(.003)***	.04(.003)***
BIRTHG	.023(.003)***	.022(.003)***	.023(.003)***	.02(.003)***
SINGLE	.01(.03)			-.003(.03).014(.029).01(.03)
COHABHH	.07(.05)			.09(.05)*.08(.05).08(.05)
COHABOTH	.03(.05)			.045(.06).036(.05).04(.05)
DIVORCE	.09(.026)***	.072(.031)**	.088(.026)***	.08(.03)***
WIDOW	.04(.02)**	.022(.027)	.045(.023)**	.04(.02)**
HEAD	.015(.02)	.016(.026)	.016(.022)	.02(.02)
CHILD	.039(.4)	.08(.043)*	.04(.04)	.04(.04)
GCHILD	-.10(.12)	-.17(.14)	-.09(.12)	-.08(.12)
SERVANT	.07(.13)	.17(.14)	.07(.13)	.08(.12)
NOTREL	.025(.09)	-.03(.11)	.023(.09)	.04(.09)
OTHREL	.01(.03)	-.003(.03)	.009(.027)	.02(.03)
WIVES	.036(.01)***	.029(.014)**	.035(.012)***	.04(.01)***
EAST	-.026(.016)	-.04(.02)**	-.010(.017)	-.01(.03)
WEST	-.054(.016)***	-.08(.02)***	-.045(.017)***	-.04(.03)
NORTH	.043(.035)	2.9(3513.6)	.06(.04)	.07(.04)*
GNAT	.02(.06)			-2.8(3513.6).036(.4.04(.06)
NODMKT				-.0(.04)
NOPMKT				.02(.02)
SCALE	.45(.006)	.46(.007)	.45(.006)	.45(.01)
Log-likelihood	-5784.2	-4218.1	-5786.5	-5799.5
(SE in brackets) N	9343	6813	9343	9343

Source: author's calculations from the 1992/3 Integrated Household Survey

Table 13:
Mortality of children of the spouse of the household head: testing for the flow of information within the household

	(1)	(2)	(3)	(4)
CONST	-.34(.05)***	-.37(.05)	-.36(.05)	
EDUC1	-.03(.07)	-.01(.07)		
EDUC11	-.03(.05)	-.02(.05)		
EDUC12	-.003(.03)	-.005(.03)		
EDUC13	.006(.03)	.008(.03)		
EDUC14	-.06(.03)**	-.06(.03)**		
EDUC15	-.06(.03)**	-.06(.03)		
EDUC16	-.02(.03)	-.02(.03)		
EDUCJUN	-.1(.1)	-.14(.11)		
EDUCSEC	-.11(.03)***	-.14(.03)***		
EDUCFUR	-.16(.06)***	-.21(.05)***		
HEADED1	.11(.07)*		.11(.07)*	
HEADED11	.04(.05)		.04(.05)	
HEADED12	-.03(.03)		-.02(.03)	
HEADED13	-.03(.03)		-.03(.03)	
HEADED14	-.01(.03)		-.02(.03)	
HEADED15	.01(.03)		.01(.03)	
HEADED16	-.004(.02)		-.01(.02)	
HEADJUN	-.08(.04)*		-.09(.04)**	
HEADSEC	-.06(.03)**		-.07(.03)***	
HEADFUR	-.09(.03)***		-.13(.03)***	
GOODDIA	-.02(.03)	-.03(.03)		
SOMEDIA	-.02(.03)	-.03(.02)		
GOODMAL	.01(.03)	-.04(.03)		
SOMEMAL	.003(.03)	-.002(.02)		
NOMAL	-.007(.03)	-.04(.03)		
GOODHDIA	-.006(.03)		-.02(.03)	
SOMEHDIA	-.02(.03)		-.04(.02)	
GOODHMAL	-.08(.03)**		-.07(.03)***	
SOMEHMAL	.005(.03)		.003(.02)	
WOOD	.06(.03)*	.06(.03)**	.07(.03)**	
RMFARMW	-.45(.24)*	-.42(.24)*	-.46(.24)*	
AVAIL	.0008(.0008)	.0007(.0008)	.0009(.0008)	
NOMFW	.011(.07)	.01(.07)	.01(.07)	
NOAVAIL	.02(.10)	.04(.10)	.02(.10)	
DISTCMKT	.0029(.0016)*	.003(.002)*	.003(.002)*	
DISTMMKT	-.001(.004)	-.0001(.0004)	-.0001(.0004)	
DISTTRAD	.0006(.0009)	.0008(.0009)	.0005(.0009)	
DISTPMKT	-.0001(.0009)	-.0001(.0009)	-.0001(.0009)	
WELFARE	.02(.02)	.013(.015)	.01(.01)	
WELFSQ	-.002(.002)	-.001(.001)	-.002(.002)	
NROOMS	-.03(.006)***	-.03(.006)***	-.03(-.006)	
INDDWELL	.0002(.02)	-.0005(.02)	-.002(.02)	
AGE	.006(.0007)***	.006(.0007)***	.006(.0007)***	
URBAN	-.04(.02)*	-.05(.02)**	-.05(.02)**	
BIRTHB	.04(.004)***	.04(.004)***	.04(.004)***	
BIRTHG	.03(.004)***	.03(.004)***	.03(.0004)***	
SINGLE	.06(.36)	.06(.36)	.05(.36)	
COHABOTH	.12(.19)	.13(.19)	.11(.19)	
WIVES	.037(.015)**	.04(.02)***	.04(.02)**	
EAST	-.012(.02)	-.015(.022)	-.01(.02)	

cont ...

Table 13 cont ...

WEST	-.07(.02)***	-.06(.02)***	-.06(.02)
NORTH	-.04(.04)	.03(.04)	.04(.04)
NOWOOD	.06(.07)	.06(.07)	.09(.07)
NODMKT	.03(.05)	.02(.05)	.03(.05)
NOPMKT	.02(.03)	.02(.03)	.02(.03)
SCALE	.43(.007)	.43(.007)	.43(.007)
Log-likelihood	-3192.4	-3212	-3205.2
(SE in brackets) N	5423	5423	5423

Source: author's calculations from the 1992/3 Integrated Household Survey

Table 14:
OLS Estimation of the Simplified Models of Height-for-Age

	(1)	(2)	(3)	(4)
CONSTANT	-.5(.5)	-.6(.5)		-.6(.5)
RMATPR	-.09(.4)	-.2(.4)		-.1(.4)
RMZPR	9.3(11.9)	10.7(12.2)		10.6(11.9)
RCASPR	-.1(.8)	.03(.9)		-.06(.8)
RPOTPR	-.3(.7)	-.4(.8)		-.4(.7)
RMILPR	-6.2(4.8)	-8.7(5.4)		-6.0(4.7)
RMLKPR	1.6(2.2)	1.9(2.2)		2.9(2.2)
RBFPR	-6.4(2.2)***	-6.2(2.2)***		-5.8(2.1)***
RBNPR	4.7(2.9)	5.0(2.9)*		4.1(2.8)
RSOPPR	-1.46(4.0)	-1.0(4.0)		-.7(4.0)
RASPPR	1.4(9.0)	1.3(9.0)		3.3(9.0)
RMALPR	.3(1.6)	.5(1.6)		.3(1.6)
RANTPR	-1.2(.9)	-1.2(.9)		-1.1(.9)
RCONSPR	4.6(4.0)	5.4(4.1)		5.4(4.0)
RHOSP	.2(.09)**	.21(.09)**		.2(.1)**
FLIT	.04(.3)	.06(.3)		.03(.3)
FPRIM	-.02(.07)	-.02(.07)		-.01(.07)
FP7	-.03(.08)	-.01(.08)		-.01(.08)
FS4	.06(.1)	.07(.1)		.08(.1)
FALEVEL	.13(.1)	.15(.14)		.2(.1)
FFUR	.39(.2)	.5(.2)**		.5(.2)**
NOFED	-.07(.2)	-.1(.2)		-.06(.2)
MLIT	.06(.3)	.07(.3)		.1(.3)
MPRIM	-.06(-.06)	-.06(.06)		-.1(.1)
MP7	.04(.08)	.05(.08)		.05(.08)
MS4	.10(.12)	.13(.11)		.1(.1)
MALEVEL	.5(.25)**	.51(.25)**		.6(.2)**
MFUR	.12(.54)	.01(.5)		.1(.6)
NOMED	-.24(.25)	-.2(.2)		-.2(.2)
HTAP	.06(.10)			
HVENDOR	-.23(.25)			
HPWELL	.50(.16)***			
HNPWELL	.13(.05)***			

cont ...

HRAIN	-.2(.3)		
NOHWATER	.1(.2)		
HCOLLECT	.17(.08)**		
HBURY	.001(.07)		
HMANURE	-.04(.06)		
NOHGARB	.06(.06)		
HBUCKET	.2(.3)		
HFLUSH	.5(.14)***		
HLATRINE	-.01(.07)		
NOHTOIL	-.3(.3)		
TAP		.1(.1)	
VENDOR		-.3(.3)	
PWELL		.12(.07)*	
NPWELL		.09(.07)	
RAIN		-1.1(.4)***	
NOWATER		-1.0(.6)	
COLLECT		.04(.1)	
BURN		-.1(.1)	
BURY		.14(.1)	
MANURE		-.14(.07)**	
NOGARB		.7(.5)	
BUCKET		1.4(.8)	
FLUSH		.5(.2)***	
LATRINE		.1(.08)	
NOTOIL		1.9(1.0)**	
WOOD	-.18(.09)*	-.15(.1)	-.3(.1)***
WELFARE	.12(.05)**	.13(.05)**	.15(.05)***
WELFSQ	-.008(.006)	-.01(.01)	-.01(.01)
NROOMS	.07(.02)***	.08(.02)***	.07(.02)***
INDDWELL	-.05(.05)	-.05(.05)	-.03(.05)
SEX	.25(.04)***	.26(.04)***	.25(.04)***
NOUGHT5	-.66(.1)***	-.7(.1)***	-.7(.1)***
ONE	-1.0(.1)***	-1.0(.1)***	-1.0(.1)***
ONE5	-1.2(.1)***	-1.2(.1)***	-1.2(.1)***
TWO	-.8(.1)***	-.8(.1)***	-.8(.1)***
TWO5	-1.0(.1)***	-1.0(.1)***	-1.0(.1)***
THREE	-.8(.1)***	-.8(.1)***	-.8(.1)***
THREE5	-1.3(.1)***	-1.3(.1)***	-1.2(.1)***
FOUR	-.9(.1)***	-.9(.1)***	-.9(.1)***
FOUR5	-1.2(.1)***	-1.2(.1)***	-1.2(.1)***
URBAN	.2(.07)***	.2(.07)***	.27(.07)***
KIDORDER	-.05(-3.3)***	-.05(.02)***	-.04(.01)***
KIDRATIO	.3(.2)	.3(.2)	.2(.2)
GCHILD	.04(.08)	.06(.08)	.05(.08)
SERVANT	.01(.1.6)	-.01(1.8)	-.1(1.8)
NOTREL	-.6(.5)	-.5(.5)	-.6(.5)
OTHREL	.2(.1)*	.2(.1)**	.2(.1)**
EAST	.005(.07)	-.01(.08)	.04(.08)
WEST	-.08(-1.1)	-.1(.07)	-.06(.07)
NORTH	-.03(.1)	-.08(.2)	-.0(.1)
FEB92	.1(.3)	.04(.3)	.1(.3)
MAR92	.4(.4)	.2(.4)	.3(.4)
APR92	.3(.3)	.2(.3)	.3(.3)
MAY92	.1(.2)	-.03(.2)	.1(.2)
JUN92	.1(.2)	-.04(.2)	.05(.2)

cont ...

Table 14 cont ...

JUL92	.03(.3)	-.1(.3)	.01(.3)
AUG92	-.05(.2)	-.2(.2)	-.06(.2)
SEP92	.07(.3)	-.01(.2)	.04(.2)
OCT92	.2(.3)	.04(.3)	.1(.3)
NOV92	-.1(.3)	-.1(.2)	-.1(.2)
DEC92	-.2(.2)	-.3(.2)	-.2(.2)
JAN93	-.02(-.1)	-.1(.2)	-.08(.2)
FEB93	.2(.2)	.1(.3)	.1(.2)
MAR93	.1(.3)	-.01(.3)	.09(.3)
NOMAPRIX	-.1(.1)	-.1(.1)	-.1(.1)
NOMZPRIX	.1(.3)	.2(.3)	.2(.3)
NOCAPRIX	-.2(.1)*	-.2(.1)**	-.2(.1)*
NOPOPRIX	-.1(.1)	-.1(.1)	-.15(.09)*
NOMIPRIX	-.2(.1)**	-.2(.1)	-.2(.1)**
NOMKPRIX	.1(.1)	.1(.1)	.16(.08)**
NOBFPRIX	-.3(.2)*	-.3(.2)	-.2(.4)
NOBNPRIX	.1(.1)	.1(.1)	.1(.1)
NOSPPRIX	.1(.1)	.05(.1)	-.0(.1)
NOASPRIX	-.0(.1)	-.0(.1)	-.04(.1)
NOFMFW		.07(.07)	
NOMFW		-.6(.2)***	
NOANT	.2(.4)	.07(.07)	.2(.4)
NOMALP	-.3(.4)	-.4(.4)	-.2(.4)
NOCONS	.05(.1)	.1(.1)	.1(.1)
NOHCOST			-.0(.1)
GNAT	-.3(.2)	-.2(.2)	-.4(.2)*
N	6612	6612	6612
R^2	.07	.07	.07
F	5.4***	5.3***	5.7***

Source: author's calculations from the 1992/3 Integrated Household Survey

Table 15:
OLS Estimation of the Simplified Models of Weight-for-Height

	(1)	(2)	(3)	(4)
CONST	1.3(.3)***	1.4(.3)***	1.4(.3)***	1.3(.4)***
RMATPR			.1(.2)	-.1(.3)
RMZPR			1.0(3.1)	4.2(8.1)
RCASPR			.1(.4)	.7(.6)
RPOTPR			-.0(.3)	-.6(.5)
RMILPR			-6.9(2.4)	-2.0(3.3)
RMLKPR			-1.6(.12)	-2.1(1.5)
RBFPR			.8(.5)	1.5(1.5)
RBNPR			-2.8(1.4)**	-4.8(2.0)**
RSOPPR	-6.1(2.7)**	-5.5(2.7)**	-5.2(2.7)**	-4.8(2.7)*
RASPPR	7.1(6.0)	6.9(6.0)	6.8(6.0)	7.0(6.1)
RMALPR	-2.1(1.1)*	-2.5(1.1)**	-1.9(1.1)	-1.8(1.1)
RANTPR	.3(.6)	.4(.6)	.3(.6)	.2(.6)

cont ...

RCONSPR	5.4(2.7)**	5.4(2.7)**	5.3(2.7)**	5.4(2.8)*
RHOSP	.2(.06)***	.17(.06)***	.17(.06)**	.2(.06)**
MLIT	.2(.2)	.18(.17)	.2(.2)	.2(.2)
MPRIM	-.04(.04)	-.04(.04)	-.05(.04)	-.03(.03)
MP7	-.03(.05)	-.0(.0)	-.02(.05)	.01(.05)
MS4	-.09(-1.3)	-.1(.1)	-.06(.07)	-.01(-.07)
MALEVEL	-.4(.2)**	-.4(.2)**	-.33(.16)**	-.3(.2)*
MFUR	.5(.3)	.5(.3)	.47(.35)	.5(.3)
NOMED	-.2(.2)	-.2(.2)	-.2(.2)	-.2(.2)
MALEDIA	.01(.04)	.02(.04)	.02(.04)	
MALEMAL	.07(.04)**	.07(.04)**	.07(.036)**	
NOMMAL	.2(.07)***	.21(.07)***	.2(.07)***	
DISTCLIN	-.0(.0)	-.0(.0)	-.0(.0)	.0(.0)
SUPPLIES	-.0(.0)	-.0(.0)	-.0(.0)	-.0(.0)
DOCTOR	.2(.06)***	.24(.06)***	.21(.06)***	.21(.06)***
NURSE	.04(.1)	.05(.1)	.0(.1)	.05(.1)
INGOHOSP	-.05(.1)	-.05(.1)	-.0(.1)	-.1(.1)
LNGOHOSP	-.01(.08)	-.07(.1)	-.0(.1)	-.0(.1)
PRIVHOSP	.03(.07)	-.0(.1)	.0(.1)	.0(.1)
HTAP	.2(.06)***			
HVENDOR	.1(.2)			
HPWELL	.2(.1)*			
HNPWELL	.03(.03)			
HRAIN	.09(.2)			
NOHWATER	.05(.1)			
HCOLLECT	.09(.05)*			
HBURY	.05(.05)			
HMANURE	-.08(.04)*			
NOHGARB	.0(.0)			
TAP		.1(.1)		
VENDOR		-.0(.2)		
PWELL		-.06(-1.2)		
NPWELL		.1(.1)		
RAIN		-1.1(.3)***		
NOWATER		-1.0(.4)**		
COLLECT		.22(.07)***		
BURN		-.1(.1)		
BURY		.0(.1)		
MANURE		.1(.05)*		
NOGARB		.8(.6)		
SSUPPORT	.1(.05)**	.1(.05)**	.09(.05)*	.1(.05)**
LSUPPORT	.02(.06)	.0(.1)	.0(.0)	-.0(.05)
DISTCMKT	.0(.0)	-.0(.0)	.0(.0)	-.0(.0)
DISTMMKT	.002(.0)**	.002(.001)**	.002(.001)**	.002(.002)**
DISTTRAD	.004(.0)**	.002(.002)	.004(.002)**	.003(.002)*
DISTPMKT	-.0(.0)	-.001(.002)	-.0(.0)	-.0(.0)
WELFARE	.07(.03)**	.08(.03)**	.09(.03)***	.1(.03)***
WELFSQ	-.0(.0)	-.007(.004)	-.007(.004)	-.008(.004)*
SEX	.04(.03)	.04(.03)	.04(.03)	.04(.03)
NOUGHT5	-.7(.08)***	-.7(.08)***	-.7(08)***	-.7(.08)***
ONE	-1.2(.08)***	-1.2(.08)***	-1.2(.08)***	-1.2(.08)***
ONE5	-1.3(.08)***	-1.3(.08)***	-1.3(.08)***	-1.3(.08)***
TWO	-1.3(.07)***	-1.3(.07)***	-1.3(.07)***	-1.3(.07)***

cont ...

Table 15 cont ...

TWO5	-1.2(.09)***	-1.1(.07)***	-1.2(.09)***	-1.2(.09)***
THREE	-1.2(.07)***	-1.1(.07)***	-1.1(.07)***	-1.2(.07)***
THREE5	-1.2(.09)***	-1.2(.09)***	-1.2(.09)***	-1.2(.09)***
FOUR	-1.2(.07)***	-1.2(.08)***	-1.2(.08)	-1.2(.08)***
FOUR5	-1.1(.09)***	-1.1(.09)***	-1.1(.09)	-1.1(.09)***
URBAN	-.03(.05)	.03(.05)	.04(.05)	.06(.05)
KIDORDER	-.03(.01)***	-.03(.01)***	-.03(.01)***	-.03(.01)***
KIDRATIO	-.1(.1)	-.1(.1)	-.1(.1)	-.1(.1)
GCHILD	-.06(.05)	-.05(.05)	-.06(.06)	-.07(.05)
SERVANT	-1.2(1.2)	-1.3(1.2)	-1.3(1.2)	-1.4(1.2)
NOTREL	-.1(.3)	-.2(.3)	-.2(.3)	-.2(.3)
OTHREL	-.1(.06)	-.1(.1)	-.1(.1)	-.1(.06)
EAST	-.2(.03)***	-.21(.07)***	-.23(.08)***	-.23(.08)***
WEST	.09(.07)	.09(.07)	.09(.07)	.08(.07)
NORTH	-.6(.08)***	-.5(.08)***	-.55(.1)***	-.5(.08)***
FEB92	-.08(.2)	-.1(.2)	-.1(.2)	-.1(.2)
MAR92	.15(.25)	.1(.3)	.1(.3)	.1(.3)
APR92	.0(.2)	-.1(.2)	-.0(.2)	-.0(.2)
MAY92	-.2(.2)	-.3(.2)	-.3(.2)	-.3(.2)
JUN92	-.2(.2)	-.3(.2)	-.2(.2)	-.3(.2)
JUL92	-.2(.2)	-.2(.2)	-.2(.2)	-.2(.2)
AUG92	-.1(.2)	-.2(.2)	-.1(.2)	-.1(.2)
SEP92	-.0(.2)	-.1(.2)	-.1(.2)	-.0(.2)
OCT92	-.1(.2)	-.2(.2)	-.2(.2)	-.2(.2)
NOV92	.2(.2)	-.1(.2)	-.1(.2)	-.1(.2)
DEC92	-.0(.2)	-.1(.2)	-.1(.2)	-.1(.2)
JAN93	.1(.2)	-.0(.2)	-.0(.2)	-.0(.2)
FEB93	.1(.2)	-.0(.2)	-.0(.2)	-.0(.2)
MAR93	.2(.2)	.1(.2)	.1(.2)	.2(.2)
NOMAPRIX				-.05(-.06)
NOMZPRIX				.1(.2)
NOCAPRIX				.1(.1)
NOPOPRIX				-.1(.1)
NOMIPRIX				.2(.1)
NOMKPRIX				-.0(.1)
NOBFPRIX				.1(.1)
NOBNPRIX				-.1(.1)
NOSSPRIX	-.1(.1)	-.1(.1)	-.1(.1)	-.2(.1)
NASPPRIX	.1(.1)	.1(.1)	.1(.1)	.1(.1)
NOANT	-.4(.3)	-.4(.3)	-.4(.3)	-.4(.3)
NOMALP	.2(.3)	.2(.3)	.2(.3)	.3(.3)
NOCONS	.1(.1)	.1(.1)	.0(.1)	.0(.1)
NODISTCL	.2(.1)	.2(.1)	.2(.1)	.2(.1)
NOHCOST	.1(.1)	.1(.1)	.1(.06)	.1(.1)
NOWOOD			-.0(.1)	
NOHOWN	-.2(.2)	-.2(.2)	-.2(.2)	-.2(.2)
NOLSUPP	.2(.2)	-.4(.6)	.1(.2)	.2(.2)
NODMKT	.1(.1)	.1(.1)	.1(.1)	.1(.1)
NOPMKT	.0(.1)	-.0(.1)	-.0(.1)	-.0(.1)
N	6612	6612	6612	6612
R^2	.11	.11	.11	.11
F	9.5***	9.6***	9.5***	9.0***

Source: author's calculations from the 1992/3 Integrated Household Survey

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